POPULAR WIRELESS WEEKLY. August 5. 1922.

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No. 10. THE BEST OF PAPERS FOR THE BEST OF HOBBIES

POPULAR WIRELESS

3d.

Weekly

No. 10.
Vol. 1.
Aug. 5,
1922.

Mr. Huntley Wright and Miss Winnie Collins Broadcasting at Marconi House.

FOR AND AGAINST THE ETHER — BY SIR OLIVER LODGE, F.R.S., D.Sc., LL.D.

Popular Wireless

TOPICAL NEWS AND NOTES.

Wireless Demonstration.

A GRAND Garden Fête will be held on Monday, August 7th, at "Bewlay," High Road, East Finchley. One of the features will be a wireless telephony demonstration. The fête will open at 2 p.m.

* * *

Police Wireless.

MIDDLESBROUGH Watch Committee have instructed Chief Constable Riches to instal a receiving set for wireless telephony, and he has been asked to report upon the desirability of also having a transmitting station.

* * *

Long-Distance Rights.

MR. PIKE PEASE informed General Sir Hunter Weston, who is the Co-Unionist member for Bute and North Ayrshire, that the Empire had reserved for herself the right to the use of certain wavelengths imperative for long-distance wireless.

* * *

No Longer an Anxious Wait.

WHEN a sailor went to sea, his family used to spend many an anxious moment wondering whether he were in peril. Now this difficulty can be got over, and Captain C. A. Smith, commanding the Cunard liner Berengaria, is leading the way, for he has had a wireless receiving apparatus erected in his home at Kew, so that his wife can listen-in every day at noon and hear the great liner sending out her daily weather report.

* * *

S. O. S.

THE hon. secretary of the Wolverhampton and District Wireless Society has sent the Editor an S. O. S. to the effect that the members of the society are thirsting for lectures.

Will any gentleman, within reasonable distance of Wolverhampton, render assistance and give a lecture or demonstration to the members?

The hon. secretary is Mr. G. W. Jones, and his address is 8, Rosebery Street, Wolverhampton

I would oblige myself, only I s-s-s-tutter!

* * *

Manchester Amateurs' U.S. Experiments.

THE Manchester Wireless Society has just received official permission to carry out one transmission with America between 1 p.m. and 8 p.m. each Sunday (8 p.m. Saturday and 3 a.m. Sunday in America).

The society hope to have their station working by August, and would have had it going before but for a delay in obtaining the final permit. If this proves a success, the Manchester Amateurs hope to start a Wireless Relay League, by which amateurs from other societies may benefit from their experiments.

Ungava the Unknown.

TEN years ago Ungava was made part of the province of Quebec, and until recently very little has been done to improve it. An expedition is now being organised whose object is to establish stations or posts, from whence parties will explore and survey the surrounding country. By means of the wireless telephone communication will be kept between these posts, and will prove a great asset to the pioneer work.

Except that Indians and Esquimaux inhabit this northern region, and that there are a few white trappers scattered here and there, practically nothing is known of what may prove to be a very valuable section of territory.

* * *

Powerful New Wireless Station.

THE scheme for linking up the Mother Country with the Empire Overseas has had an important modification. Now, instead of having a wireless chain that would proceed by steps of a thousand miles or so at a time, a new wireless station is to be erected that will be able to get into direct touch with Australia, South Africa, India, etc.

This station will be capable of developing 240 kilowatts of high-frequency power, and, naturally, a station of this magnitude will be one of the largest in the world.

It is almost certain that the site will be near Bourne, on the south-west boundary of Lincolnshire. Naturally, Australia and the others will want to get into touch with the Mother Country, and for this purpose a receiving station will be erected at Banbury.

* * *

Some Horse-power!

THERE is a progressive increase in the power used for transmitting stations of wireless telegraphy, and this has been brought to the notice of M. Henri Deslandres, of the Meudon Observatory.

Looking up records, he found that the first French station at the Eiffel Tower was only 3 h.p.; that in 1910 it was increased to 75 h.p.; to 150 at the beginning of the war; and that to-day it was over 300 h.p. The station at Bordeaux has the tremendous power of 1,500 h.p., but this will be beaten by a station now under course of erection at St. Assise, which will be 2,000 h.p.

I hear that it is possible to generate 10,000 h.p. at the new American station, Radio Central.

* * *

Wireless and the Irish Problem.

CONSIDERABLE difficulty in forecasting the weather has arisen through the chaotic conditions prevailing in Ireland. There has been a lack of weather reports from the "Outpost" stations in Western Ireland, with the result that a lot of guesswork has had to be indulged in during the last week or so.

The valuable observations usually sent from Blacksod Point (Mayo) and Valencia (Kerry) have not been received, except one of Valencia's messages, which is sent by wireless.

Four daily reports are sent from these two stations, and it seems that a way of getting over the difficulty would be for the Air Ministry to issue instructions that all of the messages be sent by wireless until the telegraphic services are restored to normal. Without weather forecasts from these two stations weather experts are bound to go astray.

* * *

Beaver!

DOES broadcasting tend to promote the growth of the hair?

This was a question put to members of the Hounslow Wireless Society by a spectator at a demonstration by that institution at Isleworth.

The spectator was evidently impressed by the fine "crops" on the heads of the society's members.

He was informed that the question was one for experts.

It was, however, quite possible that the electric waves were responsible for promoting the growth, and that none of the party knew of the existence of a bald-headed operator.

Moreover, a good head of hair was an acquisition to an operator in his work, as it helped to remove the discomfort of the receiver, which at times had to be worn for long periods.

* * *

French Lessons by Wireless.

ONE of the newest ideas for wireless is that lessons in French be sent by wireless telephone from French schools and broadcasted to pupils in English schools.

The idea was originated by a schoolmaster in Hastings, who, after listening-in to the songs and speeches in French sent out by the Eiffel Tower, was so impressed with the clearness that he thought out a scheme for a valuable educational reformation.

The Eiffel Tower is one of the greatest of stations, and the schoolmaster's suggestion is that during school hours a short educational programme should be radiated across the Channel. He feels certain that this novel way of learning would be eagerly appreciated by his scholars. The Eiffel Tower authorities are considering the scheme, and there is every possibility that something may come of it.

If England could broadcast lessons in English to French scholars, a not impossible feat, then we shall have a really great achievement, for it will serve to forge a link between the younger generations of the two countries.

But there are many points to be settled before this scheme can be adopted, such as the consent of the Postmaster-General, the erection of receiving sets at various schools, the subjects to be taught, and many other minor considerations.

NEWS AND NOTES.

(Continued.)

Spirit Wireless.

SIR ARTHUR CONAN DOYLE, who recently came to America to lecture on his psychic investigations, has become a radio fan, and will take back with him to England a complete wireless outfit of American make. He states that, though so far he knows nothing of radio, he feels sure that it will give him a deeper insight into the psychic world.

* * *

Dr. Langmuir's Invention.

IT is not intended that Dr. Irving Langmuir's radiotrons shall immediately take the place of the Alexanders on generators in the high-power transmitting stations, but it is the present intention to link up the tubes with the alternators to make a more powerful station which shall be capable of hurling out stronger signals, and, ultimately, to cast the human voice to the far ends of the earth on waves of electric energy.

* * *

Honour for Marconi.

THE John Fritz Medal for 1922 has been awarded to Senatore Marconi. It is the highest engineering distinction bestowed in the United States. The medal was formally presented to the Italian scientist at a notable gathering of engineers from all parts of the country at the Engineering Societies Building, 29 West 33rd Street, on July 6. This gathering was in the nature of an international celebration marking the close relation of scientific progress between America and European countries.

* * *

Marconi Concerts.

OWING to the short notice at which many of the transmissions from Marconi House are arranged, the Marconi Company regrets that it is impossible to publish beforehand anything like a time-table of forthcoming concerts. The company, however, will be pleased to mail its latest arrangements to any interested persons who care to send stamped postcards for the purpose. It also invites criticisms of the transmissions by 2 L O., together with technical data respecting the conditions under which the concerts are received.

Postcards should be addressed to Room 35, Marconi House.

ARIEL

Broadcasting Programmes

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

The "Daily Mail" Concerts.

THE first "Daily Mail" wireless concert was broadcasted from The Hague on July 27th, and, from the numerous reports received, it appears to have been well received except in London. Writing in the "Daily Mail," Mr. E. Blake, A.M.I.E.E., the well-known writer on wireless subjects, offers valuable information to the amateur for the reception of the concerts. The following are extracts of especial interest:

"From The Hague to the middle of England is a distance of about 270 miles as the crow flies, and I suppose it would take an energetic crow several hours to perform the journey. For wireless the distance may be considered non-existent.

"When the 'Daily Mail' broadcast concert at P C G G begins at 7 o'clock every aerial in this country will pulsate with electrical power radiated from Mr. Idzerda's aerial in less than 1-500th of a second after the first word is uttered into the transmitter.

"The amount of electrical power an amateur will capture from The Hague concert would not be missed by a power station. The present power of P C G G is 1500 watts. It must be recollected that this power has to be spread out over an enormous area, and a crystal receiver, which cannot magnify signals, will be quite useless in this country for receiving P C G G.

"At least two valves should be used in conjunction with the best-designed, largest, and highest outside open aerial you can contrive up to the limits allowed.

"The question of range, for a wireless telephone station particularly, is not easy to settle when more than one receiver is involved. Besides, telephonic range does not depend altogether upon the total power of the transmitter, but largely upon the 'modulation' or variation of the power by the voice or music.

"*To receive telephony the valve must not oscillate.* You may obtain more noise by adjusting to just inside the oscillating point, but you will get less music, make yourself a nuisance to fellow-amateurs, and run the risk of having your licence cancelled."

The "Daily Mail" concerts are broadcasted every Thursday and Sunday between 7 and 8 p.m. on a wave-length of 1,050 metres.

It is estimated that an audience of 100,000 in a 1,000 miles' radius enjoy the concerts.

If you wish to swell the ranks of listeners-in, and are not quite sure as to the best way to purchase a set, write for the Free Booklet given away by this paper. You will find it invaluable in giving useful advice. The booklet is sent by post, free of charge.

Weather Reports.

No fewer than twenty-four weather messages are now broadcast from the Air Ministry daily between the hours of 2 a.m. and 9.50 p.m. (G.M.T.). Of these, fourteen consist of special "Aviation Reports," transmitted on 1,680 metres C.W. hourly from 4.35 a.m. to 5.35 p.m. (G.M.T.).

Although very many amateurs listen-in for the "General Inference," issued at 9.15 a.m. and 8 p.m. (G.M.T.) each day, comparatively few are aware that detailed weather forecasts for six separate districts of England and Southern Scotland are dispatched on 1,300 metres C.W. in a simple code thrice daily, at about 9 a.m., 3 p.m., and 8 p.m. (G.M.T.). This code (known as "Meteorological Office Publication 244") may be obtained from H.M. Stationery Office, price 1s.

"Synoptic Reports," giving all the information necessary for the construction of a complete weather chart, are issued on 4,100 metres C.W. five times daily, at 2 a.m., 6 a.m., 8 a.m., 2 p.m., and 7 p.m. (G.M.T.). Full details of the code employed in these messages are given in the pamphlet.

British Broadcasting.

The six companies which are to have control of the British wireless broadcasting stations, says the London "Evening News," are the Metropolitan Vickers Electric, the General Electric, the Western Electric, the Radio Communications, the B.T.H., and the Marconi Companies.

The Postmaster-General's meetings with the representatives of the wireless distributing companies have been satisfactory, and the companies will now get to work in earnest.

Other Transmissions.

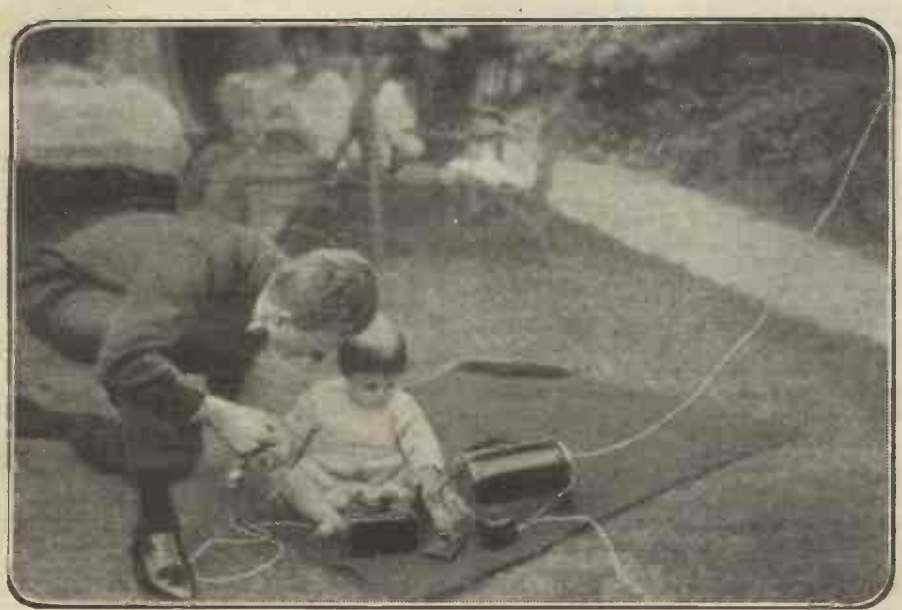
The Writtle concert is given every Tuesday evening at 8 o'clock, B.S.T., on a wave-length of 400 metres. The call sign is 2 M T. The concert lasts from twenty to thirty minutes.

Königswusterhausen transmits telephony usually at 7 and 10.30 a.m. (G.M.T.), on a wave-length of 2,500 metres. The station is situated near Berlin. Call sign, L O.

The Eiffel Tower radio station (call sign, F L) may usually be relied on for a telephony transmission (and sometimes a concert) at 5 o'clock (B.S.T.). A weather forecast is sent in French at 6 o'clock. The wave-length is 2,600 metres.

Croydon (G E D) may be heard in radio-telephonic communication with various aeroplanes on the Continental air routes at all times of the day.

Other aviation centres which transmit telephony include Castle Bromwich (G E C), Didsbury (G E M), Hinton-Admiral (sign not allotted yet), Lympne (G E G), Renfrew (G E R), Pulham (G E P) on 900 metres.



Master Anthony Sutton, 18, Melford Road, Dulwich, is another wireless prodigy. He is seen here listening in to 2 L O.

NEW SERIES FOR THE BEGINNER

By E. BLAKE, A.M.I.E.E.

PART 3.

SUMMARY OF LAST ARTICLE.

Electrons moving steadily through a conductor in one direction constitute a "direct electric current"; when they move to and fro at a moderate rate, say sixty times a second, the current is termed "alternating" current; and when the rate is many thousands of times a second the current is a "high-frequency oscillating" current.

An electric battery or dynamo is an apparatus which acts as a pump to force electrons through a circuit by means of electromotive force, which in the case of a battery is created by chemical means and in the case of a dynamo by magnetic means.

The unit of current is the ampere; the unit of electromotive force is the volt.

Conductors oppose resistance to the passage of an electric current. The unit of resistance is the ohm. Resistance dissipates the energy of the moving electrons in the form of heat.

Electric power is expressed by the product of volts × amperes. The unit of power is the watt. One-horse power equals 746 watts.

BEFORE an electromotive force is applied to a wire the electrons within it are performing very erratic movements as a result of the ceaseless exchanges of electrons between the atoms and the innumerable collisions between the electrons and the atoms. The average velocity of an electron under these conditions would be of the order of about 30 miles a second. When a steady electromotive force is applied to the wire these dancing electrons take on a steady drift in one direction, and it is this drift which constitutes an electric current. Imagine a crowd of people, a collection of jostling, colliding individuals, slowly moving as a whole in a certain direction, as they would do if moved on by the police, and you have a conception of the direct electric current. The individual movements of the electrons are very swift, but the progressive speed of the drift (or current) is very slow, a fraction of an inch per second, because of the enormous number of collisions each free electron sustains.

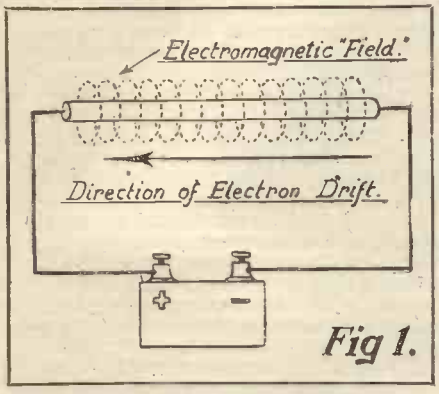


Fig 1.

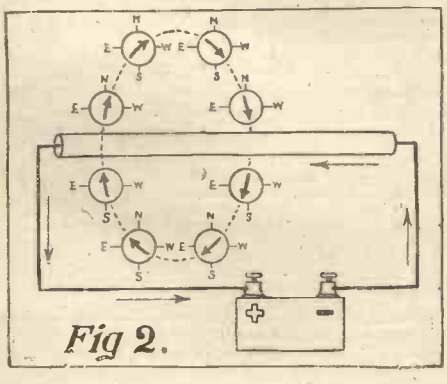


Fig 2.

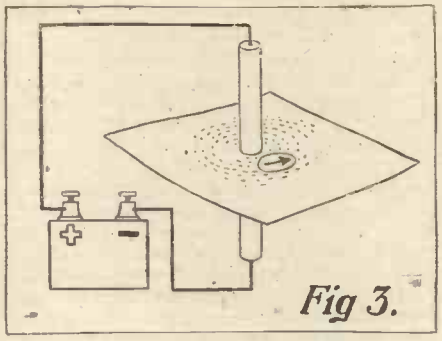


Fig 3.

It is not difficult to see that when in addition to its normal haphazard adventures amongst the atoms an electron is forced to take part in a general progressive movement it is bound to undergo many more collisions. If you have tried to move steadily through a crowd you will understand this. The result is that more heat is generated, and when the current is sufficiently powerful the heat can be detected by the hand; as this process continues the constituent particles of the wire become more and more active, hence more collisions take place and the resistance of the wire increases, and finally the radiation of energy assumes the form of light, as in the case of the filament of an electric light bulb or wireless valve. So much for the effect of the electric current upon the wire.

The electric current exerts an even more important and wonderful effect upon the space surrounding the wire in which it flows, for it produces around itself what is known as an electromagnetic "field," a peculiar condition of space which is generally represented as in Fig. 1. This diagram shows that the "field" (or sphere of influence) is, theoretically, distributed evenly round the wire. The arrows on the circles indicate that the "field" has a "direction," which means that wherever a compass-needle is placed in the field it will in each case point the same way round the wire. Look at Fig. 2, which represents a wire carrying a current, and a compass placed at various points round it.

Now, it is very important to realise that if the current is caused to flow in the opposite direction, the direction of the electromagnetic field becomes reversed. In other words, if the terminal of the battery in Fig. 2 were connected to the left-hand end of the wire and the + terminal to the right hand, then the direction of the compass-needle would be reversed. If you will experiment with a few dry cells, a piece of wire, and a pocket compass, you can demonstrate that this is a fact. Moreover, it is a fact which is at the root of the process of wireless radiation, as you will learn in a future article.

By passing the wire which carries the current through a piece of thin card (with a smooth surface) on which has been sprinkled some fine iron filings, you can map out the "field." When the filings are spread out as uniformly as possible (sprinkle them from a sugar-castor), turn on the current and gently tap the card. The filings will then group themselves as shown in Fig. 3. By placing a pocket-compass on the card, observing the direction in which the needle points, and then reversing the current, you will learn a great deal about the facts I am dealing with.

If the current in the wire be increased, say by adding another cell to the battery, or by employing a thicker wire (*i.e.*, reducing the resistance), the electromagnetic field will expand. On the contrary, if the current be reduced the field becomes less, and when the current is stopped the field collapses upon the wire and disappears. This electromagnetic field is only produced by electrons moving steadily as a crowd in one direction, and not by the fortuitous movements of electrons as individuals. When electrons change their velocity or alter the direction of their movement, energy is radiated.

The essence of wireless transmission is the radiation of energy in electromagnetic form. Bearing this in mind and re-reading this article, you will see that already we are dealing with the essential phenomena of wireless.

RADIO'S PART IN EMPIRE BUILDING.

WIRELESS, as the herald of a new age, is already creating lively interest in the wide spaces of the Empire. At Winnipeg, recently, a Society of Wireless Amateurs was formed, to protect and extend the hobby throughout the province of Manitoba. Permanent club premises are to be acquired, together with a bureau for dealing with questions of interest to wireless enthusiasts.

This is typical of the rapidly growing interest in wireless throughout the Dominion. Every city has its "radio fans" in large numbers, and the newspapers are giving serious attention to the new influence in daily life.

One of the questions asked through the columns of a newspaper gives a clue to the rapid rise in the popularity of wireless. "We are 700 miles from Winnipeg," states the inquirer, who is anxious to acquire a radio set.

It is difficult for people in England to appreciate what that distance means, and what a boon wireless is in annihilating it. The little collection of cylinders and wires presents a triumph over vast spaces, bringing the farmer into as close contact as the city man with the affairs of the world. Besides being informed on the general news of the day, the settler can know the market prices of grain and stock as soon as the gentleman on the produce exchange.

Men in the distant lumber camps, once exiles from the world, will know the result of the Derby within an hour or so of the finish of the race; they can be entertained by fair singers situated hundreds of miles away. The trapper, too, may soon be able to link up his bleak hunting ground with the handsome fur warehouses in the cities.

But apart from these and other amenities, wireless is likely to have an important effect upon the development of the Dominion. Some of the most fertile areas are being but slowly put under cultivation because of the lack of communication between the settlements. One provincial government is seriously considering whether or not radiophones should replace long-distance telephones. If this is practicable, development will be greatly expedited.

HOW TO MAKE A SHORT-WAVE RECEIVER.

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

PART 2.

BEFORE passing on to a consideration of the component parts of this set in greater detail it may be useful to explain the uses and functions of the reaction coil rather more fully.

The three-electrode valve, consisting of a heated filament, a grid, and a plate electrode in an exhausted glass bulb, is essentially and before everything else an amplifier—that is to say, it functions as an instrument which gives out more than is put into it. Taken at its face value, such a statement as this may seem to be an exaggeration, but it is literally true when considering the valve itself. Of course, when all the auxiliary apparatus is taken into consideration as well, there is no overall gain of energy and no energy is created in the entire system, but, on the contrary, some is lost as heat radiation.

The Reactional Coil.

What the valve does is to *convert* some of the energy available from the batteries, or other sources of electric current which are used with it, into a form in which it can perform other functions. It converts it into a form identical in nature with the form in which the energy is applied to the input side of the valve. To be more precise, the valve enables the direct-current energy derived from the high-tension batteries to be converted into alternating-current energy having exactly the same characteristics as the alternating energy supplied to the grid or input circuit of the valve, except that it has a greater energy associated with it.

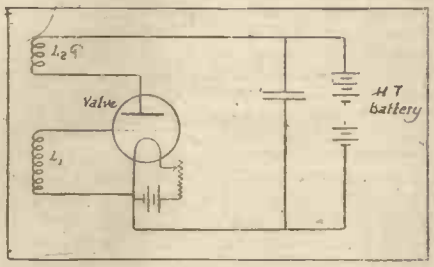


Fig. 1.

The wave-form of the output currents from a valve is identical with the wave-form of the input currents. In other words, if low-frequency currents are applied to the grid of the valve, magnified low-frequency currents of the same type can be drawn from the output circuit joined to its plate; and similarly, if radio frequency or any other type of current is applied to the grid, similar currents, but of greater energy, will be obtainable from the plate or anode circuit. In this way the valve is an amplifier.

Suppose, now, we include in the plate or output circuit of the valve a coil of wire L_2, Fig. 1, which can be coupled magnetically to any other circuit so as to hand on the amplified energy from the valve into any other circuit where we wish to have it. Evidently, then, we can couple this coil back again to the input or grid circuit so as to induce electromotive forces into that circuit. These electromotive forces will have identically the same wave-form as those already existing in that circuit, since they are merely magnified copies of them obtained by the amplifying properties of the valve.

These induced electromotive forces will therefore either be in the same direction as those already existing in the grid circuit or in the opposite direction, depending upon the direction in which the auxiliary coil L_2 is coupled with the coil L_1. If either of these coils is turned round the direction of the induced electromotive forces will be changed, thus making them assist or oppose the existing electromotive forces.

The former case is the more generally useful, although the latter occasionally finds some practical application as well.

The action of this coil L_2, which is the coil usually termed the "reaction coil," when used in this manner is therefore to help and strengthen the flow of current in the grid circuit of the valve. Evidently the amount of energy thus handed back to the grid circuit of the valve will depend upon the degree of coupling between the two coils L_1 and L_2. If this coupling is weak very little energy is handed back to the grid, but if the coupling is strengthened the energy in the grid circuit will become greater. This increased energy will obviously be again amplified by the valve, thus increasing the amplitude of the current changes in the plate circuit. If there were no losses in the circuits—*i.e.*, if the wires, coils, etc., had no resistance—this process would continue indefinitely, as the reamplified currents in the plate circuit would be handed back to the grid again through the reaction coupling, thus continually building up the strength of the currents flowing in the various circuits.

Its Use.

In actual practice, however, these idealised conditions are obviously not realised, and the increased currents give rise to increased losses in the various circuits, so that the full amount of energy is not available for amplification and reamplification by the valve. Hence it results that for any given reaction coupling between the input and output circuits of a valve, *i.e.*, between the coils L_1 and L_2, the intensity of the amplified currents derived from a given input reaches a steady value. As the coupling is increased this strength of the amplified currents increases also until a point is reached where sufficient energy is handed back to the grid circuit to maintain the valve in a steady oscillatory state.

The reaction coil coupling between the input and the output circuits of the valve therefore serves two purposes—it may be used simply to obtain extra amplification above that obtainable by the valve used alone, or it may be used simply for enabling the valve to set up permanent oscillations. Both these uses find application in wireless receiving apparatus, but in general the conditions under which they are used are quite distinct.

Reaction—or retroaction, as it is also called—may occur with currents of any frequency, whether radio frequency or low acoustic frequencies. In general it is used in practice solely for radio-frequency currents both for amplification and oscillation generation, but it occasionally also finds application in low-frequency circuits, particularly for oscillation generation for special purposes.

In the receiving set which forms the subject of these articles, reaction is employed solely in the radio-frequency circuits for increasing the amplification of the radio-frequency currents picked up by the receiving aerial, and it is not intended that in general it shall be used for making the valve oscillate. This condition should be avoided when receiving radio signals, particularly signals of these short wave-lengths, for the reasons that were given in the first instalment of this article.

In this case, therefore, the grid or input circuit of the valve becomes the tuned receiving aerial circuit, while the output circuit of the valve includes the reaction coil, the telephones, and the high-tension battery as shown in Fig. 2.

Practical Considerations.

In this diagram, as in Figs. 1 and 2 published last week, a by-pass condenser is shown across the telephones and H.T. battery to provide a path for the amplified radio-frequency currents which, as we have just seen, flow through the reaction coil when it is in use.

Several practical considerations govern the design of the reaction coil for use with any given receiving set and for any specific purpose. Since it is traversed by radio-frequency currents it must be a simple type of coil without any iron core. It must have a sufficient number of turns to give an adequate coupling effect with the main tuning coil in the grid circuit when it is traversed by the plate current of the valve, but it must not have too large an inductance, or this inductance, acting as it does in conjunction with the natural self-capacity of the coil windings plus the capacity of the valve and its holder, etc., will tune the reaction coil to a wave-length longer than that which it is desired to receive. For stability in operation the natural oscillation frequency of the complete plate circuit of the valve, including the reaction coil, must be higher than the frequency of the shortest waves on which it is to be used.

These conditions are somewhat conflicting, since one would indicate a large coil with many turns of wire, while the other points to a small coil with very few turns. The practical design must be a compromise of such a value that the coil will perform its functions over the desired range of wave-lengths. Details of a reaction coil to meet these conditions, and suitable for use in the receiver under discussion, will be given next week.

(To be continued.)

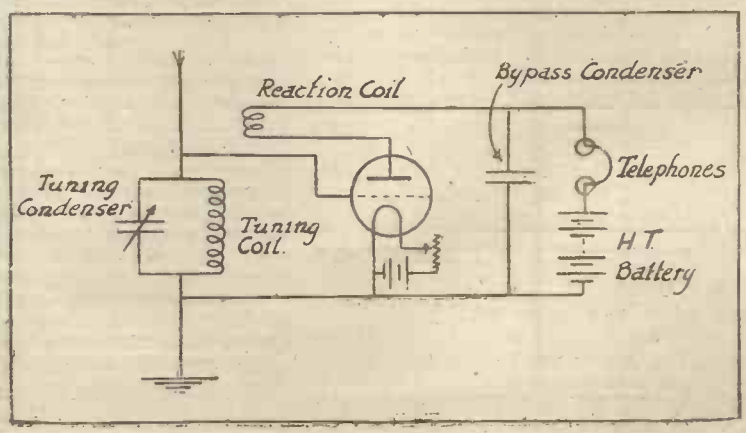


Fig. 2.

FOR AND AGAINST THE ETHER.

By SIR OLIVER LODGE, F.R.S., D.Sc., LL.D.

SIR OLIVER LODGE.

Those who read Mr. Risdon's article in last week's POPULAR WIRELESS will have realised the importance of the controversy that is now agitating the scientific world of America.

In this article Sir Oliver Lodge, the greatest scientist of our day, expresses his views on the new theory which Dr. Steinmetz, the chief engineer of the General Electric Co. of America, believes to have abolished the present belief in an etheric medium.

In the following brilliant article Sir Oliver Lodge explains why it is impossible for Dr. Steinmetz to lay down the law and to say "There is no ether."

The merest novice and beginner cannot fail to be interested in this fascinating subject, and if Sir Oliver Lodge's article is read with care the layman will easily comprehend.

EDITOR.

THE Theory of Relativity ignores the Ether of Space, "having no need of that hypothesis." It treats of occurrences mathematically, from the point of view of the individual observer, and in terms of what he can observe. It is quite clear that we, as human beings, can observe only Matter. That is what our senses enable us to perceive, and everything else is an inference. Mind, for instance, makes no direct appeal to our senses, and though it is the instrument of Consciousness, it is a philosophic question how far Mind can be regarded as an *object* of Consciousness.

But we are directly aware that we are thinking beings, and therefore each individual concludes that he himself possesses a Mind; or if he thinks deeper he may conclude that he *is* a mind and possesses a body. By some means or other most people come to the conclusion that they consist of both Mind and Body, though how rightly to express the conjunction may be difficult even to a Metaphysician. We do not, however, directly perceive the minds of other people; we only perceive their bodies, but those bodies look something like our own; and the way they act suggests that they are similarly each associated with a Mind. That, however, is an inference, and there is a system of Philosophy in which it has been argued against—the system known as Solipsism.

Does Magnetism Exist?

To common-sense, however, such a system seems absurd, and we most of us are quite willing to make the inference that other people have minds like our own, whether we directly perceive them or not. There are many other entities in like case—lots of things which make no appeal to the senses directly, but which are inferred from the behaviour of Matter. Life, like the life of a tree for instance, is of such a nature. We only infer that a tree is animated by something which we call Life because of the way in which it grows and develops and fructifies and reproduces and decays. But many Biologists have doubted the existence of any separate vital principle, and endeavour to treat the organism as sufficiently explained by the laws of Physics and Chemistry, and by the interactions of molecules, the effects of which they observe.

We might go further and say that Electricity and Magnetism are in a similar position. How do we know that such a thing as Magnetism exists? Only by observing the behaviour of some kinds of matter—behaviour which seems inexplicable unless we assume that it is, as it were, animated by something that we call Magnetism, though we have no idea, at present, what it really is. It is hardly true to say that we have *no* idea: some of us have ideas, but there is no certainty about them. And I suppose it would be possible to work out a theory of the Motions of Matter without mentioning the term Magnetism at all; for after all, by derivation, it only means the singular property of a certain stone which was found in Asia Minor. (The "Lodestone," which pointed in a certain direction when suspended, and which imparted its property to steel, is supposed to have been first found near a place called Magnesia.)

The Aim of Relativity.

But a gyrostatic compass points to the North, and the theory of its behaviour can be worked out without reference to anything magnetic. Indeed, there is nothing magnetic about it, only an elaborate spinning top. If we knew all about a compass needle it is probable that its theory could be worked out on somewhat similar lines. There is a hypothetical spin inside the atoms of the steel which may account for its behaviour, just as the spin of the gyroscope accounts for its behaviour, provided the spin of the earth is taken into account, too. So it may be with Magnetism. But no one has ever seen the magnetic spin, nor do we know for certain what it is that is spinning.

Again, we never actually see an electric current. What we observe is the motion of a compass needle which it deflects (as in a galvanometer), or the bubbles which arise in a liquid which it has decomposed (as in an electrolytic cell), or the light which is emitted by a filament which it has heated (as in an ordinary glow-lamp). No one has seen an electric charge. All we perceive is the behaviour of bodies—the attraction of light things in its neighbourhood; and to say that that behaviour is due to an electric field, or that the pattern of iron filings is due to a magnetic field, is no better than saying that it is due to Electricity or to Magnetism. It might be difficult, but it would be possible, to work out a theory of the Motions of Matter without introducing those terms. And if we forcibly limited ourselves to that which was really and directly observed, such a theory would be the inevitable result.

That is what the Theory of Relativity aims at—to specify exactly what is perceived, and to make no hypotheses beyond it. If an observer fails to detect any difference in the Velocity of Light through Space—whether he has reason to think he is moving towards the source or not—then let us proceed on the assumption that the Velocity of Light is absolutely the same relatively to every observer—granting the hypothesis, which is doubtful—for it *is* constant so far as the observer is concerned. If an observer is unable to detect any difference between his own motion and the motion of Matter near him, then let us assume that there is no difference, and that everything is as relative as it appears to be. So says the doctrine of Relativity. In that way we get rid of the idea of Absolute Motion, that is, of the motion of bodies referred to something which is not Matter—something omnipresent and fundamental, in which Matter, ever since Newton, has been hypothetically held to exist.

The Extreme Relativist.

The Theory of Relativity is professedly a pragmatical and observational mathematical theory, and hence it is claimed that it ought to be acceptable to Physicists. It dispenses with speculation, dispenses with hypotheses, and attends only to what can be observed and measured—at least, that is its ideal, though whether it quite comes up to its ideal may be doubted. We will give it the benefit of the doubt, and assume that a Theory of the Universe can be elaborated without reference to anything but Matter and its motion relative to other Matter.

An interesting example of this kind of Relativity is furnished by a letter in "Nature" for July 8th, 1922.

A correspondent there points out that, of the two theories of the Atom, one (namely, Bohr's) requires the electrons to be revolving round a nucleus, while the other (namely, Langmuir's) requires them to be stationary. He proposes a Copernican reconciliation, letting them be stationary while the nucleus spins on its axis, saying that according to the Theory of Relativity that should do just as well; in other words, that it does not matter whether a group of electrons revolve round a nucleus, or whether the nucleus rotates inside a group of electrons. Just so, according to an extreme Relativist, it might be held that it makes no difference whether the whole system of stars revolves round the earth once a day, or whether the earth rotates diurnally on its axis.

Ignoring the Ether.

Put in this way, the notion is repugnant to common-sense, and, we need not hesitate to say, is false. So, also, the reconciliation of atomic theories suggested in the ingenious letter to "Nature" is imaginary and devoid of efficacy. But according to strict Relativity it is not so easy to say why common-sense comes to these conclusions. The fact is that the centrifugal acceleration required for radiation cannot be conferred on an electron by a relatively rotating nucleus. Nor is it possible for the stars to move far quicker than the Velocity of Light—as they would have to if they were to revolve round the earth.

For what, after all, is the Velocity of Light, and why should a thing be unable to move faster than that? If we wholly and finally ignore the Ether, no explanation is forthcoming. We can only merely say that it is so. Relativists all agree that it is

FOR AND AGAINST THE ETHER.

(*Continued from previous page.*)

so—the equations demonstrate that—but by pure Relativity they cannot explain why.

Hence, those who have gone most deeply into the Theory of Relativity sooner or later perceive that there must be something substantial filling otherwise empty space; in other words, that the Ether is really and truly indispensable, however much for practical purposes it may be ignored. For though we can proceed a long way without mentioning or thinking of it, sooner or later it is bound to make its existence felt, not physically but mentally; because of certain physical effects or consequences which are inexplicable without it, and because its existence is necessary to clear and adequate conceptions. To put it in the most ordinary and elementary form—one cannot really think of waves without some substantial medium for their conveyance.

So Far and No Further.

Let it be known, then, that the great apostles of Relativity have never denied the existence of Ether. They have dispensed with mentioning it as far as they can. It does not seem essential to their theory as far as that has been worked out. It does not seem amenable to direct experiment; and they can write down their equations without attending to it. But to deny the existence of the Ether, or of Electricity, or Magnetism, or Life, or Mind, merely because we find it possible for many purposes to ignore them, is to stultify ourselves. And to accuse any of the great Relativists of denying the existence of an Ether is to attribute to a man of genius a stupidity which he is very far from exhibiting—still less of possessing.

How, then, is it possible for Dr. Charles P. Steinmetz to lay down the law and to say that "there is no Ether," that "there are no Ether Waves," that "according to the Theory of Relativity there can be no such thing"; and that no carrier for Light or Electro-magnetic Waves is needed?

Plainly, because he has gone a certain distance into the Theory of Relativity, and has not emerged into the atmosphere beyond it. He is satisfied with the way in which it works out the motions of Matter as observed by the senses, and he considers that any inference beyond the immediate testimony of the senses is illegitimate.

Freer Play for the Mind.

That, then, is where we part company. To limit ourselves to sense indications alone is to reduce ourselves to the level of animals. No one really does it; and some even of the animals may make inferences of a kind. Certainly it is our human privilege to discover, to infer, to generalise, and to predict. And I advise those who are every day using the Ether, for electrical and magnetic and optical purposes, not to confuse themselves with the gratuitous and rather stupid hypothesis that Matter is all that exists because Matter is all they perceive; but to allow their minds freer play, and to realise that many other things exist, too, for which we have no sense organ.

So, if they care for my advice, I will recommend them to use a nomenclature in accordance with common-sense; to give a name to the substance or medium in which all their phenomena are occurring; to realise that wherever there is an electric field, or a magnetic field, or a gravitational field, or a beam of light, there must be something going on in this medium—something which Physicists can hope to analyse and examine and reduce to law and order. I would urge them not to remain satisfied with an abstract statement about the existence of unexplained forces in absolutely empty, unphysical, and merely geometrical Space.

No Easy Task.

A field of force *in vacuo* has to be accounted for: the mere statement that it exists is no theory. A theory of the Ether has not yet been worked out; it remains for the next generation of workers to do it. Perhaps some of those now living will lend a hand. It is no easy task. Meanwhile, we can remember always that the properties of the Ether are largely unknown and remain to be discovered—which surely is a stimulus to us to pursue our researches. That which we know definitely about it so far is the rate at which it can transmit waves; and we know, also, a great many things which follow directly therefrom.

We know, further, that it has properties akin to elasticity and inertia, which are experienced respectively in Electricity and Magnetism; and again we know (through the genius of Clerk Maxwell) that the combination of these two properties gives rise to that special kind of disturbance which stimulates the eye, and is responsible for all that is experimented on in Wireless Telegraphy.

A PRE-MARCONI STATION.

By H. R. RIVERS-MOORE, B.Sc., A.C.G.I., A.M.I.C.E., A.M.I.E.E.

IT is not perhaps known that wireless telegraph stations were in commercial operation in this country some years before the famous experiments of Signor Marconi, and that his reception by the Post Office authorities here, who assisted him in carrying out tests very early in his career, was largely due to the interest in the subject felt by the then Engineer-in-Chief, Sir William Preece.

It fell to my lot to replace one of these pre-Marconi installations with the newer system, after it had given good service for some years, and the change was then made only because of trouble experienced from natural disturbances.

The origin of the method was somewhat romantic. It happened during one of the periods when Ireland's dissatisfaction with the Union had become more than smouldering. There was much correspondence of a highly confidential nature over the wire connecting Dublin Castle with Downing Street.

An easily imaginable consternation arose when the whole correspondence began to be forwarded daily by post, and anonymously, to the Postmaster-General. What secret service agent was disclosing all that passed, and what use might be made of the information?

Watch was kept on all connected with the transmission, but no clue could be obtained, until one day the culprit disclosed himself.

It transpired that this individual had a wire which by chance ran parallel and near to the Dublin Castle private wire, and he found, accidentally, that he could overhear what passed, by means of the now well-understood principle of induction. He had amused himself for a while taking down and forwarding the messages, but eventually explained what was happening so that steps might be taken to overcome the difficulty.

Mr. Preece began thinking of the possibilities of the discovery, and set to work to find out over what distances the overhearing would take place. Eventually a telegraph wire was carried along the shore of Anglesea, opposite the Skerries, and a similar wire on the rock itself, and the two ends of each wire led into the sea.

It was found that telephone currents in the line on Anglesea were repeated faintly on the Skerries, and by this means communication with the lighthouse was secured. There were no amplifiers in those days, and disturbances from earth and sea currents were very great, so that conversation was by no means easy, and it is said that the only persons who could work the arrangement were a young light-keeper on the rock and the postmaster's daughter on shore, to whom he happened to be engaged.

A system which depends on the provision of engaged couples at the two ends is not entirely a commercial proposition, but none the less a second installation was used with little trouble for communication with Rathlin Island from Ballycastle, a distance of about four miles. Here it was possible to have much longer lines at each end, and also telegraphy was used instead of telephony—a much simpler proposition.

Current from a battery of dry cells was passed to the line through a motor-driven interrupter which gave a low hum in a telephone receiver. The circuit could be closed and opened by means of a telegraph key, on working which signals could be heard in the receiving circuit similar to a low note radio signal, but quite lacking in "grit."

Owing largely to this softness of tone earth current disturbances caused severe interference, often for days at a time, and, as already stated, it was for this reason that Hertzian-wave telegraphy was eventually substituted.

The apparatus consisted of a small fixed spark outfit with ignition coil worked from dry batteries as the high-tension unit, Leyden jar condensers, coupled aerial circuit, and for receiver a small magnetic detector with a simple tuner fitted in the base.

The whole was installed in standard telephone boxes at the post offices at each station. Similar apparatus had been in use—not too successfully—over a twelve-mile range in the Orkneys, but a great part of the distance was over land.

These ranges seem small, even with low power apparatus, in these days of crystals, valves, and amplifiers. On the other hand, no doubt the Preece inductive system could have been greatly extended by the use of amplifiers, but the defect of earth disturbances would remain, since without very special devices these would be magnified along with the signals. I remember at Ballycastle clearly hearing Wheatstone telegraph signals passing on a line of wires twenty miles away when I was listening for Rathlin Island, before making the change.

I also remember receiving a telegram from headquarters asking me to make a special listening test on the old system during an eclipse of the sun which was due, but as I had been watching the said eclipse from the train which bore me to Ballycastle, my arrival was too late to allow of what might have been an interesting experiment on the effect of eclipse on earth currents.

STEP BY STEP IN WIRELESS.

No. 10.—AN IMPORTANT CONDENSER.

NO amateur would knowingly construct a faulty condenser. Let us suppose, for instance, that the question of constructing a two-plate blocking condenser arose.

One would hardly include a faulty or punctured plate in its construction. Yet many amateurs have what is equivalent to a faulty plate in the most important condenser in their set. Much has been written in POPULAR WIRELESS regarding condensers. Much has also been written respecting the erection and care of aerials. At first sight there does not seem to be much connection between the two, but a little thought will show their relationship.

A Good Earth.

Exceptional care is always exercised when erecting an aerial. Every factor detrimental to its efficiency is carefully eliminated, and one plate of your condenser is complete. The second plate, however, which is the earth, is very rarely given the attention it deserves.

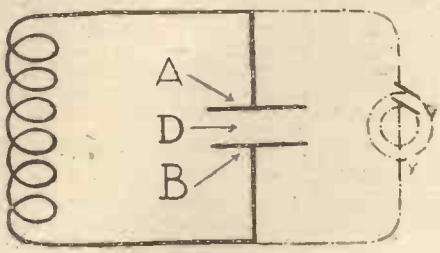


FIG. I

The aerial and earth form two plates of a huge condenser, the air between them acting as the dielectric.

It will therefore be obvious to all that a good earth is as important as a good aerial. It is not sufficient to drop the end of the earth wire attached to the set into a puddle or down a drain, any more than it is sufficient to hang out the aerial in a haphazard manner from the two most convenient points irrespective of other considerations. To fully understand the importance of a good earth we must consider the nature of the received waves, and the manner in which they will affect different circuits.

Effect of a Fault.

In a previous article it was shown how wave-length depended upon frequency and velocity. Frequency is therefore a factor to be taken into account when considering wave-length. Wave-length, however, also depends upon the amount of capacity and inductance in a circuit. This is because different values of capacity and inductance will alter the *frequency* of the oscillatory current in a circuit, and will therefore alter the wave-length. It will easily be seen that the connecting factor between the two formulæ for wave-length is frequency.

If wave-length $= 1885 \sqrt{C \times L}$

Where C = capacity and L inductance.

And wave-length $= \frac{\text{velocity}}{\text{frequency}}$,

frequency is governed by the respective values of C and L.

Fig. I. shows a circuit connected up to a source of alternating current supply. The frequency of the alternations passed into the closed circuit, which is marked in heavy lines, can, however, be varied by altering either the amount of capacity or inductance in that circuit. It has been stated that this circuit is a "closed" one.

In other words, although oscillations are set up in it, they are kept within the circuit itself, and this factor makes it a poor circuit for either radiation or absorption of wireless waves.

The amplitude of the waves produced by such a closed circuit is very small. The capacity and inductance of the circuit are distinctive; that is, they occupy separate and defined positions in the circuit, and are not both mixed up together, all of the capacity being contained in the condenser and all of the inductance in the coil. Now look at Fig. II., which is also an oscillatory circuit, although it is called an "open oscillatory circuit," instead of "closed."

Such a circuit will produce waves of high amplitude, and is therefore a good radiator, and incidentally a good absorber. In this circuit the capacity and inductance do not occupy any definite positions, but are distributed around the overall length of the circuit. The aerial, therefore, although acting as one plate of the condenser, also possesses a certain amount of inductance.

Now let us return to Fig. I., the original oscillatory circuit. Let us imagine A as being the aerial wire or wires corresponding to one side of the condenser. D, which is the air between the aerial and the earth in Fig. II., is the dielectric, and the earth B will correspond to the other side or plate of the condenser. A faulty or poor connection to earth from your set means, therefore, a faulty condenser plate.

It has been seen that the circuit shown in Fig. I. will oscillate at a certain frequency dependent upon the amount of capacity and inductance it possesses. The same ruling applies to Fig. II. The aerial and earth circuit, possessing capacity and inductance, will oscillate at a certain frequency, governed by these two factors, apart from any other considerations. This frequency will, of course, produce a wave of a definite length, which is known as the fundamental wave-length.

Worth While.

Now, waves sent out from a transmitting station do not confine themselves to the upper reaches of the ether. They "impulse" the ether from the ground upwards. During one alternation of the received oscillations the current runs from the aerial, through the set, and down to the earth. When the alternation reverses, however, the current travels in the reverse direction—namely, from the earth up to the aerial.

If it is borne in mind, then, that the earth is as important as the aerial, many amateurs will be spared a good deal of worry when endeavouring to find out why their apparatus is "not as efficient as it should be."

Earth plates or wires should be used whenever possible. It is worth while. Keep your earth lead as short as you can, and use a fairly thick wire. If earth plates are used, see that the connections to the earth lead are firmly and cleanly made. Do not bury your plate or plates parallel with the earth's surface; in other words, with the flat surface upwards. Sink them into the earth "edge on." If wires are used, run them under the earth as nearly under the aerial wire or wires as possible.

If a pipe *must* be used, see that it is a water-pipe, and make certain that it is connected to

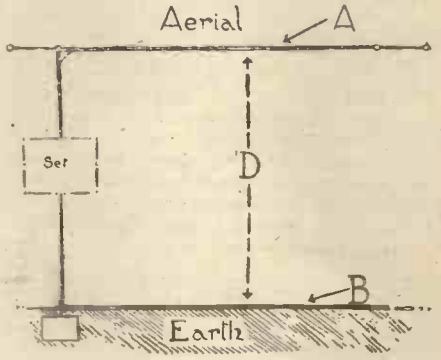


FIG. II

the mains and not to a tank. Beware of pipes that do not contain water. They may "go to earth" all right, but if they have cement or rubber jointing your "earth" will be no earth.

Treat this portion of your set with the care that such an important part of it warrants. Remember that you are constructing one of the two plates in the most important condenser in your set.

HINTS FOR AMATEURS.

SHOULD you have the misfortune to break off a small screw in some metal part of your instrument, and it is too short to get hold of, it will be found easy to remove it in the following manner.

Get a drill that is a bit smaller in diameter than the screw and grind it the reverse way; then centre-punch the broken screw and drill in the opposite way. This will have the effect of drilling a hole left-handed, and as soon as the drill begins to bite the metal it will undo the screw, as the drill will be travelling in the right direction for undoing screws.

Should the drill go right through and not undo the screw, drive the tang of a file, or something similar, into the hole and unscrew.

* * *

Pocket batteries are often used for the H.T. battery, and a good way to link them up is to make clips similar to a trouser-clip used for cycling. These clips should be made up in pairs on a short length of flexible wire. It will readily be seen that it is easy to remove a run-down battery, or to make any sort of combinations of connections, without the bother of soldering. Make sure that the clips are a tight fit and make good contact.

* * *

Keep all your old photographic plates: they are most useful for lining battery boxes or constructing fixed condensers. If used for lining a battery box, the joints may be easily made with paraffin wax. Put it on with a piece of hot iron, but see the iron is not too hot.

* * *

Always keep the terminals of your accumulator well greased. Vaseline is a good medium for this purpose, and will save a lot of trouble and add to the life of the accumulator.

* * *

Do not test your pocket batteries with a lamp; a volt-meter is much the better way. A lamp will take a lot out of the battery in a very short time, and a volt-meter is a good investment. Never test with anything metal to see if it "sparks"; this also applies to the accumulator. It is a very bad practice indeed.

WIRELESS DIRECTION FINDING.

ONE of the greatest advantages of wireless in marine navigation is its ability to obtain the ship's position during foggy weather.

Supposing a ship which has on board the necessary apparatus encounters a thick fog off the south coast of Ireland? How is it possible to find the position of the ship by wireless?

In the first place the wireless operator listens in for any shore wireless stations which happen to be sending messages to other ships. He will probably pick out the post office station of Land's End in Cornwall, which works almost ceaselessly with vessels in the Atlantic.

Three Stations Necessary.

By means of certain instruments—to be described later—it is possible for the operator to ascertain that the wireless signals being sent from Land's End are coming from a definite direction, which we will suppose is the south-east. Therefore, the operator knows that Land's End is south-east from the ship, so that from Land's End the ship is in an exactly opposite direction, namely, north-west.

The operator now listens in for some other shore station sending messages. We will presume that he hears Fishguard Radio in Wales, and that his instruments record the fact that Fishguard is due east; therefore, from Fishguard the ship is due west.

The operator now takes a chart and draws upon it a line north-west from Land's End and another line due west from Fishguard—if these lines are prolonged they will meet, and where they do so is the ship's position.

In order to get the position accurately it is necessary for the operator to obtain the direction or bearing of at least three shore stations, and the third one in this case would probably be Ushant, a French station.

The Rotating Aerial.

Practically everybody is familiar with the aerial wires stretched between the masts of a ship which are used for picking up (or transmitting) wireless messages. The wires of the aerial used on ships for direction-finding work, however, are not stretched between the ship's masts, but are wound round a square wooden frame. This frame might be likened to a huge square picture-frame with flat outer edges on which several turns of wire are wound.

This aerial is supported vertically, a foot above the wireless cabin, by a shaft which enters the wireless cabin through a hole bored in the roof, and by rotating this shaft the aerial can be turned in any direction through 360 degrees.

Attached to the shaft inside the cabin is a small pointer which is parallel with the two horizontal sides of the aerial. Also, directly underneath the end of the shaft is a mariner's compass, so that as the shaft is rotated the pointer which is parallel with the aerial indicates the direction of the aerial on the compass. The rest of the apparatus consists of an ordinary wireless receiver.

Now, if the operator hears Land's End sending wireless messages he revolves the aerial until he hears these messages at their maximum strength. He then knows that one side of the aerial is pointing to Land's End—for it is an electrical law that any coil of wire, such as a direction-finding aerial, will absorb the maximum amount of wireless energy when one side of the said coil is turned in the direction of the station which is transmitting the wireless energy. By connecting the direction-finding aerial to the ordinary aerial stretched between the ship's masts, it is possible for the operator to tell which side of the direction-finding aerial is pointing to Land's End.

If the operator continues to rotate the aerial the signals from Land's End will grow fainter and fainter until they are very weak or, perhaps, die away altogether; this is a sign that the plane of the aerial is at right angles to Land's End.

A Boon in Fog.

As mentioned before, if the operator hears the incoming signals at their maximum strength, one side of the aerial is pointing to Land's End. By means of the mariner's compass the operator reads the direction in which the aerial is pointing—namely, south-east; therefore Land's End is in a south-easterly direction from the ship.

If the aerial is placed at right angles to Land's End, which is shown by the weakest signals, a simple calculation will also inform the operator that Land's End is south-east.

The wireless signals from Fishguard are heard loudest when the aerial is pointing in an easterly direction; therefore, Fishguard is east from the ship.

This system of wireless direction finding, which is the most up-to-date of its kind, has only been in use a few months in the American merchant service, but already cases have been reported where ships equipped with such an apparatus have been able to avoid collision with other ships in foggy weather, and on at least three occasions a ship in distress has been located by some other ship with direction-finding apparatus on board—when such an undertaking was out of the question for unequipped vessels, owing to bad visibility.

Interference Minimised.

It will easily be seen that the possibility of interference from stations other than the one special station it is desired to receive is greatly minimised by the use of a frame aerial.

This type of aerial, therefore, gives the receiving station a certain amount of "selectivity" which stations using the ordinary line type of aerial do not possess, because altering the direction in which the edge of the frame is pointing will alter the strength of the signals received from any one station. Reference to the illustration shows that such a station radiates most strongly in a definite direction.

As, therefore, it is possible for a frame aerial to receive its strongest signals when pointing in a definite direction, it is but a step to see that two stations of the types mentioned could, if working in conjunction, almost eliminate any interference from other stations.

In other words, one station can send its strongest signals in a given direction, and the receiving station can receive its strongest signals from that direction.

Wireless Lighthouses.

It is quite a common error to suppose that directional wireless is a new departure in the wireless world. As a matter of fact Hertz himself proved that the electro-magnetic ether waves discovered by him are capable of being reflected, as are light and sound waves.

Later on, when Marconi developed the wireless telegraph system, he employed reflectors to concentrate the waves and direct them, and so to increase their range. When, however, he found that by means of longer waves a very great increase of range could be obtained, the development of directional wireless stopped for the time being, the demand then being for increased range and broadcast working as, for instance, applied to ships at sea.

In the year 1916 he commenced investigations in Italy, in connection with the war, with a view to the utilisation of very short waves, in conjunction with reflectors for directional purposes. The waves then used were of 2 and 3 metres. It may appear surprising, but in those experiments interference was experienced from waves set up by the electric ignition systems of ordinary motor-cars and motor-boats. The experiments proved that directional signals were effective up to 6 miles' range at sea.

Subsequent tests in 1917 at Carnarvon with 3-metre waves gave an effective range of 20 miles at a transmitting altitude of 600 feet and a receiving altitude of 300 feet, the power of the signals and their range decreasing rapidly with less altitude. Thus, transmitted and received at sea-level and over the sea, the signals were weaker at 4 miles range than at 20 miles with the receiver at a height of 300 feet.

Inchkeith D.F.

The next step was in the application to a directional telephone system. Valve transmitters and waves of 15 metres were used, and communication was established with a ship 70 nautical miles from Carnarvon, it being proved that after passing the horizon line there was no rapid falling off in strength.

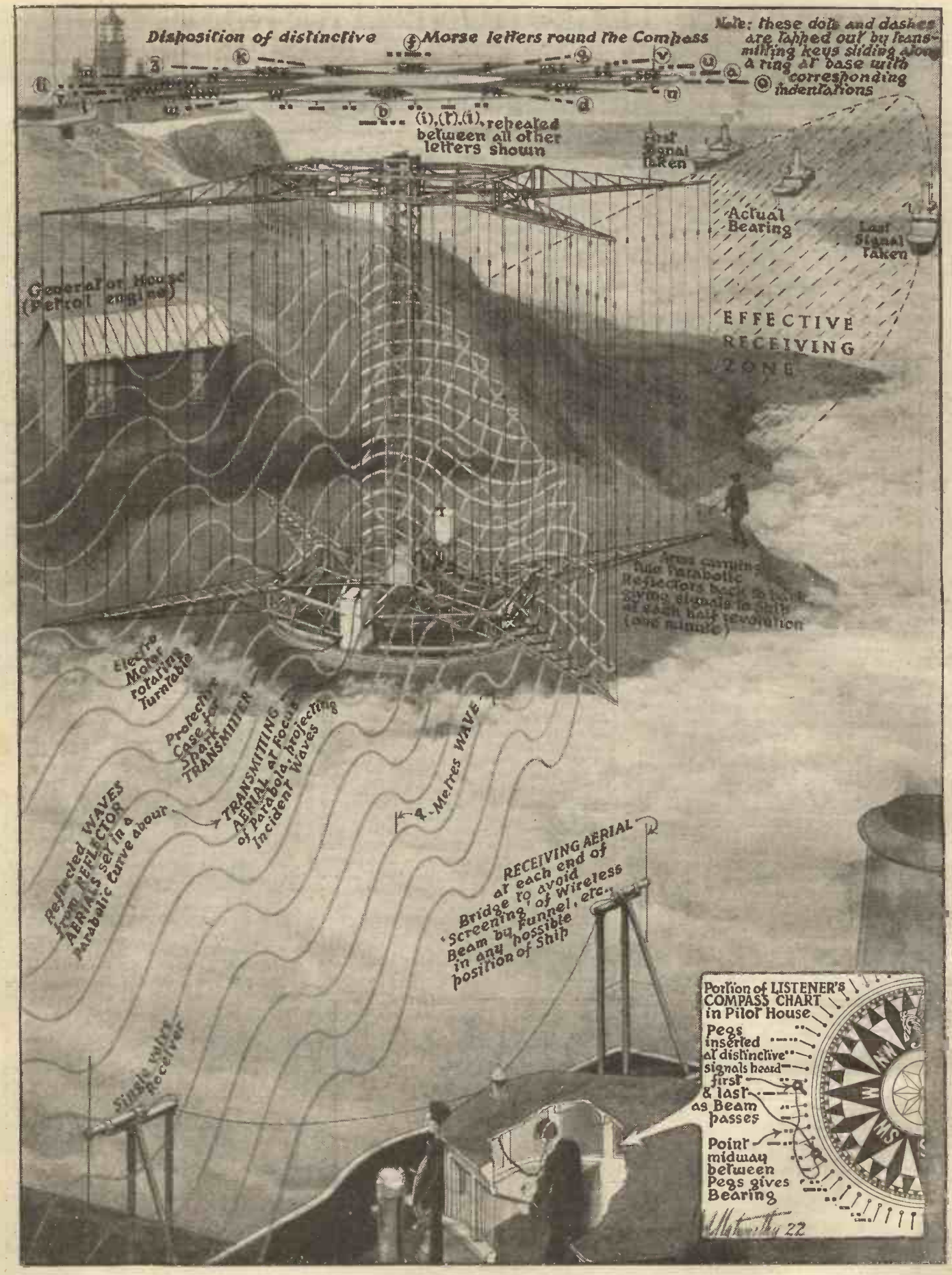
Directional telephonic communication was also effected over first 20 miles and then 66 miles of land, the receiver being on a motor-car, and also nearly twice that distance between London and Birmingham. The use of reflectors was proved to increase the strength of signals 200 times.

The idea was then conceived of applying the system to lighthouses, so that, instead of light beams, wireless sound beams should be employed for the guidance of vessels, irrespective of fog and other weather conditions. On the island of Inchkeith, in the Firth of Forth, a revolving reflector has been installed as shown in our picture. It comprises a revolving table with a central mast from the top and bottom of which four arms radiate outwards. Between the upper and lower arms vertical wires are stretched, tuned to suit the wave-length of the signals transmitted. These wires constitute the reflector. The wave-length in this experimental apparatus is 4 metres and a spark transmitter is used. As the radiating waves strike the reflector wires they are reflected and projected in an almost parallel beam as indicated on the diagram.

Accurate Results.

The reflector completes one revolution every two minutes, and a distinctive signal is sent out every half-point of the compass, enabling the bearing of the transmitter to be determined by the navigating officer on a vessel within a quarter point of the compass, or within 2·8 degrees. These angular intervals are regulated by contact segments on the base of the revolving reflector. A working range of 7 nautical miles has been attained.

This interesting application of wireless is being further developed, and there is apparently no practical reason why the present lighthouses should not be entirely superseded by it.


Disposition of distinctive Morse letters round the Compass
Note: these dots and dashes are tapped out by transmitting keys sliding along a ring at base with corresponding indentations
(i),(r),(i), repeated between all other letters shown
First Signal taken
Actual Bearing
Last Signal taken
EFFECTIVE RECEIVING ZONE
General or House (Petrol engine)
Electro Motor rotating Turntable
Protective Case for Spark TRANSMITTER
TRANSMITTING AERIAL at focus of Parabola projecting Incident Waves
4 Metres WAVE
Reflected WAVES from REFLECTOR AERIALS set in a Parabolic Curve about
RECEIVING AERIAL at each end of Bridge to avoid Screening of Wireless Beam by Funnel, etc., in any possible position of Ship
Single valve Receiver
Portion of LISTENER'S COMPASS CHART in Pilot House
Pegs inserted at distinctive signals heard first & last as Beam passes
Point midway between Pegs gives Bearing

WIRELESS TELEPHONE TRANSMISSION.

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

Author of "Wireless Valves Simply Explained," "Elementary Text-book on Wireless Vacuum Tubes" and "Thermionic Tubes in Radio Telegraphy and Telephony."

IN a previous article the writer described how a three-electrode thermionic valve may be caused to generate continuous oscillations. These oscillations really consist in a current flowing up and down the aerial of a wireless sending station. The currents first of all are weak, and strengthen up to a maximum value, and then decrease to zero, then reverse and flow in the opposite direction, gradually gaining in strength, but falling back to zero after a certain point. The currents, in effect, very much resemble what are known as alternating currents, the only difference being that the oscillation currents used for continuous wave wireless transmission are very much more rapid, and in the case of a broadcasting station take place at about 1,000,000 times per second.

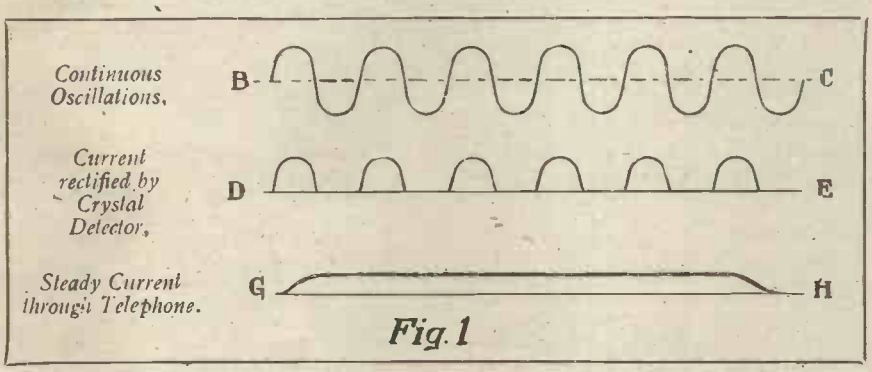


Fig. 1

Continuous Waves.

These oscillating currents in the aerial produce very similar wireless waves. Continuous wireless waves are very different from the kind of waves sent out by a spark station. If the key of a spark station be depressed, a series of sparks will be produced, each spark producing a group of a few waves. If the key of a continuous wave transmitting station is held down, the transmitted waves are continuous and are not cut up into groups.

The top line of Fig. 1 shows the nature of continuous oscillations. It is to be understood that the oscillations produced in a wireless receiver by continuous waves will be exactly the same only of weaker strength or amplitude, the amplitude being the height of the wave. In Fig. 1 the amplitude of the oscillations is measured from the top of the "hump" to the dotted line, B, C. The dotted line, B, C, represents normal conditions. The "humps," or half-cycles as they are called, above the dotted line indicate a flow of current in what may be called a positive direction, while the lower half-cycles indicate a flow of current in the opposite direction.

When continuous waves strike a receiving aerial, continuous oscillations are set up in the receiving circuit, and if we use a rectifier and a pair of telephone receivers to rectify the oscillating currents we will see that the current through the telephones will be a steady one while the incoming oscillations are received.

The second line of Fig. 1 shows the negative half-cycles being prevented from passing through the crystal detector. The positive half-cycles all pass in the same direction, and their average effect, so far as they affect the telephone receivers, will be the same as if a steady current were flowing through the telephones. Such a steady current is shown in the third line of Fig. 1. The steady current will produce no note in the telephone receivers, because the diaphragm will remain deflected and will only vibrate if the current through the telephones varies in strength. We see, then, that if we use an ordinary detecting apparatus employing a crystal detector or valves, a steady stream of continuous waves sent out by a continuous wave station will produce no audible signals in the telephone receivers.

It is necessary to explain this effect if we are to understand how wireless broadcasting stations work. All wireless telephone transmitting stations use continuous waves, and most of them use valve generators. When no speech is actually going on, the waves radiated from the transmitting station are continuous waves, and they have no effect on an ordinary receiver. When, however, someone is speaking, or music is being transmitted, the nature of the waves radiated is modified in accordance with the speech or music, and the modified waves produce modified currents in the receiver which, when rectified, produce sounds in the telephone similar to the original speech or music. The actual waves are really only employed for the purpose of carrying the speech through the ether. The electric currents produced when speaking into an ordinary microphone could not be made to travel through space, although they may be made to travel along wires, as in the case of the ordinary telephone. The only way of bridging the ether effectively is by the use of wireless waves.

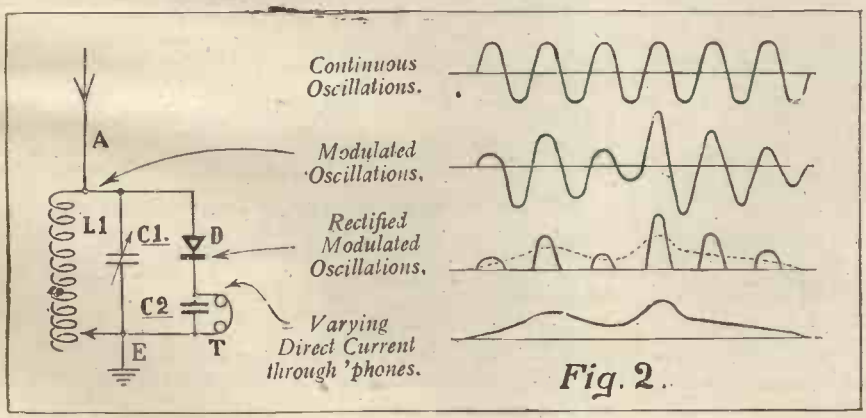


Fig. 2.

Varying the Amplitude.

In actual practice, we eliminate the high-frequency currents at the receiving station by rectifying them, leaving only the kind of currents originally produced by the microphone at the transmitting station. What we really do when transmitting speech by wireless is to mix the speech currents with the continuous oscillations and apply the resultant currents to the aerial of the transmitting station. The waves of impure shape pass through the ether, strike the receiving aerial, and set up currents in the receiver. These currents are of high frequency, but, instead of being continuous oscillations, vary considerably in their amplitude or strength.

The crystal detector, by rectifying the oscillations, eliminates the high-frequency currents mixed up with the speech currents, which latter are left to operate the telephone receivers. This is a very crude method of explaining what happens, but as it is assumed that the reader for whom this is written knows very little about the subject, the most simple explanations have been given.

The waves which carry the speech currents through the ether are often called the "carrier" waves. When not speaking, the waves are continuous. That is to say, their amplitude remains the same as shown in the top line of Fig. 1. When speaking, however, the strength of the waves varies in a special way which always remains the same for certain sounds. When speaking at a wireless telephone transmitting station the currents passing in the aerial are continually varying in strength, and as a result the amplitude of the waves is continually varying.

Modulating.

Fig. 2 shows in the top line the ordinary continuous waves sent out when not speaking; the second line shows how, for a certain particular sound, the strength or amplitude of the waves goes up and down. Different sounds produce different variations in the strength of the oscillations at the transmitting station, and therefore in the oscillations in the receiving circuit. This variation of the steady continuous oscillations by speaking into the microphone is called "modulating" the high-frequency current. There are various methods by which we can modulate the waves radiated from a continuous wave station, but it is only proposed to describe one or two methods here.

The chief point to notice is that we normally start with pure continuous oscillations, and then vary their strength up and down by speaking into or otherwise affecting a microphone. The modulated waves set up oscillations in the receiving circuits, which change

direction at the same rate as the original oscillation, but which vary in amplitude in identically the same way as the currents in the transmitting aerial.

Voice Inflexions.

The second line of Fig. 2 shows the currents in the receiving oscillation circuits. When these currents are applied to a rectifier, such as a crystal, the currents are rectified and the currents passed by the detector are unidirectional, but vary in strength as shown in the third line of Fig. 2. The telephone receivers only respond to the average effect of these currents. This average effect is shown by a dotted line in the third line of Fig. 2.

The fourth line of Fig. 2 shows a line, which represents the current through the telephone receivers. If we compare this line with the line G, H, of Fig. 1, we will see that instead of a steady current flowing through the telephones a slowly varying current passes through them, and this slowly varying current will cause the telephones to emit the same kind of note as that applied to the microphone at the transmitting station. Although only a few oscillations are shown as being modulated in Fig. 2, it is to be understood that, while speech or music is going on, the waves are continually varying in strength. For example, if the word "broadcast" is spoken into the microphone at a transmitting station, nearly 1,000,000 oscillations and waves will be modulated, their strength increasing and decreasing with every inflexion of the voice. It is, in a way, very extraordinary that these inflexions are faithfully carried through the ether and may be detected by a wireless receiver tens or hundreds of miles away.

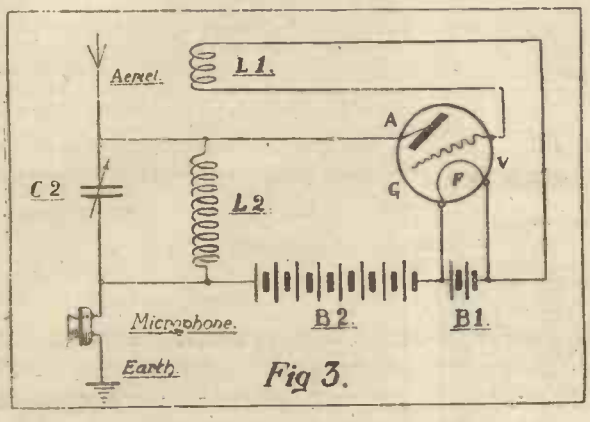


Fig 3.

To the left of Fig. 2 will be seen a simple wireless receiving circuit using a crystal detector, and arrow-heads show the kinds of current flowing in various parts of the circuit.

Continuous Valve Oscillations.

Having described the general principles of wireless telephone transmission, it is proposed to give one or two examples of how the continuous oscillations produced by a valve generator may be varied in strength in accordance with speech. It is well known that if you pass a current through a microphone consisting of a carbon diaphragm pressing on some carbon granules, the impinging of sounds on the diaphragm will vary the pressure between the granules and the diaphragm, and so vary the resistance of the microphone.

This variation of resistance will cause a corresponding variation of the current through the microphone, and if telephone receivers are connected so that the currents flow through them, the variations in current will produce a sound in the receivers similar to that which affects the microphone.

Various Circuits.

In the case of a wireless telephone transmitter we can vary the strength of the oscillating currents in the aerial by simply including a microphone in the aerial circuit. Such an arrangement is shown in Fig. 3, which is a valve generator similar to that described in Fig. 5 of the previous article, the only difference being that a microphone is connected in the earth lead.

As the aerial currents pass through the microphone it will be seen that, when speaking, their strength will continually vary owing to the variation in the resistance of the microphone, and in this way the waves radiated will be modulated ones. Sometimes the microphone is connected across part of the inductance, L 2, in which case it diverts energy through itself. The result in both cases is the same: the aerial current varies in magnitude.

Better methods of modulation have been devised, and these usually depend for their action on the variation of the voltages on the grid or anode of an oscillating valve. It is found, for example, that the greater we make the voltage on the anode of an oscillating valve, the stronger will be the oscillations generated. If, then, we can cause the microphone to vary the anode voltage, we have a means of varying the strength of the currents in the aerial. One method of doing this is shown in Fig. 4.

Transformer Action.

The microphone, M, is now connected in series with a battery, B 3, and the primary coil, T 1, of a step-up transformer, T 1, T 2. This transformer really consists in two coils of insulated wire wound on an iron core; the secondary winding, T 2, has very many more turns than the primary winding, T 1, and the action of the transformer is that a varying current in T 1 will produce varying currents in T 2 of higher voltage. When speaking into the microphone, M, the current through T 1 will vary, and variations of high voltage will be applied in series with B 2 to the anode, A, of the valve. The variations in anode voltage will cause varying high-frequency currents in the aerial circuit. Neither this circuit nor the next is a very practical arrangement, but will illustrate two modern methods of wireless telephone transmission. In nearly all cases the microphone potentials are first amplified before being applied to a circuit such as that shown in Fig. 4.

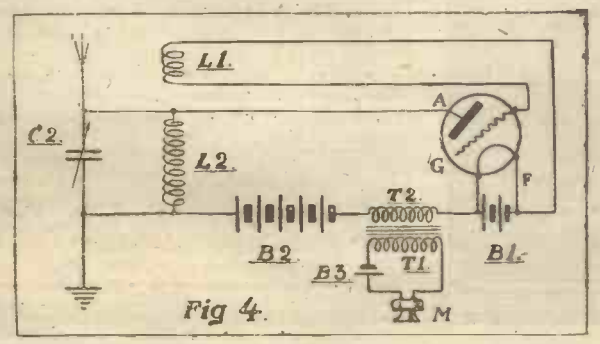


Fig 4.

Another method of modulation depends for its action on the fact that if we apply varying voltages to the grid of a three-electrode valve, which is oscillating, we can vary the strength of the oscillating current. If the grid is made negative while the three-electrode valve is oscillating, the anode current will be cut down and the result will be a decrease in the aerial current. If a positive voltage is given to the grid, the anode current will be increased and the oscillating current will likewise be increased.

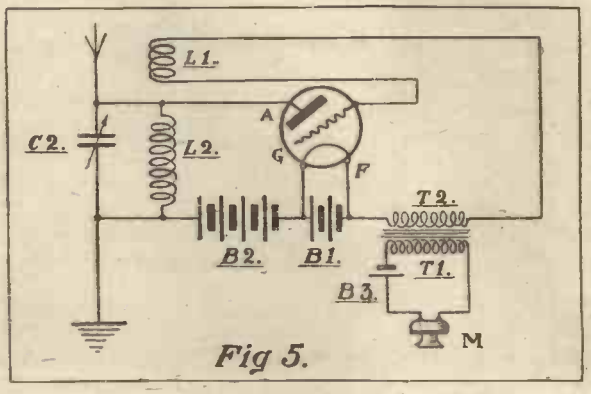


Fig 5.

In Fig. 5 the microphone potentials are being applied to the grid of the oscillating valve, and as the microphone potentials vary in strength, so will the amplitude of the radiated waves also vary.

These few examples will be sufficient to give the reader some general idea of how wireless telephone broadcasting stations are able to transmit speech and music to a distant receiving station. A fuller account is given in the author's new book, "Wireless Valves Simply Explained."

LOST WIRELESS.

THERE is at least one point in the wor'd where wireless messages cannot be received. It was thought that, providing transmitting and receiving sets were installed, communication could be established between any two points in the world, but it has just been discovered that there is a district in South California in which wireless waves entirely fade away.

The area, which so far as wireless is concerned is a region of eternal silence, lies between Porterville and Modesta. It is as if an invisible barrier existed around the locality between these two points, through which wireless waves find it impossible to penetrate.

It was a member of the staff of a bank in Los Angeles who made this startling discovery. He was accustomed, whilst on his travels, to keep in touch with his bank by means of a portable set, but when he reached the above-named district he found this was impossible.

Naturally, he at once attributed the fault to his apparatus, and at once took it to pieces, examined it carefully, and re-assembled it. All to no avail. Then he encountered other wireless operators who were also "cut off."

Aviators have for a long time spoken of "pockets in the air." Whilst flying they have described how their machines have entered spaces where there was a vacuum, and they had fallen quickly to the bottom of the "pocket."

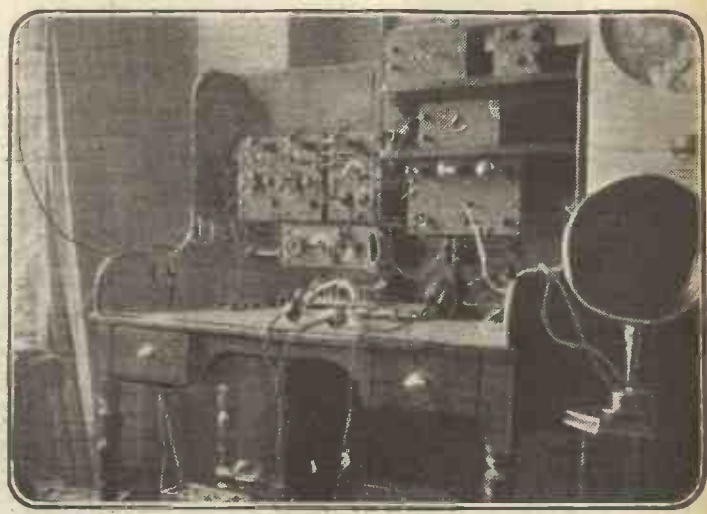
Is it possible that similar pockets exist in ether? All possible information is at once being gathered and investigated. Experiments are being made, and every effort is being exerted to ascertain the source of this remarkable phenomenon.

Box kites, to which are attached fine wires, are being flown at great heights, to discover if in the upper atmosphere there exists that elusive medium, ether, which is so essential to wireless communications.

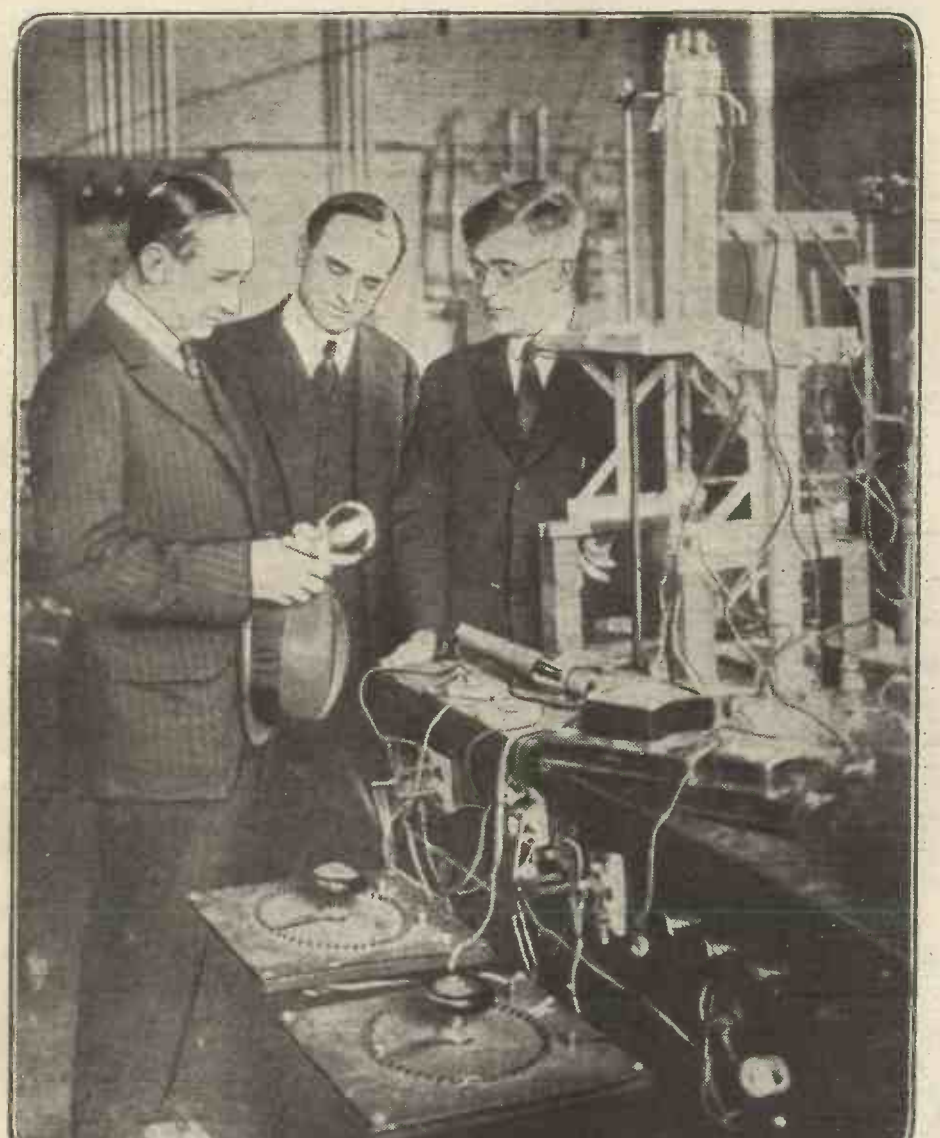
WATCHING FATHER.

Mr. F. S. Porter, 4, Thornfield Road, Lockwood, Huddersfield, has an interested audience when he begins work on his tuning coil. Mr. Porter is seen in the photograph connecting the tappings of his tuning coil to a switchboard panel.

A HOME-MADE RECEIVER.



Mr. J. C. Walker, 9, Curzon Park Road, Chester, is the owner of this first-class set. Mr. Walker constructed practically all the apparatus himself, and although he had no original intention of constructing such an elaborate set, his enthusiasm eventually resulted in the above.

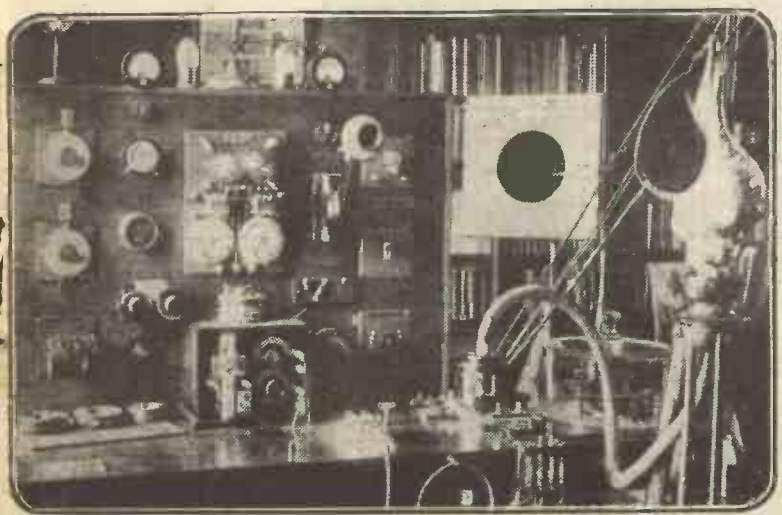


Senatore Marconi is seen here inspecting the new wonder tube invented by Dr. Irving Langmuir, at the research laboratories of the General Electric Co. of America. It is claimed that Dr. Langmuir's invention will render high-frequency alternators obsolete.

A SHIP'S D.F

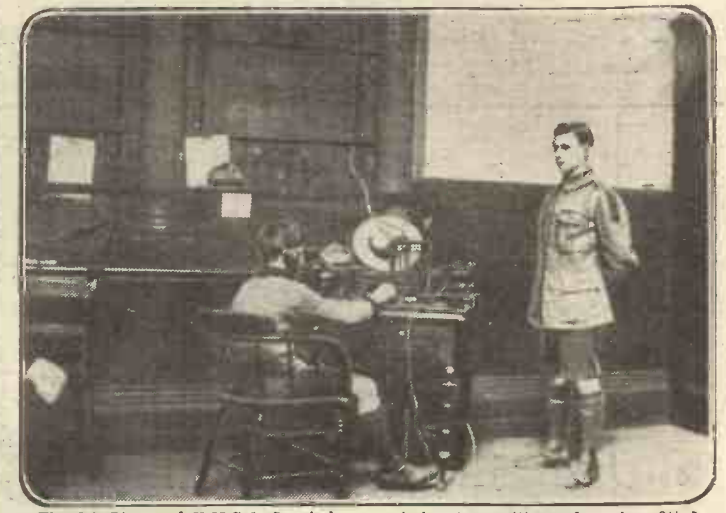
The lower aerial in this photograph is attached to the Marconi on the larger vessels. The compass aerial is in two loops, at ri the direction of messages, enabling the operator to

SEA SHELL LOUD SPEAKERS.



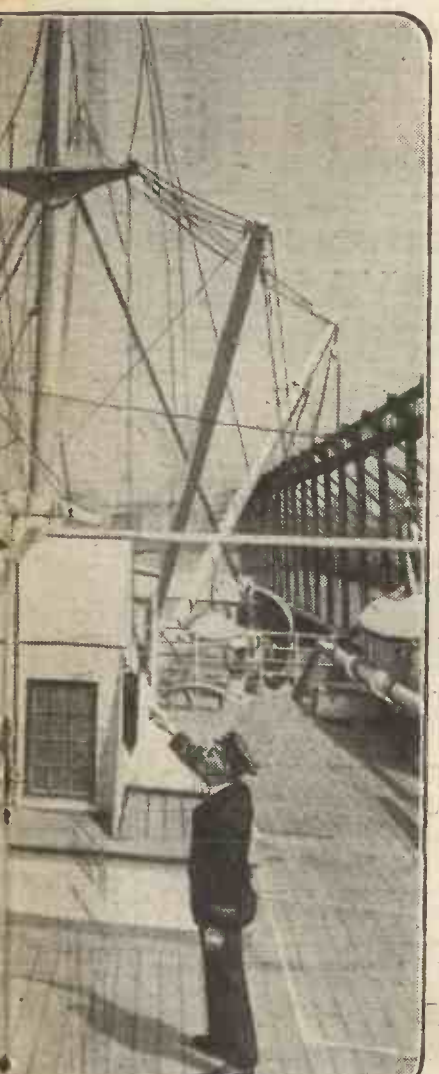
The conversion of a large sea shell into a loud speaker is the invention of the Rev. Frederick L. Odenbach, director of the St. Ignatius College Observatory, U.S.A. The inventor claims that his arrangement will solve the problem of bringing out certain musical sounds.

SCOUTS AND WIRELESS.



The 8th Liverpool Y.M.C.A. Scouts have a wireless transmitter and receiver fitted up at their headquarters, and all ranks get excellent practical instruction. This photograph was sent in by Scout A. V. S. Terry, 21, Underley Street, Smithdown Road, Liverpool.

AERIAL.



Radio Compass and Direction Finder, which is fitted at right angles to one another. The compass ascertains and determine the ship's position in a fog.

This is a modern valve ship's transmitting set, and is capable of transmitting a message 1,500 miles, using an input of only 1½ kw. The receiving instruments are also of extreme sensitivity, and signals a distance of 11,500 miles away have been clearly received. The ship is the s.s. Vauban.

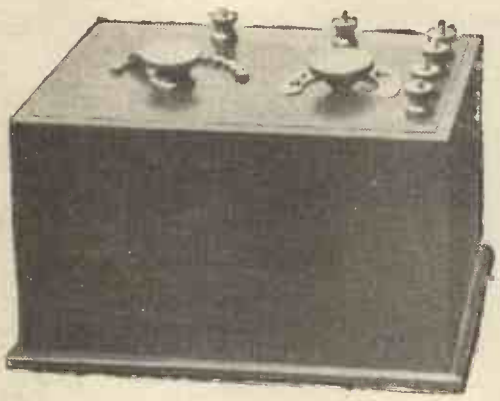
LAND STATIONS IN FRANCE.

D F—Direction-finding stations. C W—Continuous Wave system of transmission. T—Telephony.

Amateurs desiring a complete and detailed list of all the wireless stations in the world should purchase the International List of Radio Telegraph Signals, published at Berne, price 18 francs.

Call Sign.	Name of Station.	Approx. Normal Range in Miles.	Wave-Lengths in Metres.
F U I	Ajaccio (Corsica)	—	—
F E B	Bernieres-Gonio (D F)	—	450
F F C	Bonifacio	350	300—600
F F X	Bordeaux	250	300—600
F F B	Boulogne	250	300—600
F H A	Brest (D F)	—	450—600
F U L	Calais	—	—
F U H	Chemoulin	—	450—600
F U C	Cherbourg-Gonio (D F)	—	450
F U C	Cherbourg Rouges Terres	300	300—600
F F I	Dieppe	150	400
F U D	Dunkerque	800	600
F L	Eiffel Tower, Paris (T)	5.000 to 6,000	2,600 6,500 3,200 3,000
F E P	Finistere (D F)	—	450
F E N	Griz-Nez-Gonio (D F)	—	450
F E G	Guipavas-Gonio (D F)	—	450
F F H	Havre	250	300—600
L Y	Lafayette Radio, near Bordeaux	12,000	23,450
F U N	Lorient-Gonio (D F)	—	450
F U N	Lorient-Pen-Mané	300	300 (C W)
Y N	Lyons	—	15,000
F F M	Marseilles-Gonio (D F)	—	450
F F M	" "	250	300—600
F U E	Mengam, Brest	—	—
F E M	Mitre-Gonio, Toulon (D F)	—	450
U A	Nantes	—	8,000
F F N	Nice	250	300—600
F F U	Ouessant-Gonio (D F)	—	450
F F U	Ouessant	400	300—600
F E O	Ouessant Pen ar Roche (D F)	—	450—600
L O	Paris	—	6,500 (C W)
Z A	Paris	—	1,400
F E R	Pointe du Raz-Gonio (D F)	—	450
F U Q	Porquerolles (Hyeres Isles)	—	—
F U R	Rochefort-sur-Mer	—	—
U F Q	Sainte Assise (Paris) (C W)	—	—
F F S	S. Marie de la Mer	450	300—600
F E Z	S. Nazarei Ville es Martin (D F)	—	450
F E S	Souboise-Gonio (D F)	—	450
F U X	Toulon	—	—
F U T	Toulon-Mourillon	—	450
Y G	Tours	—	5,300 (C W)
F E T	Tréguier (D F)	—	450—600

R.F.H. RADIO SETS



SPECIAL CONCESSION
TO SCHOOLS, COLLEGES, CLUBS, STUDENTS, ETC.

The No. 11 R.F.H. Radio Set consists of the following:
One 2-Valve Receiving Set with Polished Mahogany Cabinet; one Improved Tuning Set with a wave-length range of 200 to 2,000 metres, also with Polished Mahogany Cabinet; an H.T. 60-Volt Battery; a 4-Volt 40 amp. Accumulator. An Aerial with 100 feet of 7/22 Stranded enamelled Wire, a pair of Spreaders, 6 Insulators and Loops, one pair HEAD-PHONES, less Valves and H.F. Transformer **£12 12s.**

But to those amateurs who wish to take part in the construction of their own sets we make a special offer. The whole of the above set is mounted on the panel in correct positions, and complete in every way, except valves and H.F. transformer, every pin, screw, terminal, condenser, switch with studs, two coils, wound and tapped off, valve holders, filament resistance, cabinets, and flex, etc., and simply require screwing up and wiring, about one hour's work.

UNDER THE ABOVE SPECIAL CONCESSION THE PRICE IS **£10 10s.**

R.F.H. SETS are the "AMATEURS' DELIGHT" for CLEAR, LOUD, and DISTINCT RECEPTION.

THIS OFFER WILL NOT BE REPEATED

One of our customers writes:—

"I am delighted with my R.F.H. 2-valve set, which I assembled in a few minutes, and while punting in the Midlands recently I received Croydon Telephony with a 14-foot Aerial, using the punt pole as mast."

The R.F.H. Popular Radio Set, £10 10s. 0d. Complete,
ready to put together as illustrated herewith.

"GETS TO BUSINESS RIGHT AWAY."

If you are expecting perfect reception
YOU MUST HAVE AN R.F.H. SET.

We manufacture our own components, Coils, Condensers, Resistances, Switches, Cabinets, etc., etc., which not only enables us to ensure perfect workmanship and materials, but enables us to offer guaranteed high quality radio instruments at the lowest possible cost to the purchaser.

FOR SUPER EXCELLENCE IN RECEPTION AND SIMPLICITY IN OPERATION, GET AN R.F.H. 2, 3, OR 4 VALVE COMPLETE SET. IMMEDIATE DELIVERY. SEND FOR LIST.

R.F.H. SETS may be obtained through dealers in photograph apparatus, Electrical Instrument Dealers, or from the manufacturers,

BUYING AGENTS WANTED EVERYWHERE. We are wholesale and retail agents for the "Magnavox," the King of Loud Speakers. We can supply immediately, price £10 10s.

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Edward Rd., Balsall Heath, Birmingham

R.F.H.

WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of the meetings of wireless clubs and associations, reserving the right to curtail the reports if necessary. An asterisk denotes affiliation with the Wireless Society of London.

New Clubs.

The following clubs are in course of formation. Will all interested please communicate with the hon. secs.?

Wireless Club for Nelson and District (Lancashire).

Hon. sec.: H. Turner, 14, St. Phillip Street, Nelson.

* * *

District Wireless Association for Barnes, Mortlake, and Richmond.

Hon. sec.: E. Rogers, 122, Wood Street, E.C. 2.

* * *

Clapham Wireless Club.

Hon. sec.: T. Batty, jnr., 35, Larkhall Rise, Clapham, S.W. 14.

* * *

The Epsom and District Radio Club is now officially titled the St. Barnabas Wireless Society.

Hon. sec.: B. Hardy, Oakhurst, Pound Lane, Epsom.

* * *

Will amateurs in the Port Talbot district communicate with T. E. Nicholas, 22, Beverley Street, Port Talbot, with a view to forming a club?

The Hornsey and District Wireless and Model Engineering Society.

A meeting of the above was held at 29, Felix Avenue, Weston Park, Crouch End, on July 18th. The first demonstration of the club set was given, and a good selection of Morse messages were heard and taken down by the advanced members. All members present enjoyed the music, etc., from 2 M T and 2 F Q.

Meetings of this society are held on Tuesdays and Fridays at 7.30 p.m. New members are cordially invited, as a series of lectures for beginners is just starting.

Hon. sec.: Mr. H. Davy, 134, Inderwick Road, Hornsey, N. 8.

Newcastle and District Amateur Wireless Association.*

A meeting of the above association was held in headquarters on Monday, July 17th.

After the minutes of the last general meeting had been read and passed, the chairman called upon Mr. Colin Bain to deliver his lecture upon the relationship between wave-length and frequency. Mr. Bain dealt with the subject in a most interesting and lucid manner, chiefly in order to assist those members who have but recently joined the ranks of wireless experimenters.

Mr. Dixon, the chairman, then lectured on the various oscillations produced in "spark" transmission, giving a very detailed account of the production of wave-trains, dealing first with the induction coil, then the spark gap, used by some of the large commercial spark-transmitting stations, and the wave effects produced from each, illustrating each section of his lecture with very clear diagrams.

A discussion then followed upon the peculiar action of a tapped high-frequency transformer, which gave three high-efficiency "peaks" at different wave-lengths for the first tapping. Further experiments are being carried out with this transformer, the results of which, when completed, will be explained to the members.

Hon. sec.: Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

The Leicestershire Radio and Scientific Society.*

At the monthly meeting of the above society, held recently at headquarters, the president being in the chair, the usual business was transacted, together with certain special matters of great interest to all. Two new members were elected. The president then called upon Mr. J. W. Pallett to read his paper on "Continuous Wave Transmitters." With the aid of diagrams, Mr. Pallett showed a number of circuits as used in practical C.W. work and concluded with a selection of slides, kindly lent by Messrs. The Marconi Co., depicting various types of actual gear, including the well-known 2 L O.

The paper was given in the characteristic style of its author, and at the conclusion a hearty vote of thanks was given to Mr. Pallett, proposed by the president, Mr. C. T. Atkinson, and seconded by Mr. H. E. Dyson.

All communications should be addressed to the hon. sec., J. R. Crawley, 269, Mere Road, Leicester.

Hackney and District Radio Society.

A meeting of the above society took place at 111, Chatsworth Road, Clapton, at 8 p.m., July 20th.

Mr. Ison lectured on the "Three-electrode Valve." He showed how the filament, on becoming incandescent, discharged electrons, and how these were controlled by the grid.

The subject was capably handled, and made clear even to the beginner. Numerous questions were then asked the lecturer, and an animated discussion followed.

Those desirous of joining should write to the hon. sec., or make personal application at 111, Chatsworth Road, Clapton. Thursdays only.

Hon. sec.: Mr. E. R. Walker, 48, Dagmar Road, South Hackney, E. 9.

Birmingham Experimental Wireless Club.*

At a recent meeting held at Digbeth Institute, Mr. L. J. Dore lectured on "Condensers in Radio Circuits."

Mr. Dore commenced with the electroscope as a means of detecting static charges, and gave a description of the action of a condenser.

He then described a large number of different methods of constructing condensers which could easily be used by amateurs. Many of the ideas described were extremely ingenious, particular reference being made to methods of obtaining fine adjustment.

A discussion followed, in the course of which regenerative and retroactive circuits were drawn on the blackboard, and their relative advantages discussed.

A new financial year commences on August 1st. Intending members are therefore advised to communicate with the hon. sec., 110, Ivor Road, Sparkhill, Birmingham.

The Fulham and Putney Radio Society.

The above society has been recently formed, and held a meeting at their temporary headquarters on Wednesday, July 19th. Considerable business was done regarding placing of the society on a proper basis, the officers were elected, the subscription rate fixed, and the meetings arranged for every Thursday evening at 7.30 p.m. Also, it has been proposed to start a technical library and workshop for the use of the members. There is an aerial fitted, and the founder of the society, Mr. Houstoun, has promised a valve panel and other apparatus.

The standard will not be too high for the beginner, and yet we have a good selection of experienced amateurs as members, and the committee will cater for both. An elaborate programme is being prepared for the coming season, and prospective members of both sexes are invited to write to the hon. sec. for particulars.

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

(Continued on next page.)

WIRELESS CLUB REPORTS.

(Continued from previous page.)

The Durham City and District Wireless Club.

The above club held their first meeting on Tuesday, July 11th. The attendance quite exceeded all expectations, also the enthusiastic spirit displayed. In the absence of Mr. Morsen, Mr. Sargent very ably carried out the duties of chairman.

It was decided to hold the meetings every 14 days, on Fridays at 7 p.m. A committee was then elected, consisting of the Rev. Perkins of Shadforth, Mr. Brown of Sherburn Hill, Mr. Nurthen of Durham, Mr. Clark of Chester-le-Street, Mr. Sargent of Durham, Mr. Kelly (treas.) of Durham, and Mr. Geo. Barnard (sec.) of Sacriston.

This committee only holds office for three months, after which time another election will take place.

The sec. takes this opportunity of extending a hearty invitation to all who are interested to come along to the next meeting; failing this, to send their names and addresses to him.

Hon. sec. : G. Barnard, 3, Sowerby Street, Sacriston, Durham.

Sutton and District Wireless Society.

The above society has been formed and meetings will be held every Thursday evening.

For full particulars, apply to Mr. E. A. Pywell, Stanley Lodge, Rosebery Road, Cheam, Surrey.

The Wireless and Experimental Association.*

At the meeting of the above association on Wednesday, July 5th, Mr. N. G. Hersey concluded the lecture the first portion of which he gave at the previous meeting. He brought with him a specimen panel, and tuner, for demonstration, and his remarks proved both entertaining and instructive.

The panel had three excellent points to recommend it, viz. : simplicity, economy, and efficiency. In fact, it had all the advantages of the more expensive panels, but few disadvantages. With the aid of chalk and blackboard Mr. Hersey made this quite clear.

A descriptive pamphlet, dealing with a new instrument called the "Symoplion," was distributed to the members. By its use, it makes a three-valve set equal to a five-valve set, and it can be added to existing crystal sets, thus greatly improving the results.

A suggestion was made that a wave-meter would be a most useful acquisition to the association, and as the idea met with general approval it was decided to consider the matter.

The remainder of the time was given up to a discussion on valves.

On Wednesday, July 12th, a letter of thanks received from King's College Hospital was read, acknowledging the receipt of the donation sent by the association from the surplus fund in connection with the recent public demonstration.

The chairman, for the express benefit of members new to wireless, then drew on the blackboard all the principal signs used in the science, and which, to the uninitiated, appear so much Greek.

A considerable discussion followed on the advantages and disadvantages of a loose-coupled aerial circuit, compared with an auto-transformer.

Mr. Joughin, having brought with him many specimens of wireless valves, gave us a short historical sketch. A Fleming valve (two-electrode) and several older forms, fitted with the old-fashioned bayonet cap, were exhibited; an obsolete White valve, some German valves, a V 24, and a Q valve followed, and finally four different R valves were shown.

Our assistant secretary, Mr. W. J. Joughin, of 21, Troughton Road, Charlton, S.E. 7, will be pleased to give particulars of the association to intending members.

Barnsley Amateur Wireless Association.

A general meeting of the Barnsley Amateur Wireless Association was held on Tuesday, July 11th, in the Guild Room of the Co-operative Education Department, Market Street.

The question of permanent headquarters was freely discussed and suggestions from the members present were considered, with the result that the association is very hopeful that at a very early date some of the proposals brought forward will materialise and that the work of the association will commence in earnest.

The annual subscriptions were fixed as follows : Adult members, 10s. ; age 18 to 21, 7s. 6d. ; junior members, 5s.

The existing committee was re-elected *en bloc*, viz. : Mr. G. W. Wigglesworth (secretary); Mr. J. A. T. Carr (treasurer); and Messrs. C. Pickering, Crossley, and Harding ; with the following additions : Messrs. Smith, Hattersley, Roseveare, Lewis, and Rhodes, whilst Mr. C. Pickering was subsequently elected as chairman.

The question of president, vice-presidents, etc., was then discussed, and finally left in the hands of the committee.

In conclusion, a vote of thanks was passed to the local Co-operative Education Department for the loan of the room for this meeting, and also to the chairman of the evening's proceedings.

Will intending members please communicate with the secretary, Mr. G. W. Wigglesworth, 13, King Edward Gardens ?

Ilkeston Radio Club.

It is proposed to form a Wireless Club at Ilkeston. Will all interested please communicate with Mr. R. W. Eminson, 2, Station Road, Ilkeston ?

Portsmouth and Wireless.

It is proposed to form a Portsmouth Wireless Club. Will all interested please communicate with Mr. C. Stephenson, 23, Hyde Street, Southsea ?

Brighton Radio Society.*

At a recent meeting of this society an interesting discussion ensued, during the course of which the methods of short-wave reception were considered. Various useful suggestions were offered by different members who were present, and it was ultimately suggested and decided upon that at the next meeting all members who so desired should bring their respective short-wave sets along for trial with a view to comparing results.

As a means of assisting the beginner as far as possible in the construction of a set capable of attaining the best possible results at the minimum cost, Mr. Magnus Volk, vice-president of the society, very kindly offered to provide the funds for the construction of a set upon these lines, which should be used solely for the assistance of members on the lines indicated.

Everything possible is being done to meet the needs of the amateur in this society, and it is sincerely hoped that gentlemen wishing to obtain a knowledge of this fascinating science will avail themselves of the facilities which are now being offered by the society.

Any gentlemen interested are invited to communicate with the hon. secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full particulars as to membership, etc.

The Radio Rendezvous.

All amateurs in the districts of East Ham, Manor Park, Ilford, Wanstead, Forest Gate, and Barking are cordially invited to become members of the above club. The club rooms are open every night until 10 p.m. except Sundays. Secretary, W. F. Fuller.

A Beckenham Club.

It is proposed to form a wireless society for Beckenham and district, and anyone interested is requested to communicate with Mr. S. Graves, 9, Rectory Road, Beckenham.

QUERIES ANSWERED BY POST.

RADIOTORIAL

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

In this number my readers will have had the opportunity of reading a brilliant article by Sir Oliver Lodge. It is an article which should be read with care, because the subject it deals with is of considerable importance, although perhaps a trifle difficult to grasp in detail.

However, I shall welcome letters from readers giving their opinions on the subject. I will award a prize of one guinea to the best postcard summary of the article.

Postcards should be addressed to
POPULAR WIRELESS Competition Dept.,
Gough House,
Gough Square,
London, E.C. 4.

Postcards should be sent not later than August 20th.

EDITOR.

Questions Answered

D. B. M. (Kettering).—How can I increase the capacity of my variable condenser ?

If a suitable container is available the plates can be immersed in a good mineral oil. This would increase the capacity considerably, as oil has a specific inductive capacity of two to three times that of air.

* * *

P. K. L. (Torquay).—Owing to the fact that my set has to be in a room on the second floor of the house the earth lead is 17 feet long. Will this be too long to give good results ?

This is long; two or three more wires should be run in parallel to earth to reduce the resistance.

* * *

"RADIOMETER" (Exeter).—Will it be all right if I run the lead-in down the wall of the house on staple insulators like a telephone wire ?

No; the aerial lead-in should be kept well away from the wall and should follow as straight a line as possible to the set.

* * *

J. C. (Reigate).—What are the shortest and longest wave-lengths obtainable using an inductance 4½ in. in diameter, wound with 130 turns of No. 22 enamelled copper wire on an aerial 96 ft. long and 20 ft. high ? What is the best crystal to use ?

150—900 metres. Zincite pressing against chalco or copper pyrites is as good as any.

* * *

G. B. N. H. (Manchester).—Would the P.M.G. allow a double aerial composed of about 200 ft. of wire having a lead-in at both ends for two persons ?

No. In any case it would not be an efficient arrangement.

* * *

"INQUISITIVE" (Darwen).—Is it possible to work the valve using the ordinary electric light power with a suitable resistance as the high-tension battery ? Is there any advantage in using a loose-coupled inductance instead of a simple direct-coupled inductance ? If so, what is it ?

No; it would prove too "noisy" for the purpose of valve reception. This is due to the armature of the generator. By using a loose coupler and arranging two circuits, one open and one closed, it is possible to tune out a great proportion of the "atmospheric" and earth stray noises, and also "jamming" by unwanted stations.

* * *

S. M. F. (Belfast) asks several questions as to service in the R.A.F. as a wireless operator.

You should apply for full particulars to the R.A.F. Recruiting Office, 4, Henrietta Street, London, W.C. 2.

O. K. (Oldham).—My condenser has 15 moving and 16 fixed vanes, made of aluminium $\frac{1}{32}$ in. thick. The diameter of the fixed vanes is 3½ in. and the moving 2½ in., and they are separated by $\frac{1}{10}$ in. What is the capacity ?

·0015 mfds.

* * *

"POPULAR" (Cardiff).—My aerial is 35 ft. high, but 10 ft. below some telegraph wires. Will this give good results ?

Yes, if the aerial does not run parallel to the wires. Using valves, however, there will doubtless be a certain amount of interference, and it would be advisable to have no stages of L.F. amplification, confining the circuit to H.F. and detecting. Such interference from telephone wires, tram cables, etc., has a low frequency.

* * *

"MIXED UP" (Torquay).—

A licence must be obtained before the set can be purchased. A three-valve set, for which an accumulator and dry batteries are necessary, as you suggest, will give you a very good range, using a good outdoor aerial. You should hear Eiffel Tower telephony very clearly.

* * *

W. E. G. (Clapham).—Will the enclosed specimen of wire do for the inductance ? Would a piece of steel rod driven into the ground to a depth of 4 ft. answer for the earth ?

Yes, that wire is quite suitable. Driven into fairly moist ground, such a rod would make a good earth.

* * *

"ENTHUSIAST" (Eccles).—Is it possible to test a piece of crystal for sensitiveness without actually placing it in the circuit ? Will a battery such as is supplied for pocket flash-lamps be suitable to use with a carborundum crystal ?

Not satisfactorily. Yes, if it is a battery of three cells as supplied for 4-volt lamps.

* * *

J. S. (Bury).—Is an inductance coil necessary with a frame aerial ?

No. A variable condenser is placed across the ends of the wire where it leaves the frame to give the tuning.

* * *

A. W. (Bradford).—How many plates are required for variable condensers of ·0003, ·0004, and ·0005 mfds., and how many plates for a fixed condenser of ·0003 mfds. ?

For the variable condensers, using vanes with a diameter of 4 in. and spacing them 1·5 in., 5, 7, 8 total vanes respectively. For the fixed condenser, using foil and thin waxed paper, 4 foils and 3 papers, with a minimum overlap of 2 sq. in.

Are you having trouble with your set? If you are, write to POPULAR WIRELESS for advice and help. Questions answered free by post.

N. R. S. (Chiswick).—Would it be possible to hear the Hague and Paris concerts on a certain two-valve set with an aerial 40 feet high ?

With careful handling, yes.

* * *

F. W. (Retford).—Is the vacuum of a valve as equally essential for the flow of electrons as it is for the lasting of the filament ? In other words, if it were possible to light the lamp without the vacuum, would you still get a flow of electrons ?

Yes; but, as you suggest, the filament would not last long. Early experiments were carried out without employing a vacuum, with electric arcs, but with no great success.

* * *

W. R. M. (Perth).—I am winding a loose coupler with 29 and 40 S.W.G. It is purely experimental, as I have never seen such fine wire used for inductances.

No, and for a very good reason, because it is not wise to use such fine wire owing to the high resistance, especially in the case of the A.T.I. High-frequency currents such as are received on the aerial can almost be classed as static charges, inasmuch as they travel on the surface of the wire. A wire of small gauge will offer great "skin" resistance owing to its small surface. That, by the way, is why a stranded wire is to be preferred for aerials. For the A.T.I., 22 S.W.G. or even a stouter gauge should be used, and for the secondary, 28 or 30.

* * *

T. R. N. (Birmingham).—Does it increase the wave-length to have two sliders on the inductance coil ?

No; the idea is to give finer adjustments.

* * *

D. M. V. (Bournemouth).—Is the lead-in included in the length to which the aerial is limited ?

Yes; the length is reckoned from the set to the free end of the aerial.

* * *

D. H. S. (Willesden Green).—By increasing the size of the inductance do I increase the distance from which I can receive ?

Not directly. This will increase the inductance, which in turn will increase the range of wave-lengths to which you will be able to tune. By doing so it will be possible to hear those stations that work on the longer wave-lengths, and as these are mostly the more powerful stations you will be able to pick them up from a greater distance than the smaller and less powerful stations that work on the shorter wave-lengths.

* * *

O. H. C. (Chingford).—What is the maximum size of aerial and set that I can use without a licence ?

There is no discrimination; a licence is required for any station, however small.

* * *

"UNWIRED" (Stockport).—Will a four-wire aerial 30 feet long be as efficient as a twin 50 feet long ?

No.

* * *

W. C. P. (Portsmouth).—When winding an inductance of enamelled wire may the turns touch ?

Yes, but wind this wire carefully in order not to crack the enamel.

* * *

S. P. O. (Dartmouth).—I have a two-valve set and I wish to increase my wave-length range. Will you give me the size of former and other particulars necessary to wind a coil to tune from 150 to 20,000 metres ?

A solenoid type coil would not be suitable for such a range. The "dead end," or the turns not in use, would have the effect of rendering it impossible to tune to the shorter wave-lengths. You will require a set of honeycomb or basket coils if you desire such a comprehensive range.

* * *

P. B. T. (Chesterfield).—I have searched numerous text-books, but cannot find the formula for working out the inductance of basket or honeycomb coils. Can you enlighten me ?

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

For the basket coil apply the same formula as for a single layer inductance. Take the mean diameter, and, for the length, the mean winding depth. This is not absolutely accurate, but is near enough for practical purposes. There is no satisfactory formula for honeycomb coils. With a calibrated condenser and wave-meter, the value of any coil can be determined very accurately.

* * *

P. I. (Tottenham).—Why is it that, when I place my hand on the reactance coil, the set oscillates on wave-lengths that I cannot get it to oscillate on without doing so ?

That is due to a capacity effect set up by the hand. The addition of capacity tightens the coupling. You should place a small variable condenser across the reactance.

* * *

F. M. (Brentford).—My house at Osterley Park is some 650 feet from the District Rly. Will that interfere with reception using a valve set ?

There will be a certain amount of interference due to earth currents caused by leakage, but it will not be very objectionable over that distance.

* * *

C. E. (Walthamstow).—You say in your reply to S. P. (Walsall) that 'phones are in a sense buzzers. True. Well, wouldn't it be possible to wind a buzzer to high resistance and replace that for the telephone receivers ?

No. Even if it were possible to adjust the armature so finely that it would make and break, the movement would be extremely small owing to the very small current received. Therefore, to make this movement perceptible to the senses it would be necessary to attach a very light diaphragm to create sound waves. The buzzer would then be a telephone receiver !

* * *

"RADIO" (Edinburgh).—What will be the wave-length range of an inductance wound with 24 S.W.G.? There are about 250 turns, and my aerial is a single wire about 90 feet long.

Cannot say, as you do not mention the diameter of the coil. This is one of the principal factors. If 4-in., 1,300 metres, 5-in., 2,100, and 6-in., 3,500.

* * *

M. C. (Margate).—Would I be able to hear any music on a crystal set in this town ?

Not unless there happens to be a local amateur station that transmits telephony.

* * *

C. H. P. (Swanage).—Do I need a licence for a receiving set ?

Yes.

Would telegraph wires affect the aerial ?

Not unless close and running parallel.

Would an aerial from one tree to another be all right ?

Yes, providing that it is kept well clear of leaves and branches.

* * *

F. S. (Clacton).—Would I be able to hear the concerts sent out from Chelmsford using a crystal set ?

No : a crystal set is limited to a range of 15–20 miles for telephony, although this distance has been exceeded under very exceptional conditions.

* * *

R. F. C. (Cardiff).—Which is the best way to fix an earth arrester—just inside the house or outside on the window-sill enclosed in a box ?

The best and neatest way is to mount the instrument on the set itself, including it in the internal wiring.

* * *

"DATA" (Preston).—What set would you recommend for the reception of music, concerts, etc., and what would be the probable cost ?

A three-valve set employing one H.F., one detecting, and one L.F. circuit would give you a very useful range for this purpose. The cost would be anything from £20 to £35.

* * *

N. N. N. (Moseley).—What weight of No. 26 S.W.G. wire would be required to wind a tuning inductance 6½ by 4 inches diameter ?

Half a pound would be ample.

The capacity for a fixed condenser for this set ?

·01 mfds. This would go across the 'phones. A variable condenser of ·0005 mfds. can be placed across the inductance to give fine tuning.

Should I receive music from an amateur station two miles away ?

Yes, quite easily.

* * *

A. J. S. (East Ham).—What is the longest possible wave-length that I could wind an inductance to for a crystal set ?

It would be quite possible to reach 20 or 30 thousand metres, but quite unnecessary. Apart from that, the size of the coil would be too large to be neat. It would be as well to confine your wave-length range to 3,000 metres or so. This will cover most stations of interest. It must be pointed out, too, that with the very large coil required for your ambitious range it would be impossible to tune in the short wave-length stations.

For the coil giving the more useful range mentioned, you should wind 300 turns of 22 S. W. G. on a 5 in. former. Take 20 or so equally placed tappings and employ a ·0005 mfds. variable condenser.

(*Continued on page* 184.)

"EARTHBOUND."

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 182).

H. G. W. (Plymouth).—I am shortly sailing for India and will be stationed in a very lonely part of the country. I therefore desire to take with me a valve receiving apparatus that will enable me to listen to the concerts that will be broadcasted in this country. Please advise the specification of a set capable of doing that.

That would be impossible. The broadcasting stations will not have sufficient power for such an enormous range of transmission.

* * *

"WANNANO" (Luton).—Will that "pill-box" wireless receiver that was mentioned in POPULAR WIRELESS receive telephony ?

Yes ; but, of course, the range for reception would be very limited.

* * *

L. K. L. (St. Heliers).—Will a crystal set be of any use to me ?

That depends upon what you desire to receive. With a crystal detector set you should be able to hear ships and the larger spark stations transmitting Morse signals, and if the wave-length range includes 2,600 metres you should have no difficulty in hearing the Paris time signals. For telephony, however, you would be limited to such amateur stations that might be within the range of a few miles.

* * *

O. B. (Dublin).—Does it matter if my aerial points N. and S. ?

Not necessarily : but it must be remembered that where one has the choice of direction due regard should be paid to the directional effects of the simple inverted "L" aerial. The lead-in or instrument end should point to that direction from which it is desired to receive the strongest signals.

* * *

N. C. H. (Gosport).—Is a licence required for a frame aerial ?

Yes.

* * *

A. T. E (Liverpool).—Will it be possible to get numbers 1 to 6 of POPULAR WIRELESS ?

Yes. Apply to the "Back-number Dept.," POPULAR WIRELESS, 7-9, Pilgrim Street, Ludgate Hill, E.C. 4. 2s. post paid.

* * *

J. G. (Brecon).—Is it possible to pick messages up from Paris and London with a single-valve set ? How much would it cost ?

Yes, and the more powerful spark stations even greater distances than that. £7 10s. upwards.

* * *

G. A. B. (Hull).—Do you recommend the block type of accumulator ?

For intermittent work that type is undoubtedly very efficient as it will hold its charge for long periods.

* * *

D. G. B. (Manchester) states that the P.M.G. has refused to pass his valve set diagram on the grounds that it is liable to energise the aerial, and asks how he can modify it.

It will be necessary to dispense altogether with the reactance. The terminals marked "reactance" on the valve panel shown in the diagram should be shorted by a strip of brass.

* * *

"SCHOOLBOY" (Highbury).—Would a twin aerial 20 feet long, 30 feet high at one end and 12 the other receive concerts from Marconi House on a crystal set ?

Yes, it is quite probable, but for general purposes such an aerial would be very inefficient. Endeavour to increase the height at the lower end and make it a four-wire aerial.

What wire is best suited for the inductance of a crystal receiver ?

22 S.W.G.

Would a fixed condenser ·00045 mfds. be suitable for such a set, and would it increase the range of reception ?

Placed across the 'phones it would improve the quality and tone of the signals, but would have no effect on the range of reception.

* * *

"POPREADER" (Edinburgh).—Are high-resistance telephones required for valve sets ?

Yes, unless a telephone transformer is employed.

* * *

B. K. L. (Stratford-on-Avon).—My valve set will not oscillate above 8,000 or below 900 metres. Can you give me any information as to the reason ?

Evidently, from the rather meagre details supplied you have a fixed reaction coil. You cannot expect one size of reaction coil to be suitable for all wave-lengths. The number of turns must be increased for the longer wave-lengths and reduced for the shorter.

* * *

P. U. (Cardiff).—Is it possible to get good results with 1,000-ohm telephone receivers on a crystal set ?

The resistance should preferably be higher than that, but no doubt results will be satisfactory.

* * *

"TOONU" (Chesterfield).—Is L.F. amplification much better than H.F. amplification for weak signals ?

No. As a matter of fact high-frequency amplification is to be preferred for that.

* * *

P. L. C. (Winchester).—Is a filament rheostat the same as a filament resistance, and what is the difference between a regenerative and a reactance circuit ?

In each case the terms apply to one and the same thing.

* * *

O. P. S. (Stockport).—What is meant by self heterodyne and separate heterodyne ? How is it arranged ?

In the case of the former it implies the introduction of a coil in the anode circuit that, coupled inductively to the A.T.I., will feed back the energy variations of the plate into the grid circuit and thus increase the voltage operating on the grid. In the case of the latter a separate circuit is arranged to couple to the A.T.I. This circuit is caused to oscillate and performs the same function.

The Editor will pay 10/6 for every amateur photo sent in and used in POPULAR WIRELESS. If the photo is used as a cover plate, £2 2s. will be paid.

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POPULAR WIRELESS WEEKLY, August 12, 1922.

REGISTERED AT THE G.P.O. AS A NEWSPAPER.

No. 11.—"EVERYBODY'S WIRELESS": WRITE FOR FREE BOOKLET.

POPULAR WIRELESS

3d.

No. 11. Vol. 1.
August 12,
1922.

Weekly

SIR ARTHUR CONAN DOYLE "LISTENS IN."

BROADCASTING HAS BEGUN!
HAVE YOU A WIRELESS SET?

WRITE TO POPULAR WIRELESS FOR FULL INSTRUCTIONS.

An Article entitled
"WHAT THE AMATEUR CAN DO,"
By
Professor LOW, A.C.G.I., F.C.S.,
appears in this issue.

Popular Wireless

TOPICAL NEWS AND NOTES.

"EVERYBODY'S WIRELESS."

Have you written for this useful 24-page booklet?

Send a postcard to—Gough House, Gough Square, London, E.C.4, and it will be sent to you by post, free of charge.

Honour for Senatore Marconi.

SENATORE MARCONI, G.C.V.O., LL.D., D.Sc., has been elected a vice-president of the Royal Society of Arts.

* * *

Wireless at Rhyl.

THERE is now installed at the Marine Lake Pleasure Gardens, Rhyl, a wireless installation which receives radio messages from all parts, and there is daily a large attendance to hear the concerts.

Ruins of the German Wireless Station at Damascus.

Direct to Australia.

EXPERTS have visited Bourne, Lincs, with reference to the proposed great wireless station for direct service to Australia, and it is understood that their report is favourable.

* * *

Clifden Radio Destroyed.

THE wireless station at Clifden has been destroyed. The receiving station was burned down by Irregulars, and the condenser house was bombed, the vital parts being destroyed.

* * *

Mr. William Le Queux.

MR. WILLIAM LE QUEUX, M.I.R.E., is assisting the Hastings Corporation in their scheme for establishing a radio receiving set of commercial type for the benefit of visitors to St. Leonards and Hastings. The site chosen is near White Rock.

* * *

The Wireless Bard.

"We've had radio for breakfast,
Radio for lunch,
Radio for supper,
And I've kinda got a hunch
We'd be rocked to sleep by radio
If it wasn't for the fac'
That we've sold our bloomin' bedspring
For some wave-lengths and a tack."

(*Dundee Advertiser.*)

Wireless Operators' Federation.

AT a meeting of representatives of marine wireless-telegraphists from Belgium, Denmark, Great Britain, Greece, Holland, Italy, and Sweden, at Brussels, the first International Federation of Radio-telegraphists was formed. The Federation, which has offices at 10, Norfolk Street, London, desires to co-ordinate action amongst the various national organisations; to secure adequate representation on any international authority dealing with wireless matters affecting the position of marine radio-telegraphists; and to secure the uniform and satisfactory application of wireless telegraphy on board ship, so as to assure the maximum degree of safety of life at sea.

* * *

The Church and Wireless.

"THE Church should, without delay, take hold of this new instrument, not as a substitute for church attendance—for that it can never be—but so that those who sing and speak to invisible listeners may do so with authority. Otherwise, the danger is that religion may be vulgarised by sloppy hymns rendered by weird quartet parties, and sermons by Yankee tub-thumpers."

(The Rev. F. S. Myers, B.A., in an article on Wireless and the Pulpit, in the Manchester Dispatch.)

* * *

A Wireless Sermon.

A TEMPORARY wireless aerial constructed by means of clothes-props on the roof of a London church, recently received a "broadcast" sermon.

The Peckham Christian Union organised the experiment, and the sermon of the president of the union (Dr. J. Boon), spoken into a microphone at the Burdette Aerial Works at Blackheath, was received at Christ Church, McDermott Road, Peckham. The sermon was heard by "listeners-in" within a radius of one hundred miles from Blackheath. At Christ Church a three-valve receiving and amplifying set was installed and fixed to a table in front of the pulpit rails, and the words were heard clearly all over the building. The church was crowded.

* * *

Wireless Chess.

A CHESS game by radio, from mid-Atlantic to Chicago, was played recently between Edward Lasker, American amateur chess champion, and E. T. Grumbach, of Chicago and New York.

The two had planned a game when Grumbach was suddenly called to Europe. He sailed on the President Taft, of the United States Lines, after making arrangements to fight out the game through the ether.

Grumbach's moves were wirelessed to the steamship company's offices in New York, and then wired Lasker in Chicago. His return moves were transmitted the same way.

* * *

A Well-Known Amateur.

AMONG the most efficient receiving sets in the kingdom is that of Mr. R. W. James, of Thames Bank, Whitchurch, Oxfordshire. River folk who punt about the Pangbourne district will notice a fine aerial strung across the lawn by the riverside to the big white house amid its glorious gardens. Inside, the set is a revelation, and signals are often deafening. Mr. James, who is on the committee of the Reading Radio Research Society, is a very enthusiastic amateur, and bestows great time and care upon his beautiful commercial set. He can hear practically everything, American signals being very loud and distinct.

* * *

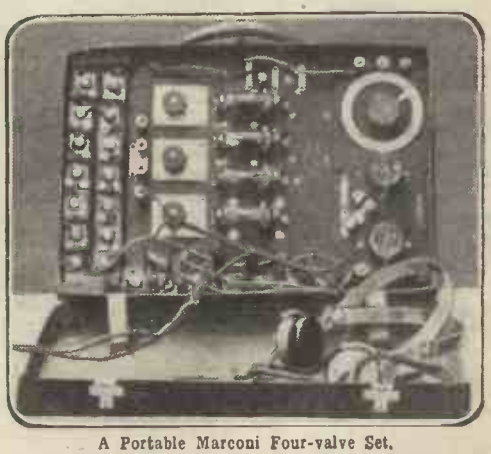
French Wireless.

THE radio-telephone has begun to attract popular attention in France, as concerts and weather reports are broadcasted from the Eiffel Tower (FL) in Paris. The situation in France is somewhat complicated, however, as FL.'s schedule is irregular, and the Postal, Telephone, and Telegraph Bureau is endeavouring to tax all receiving sets as well as transmitters. At first the tax was 5 francs for each receiving set, now it is 10 francs, and it is proposed to raise it to 20, which latter sum would be more than the cost of a simple crystal set. A tax of 250 francs is to be imposed on transmitting sets. However, the entire situation is clouded by doubts as to the legality of the tax, and hence French amateurs are inclined to await the decision of the courts.

* * *

Universal Code.

THE daily Press announces that to facilitate the use of wireless telephony on aircraft, according to a report issued on July 19th, by the Directorate of British Civil



A Portable Marconi Four-valve Set.

NEWS AND NOTES.

(Continued.)

Aviation, Great Britain, France, and Belgium have prepared a vocabulary of standard phrases in English, French, and Dutch. Each phrase and word is numbered for the benefit of operators unacquainted with languages other than their own. With this code the only parts of a foreign language a pilot or ground wireless operator need know to carry on a conversation are the numerals, the code consisting simply of the figures 1 to 85, each figure representing a phrase dealing with such matters as weather, illness, time, and position. For example, the operator at an air station who hears "70" knows to "Arrange for a doctor." The code number "44" is a request for weather conditions, and "48" conveys the news "The sun is shining."

* * *

Wireless Control.

A FEATURE of the recent Naval tests was the wireless control of the Agamemnon. "Without a human being on board she twisted and turned at 15 knots, directed from the destroyer Truant, in a fashion that suggested witchcraft; her fires were stoked with oil fuel, and she appeared as though she had a full crew on board," says the "Daily Mail."

This is the first time that a battleship with no one on board has been handled through a long day at so high a speed. In the American tests 10 knots was not reached.

* * *

Inventor of Telephone Dead.

DR. ALEXANDER GRAHAM BELL, inventor of the telephone and associate in many experiments with Mr. Edison, died at Baddeck, Nova Scotia, on August 1st. Dr. Bell was 75 years of age.

It is an irony of fate and commonplace enough throughout the history of the world that genius is more appreciated by posterity, and in the case of Dr. Graham Bell, although his invention made him famous in his lifetime, the full recognition of his genius has yet to be acknowledged.

Dr. Bell was a Scotsman. At the age of 23 he emigrated to Canada, and thence to the States.

Long before he invented the telephone his ability had been demonstrated. He invented the photophone, the induction balance, and telephone probe for the painless extraction of bullets from the human body.

Dr. Bell "hawked"—there is no other word for it—his telephone invention from door to door before he finally obtained recognition and the necessary money to finance his invention.

That was fifty years ago.

Wireless men should pause and consider the debt we owe to Dr. Graham Bell.

When you purchase your 4,000 or 8,000 ohm phones as the case may be, give a thought to the genius of the man who invented them, and try to imagine where wireless would be to-day without them. Certain it is that the pleasures of broadcasting would be unknown.

* * *

Wireless Bands at Cinema Palaces.

A DEMONSTRATION was held by the Walturdaw Film Company in Gerrard Street, London, just recently to demonstrate the wonders of a musical entertainment supplied through the Marconiphone.

A crowd gathered outside, for the music was easily audible out in the street, especially as a Stentorphone had been used to increase the volume of sound. The result was very effective, so much so that several exhibitors applied for contracts. Walturdaw's have received many inquiries from exhibitors, who have realised the possibilities of this new form of entertainment, and, from what I can gather from their representative, over 500 picture palaces have applied for installations.

* * *

A Report on Radio.

"RADIO telephony is in an extremely elementary stage," reports the sub-committee on radio telephony set up under the radio research board.

The experts state: "We see no line of development which would be likely to lead to its establishment on a commercial basis within a measurable period.

"For ranges of the order of 1,000 miles we consider that in certain remote localities, where the interference from atmospherics and other radio communications is not excessive, it would be possible to establish non-secret radio telephonic services, using waves of the length usually employed by medium power radio telegraph stations communicating over the same range.

"The power necessary for radio telephony, however, would be much greater than that required for satisfactory communication by radio telegraphy over the same distance for ranges of the order of 200 miles.

"We cannot recommend the use of radio telephony as a substitute for any other means of telegraphic communication, except in those cases where the special requirements can be met in no other economic way. ARIEL.

Professor Low, who contributes an interesting article to this issue.

Broadcasting Programmes

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

The "Daily Mail" Concerts.

THE power used for the broadcasting of the Hague concerts is now 1,500 watts, and the range is approximately 2,000 miles. Using a three-valve amplifier, the writer has obtained very good results, the last two concerts being a great improvement on the first.

On the 1,050 metre wave-length, jamming is usually more in evidence than on the 450 metre wave-length; and although the lower wave would mean a little reduction in the effective broadcasting range, the interruptions would certainly be more infrequent.

The Hague call sign is P C G G. The concerts are sent every Thursday and Sunday from 8 to 9 p.m.

Amateurs are strongly urged to manipulate their valves with care. For the reception of telephony the valve should not oscillate. Further, careless adjustment of a valve means annoyance to other amateurs.

Fair Play, Please!

It is particularly requested of all amateurs enjoying the privileges of a transmitting licence that they refrain from working, either by telephony or Morse, on a 1,000 metre wave-length during the transmission period of the "Daily Mail" concert.

They should bear in mind the fact that there are many more amateurs with receivers than transmitters in this country, and that indiscriminate jamming is pure selfishness.

The recent jamming of the "Daily Mail" concerts was so extraordinary as to appear—in some cases—almost deliberate.

Commercial stations might also surely refrain from sending out "V" signals, and leave their "stunt" tuning until a little later.

If the impression gains ground that only music interrupted by a series of shrieks and spark station signals can be expected, it is not likely that wireless will come into its own, or that any other fate than that which broadcasting has experienced in America will ensue.

It is understood that the "Daily Mail" is making representations to the Dutch Postmaster-General with regard to getting the wave-length reduced, and this may give relief from jamming by some of the service stations. But it will not, obviously, cut out interruption from the oscillations of carelessly handled amateur sets.

Those with valve sets are advised to keep a watchful eye on the "Daily Mail" wireless columns. Changes in the programme and hours of transmission are liable at a moment's notice, and it is not possible for POPULAR WIRELESS to record each week the very latest news about the concerts owing to the fact that the paper goes to press at a certain fixed hour.

The Editor will be pleased to publish concise postcard reports of the "Daily Mail" concerts. A selection will be made each week. Postcards should be addressed to POPULAR WIRELESS, Fleetway House, Farringdon Street, E.C. 4.

Other Transmissions.

The Writtle concert is given every Tuesday evening at 8 o'clock, B.S.T., on a wave-length of 400 metres. The call sign is 2 M T. The concert lasts from twenty to thirty minutes.

Konigswusterhausen transmits telephony usually at 7 and 10.30 a.m. (G.M.T.), on a wave-length of 2,500 metres. The station is situated near Berlin. Call sign, L O.

The Eiffel Tower radio station (call sign, F L) may usually be relied on for a telephony transmission (and sometimes a concert) at 5 o'clock (B.S.T.). A weather forecast is sent in French at 6 o'clock. The wave-length is 2,600 metres.

Croydon (G E D) may be heard in radio-telephonic communication with various aeroplanes on the Continental air routes at all times of the day.

Other aviation centres which transmit telephony include Castle Bromwich (G E C), Didsbury (G E M), Hinton-Admiral (sign not allotted yet), Lympne (G E G), Renfrew (G E R), Pulham (G E P) on 900 metres.

NEW SERIES FOR BEGINNERS.

By E. BLAKE, A.M.I.E.E.

PART 4.

SUMMARY OF LAST ARTICLE.

A direct electric current is a steady "drift" of electrons under the influence of Electromotive Force. The speed of the general drift of electrons is very slow. When an electric current flows through a wire, a sphere of magnetic influence called an electromagnetic field is set up around the wire. The stronger the current, the stronger the field. When the current is stopped, the field collapses upon the circuit and disappears.

THE electromagnetic field is generally represented on paper by lines, which are referred to as lines of force. This a convenient diagrammatic artifice, but the reader should beware of placing too literal an interpretation upon them, because it is not proved that such lines have objective existence. The phenomena we are studying are not such as can be photographed, and can be depicted only by mathematical symbols or conventional diagrams. In order to enable students to grasp the underlying principles of electrical science, teachers are bound to present them with mechanical analogies and diagrams as aids to the formation of mental pictures, but these pictures must of necessity be crude and incomplete.

This warning applies with special force in the case of diagrams representing æther waves, for from questions which have been addressed to me I am sure that many people believe wireless waves to be a sort of ethereal switchback railway; they have failed—and the fault is not theirs—to realise the difference between a wave and what electricians term a "wave form." Wireless waves have no shape, because they are not material, and lines of force exist only on paper.

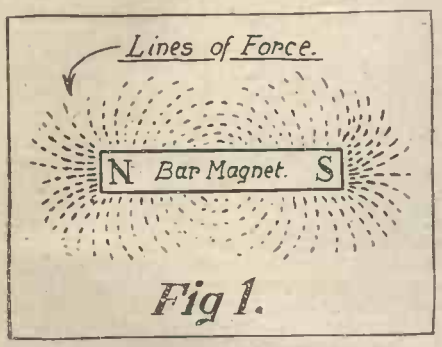


Fig 1.

The value of the conception of a line of force lies in the fact that having conceived a line we can conceive it as having direction, and further, we can conceive its multiplication. The direction of the lines has already been referred to as the direction of the field; it may be considered as the direction in which the north pole of a compass-needle points if the latter were placed in the field. The intensity of the field is judged by the number of lines which pass through a unit area of space.

The E.M.F.

For the sake of illustration we may imagine that the field round a wire carrying a certain current is of an intensity such that through a square inch of space in the field there pass five lines of force. Then if the current through the wire be increased, we may imagine that more lines of force will pass through that square inch of space; in other words, the magnetic field becomes stronger.

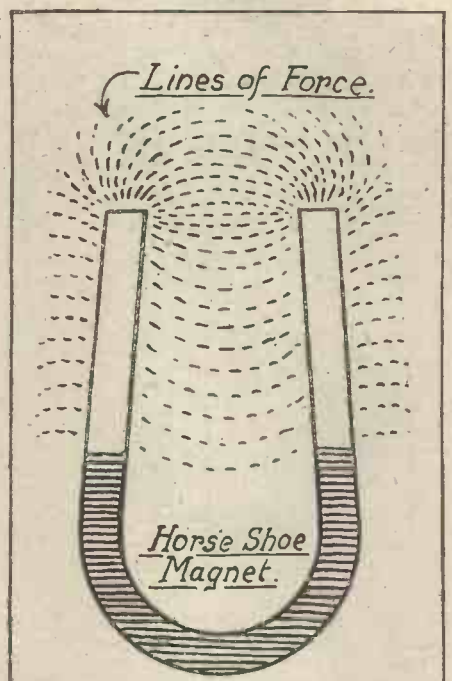


Fig 2.

The lines of force from a magnet stretch between its poles, as shown in Figs. 1 and 2. These lines may be mapped out by placing a sheet of glass or paper over the magnet and sprinkling it with fine iron filings. The glass or paper should then be lightly tapped.

When a magnetic field is cut by a conductor, it generates therein an electromotive force (E.M.F.), and, therefore, if the conductor is in the form of a circuit or complete path, a current will flow in it so long as it continues to cut the lines of force composing the field. It follows also, therefore, that if a moving field cuts a stationary wire the same result is obtained.

A Magnetic Experiment.

Fig. 3 represents a coil of wire whose circuit includes a galvanometer, an instrument which registers an electric current by the movement of a needle. When the magnet *M* is plunged into the coil its lines of force cut the wire and the current thereby set up in the coil is registered by a "kick" of the galvanometer needle.

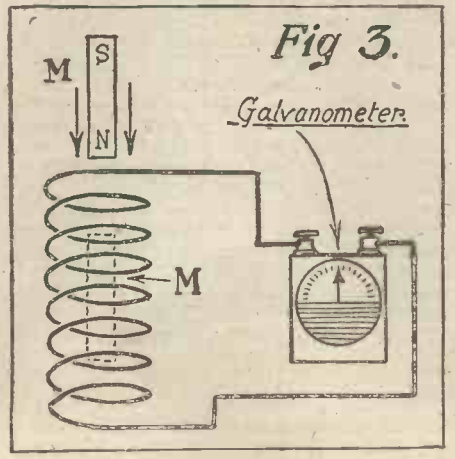


Fig 3.

While the magnet remains stationary within the coil the galvanometer needle will not move, indicating that there is no current in the coil; but when the magnet is pulled out of the coil the needle gives another kick, but in the opposite direction, showing that the current set up in the coil is in the reverse direction to that which flowed when the magnet entered the coil.

To take another example, suppose we set up two circuits, as in Fig. 4, one containing a variable resistance and a battery, and the other a galvanometer. The two circuits are arranged so that the magnetic field of the first can cut the second. Immediately the first circuit is completed the resultant field cuts across the second circuit, the momentary current therein set up being indicated by a kick of the needle, say, to the right hand. Now suppose we move the sliding contact which varies the resistance of the first circuit, so that some of the resistance is cut out.

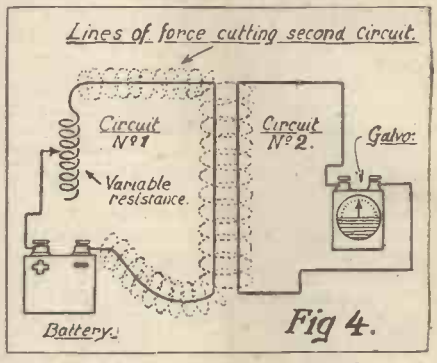


Fig 4.

A Left-hand Kick.

This results in the increase of the current (See Ohm's Law. Art. 2). The field therefore increases in strength, and as the new lines of force cut the second circuit the needle again registers a slight right-hand kick. A similar thing happens every time we alter the strength of the field. For instance, if we reverse the resistance slider and add resistance to the first circuit, its field will collapse a little, thereby cutting Circuit No. 2 in the reverse direction. Hence the needle will give a left-hand kick.

If we were to take out the battery and introduce into Circuit No. 1 a device such as an alternator, by means of which we could vary the direction in which the current flowed through Circuit No. 1, we should make that current an "alternating" current; it would flow first in one direction, producing a field having a certain direction, and then in the reverse direction, with the result that the field would alternately decrease to zero strength and then grow up again having a reverse direction.

All these variations of field direction would be indicated by the needle, and the current in Circuit No. 2 would vary rhythmically between zero and maximum strength as the current in Circuit No. 1 did the same.

These two circuits are rather near to each other, but if we could make the first affect the second over a great distance we should obviously have a means of signalling across space. In other words, we should have a system of wireless telegraphy.

How the electrical energy of one circuit is caused to set up an electric current in another circuit many hundreds or thousands of miles away will be explained in the following articles.

OUR CHIEF TECHNICAL ADVISER.

IT is with considerable pleasure that I am able to announce to readers that Mr. John Scott-Taggart, M.C., F. Inst. P., A.Am. I.E.E., has joined the advisory staff of POPULAR WIRELESS as Chief Technical Adviser.

Mr. John Scott-Taggart needs no introduction to most of the readers of POPULAR WIRELESS. He is best known probably as the author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Textbook on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," and other works.

He has made a special study of thermionic valves, as the titles of his books indicate, and has achieved a well-deserved reputation in this field.

Very many experimenters have gained their first knowledge of valves through the numerous articles on valves, written by Mr. Scott-Taggart in the technical press. He was, I believe, the first one in this country to write a series of articles on valves—long before any British books on the subject were published.

Mr. Scott-Taggart's experience of technical literary work is unrivalled, and his total writings greatly exceed those of any other writer on wireless subjects. The extraordinarily large sales of his books is a proof of their popularity, which is evinced, moreover, by the universal commendation of the technical press and those best able to judge.

His ability to explain difficult problems in a simple, lucid, and interesting manner, without sacrificing accuracy is, no doubt, one reason why everything he writes is eagerly read by tens of thousands.

Mr. Scott-Taggart's activities are specially connected with the technical side of wireless. He is departmental manager of Radio Communication Company, Ltd., and in addition to these duties, he acts as a technical adviser to C. F. Elwell, Ltd., and the Mullard Radio Valve Company, Ltd. His knowledge of

Mr. John Scott-Taggart.

wireless patent matters and the situation in this country is probably unrivalled. His work as adviser to this journal will now be an addition to his many activities.

Immediately before joining the Radio Communication Company in May, 1920, Mr. Scott-Taggart was in charge of valve design and construction at the Edison-Swan Electric Company's lamp works.

During the war, he served from 1914–1919 with the Army, and spent several years at the Front as a wireless officer in the Royal Engineers. There he did valuable work, maintaining wireless communications during the operations at Vimy Ridge in April, 1917, and was one of the first to use continuous wave sets in action.

Throughout the great German offensive in April, 1918, Mr. Scott-Taggart's wireless section did very valuable work in maintaining communications. For this work he was mentioned in despatches, and later in the year was awarded the Military Cross for the part he played in the final Allied advance.

In the field of research Mr. Scott-Taggart has introduced a number of developments of considerable importance; there are very few wireless engineers who can claim equally brilliant inventive ability, and more than thirty patents stand in his name.

His best known invention is probably the Negatron valve, a device for generating continuous oscillations. This invention was described by him before the British Association last year. It is very widely used in the Mercantile Marine and many ships, including the Berengaria (the second largest ship afloat), the Scythia, the Caronia, the Union Castle liners, and others, are fitted with this apparatus.

Mr. Scott-Taggart is a Fellow of the Institute of Physics and holds membership in the Physical Society of London, the Institute of Radio Engineers, the Institution of Electrical Engineers, the Société Française des Electriciens, and various other learned societies. He is the president of several wireless societies, and a member of the Committee of the Wireless Society of London, and now, I am happy to announce, Technical Adviser to POPULAR WIRELESS.

Articles from his pen will appear from time to time in this magazine, and readers will have the benefit of his unrivalled knowledge on wireless valves.

EDITOR.

WIRELESS AND THE LADIES.

WHENEVER we see a photograph of a wireless receiving set being operated, it is always a more or less young man who is doing the operating.

If a girl figures in it at all, it is merely as a passive listener-in. We all know very well that a lady does not appear at her best when she is just listening. Nature seems, somehow or other, to have ordained it otherwise. For all that, they do make very attractive listeners—at times.

Now that the modern girl is becoming less and less trammelled by tradition, it is but right and proper that she should be allowed to share our scientific games and hobbies. The purpose of this article is to try to encourage the lady, where necessary.

Crochet v. Radio.

First of all, we would suggest that, though wireless science is very wonderful, there is much in it that could soon be mastered by anyone—even a man! Indeed, are not the marvellously intricate instructions given in crochet and knitting and dressmaking periodicals much more highly technical than many things we have in straightforward wireless? As a trained instructor and the hon. sec. of a wireless club, the writer knows very well that no girl could be so stupid as a boy can sometimes be when one desires to impart useful knowledge.

Clothes'-lines and Aerials.

Certainly the erection of a permanent aerial might be a matter of some difficulty, but it is astonishing what good signals can be obtained on a copper wire, properly insulated and slung no higher than an ordinary clothes'-line. All girls can reach a clothes'-line; sometimes they have to.

The writer was assisting recently with some experimental aerials run from the sill of a first-floor window to the top of the garden fence, and was considerably surprised at the results obtained. A girl could reach as high as that without a ladder.

The construction of the other apparatus has been too ably described by others to justify reference here and now, but, with the exception of the headgear telephones, which must be bought, there is not much a girl could not accomplish.

Nearly all big wireless apparatus dealers have a service department where inquiries are dealt with, and where the services of an efficient assistant are placed at the command of their customers. When you purchase your headgear 'phones, do not let such services be monopolised by boys and men, but see to it that the ladies are given a chance.

A "Fair" Share.

Even if it were only Morse signals which came in over the ether, are there not thousands of lady telegraphists who would smile at twelve to twenty words a minute?

There is still another aspect of the case. Most men are not content unless they have at least three valves at work, either to fill the house with raucous groans and shrill whistles, or to reach out to listen to the faint whisper of a time signal being sent from Honolulu. Why Paris is not good enough, we do not know. At any rate, we all know that woman (we mean no disrespect) can always make the most of a little, whether in food, dress, or any other circumstances in life; and if we were only to give them a fair field and no favour, they would soon teach us what we might easily be able to do without.

But stop! Is that a reason why we should let them in on equal terms? Is it good for trade, or our opinion of ourselves? Perhaps not; but it would be a courteous act, and one which would really make for the advancement of amateur wireless science.

Has it really been brought home to us that in setting aside part of the domestic accommodation for the installation of our wireless plant, we have pegged out a claim on the social preserve of the ladies of the home? Let us, then, do all we can to smooth the path for the first steps of the wireless ladies, the partners of all our joys and most of our sorrows.

HOW TO MAKE A SHORT-WAVE RECEIVER.

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

PART 3.

FOR a set of the type that has already been outlined, the following components are required :

One wood box to contain the set (the size of this has already been given).
One ebonite sheet to form the top of the box, and to provide an insulating panel on which to mount the parts.
One tuning coil with tapping.
One support for the tuning coil.
One reaction coil.
One pivoted support and knob for reaction coil.
One variable air condenser.
One double-pole range switch, with extra blade for filament control.
One valve holder (R type).
One filament regulator.
One by-pass condenser.
One grid condenser.
One grid leak.
Ten terminals.
Sundry screws, wire, etc.

Taking these in order, the main tuning coil can be constructed first. The experimenter is advised to build this item himself in any case, as the coil is a special one, and it is therefore very unlikely that one could be purchased ready-made, unless it was specially ordered and made up for the purchaser.

The former or support on which the coil is wound is a cylindrical one, 2½" outside diameter by 3¾" long. The coil is thus of the solenoid type, which for these wave-lengths is usually the most satisfactory. A single layer of winding only will be employed, for the reason that by this means the self-capacity of the coil can be kept as small as possible.

Any two conducting bodies, separated from one another by some insulating material —which may be fluid or solid—have electrical capacity to each other. This capacity may be large or small, depending upon the size, shape of and distance between the two

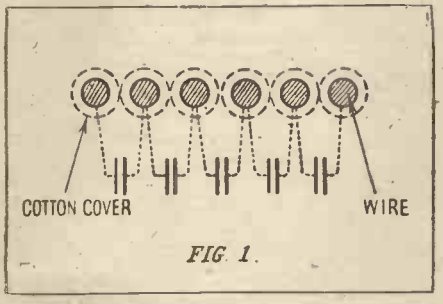


FIG. 1.

bodies, as well as upon the nature of the material between them, as we shall see later, when describing the details of the condensers which form part of this receiving apparatus.

Further than this, it is not essential that the two conducting bodies referred to above should be disconnected from each other for an electrical capacity to exist between them ; but in this case the effects of such capacity will not be felt unless there is an electrical potential difference between the points considered.

Thus, adjacent turns of wire forming the tuning coil possess a capacity between them, although they are connected together round the periphery of the turn.

The effects of this capacity will only come into play when a current is flowing through the coil, since only under these conditions will there be a potential difference between adjacent turns of wire. The greater the potential difference across any one of these small capacities, the greater will be the *effect* of this capacity upon the behaviour of the whole coil, since the greater will be the current which will flow through the capacity when there is an alternating or oscillatory potential across it, as when the coil is used in a radio frequency circuit.

Thus, Fig. 1, if the shaded circles represent sections through the turns of wire on the coil, and the condensers, which are drawn in with dotted lines, represent these little elementary capacities which exist between each unit length (say, for example, between each centimetre) of wire, the potential across each of them will be sensibly the same, and consequently no one of them will have more effect than another upon the total *effective* self-capacity of the whole coil.

In the case of a winding of the type sketched in Fig. 2, in which the turns are arranged

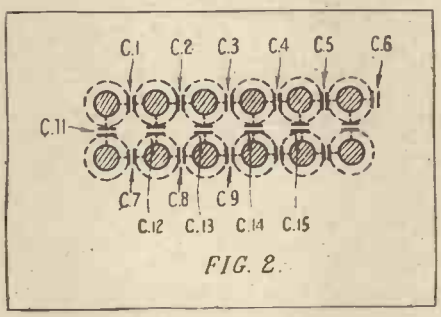


FIG. 2.

in two layers, the elementary capacities C_{11}, C_{12}, C_{13}, etc., will have more effect than the capacities C_1, C_2, C_3, etc., although the value of each—being the capacity between adjacent turns—is the same.

The capacities C_{11}, C_{12}, C_{13}, etc., have a greater potential difference across them than have the others, the capacity C_{11} having practically the whole voltage that is across the coil. These inter-layer capacities will, therefore, increase the total self-capacity of the coil much more than will the simple inter-turn capacities above.

The resultant of all these little elementary capacities is equivalent to a single capacity of suitable value joined across the ends of the whole coil, and this equivalent effective capacity is the one known as the self-capacity of the coil.

This effective self-capacity produces the same effect in the electrical properties of the coil as do all the little elementary capacities to which reference has just been made.

Since the combination of a capacity with an inductance constitutes an oscillatory circuit, it follows that the circuit formed by the inductance of the coil winding with the effective self-capacity across its ends has some natural frequency of oscillation. This is the "natural frequency" of the coil. This value may, of course, also be expressed in terms of wave-length, and is then known as the "natural wave-length" of the coil.

This point has been mentioned here because of its effect upon the use of the coils in the receiving set. When the self-capacity of a coil is large, it means that too large a proportion of the received current which should pass through the coil is shunted past it through the self-capacity, thus giving rise to a loss of efficiency.

As a matter of fact, the self-capacity of the coil brings about an increase in the effective *resistance* of the coil to high-frequency currents, which increase becomes greater the greater the self-capacity is in relation to the inductance of the winding.

For wave-lengths in neighbourhood of the natural wave-length of the coil this increase in the effective resistance may become very serious, and cause a considerable diminution of signal strength.

As a general rule, the self-capacity of the winding should be kept as small as practicable, consistent with building a coil that is reasonably economical in copper.

In our case, then, a simple single layer solenoid coil will be used, since with this not only is the self-capacity small, but the coil is a very easy one to wind. Although equivalent coils of smaller dimensions than the ones here used could be built to serve the same purposes, there is no harm done in keeping to a reasonable size for all the parts of the set, and not cramping them too closely together.

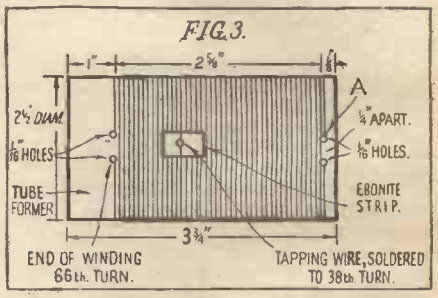
On a former, then, of ebonite, paxolin, or cardboard tube, 2½" diameter by 3¾" long, a winding of 66 turns of No. 22 S.W.G. double cotton-covered copper wire is put on, the turns being wound close up against each other. The 66 turns should occupy a length of the tube of 2⅝", this wire giving on the average 10 turns per centimetre length.

The winding should be kept up to one end of the tube, commencing ⅛" from one end. The ends of the wire should be secured by drilling two small holes, each approximately 1/16" in diameter, at a distance apart measured round the circumference of the tube of about ¼", and passing the end of the wire through one hole and back through the other (Fig. 3).

The remaining 1" length of the tube should be left free, as it will be used for mounting the coil on to the panel of the set.

Calling the end of the wire marked A in Fig. 3 the beginning of the winding, a tapping should be made on the coil after 38 turns have been wound on. When this point has been reached, a small slip of ebonite, ½" long by ⅜" wide by ⅛" thick, should be slipped over the completed portion of the winding, and the 38th turn passed OVER the ebonite, so as to raise it above the other turns. The next and succeeding turns are then drawn in underneath the slip of ebonite as they are put into place, thus leaving raised-up a small portion of the 38th turn.

FIG. 3.



The cotton coverings can be carefully scraped off from the wire over the centre of the ebonite slip, and a tapping wire soldered on at this point.

When completed, the whole coil should be dipped into a pan of molten paraffin wax, so as to secure the wire in position. Care should be taken not to overheat the wax.

A length of about 55 feet of No. 22 S.W.G. double cotton-covered copper wire will be required for the above winding, and when purchasing this wire, a length of approximately 45 feet of No. 28 double silk-covered copper wire can be procured at the same time. This will be required for the reaction coil, of which details will be given next week.

(To be continued.)

WIRELESS AND TIME SIGNALS.

By GEORGE SUTTON, A.M.I.E.E.

TIME to the nearest fiftieth of a second is very easily determinable by those who are equipped with a good regulator clock ticking seconds, but it is to be expected that the average wireless man will be quite content to be accurate to a second.

No really satisfactory general definition of time has been found, though we all have our ideas of what we mean when we speak of time. The problem seems to have been complicated rather than simplified by the recently stated theories of Einstein, but a time relative to a passing sequence of events is a description sufficiently expressive for most people.

Though sufficiently accurate, for some purposes, the sun is a notoriously bad time-keeper, and the fact is officially recognised by calling solar time the mean or average time.

The Old Way.

Even the foregoing remarks would not hold if we took the actual solar time day by day; for sometimes the sun is faster than the clock by 16 minutes 18 seconds, and sometimes slower than the clock by 14 minutes 28 seconds.

Only on December 25th, April 15th, June 14th, and August 31st does the sun keep anything approaching the right time as would be shown by a uniformly correct time-keeping clock.

During a recent partial eclipse of the sun, the shadows thrown on to the pavement by tree twigs and other small objects took fantastic shapes as the light of the sun, obscured at its middle portion, behaved as if it were in two or more separate parts, and threw two or more shadows of the same object.

An astronomer has to rule imaginary lines across the disc of the sun to obtain a point from which to take measurements.

On the other hand, the fixed stars, as they are called, make much better points in space by which to time the revolution of the earth on its axis, which is the natural datum for our day. Old clockmakers who required accurate time took great pains to set up "transit" observing instruments in order to note the exact moment that a star appeared to climb to its highest point in the heavens and then begin to fall. The "nautical almanac" supplied the other data necessary for his calculations.

Stellar Time.

A first-class observatory will, by watching the apparent movements of the "clock" stars, as some of the fixed stars are called, set its "sidereal" clock to keeping sidereal or stellar time, and this is 23 hours 56 minutes 4·1 seconds for the 24 hours of our meantime clock.

Having shown how our astronomers fix the time for us, we will pass on to the modern methods of distributing time by wireless.

Paris sends out on a wave-length of 2,600 metres, and here we would emphasise the necessity for careful tuning. The time signals do not seem to be so "broadfronted" as they once were. This means that your tuner must be arranged much more accurately than used to be the case if you are to hear anything at all.

At one time it was possible to hear the signals over a very wide range of tuning.

The usual short-wave tuner will probably bring in anything from 300 metres to 1,000 metres, if used with the 100 feet of aerial as allowed by the Postmaster-General.

To tune in Paris, you will want about three times as much wire as is comprised in your aerial and your tuner altogether; that is to say, a tuner nearly three times as long as the one you have at present.

The easiest way to arrange this is to procure a coil such as a pancake, basket wound, or honeycomb, with a natural wave-length of 2,000 metres, and put this in circuit between the aerial and the tuner, making sure that the detector circuit embraces the added coil and the tuner, or you will get very faint signals, if any at all.

You might, as many other experimenters sometimes do, get time signals by other means than careful tuning in, but you are much more likely to be successful in proportion to the care you take in following the tried and recognised methods.

The signal between 10.25 and 10.27 a.m. is sent by hand, and may vary slightly in time and method.

A Wireless Clock.

At 10.27 a.m. the clock is switched in and the remainder of the signal is sent by the clock itself. You have three points of absolute time; at the cessation of the third dash at 10.28, 10.29, and 10.30.

The occurrence of the dots of the N and the G previously to 10.29 and 10.30 respectively mark the position of the 10 seconds intervals very closely.

The note which one hears when listening to Paris is officially called a musical spark. Other time signals are sent out by Paris at intervals during the day.

The observatory authorities have recently had occasion to complain that, owing to cloudy weather interfering with stellar observations and the increase of traffic in the vicinity of the observatory, the time signal has been wrong to the extent of one-fifth of a second. Though this will not worry most wrist-watch wearers, it may be a serious matter for navigators, as an error of four seconds, at the equator, means the distance of a knot (2,029 yards), or a sea mile, in the position of an observing point.

As the signals travel through the ether at the rate of 186,000 miles per second, we need not, in any part of England, apply a correction factor unless we know that we ourselves, in hearing, are rather sluggish; but that is quite a personal matter.

The Mean Time Clock.

One may hear at about 11 a.m. B.S.T. a series of beats emanating from Paris and upon her wave-length and characteristic note, as though a seconds pendulum regulator were ticking. These ticks are actually caused by a pendulum, and though you do not hear the tick of the "escapement," as you do in a clock, you literally hear the Paris clock tick.

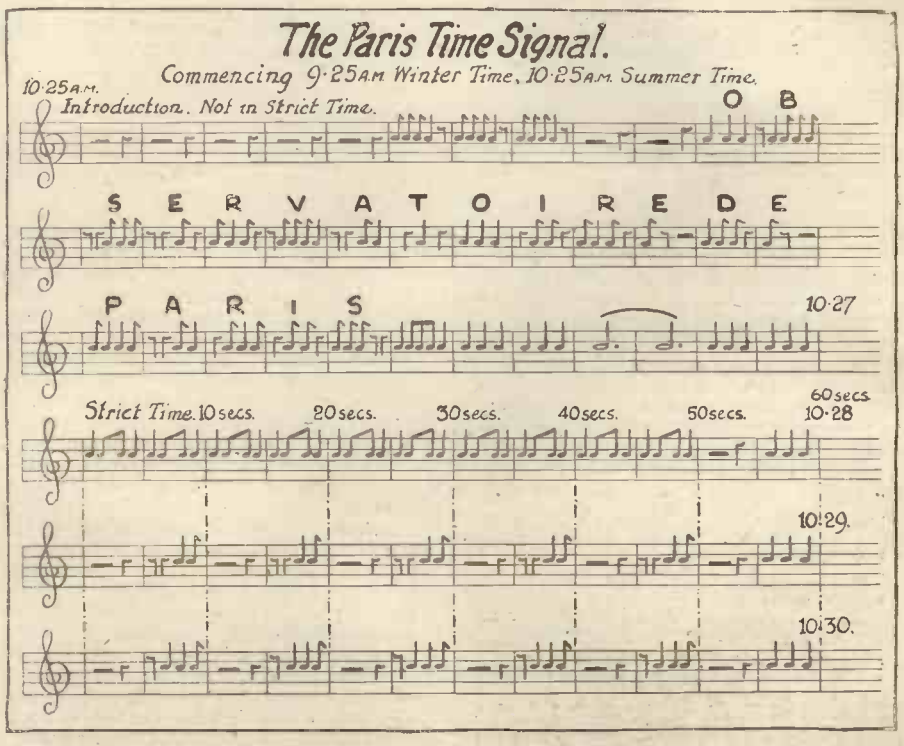
These clock ticks follow one another at intervals of ·98 of a second, an occasional one being missed for purposes of checking the counting.

If you have a seconds pendulum clock in front of you while listening to these beats the Paris clock will obviously gain upon your clock in proportion as 49 is to 50.

Suppose, for example, your clock and the Paris tick were exactly coincident on the arrival of the first wireless beat. They would both beat together again at the 49th tick of your clock and the 50th tick of that of Paris.

Later in the day Paris sends out a statement showing when their mean time clock and the ·98 seconds pendulum coincided in beat. If the coincidences were at the first beat you might be assured that your clock was right to within the one-fiftieth of a second.

If Paris mean time observatory clock coincided with the stellar clock sending out the wireless beats, we will say, on the eleventh tick, you will know that you are eleven-fiftieths of a second slow, and take steps accordingly.



The above chart shows the Paris Time Signal in music form. The crotchet ♩ stands for a dash, and the quaver ♪ for a dot. The rests, 𝄽 𝄾, are put in to space the letters. You can memorise the signal in a very short time by "tapping" it out on the piano. Each of the last three lines represents a full minute of time—the last dash being the CORRECT TIME.

THE MANCHESTER WIRELESS SOCIETY'S NEW STATION

By a Member of the Manchester Wireless Society.

AMATEUR Trans-Atlantic communication may sound rather a tall tale to those who have only recently taken up wireless as a hobby. But it is no dream of the future; it is an accomplished feat. This is how it came about.

Last winter, from Dec. 8th to 17th inclusive, certain American amateurs transmitted test signals, using up to one kilowatt in power, with the object of finding out if it were possible for their signals to be picked up in Great Britain.

When it is remembered that the normal range for a kilowatt is only a very few hundred miles, it will be seen that a certain amount of optimism was needed to attempt to communicate with places over 3,000 miles distant.

This, especially when very few American amateurs were using the full kilowatt. Further, British amateurs were only allowed, at that time, to use 140 feet of wire in their aerials, or 100 feet if only a single wire was used.

The long and short of it was that some of the signals were picked up by British amateurs, and the Manchester Wireless Society has the good fortune to have as one of its members the winner of the tests, Mr. W. R. Burne.

Now, perhaps it would be as well to give a broad outline of these tests. The American stations were scheduled to transmit for a quarter of an hour each on a certain night of one of the ten days during which the tests were carried on. American time is five hours behind Greenwich time, so that when the Americans began to send at 7 p.m. it was midnight here. As the tests were for six hours each night, it meant sitting up from midnight till six in the morning!

This for ten nights, or rather mornings, and the writer had the pleasure of sitting up for two or three nights with Mr. Burne, and only by doing so is it possible to realise the tremendous strain upon the one who is working the set.

And No Wonder!

Mr. Burne was fortunate in being able to sleep part of the day-time, but others were not in such a happy position. Mr. H. H. Whitfield, of Birmingham, who won the second prize, was only able to listen at the week-ends. Mr. Greenslade, of London, who was joint third prize winner with Mr. Spence, of Aberdeen, sat up every night and went to work at nine o'clock each morning. In his log for the last morning appears something like this:

5.30 a.m.: Feeling rather queer, so closing down.

And no wonder! But this just shows the spirit of the British wireless amateur. Nothing can stop him in the cause of science.

Set used for receiving American amateurs signals.

Mr. Burne heard seven different stations, Mr. Whitfield three, and Messrs. Greenslade and Spence one each. There were several hundred Americans transmitting, so it is quite clear that it is no easy thing to bridge the Herring Pond on one kilowatt.

The Americans sent one of their best men over to see if it were at all possible to receive the signals.

"Q. S. T," the official organ of the Amateur Radio Relay League of America, went so far as to say that this gentleman, Mr. P. F. Godley, was being sent over to show us how to receive the signals.

"Lessons" from America!

They openly declared that British amateurs and apparatus were not up to the task. But we understand our American cousins, and we understand that their enthusiasm is well meant.

But nevertheless Mr. Godley did not show us how to get the signals. Instead of using a "mighty good frame," as the Americans call our regulation aerials, Mr. Godley used 1300 feet of wire. He heard over 25 stations—but no wonder with an aerial like that, and also being able to choose the best spot in Great Britain for a station. He established himself near Ardrossan on the west coast of Scotland.

But we have a great admiration for Mr. Godley for his pluck and perseverance in face of great difficulties and hardships. His apparatus was in a tent on exposed land. This, remember, in typical English wet wintry weather. As Mr. Godley was not used to British weather conditions, he suffered somewhat.

So the result of these tests was that trans-Atlantic communication on one kilowatt was a possibility. The idea struck Mr. Burne that we might transmit back to the Americans.

We mentioned this to the secretary of the Manchester Wireless Society, who immediately wrote to the P.M.G., and after three months we received a special permit to use a power of one kilowatt with the object of transmitting to America. The application had to be considered by the Army, Navy, and Air Force, and the society is very much indebted to the P.M.G. for obtaining this permit.

An excellent site for the station was obtained at Baguley, in Cheshire, through the kindness of one of our members, who has also placed at our disposal three excellent rooms in an outbuilding, from which to work our apparatus. We consider ourselves exceedingly lucky to have these facilities placed at our disposal.

Some steel tubing was obtained, and we proposed to make up a mast. An attempt was first made to erect a mast half of wood and half steel, but this proved unable to withstand the strain of being erected, and broke in three pieces when about half way up.

Nothing daunted, we immediately collected the steel tubing and put up a 40-foot mast of this in no time. This was raised by means of a derrick, pulley-blocks, and rope, while members held firmly on to the stays. When the foot of the mast was 8 ft. from the ground, another length of tubing was socketed in and the whole lot raised again to repeat the operation.

The other mast was made of lengths of steel tubing screwed together, and the full 81 feet of it was raised by means of a falling derrick. Only four members were really necessary to do this, the side stays being fixed in position first, thus preventing the mast from swaying sideways as it was hauled up.

The mast has been down and up again several times since and presents no difficulties at all.

Ready in the Autumn.

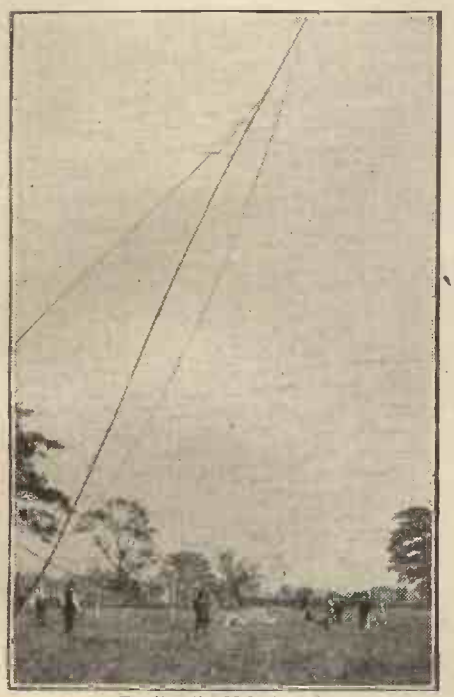
This method having proved the best, the other mast was lowered and more tubing joined on till it was 88 feet long. After all the stays were firmly spliced on and the side ones fixed in position, it was raised as easily as its companion.

Then a six-wire cage aerial was made with spreaders of light canes fixed at intervals to maintain the shape.

The earth is now being made. This is to consist of thick copper wires buried about 5 feet below the surface and soldered to large sheets of metal at either end. There will probably be two or three trenches under the aerial and small side ones as well. At four feet down one comes to permanent water, so the earth should prove to be very efficient.

The transmitting panel and a 12-valve receiver are to be constructed at once, and by the autumn we should be ready to clear traffic both ways with out American cousins.

They are wildly enthusiastic over our "stunt," and are erecting special stations to receive us and others to answer us. So English amateurs can look forward to some very interesting tests during the coming winter.



Erecting the 88 foot mast.

BOOK REVIEWS.

Radio for Amateurs. By A. Hyatt Verrill. (William Heineman, 20-21 Bedford Street, W.C.2. Pp. 228. Illustrated. Price, 7s. 6d. net.)

There is a good deal of sound, practical information for the amateur in this American book published by the firm of Heineman.

A concise history of wireless leads the novice up to the elementary principle of sound and electrical waves, and thence by easy stages to a description of simple spark transmitters, crystal detectors, aerials, and valves.

Perhaps the British amateur will find the chapters devoted to the construction of apparatus the most useful, because many new hints and practical instructions are given which are equally applicable to British as well as American apparatus.

FROM OUR NEW YORK CORRESPONDENT.

RADIO moves so fast that, like battleships, new equipments are obsolete almost as soon as they are launched. The past few weeks alone have furnished two striking instances.

It seems only a few days since we were taken to Rocky Point, Long Island, where the Radio Corporation had completed the first section of its giant new station, now known as Radio Central, and were shown the great Alexanderson alternator, the latest marvel of the wireless world. Now the General Electric Company has perfected its radiotron tube, ten of which, occupying about as much space as a desk drawer, will do the work of the 200 kilowatt of Alexanderson alternator, a large piece of machinery, weighing some ten tons, and very costly indeed. Two sets of the new tubes have been prepared, and will be put into services for final testing very shortly at Radio Central and Carnarvon respectively.

Only the final tests will make it certain that the little tubes will oust the great alternator, but the President of the Radio Corporation, Mr. E. J. Nally makes no secret of his belief that the equipment of Radio Central, is now largely out of date.

An Outstanding Event.

The Radio Corporation has just accomplished a very interesting feat at Radio Central. For its "summer service," that is, during the period of greatest interference, the engineers have connected up two arms of the great series of antennæ of which the station is composed, making a line of masts, each 410 feet high, with a total length of three miles. Each arm is a mile and a half in length, and each has its own alternator. What the engineers have succeeded in accomplishing is the synchronisation of the two alternators at 22,050 revolutions a minute.

The result is a 400 kilowatt station which can send its signals through the worst interference without the necessity of repeating. When the summer season ends, the two arms can readily be separated, and used in any other way required.

The other outstanding development of the week is the publication of details of the Armstrong "super circuit," with its astounding achievements in amplification. Edwin Armstrong is a worker in the Hartley Research Laboratory at Columbia University, New York City, where he has been able to draw upon the learning of Professor Pupin. With his circuit he has succeeded, with two tubes, in increasing the amplifying power of the best three valve sets from 5,000 times the original strength of the signals to something like 100,000 times!

How he achieves this remarkable result he himself describes thus: "It has been known for years," he says, "that the limit of amplification is reached when the negative charge in the tube approaches the positive charge. In experimenting I have found that it is possible to increase the negative charge temporarily, for about one twenty-thousandth of a second, far above the positive charge, and still keep the average down. It is the possibility of increase which permits the enormous amplification, and enables me to eliminate two tubes from the circuit.

"Another practical result of this circuit will be to make possible the detection of signals on wave-lengths of less than 200 metres with ordinary amateur sets. To illustrate the difference between a set equipped with this super-regenerative circuit and an ordinary regenerative set, I have found that signals which can just be heard with the latter can be heard all over the room with the super-circuit.

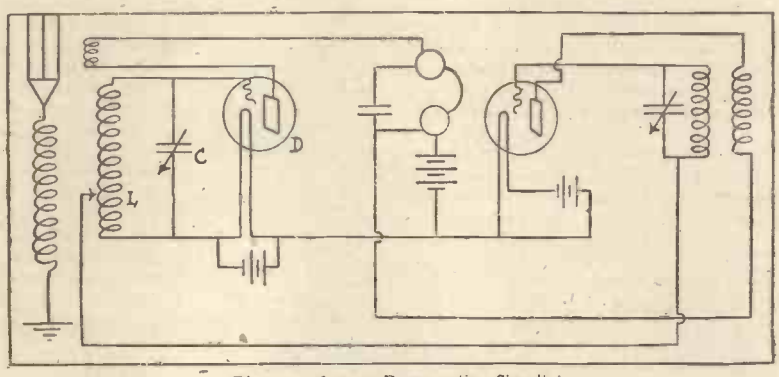


Diagram of super-Regenerative Circuit.

The Circuit.

Mr. Armstrong adds that his circuit can be worked with an ordinary indoor loop aerial, while it costs no more than the ordinary sets with outdoor aerial. And it will enable the amateur to hear the faintest broadcastings at extreme distances.

As Capt. Robert Wood, of the New York Evening "World," has pointed out in reproducing diagram shown, the Armstrong regenerator circuit is used with the second tube connected so that it acts as an automatic switch, cutting in or out a few turns on the secondary coil. The plate circuit of the second or switch tube is connected to the plate of the detector tube through the necessary capacity and inductance.

The grid and plate of the second tube are inductively coupled, introducing variation into the positive resistance of the tuned circuit. This is accomplished by means of the oscillating tube, the grid circuit of which is connected with the tuned circuit L—C of the amplifying tube D.

What are the British Army and Navy doing in the matter of Radio? The United States Army has maintained a broadcasting station in New York City for a long time, and now the Navy, not to be outdone, has established a similar station in the city, and sends out a varied programme every evening after nine o'clock on 1830 metres.

WIRELESS ON A RACER.

FOR the first time in the world's history wireless transmission was carried out from a racing car on Wednesday and Thursday, July 19th and 20th. Wireless transmission has recently been much discussed amongst the drivers of racing cars, as it would prove invaluable to them to be able to transmit to their pits where the repairs take place and give them a little time in which to get certain spare parts ready when necessary.

Mr. S. F. Edge kindly offered to allow this experiment to be carried out from his Spyker in his recent successful attempt to break the twenty-four hour world's record on the Brooklands track. Owing to the fact that it was impossible to put any sort of fixture on the car and the time available for the designing and testing of suitable apparatus limited to twelve hours, it was not anticipated that much success would attend the efforts of those responsible, *i.e.* The Electrical Disposals Syndicate and Messrs. Alfred Graham & Co., both London firms engaged on the manufacture and sale of wireless apparatus.

An aerial was hastily erected on the side of the track and coupled to a 4-valve receiver operated by members of the staff of the latter firm. The transmitter consisted of an ordinary aircraft spark set, the aluminium body of the racing car acting, as it were, as one plate of a large condenser, whilst a trailing wire acted as a counterpoise and, being in direct contact with the track, made a very inefficient earth.

At midday on Thursday sufficient progress had been made to prove that reasonable success would attend an experiment actually made from the car, and as the car was due to stop for one-and-half minutes for replenishment at one o clock, the apparatus was placed on the side of the track and the accumulators and transmitter, fixed firmly into a small box, laid exactly opposite the spot where the car would stop.

So well had matters been judged, that the whole of the apparatus was installed in the car in less than 45 seconds and the car speeding on its way round the track within one minute after it had stopped. Final adjustments were made in the first few hundred yards and the first signals obtained before the car had covered half a mile.

Transmission, which was carried out by Mr. C. H. Gardner, managing director of the Electrical Disposals Syndicate, was made under extreme difficulties owing to the fact that the transmitting key had, perforce, to be fixed on the transmitter, and it was only by hooking his arm under his leg that it was possible to reach the key. Owing to the jolting of the car, travelling at 90 miles an hour on the track, the spacing of the transmitted Morse was none too legible, but several messages were received satisfactorily.

The actual duration of thetest lasted for some three hours, but some little time before this the earthing wire had torn away through con tact with the track unaware to the operator and, therefore, the messages towards the end of the run were not successfully received.

It is hoped to elaborate with these results considerably in the near future, but it would appear doubtful at the present time as to whether there is a valve on the market which would allow of continuous wave or telephonic transmission owing to the excessive vibration and jolting which takes place under such conditions.

Excepting to those who have had experience in such matters, the utility of telephonic communication from a racing car can scarcely be gauged, but there is no doubt that the great difficulties entertained will shortly be overcome, as they have been overcome in aircraft and other such transmissions.

WHAT THE AMATEUR CAN DO.

By PROFESSOR A. M. LOW, A.C.G.I., F.C.S.

THERE is always something to me almost pathetic, though intensely valuable, in the rush that takes place to adopt the more simple portions of any scientific discovery.

The commercial aspect of work is important, but it should not be taken that any invention can be judged by its immediate prospects. Nearly every new thought, even if in itself incorrect, will lead to good.

When Faraday designed his first magneto, a woman, seeing only the insignificant results before her, asked Faraday what use it could be. His reply might well be written in every amateur's notebook: "Madam," he said, "of what use is a new-born baby?"

The Outsider's Chance.

The very simplicity with which wireless signals can be picked up, the fact that with a crystal, some silver paper, a jam-jar, and a little copper wire, it is possible to detect spark systems many miles away with an ordinary telephone, is apt to cause confusion.

The man who first purchases a wireless outfit soon appreciates that great strides have taken place between the days of simple signals and wireless in its modern form.

Yet the science of wireless is young, and when we realise that a few years ago experimenters were talking of sending simple spark messages in terms almost of feet, and that we can now speak with our friends in terms of hundreds of miles, it is obvious that wonderful progress has taken place.

The necessary apparatus was hurried on by the war, but is still very simple, and, as in all new sciences, it is very often the outsider who scores first.

Twenty Years' Work.

Many important discoveries must be made, for very little is really known of any physical science, and it is impossible for countless thousands to be working on a subject without some mass effect of effort becoming noticeable.

This is the fascination of wireless for the amateur. The work of the most humble experimenter may take him to the threshold of a new discovery, and the simplest of original thoughts is worth more to progress than the finest stereotyped plant in existence.

In twenty years we have, without any increase of sending effort, increased receptive distance a thousandfold.

It is possible by the ordinary thermionic valve to intensify the energy received. Signals can be amplified again selectively and, under good conditions, even the results glibly attributed to "pocket" installation can be obtained.

It is the words "good conditions" that mean so much. A wireless outfit will sometimes give results which seem out of proportion to its intentions, and until we know every detail connected with each phase of a temporary improvement, how can it be said that we are nearing finality?

Wireless Ideas.

At present it is undeniable that if wireless telephony became at all popular and of real business service, it would be utterly worthless. The apparatus is so simple that no law could prevent abuse, and no one would trust a private message to the mercy of their friends' aerials.

The amateur who first secures true directional results, or who first develops the secret of some complicated or combined wave form as distinct from mere frequency, will make the fortunes of many. Even in the war, when selective wireless research was at its height, jamming was never avoided.

Two delicately poised strings in a piano may respond one to the other, but a revolver fired in a room will disturb both.

This is the fault of so-called selectivity in speech.

Simple signals may be mechanically selected, but this only applies to special purposes.

I have spent years on the subject of wireless control, and can state without exaggeration that some success has been obtained; but it is a mere beginning, and is still a "war-time secret."

It may be that speech will be sent mechanically and unravelled, so to speak, at the receiving end; but this again is not true selection by wireless itself.

Consider another simple fact. All kinds of speech are rather old-fashioned. There is something absurd in the need for physical contact before we can transmit our thoughts to our friends.

May it be that atomic motion in wave form will develop a transmitting sense to our increasing minds as our bodies decline? May not a wireless outfit be the means of establishing exchange of ideas far more rapidly than is now possible, and who knows but that our own planet contains the most advanced principles on this subject!

Future Prospects.

There can be no other field for the amateur so promising as wireless; even the great bar of money is removed by its extraordinary basic simplicity.

To speak to people on the ocean-going liner is now quite easy, and we shall not have to wait long before we can see also events as they occur. Television by wire has been accomplished, poorly, it is true; but the biggest oak may rise from the smallest acorn—even if the acorn is *not* quite sound all through.

Think how many infinitesimal changes there are, all of which are perfectly reproduced, in the human voice when telephonically received.

In the ordinary half-tone printing block there are only two "shades," black and white, and it would be the easiest thing imaginable to reproduce a photograph piece by piece by wireless means. More than this, it has been done.

It remains for someone to again build some form of selenium cell or slat reproducer, which, relying on the retentivity of vision, could show us a scene "by wireless."

Think how such ease of mental travel will increase the speed of thought; think how knowledge of people and science must help to prevent war and disorder. Truly, the amateur wireless man can go far.

Simplicity the Keynote.

Even the civilised idea of time is altering as exchange of thought grows in rapidity.

A few centuries ago we made appointments by days; we now arrange our meetings by minutes, and, if we could speak and see our friends at any time, we should end by counting our appointments by seconds. Yet another point far different from control may one day become important.

The largest wireless station transmits but little energy. To move a feather from a distance of 500 miles from the sending aerial is difficult, even if 10-horse power is being dispensed.

It means energy being put in at the receiving end, though it can be controlled by the sender. The whole science of atomic energy is in its infancy, and we have yet very definitely to determine how light can help, or in what manner life and other oscillatory phenomena are interconnected.

What is the present position? With my own apparatus I can write to my friends on a ship at sea by my radio writer. I can speak to them, and with sufficiency of funds I could doubtless see them at the same time.

I can direct the course of a ship, and I can tell where it is. All of this needs quite simple apparatus. It requires no vast combine, no wonderful organisation, and no great skill.

Finality?

There is far more than ever to discover, and the amateur should be in his element, for who shall deny that one day we may have the elements to help ourselves? All of us are amateurs in our own knowledge, the way we dress, eat, sleep, fight, and live, proves this only too well.

That there are formidable difficulties ahead is known very well, but no troubles yet daunted any amateur worthy of the name.

One more point in conclusion for our amateur. The public is at present interested in tapping other people's messages. Does it not occur that if wireless was really reaching commercial finality we could not do this, and our own "listening in" apparatus would be almost useless?

HINTS TO AMATEURS

To make brass springy for contact levers, etc., hammer it on a piece of iron (an old flat-iron is quite good for the purpose), and then file out the hammer marks. Should it be just the opposite—that your brass is hard and you want it made soft—make it red-hot and immerse it in cold water. This will soften it at once. This is termed annealing.

* * *

When jointing wires together, many amateurs avoid the soldering part on account of what appears to be a difficulty. Really, soldering wires needs very little skill in the soldering line.

A very easy way is to clean the ends of the wires, twist together tightly, and rub a little powdered resin in the joint. Next, find a small piece of tinfoil and wrap the joint up, and light a match underneath, when it will be noticed that the tinfoil will melt very quickly and run well in the joint. Clean off with a piece of rag, and a firm soldered joint will be the result. A little practice on a couple of spare pieces of wire will soon give the idea of just how much tinfoil to wrap on to make a nice joint.

* * *

Switch tapping studs, to buy in large quantities, become an expensive item; but a very good substitute may be found by using brass-headed chair nails, if possible with brass points. Drill the panel with small holes that are just a tight fit for the nails, drive the nails through, and, after you have twisted the ends of the wires round the nails, bend the points over as flat as possible to the back of the panel. Solder the wires last of all.

QUITE BY ACCIDENT

By H. T. LEED.

There is a moral in this little tale which the enthusiastic beginner should certainly take heed of and bear in mind when he erects his set.

THERE are many men who have been endowed by providence with a peculiar gift: that of manipulating and moulding minute pieces of wire or fragments of wood into ingenious models and contrivances which are at once the admiration of all beholders and the priceless possessions of the designers.

These men have, I imagine, long, thin, tapering fingers, burnt brown at the shrine of my Lady Nicotine: fingers which writhe and twist like snakes in the deft fashioning of some intricate piece of mechanism, which the average hand could no more attempt to handle than the average foot.

I am not of this type. I am not even of the type that keeps rabbits or does fretwork. The hobby mania has no part in my life, and yet it happened. . . .

True, it was by accident. Fate, and the bookstall of a northern railway station, placed in my hands several newspapers and magazines with which to while away the three hours that separated me from Paddington.

I read the newspapers, and turned from the Irish question to the magazines. It was then that the insidious poison entered into my blood. I decided at first that I would purchase the whole contraption ready-made, and give Diana and the children a surprise. But second and more treacherous thoughts dissuaded me. One of the thoughts was young Batton.

Young Batton was a wireless man. Diana and I had met him—quite by accident—when we were at Cliftonville one summer, and young Batton, who lived in the same suburb of London as ourselves, had entered into a speaking acquaintanceship with myself and a warm friendship with Diana and the rest of the family.

To be candid, I do not care much for young Batton. He is too self-assertive and reliant for his age. Diana says that it is the result of experience gained by travel, which is another way of saying that I am a narrow-minded old idiot.

But the wireless fever had laid hold of me, and once young Batton got any idea that I was, so to speak, thirsting for knowledge, he would come racing round to "Yewlands" to give me his patronising assistance.

I know the man too well. That is the worst of becoming acquainted with people by accident. I decided, therefore, to keep my secret, and placed the magazine carefully in the bottom of my suit-case.

Of course, Diana unpacked it. I was not aware of this, however, until the following evening.

When I arrived home Diana sat in a thoughtful mood before the French windows in the drawing-room and gravely regarded the lawn. "A penny for——" I began, when she interrupted me.

"Pay up," she said. "I was thinking of an aerial." "I only remember hearing of one," I answered uncomfortably, "and he was a little chap in 'The Tempest.'"

Diana was not impressed. "And crystals," she said, still gazing at the lawn. "On the shelf in the bath-room," I murmured desperately, "next to the new soap."

"And telephones," she continued, just as if I had never spoken. "I agree," I replied pleasantly; "the rate is much too high, and everybody is grumbling at the service. I rang up Halticote to-day, and——" And then I saw my magazine in Diana's hand, and knew that I was found out.

Diana waxed enthusiastic, especially when I casually mentioned that I had thought of buying the component parts of the outfit and connecting them together myself.

"Much better than a ready-to-work apparatus," she agreed, "and you will be gaining knowledge all the time." I did gain knowledge—quite a lot of it, but not of the sort I had anticipated.

I found out, for instance, that a certain wire known as silicon bronze was possessed of a particularly malignant kind of devil who delighted in coiling the wire round table legs, chairs, and the sideboard, and which eventually bound me fast to the door handle.

This was before I had forcibly ejected the demon and wire on to the lawn, and after Diana had taken the children to bed half an hour before their proper time.

I found out also that one cannot stand on the top rung of a ladder and hammer heavy staples into growing beechwood. Fortunately the lawn was soft, but in this case the answer did not turn away wrath.

Soaked with perspiration and determination, I persevered, and on a never-to-be-forgotten Saturday afternoon the aerial was fixed.

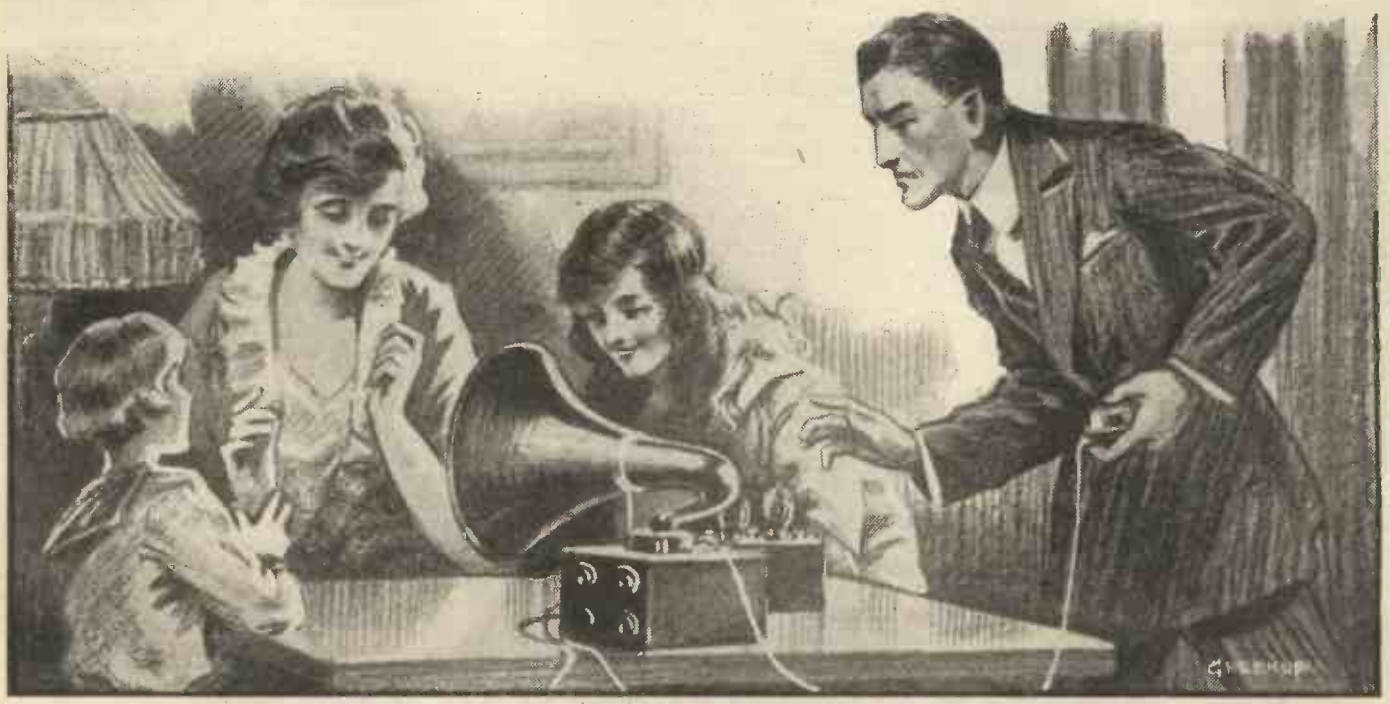
After this, with the aid of Diana, the cook, coils of wire, and a text-book, my wireless receiver gradually assumed shape. A chance remark of Diana's that young Batton would be returning from Timbuctoo or somewhere on the following Tuesday, kept me out of bed until after midnight in a feverish endeavour to complete my work before the return of the wanderer.

I am not naturally of a vindictive disposition, but I just wanted to prove that the erection of a wireless set was mere child's play if only one devoted sufficient intelligence and time to the matter.

A half-day off from the office on Tuesday saw the thing finished, and Diana and the children gathered round in an anticipatory crowd to share the fruits of my labours.

The little valves were switched on, and the glow they gave found a respondent echo in my heart.

I casually placed the telephones on my head, and commenced to adjust the condenser and inductance, which a careful perusal of my text-books had taught me was the correct thing to do.



In a second the two wires were replaced and a swift manipulation of the instrument followed

QUITE BY ACCIDENT.

(Continued.)

I moved them one at a time, and both together, but unless I had suddenly become stone deaf, there were no dots and dashes of the Morse code, or voices speaking across the ether. The little valves winked now—positively winked. The clock struck two. . . .

At half-past six Diana had given up all hopes of a *tête-à-tête* dinner, and said that she was thankful, anyway, that the Draymers would soon be arriving.

I had invited the Draymers, by the way, to hear a wireless concert which I knew was being sent out at seven o'clock. Halticote was also coming down, and bringing his wife.

I had overhauled everything: I had left nothing to chance, and yet, by some unforeseen accident to the apparatus in transit . . . .

My guests arrived, and I duly explained and apologised in the same breath. Of course, an accident had occurred to the delicate apparatus in transit. I was certain that the installing of the set had been correctly carried out, and called upon my wife for confirmation.

Diana said that it was quite as it should be—and then spoiled the effect by saying, "as far as I can see."

"Very unfortunate indeed," I was saying, "quite by accident——" when young Batton arrived.

"Hallo, Freddy," said Diana, in that familiar way of hers which I have more than once felt called upon to reprove, "back again?"

"Arrived at Southampton in the small hours," he replied.

"Had a good voyage?"

"Rather. I should have been reporting to London, but quite by accident—— Hallo! Bitten by the prevalent craze, Mr. Wallingstone?"

I do not care for the majority of young Batton's expressions, and this one seemed particularly offensive, as if I had been fraternising with mad dogs.

"I was just explaining," I answered stiffly, "that the set is all connected up, but owing to an accident——" Diana interrupted.

"Do have-a look at the thing, Freddy," she said. "Phillip has been trying like anything to get it to work since two o'clock this afternoon."

Young Batton strolled over to the set and switched on the valves. The little yellow lights gleamed evilly. He placed the telephones upon his head, and varied the little condenser and inductance handles as I had done. Then he swiftly reached over to some terminals and disconnected two wires.

In a second the two wires were replaced, and a swift manipulation of the apparatus followed. Then from my loud-speaking instrument issued a burst of music, and the voice of a tenor—singing, singing——

I crept out of the room and up to my bedroom. When the concert was over and the guests had gone, Diana explained: "Freddy was full of admiration at the way you had connected up the set, dear. He said that it would do justice to a professional. What a pity that you should have made that silly little mistake of connecting up the high-tension battery, or whatever it is you use for the lamps, to the wrong terminals! Fancy just changing over two wires and making all that difference——"

But I was asleep.

THE CARE OF ACCUMULATORS.

By W. S. SHOLL, A.M.I.E.E., A.INST.A.E.

ACCUMULATORS, or storage batteries, seldom enjoy the life they ought to by reason of the neglect or ill-usage often meted out to them. Consequently they are commonly referred to as "messy," unreliable pieces of apparatus, and only to be used on sufferance.

There is really no occasion for undue trouble to be experienced with these batteries if a few simple rules are observed in the care and maintenance of them.

An accumulator is really a chemical battery in which the active elements are renewed, not by the addition of fresh chemicals, but by the passage of an electric current which, by the process known as "electrolysis," restores the exhausted elements to their former active condition.

Actual Capacity.

The prime factor in the satisfactory functioning of these batteries is absolute chemical purity, not only in the composition of the plates, but also in the acid, dilute sulphuric acid, which is known as the "electrolyte," in which the plates are immersed.

Therefore, the acid must be pure "Brimstone" sulphuric, and the water necessary for dilution must be distilled.

In selecting a battery for stationary purposes, the glass cell type is beyond doubt the best to use, as the glass container is not only transparent, enabling a watchful eye to be kept on the plates, but it is totally acid proof, which cannot be said of celluloid.

Where small cells are required for portable purposes, celluloid is, unfortunately, about the only thing for the boxes, as ebonite is not only opaque, but rather brittle and cannot be repaired satisfactorily in case of breakage.

Purchasers of accumulators should take care to ascertain the *actual* capacity in ampere hours, as it is a common practice to rate the small "motor car" type of batteries at twice their actual capacity on constant discharge.

This point is a very important one, as not only will the cells give less output than expected, but the actual capacity will not be afforded by reason of the fact that the capacity of a cell is diminished by discharging it at excessive rates.

A battery, to give a useful and efficient account of itself, should not be discharged at a greater rate than ten per cent. of its full listed capacity. Thus a battery of 40 actual ampere hours capacity should not be discharged at a greater rate than 4 amps.

Care Needed.

The actual capacity is arrived at by taking the number and size of the Positive plates, the chocolate coloured ones.

The usual form of celluloid battery will give an output of 10 amps. per positive plate on continuous discharge; thus a five plate cell, containing two positive and three negative plates, will give 20-amp. hours at the "ten hour" rate, viz., 2 amps. for 10 hours.

If we increase the discharge to twice the rated amount, viz., 4 amps., we shall not get this output for 5 hours, but for only about 3 to 4 hours on account of the decrease in capacity under heavy discharge.

Therefore, it is necessary to see that in the first place our battery is well up to its work; secondly, that no undue discharge is permitted, and that leakage and accidental short circuiting is guarded against. The first thing to do in placing a new battery into commission is to prepare the acid according to the directions on the label of the case containing the elements.

The strength given is generally 1.175 by hydrometer, and is roughly that obtained by mixing three parts of distilled water with one part of pure brimstone sulphuric acid.

The acid should be poured into the water, not vice versa, and a glass vessel used, preferably stood in a sink in case of breakage. The acid should be poured gently in a fine stream and well stirred with a clean wooden stick; great heat is generated, which must be kept in check by slow pouring or the vessel will be cracked with disastrous effects if near to any easily damaged articles.

Points to Remember.

When cold, the mixture should be tested with an hydrometer which will show the acid to be a little on the strong side as it gains in density upon cooling; a little more water will now reduce the solution to the correct strength.

On no account must the acid be put into the battery until current is available for immediate charging, and once the charging has been commenced it must be continued without interruption until the process is complete.

Theoretically the charge should be complete in 10 hours, at 2 amps. for 20-amp. hour cell, but in the case of a new battery the charging process should proceed for at least 15 hours or until the plates "gas" very freely and the acid assumes a "milky" appearance. This colouration is due to the immense number of bubbles of oxygen from the positive plates, and hydrogen—twice in volume to the oxygen—from the negative plates.

These gases when mixed are *highly explosive*, so under no circumstances must naked lights or sparks be allowed near the vent holes of the cells. These vents, which are rubber plugs fitted with a small glass tube, which must never be stopped up, should be removed when charging and, after any froth has been wiped away when charging is complete, replaced in their holes in the battery cover.

Continuous current only is permissible in charging accumulators unless an apparatus, known as a "rectifier," is available. The user should, if possible, keep his batteries out of the local garage, not one in ten of these places is able or willing to take proper care of them, and the "charge," in a pecuniary sense is often quite out of proportion to the "charge" of an electrical nature.

The voltage of each individual cell should rise to fully 2.3 volts when fully charged; this pressure will speedily drop to 2 volts on discharge, and will remain constant over the cell's capacity upon the exhaustion of which the pressure will drop to 1.8 volts which is a signal for prompt recharging. Under no circumstances allow a cell to remain in a discharged state; it will utterly ruin it without remedy.

CORRESPONDENCE.

"THERE IS NO ETHER?"

The EDITOR, *Popular Wireless Weekly*.

DEAR SIR,—Will you allow me to point out a printer's error in my article?

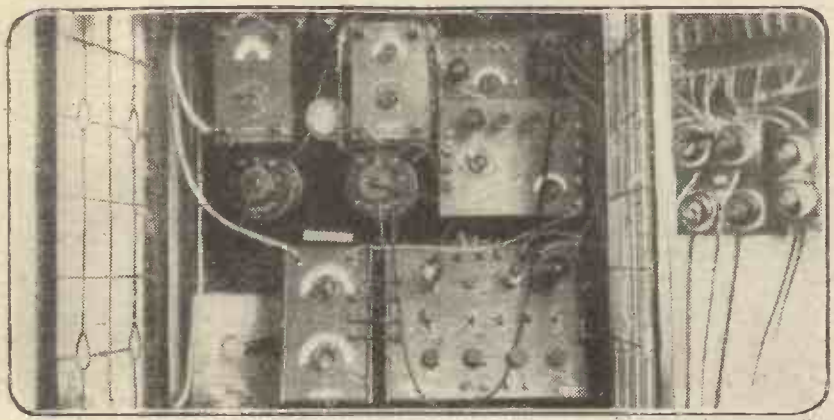
In the third paragraph, the words: "or a field of energy throughout space devoid of matter," should read: "or a field of energy throughout space *for the most part* devoid of matter."

This was an unfortunate omission.

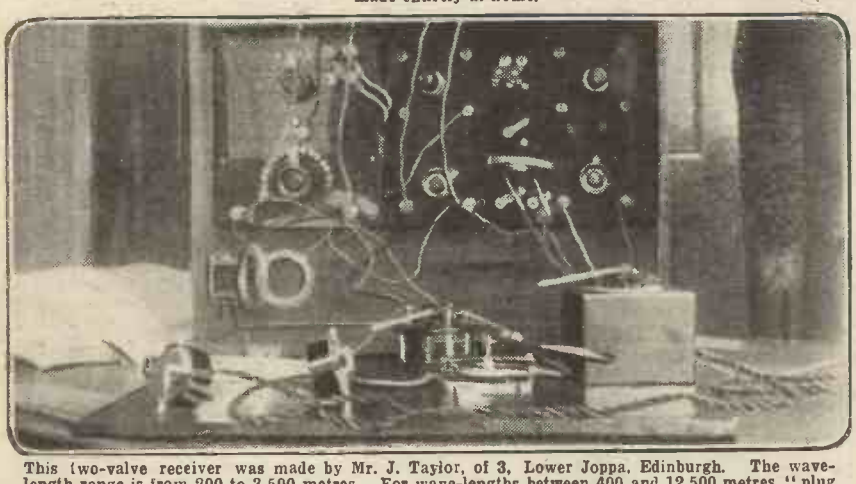
Yours truly,

P. J. RISDON.

A DRAWING-ROOM RECEIVER.



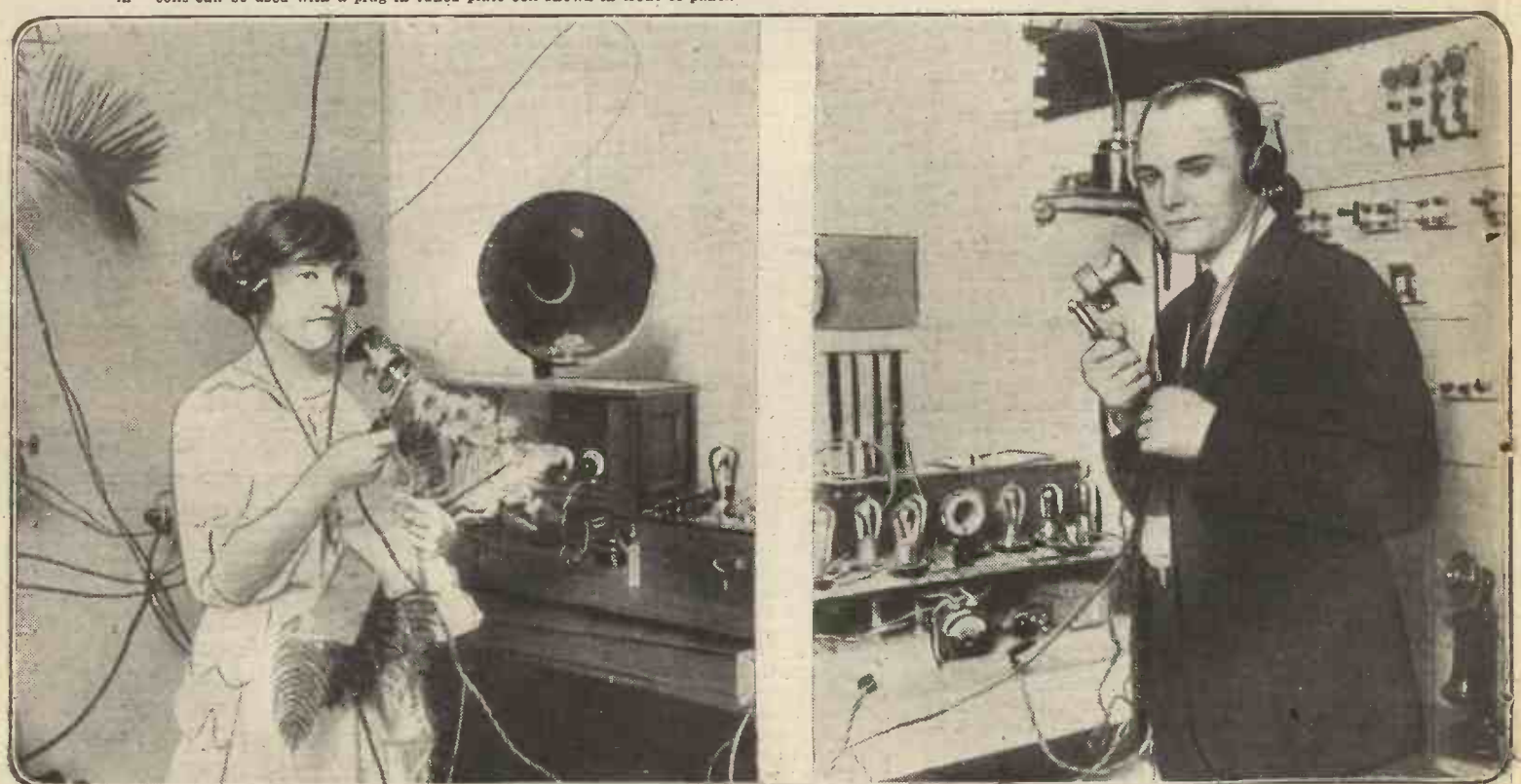
Mr. Aked's set at "Kassuli," Devonshire Road, St. Anne's-on-Sea. Mr. Aked uses a "Burndept" super-drawing-room set of four valves. For short wave-lengths he uses a separate receiver he made entirely at home.



This two-valve receiver was made by Mr. J. Taylor, of 3, Lower Joppa, Edinburgh. The wave-length range is from 200 to 3,500 metres. For wave-lengths between 400 and 12,500 metres, "plug in" coils can be used with a plug-in tuned plate coil shown in front of panel.

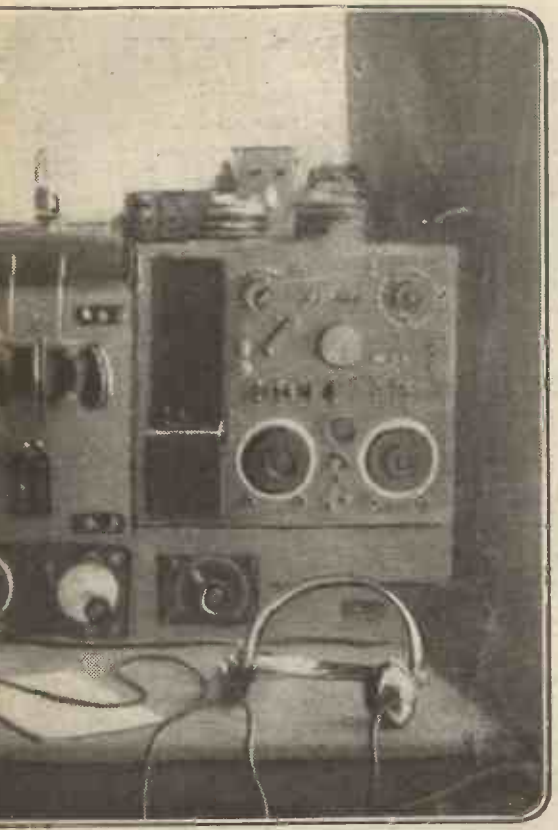
WHY NOT MAKE A SI

Mr. E. G. Lunnon, of London Road, High Wycombe, Bucks, uses a Mark III. cry[illegible]tal s[illegible] There is no knowing what you can do until you try. The above set is the result of [illegible] photo shows, Mr. Lunnon has succeeded. It is



Marriage by wireless is the latest craze in America. On the left is Miss Mabel Brady; on the right, Mr. John H. Stone. The bride attended the ceremony at one wireless station, the groom at another, and the parson at another. The marriage vows were spoken by the minister, and repeated by the marital pair via the ether. Thousands attended the wedding—also via the ether—and it is said that when the pair kissed by wireless after the ceremony, something like 750,000 valves began osculating instead of oscillating. Anyway, it's a funny way to get married.

ET LIKE THIS?



e and a two-valve set, the latter being almost entirely home made. determination to make an efficient receiver at little cost and, as the certainly a set to be proud of.

A LADY AMATEUR.

With this single valve set Mrs. J. W. E. Notts, of 6, Frederick Avenue, Penkhull, Stoke-on-Trent, receives good signals from F.L., P O Z, G.F.A., G.B.L., M.U.U., and excellent telephony from many amateur stations.

Mr. C. L. Fry's set at Vale Lodge, Norman Road, Hove. Mr. Fry is a member of the Brighton Radio Society. He uses three valves—a rectifier, and two low-frequency amplifiers. Some of the stations he has heard include 2 K.F., 2 A.O., 2 L.R., 2 M.T., 2 L.O., and the high-power American stations.

This very, very neat six-valve set belongs to Mr. G. W. Priestly, of Elmfield, Harrow-on-the-Hill. Note the compactness of the apparatus, and the "basket" tuning coils on the extreme left of the instrument. With a set of this description a loud speaker can be used with good results, and the Daily Mail concerts from the Hague should be received quite clearly, especially now the power has been doubled.

STEP BY STEP IN WIRELESS.

No. 11.—"REACTANCE" or "REGENERATION."

THE writer proposes, in the following article, to show as simply as possible the manner in which the thermionic valve functions as a generator of continuous waves in a receiving set.

There are many amateurs to-day who, because of their ignorance in this respect, are, when working their receiving apparatus, a source of annoyance to many others also endeavouring to receive signals.

Some amateurs may read this with surprise. "I have only a receiving set," they will answer. "How can I possibly be interfering with other stations if I do not transmit?"

Perhaps the following will make the reason clear. Fig. 1 shows a simple single-valve circuit, such as is employed by many amateurs. A valve so connected will not cause any interference. When, however, a circuit is used as in Fig. 2, the operator possesses the fundamentals necessary for the generating of wave trains.

The manner in which oscillations set up in the grid circuit are conveyed to the plate of the valve has already been described in POPULAR WIRELESS.

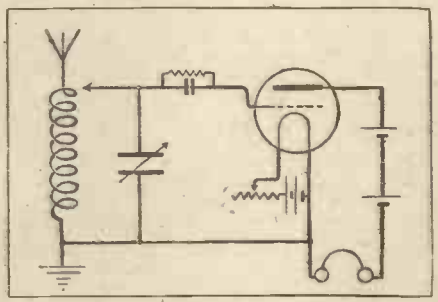


Fig. 1.

It is also known that the current so created in the plate circuit is of a proportionately large value compared with the grid oscillation. In other words, a very slight variation of grid potential will result in a comparatively large current increase in the plate or telephone circuit.

Such amplification is usually only attributed to the action of amplifying valves, the detector valve generally being considered as performing the function of a "rectifier" only.

This is not absolutely correct, as it is possible for a rectifying valve to also amplify received signals, although to a much smaller extent than a valve which was acting purely as an amplifier.

The Same Principle.

It will be seen from a study of Fig. 2 that if the current thus set up in the plate circuit is passed back to the grid, and therefore the aerial circuit, by means of a coupling coil, such an oscillating current will amplify or strengthen the signals being received.

In other words, the current in the plate circuit is made to repeat itself back through the grid circuit. It should be noted that the plate current reacting on to the grid through the coil coupling is oscillating at exactly the same frequency as the incoming signal.

If you consult a dictionary you will find the word "react," and the meaning given "to do over again," or something similar. Hence the term "reactance," which falls so glibly from the tongues of many who have not really troubled to find out what constitutes reactance in their receiving circuit.

There are many American text-books which describe such a circuit as a "regenerative circuit," implying that the current passed to the plate circuit by the action of the grid is regenerated again in the grid circuit by means of the coupled coils.

Whether you prefer to call it "Reactance" or "Regeneration," the underlying principle is the same.

Causing Interference.

The amount of assistance given to the oscillations in the grid or aerial circuit by the plate current will of course depend upon the positions of the coupling coils one to the other. The nearer they are brought together the stronger will be the effects obtained. If the two coils are brought sufficiently close together, a single train of oscillations received by the aerial and passed to the grid will so react through the plate circuit as to cause an oscillatory current of indefinite duration to flow.

This state of affairs is most undesirable in a receiving circuit, and the amateur who does not understand simply says when his set is in this condition that he is "using too much reactance." He is also probably radiating continuous waves which are capable of causing great interference to other amateurs who also wish to "listen in."

Incidentally, his own set, as a receiver, is not giving of its best. He is passing a continuous flow of oscillatory current through his telephones, and the arrival of subsequent signals will be greatly distorted, if they are audible at all.

It is therefore in our own interests, as well as that of others, that when employing a reactance coil we should take care to see that only sufficient coupling is used to enable the reception of signals at a good strength, without causing the receiving circuits of the set to oscillate.

If the reactance coil is coupled to the point where a "gurgling" noise is audible in the telephones, and then just loosened sufficiently to obviate this undesirable sound, the set will be adjusted to its most efficient and sensitive point, as far as the utilisation of reactance is concerned.

If signals can only be heard when the coils are so closely coupled as to produce the noise referred to above, you must look to other parts of your receiver for the trouble, such as the applied potential to the filament and plate circuits.

A valve can be too bright for a correct adjustment, without burning out—just as it can be too dull. Too much plate potential can also be applied, and these two factors will be found to play a very important part in the correct adjustment of any valve circuit.

I once heard an operator reprimanded and told that he "did not own the ether." Neither does any one of us, and I hope that the foregoing will help amateurs to help one another, and that complaints regarding interference from oscillating receiving sets will shortly cease.

The continuously oscillating valve circuit, however, is obviously all that could be desired for *knowingly* transmitting continuous waves. The type of valve used differs somewhat in construction from the receiving valve, although its component parts remain the same.

For a transmitting valve, also, greater high tension or plate voltage will be required. A transmitting set may have to work continuously for hours, and the plate voltage is therefore usually drawn from supply mains via a "choke" coil.

The purpose of this coil is to prevent any of the oscillatory current from getting back into the mains and creating undesirable effects in the power circuits. The energy of the oscillatory current is sustained by the plate voltage, and therefore the energy in the aerial circuit will depend for its strength upon the voltage applied to the plate of the valve.

"Hard" and "Soft" Valves.

The plate voltage cannot be increased indefinitely. Some types of transmitting valve can be given a greater plate voltage than others, but all have their limitations. Too great a plate potential will affect the vacuum inside the valve, causing it to "blueglow." When "ionisation," as this glow is called, becomes evident in either a receiving or transmitting valve, it is a sign that the valve is getting "soft."

In other words, the vacuum of a valve when it is very high gives the valve its name of "hard." When the vacuum is low, that is when the space surrounding the filament, grid, and plate inside the valve contains certain gas molecules in movement under the influence of the plate voltage, it is known as "soft." Hence the expression "hard" and "soft" valves.

It might be as well here to give a word of warning to amateurs who have a single-valve set constructed on the lines of the diagram shown in Fig. 1, and who, as a result of the undoubted advantages to be derived from using reactance, are contemplating the addition of a reaction coil to their set.

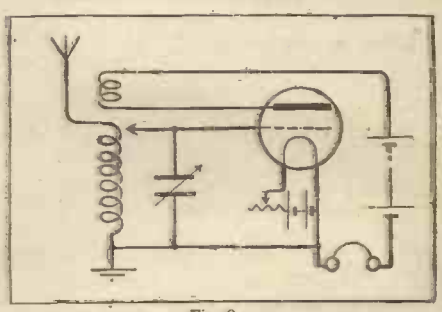


Fig. 2.

Do not be misled by the apparently simple manner—on paper—in which a reaction coil can be adapted to the ordinary single valve receiver. Consider the character of your tuning inductance, the number of turns, gauge of wire used, etc., and then obtain information as to the best reaction to use in conjunction with it.

You will probably be disappointed by the results obtained if you wind your reactance coil with the first wire that comes to hand. Make sure also that you have the right number of turns on the former.

It is very easy to sacrifice a lot in the way of efficiency, through omitting to consider these apparently trifling details.

It is also as well, after connecting a reactance coil to a receiver, to use the minimum of high tension voltage on the plate of the valve compatible with the proper functioning of the set.

If the plate voltage is too high, it may tend to place the set in a self-oscillatory condition.

H.T. batteries can be purchased with tappings and plug sockets so that the potential can easily be altered; but if your battery is sealed, care should be taken when taking tappings from the cells.

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 reports if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An asterisk denotes affiliation with the Wireless Society of London.

Newport and District Radio Association.

A WELL-ATTENDED meeting of the above association was held on Thursday, July 27th, at their headquarters (Memorial Institute, Queen's Hill, Newport).

Mr. E. Ogden, of Cardiff, gave a lecture on "Points to Beginners," and Mr. J. H. M. Wakefield presided. The lecturer advised all amateurs to get into the theory of wireless, which was an elementary essential. He indicated the various books and journals the amateur should read, but warned them not to make an obsession of it. Wireless enthusiasm in America had just been the grounds of a woman seeking a divorce from her husband (laughter). Commencing with the aerial, the lecturer proceeded to take each part of a simple set—illustrating with diagrams the functions, faults, and remedies, and in a simple order of sequence, eventually worked up to a complicated valve set.

The lecture was followed very closely by the members who at the end bombarded Mr. Ogden with questions. Enthusiasm ran very high, and the speaker invited to give a further address in the near future, he being promised a warmer time at questions. On the motion of Mr. W. B. Edwards, seconded by Mr. H. W. Winslow, Mr. Ogden was heartily thanked.

Replying to the vote of thanks, the lecturer congratulated the association upon the rapid strides made. The membership stands at 135.

Hon. Sec.: E. R. Brown, 92, Corporation Road, Newport, Mon.

The Ealing Wireless and Scientific Association.

The third meeting of the above society having been held at the Vestry Hall, Ranelagh Road, Ealing, W.5, the above society may now be considered safely launched upon a career of great usefulness in the immediate locality.

It has been decided, in view of the fact that so many of our members are beginners in the new science, to commence with a series of elementary lectures, in which branch of the club's work Mr. A. Snell is contributing a very valuable part, after some twenty years of wireless telegraphy in all its branches.

A cordial welcome is extended to all who care to accept membership with the society, and those who contemplate joining are urged to take advantage of these first series of lectures.

As soon as circumstances permit, an aerial will be erected, and practical work and demonstrations undertaken.

Hon. Sec.: Mr. Wm. Frank Clark, 52, Uxbridge Road, Ealing, W.5.

British Wireless Relay League.

Mr. Y. W. P. Evans, Hon. Secretary of the Manchester Wireless Society has obtained permission from the Postmaster-General to form a British Wireless Relay League, which a great many amateurs possessing transmitting licences have been looking forward to. Mr. Evans will be pleased to hear from those interested with a view to forming such a League as early as possible. With a good organisation and assuming that the forthcoming transmitting tests between the Manchester Wireless Society and the American amateurs are a success, there is a possibility of the scheme providing data for the advancement of amateur wireless in general. Letters should be addressed to Mr. Y. W. P. Evans, 2, Parkside Road, Princess Road, Manchester, meantime, a suitable agenda will be drawn up and distributed to those in favour of the League, not later than August 25th, 1922. Suggestions will be welcomed and any assistance will be appreciated.

The Pontypridd and District Wireless Society.

On Wednesday, July 26th, the society gave a public demonstration of wireless telegraphy at the local Y.M.C.A.

Fully 300 people were present, and a notice had to be displayed outside the building: "House full—no standing-room."

In introducing the speaker and demonstrator, Mr. D. V. Briggs, the chairman, said that the field of wireless held forth great possibilities, and he, for one, was hoping that he would be able to leave the meeting much wiser than he was at that moment.

The speaker (who is the secretary of the society, Mr. D. V. Briggs), then gave a very interesting and instructive lecture on "Practical Wireless Telegraphy." At 8.15 p.m. prompt all ears were strained to listen to a special message which was transmitted by Eiffel Tower by kind permission of General Ferrié and Commander Julien.

The set used for the demonstration was a 3-valve set made by the secretary himself, and with the addition of the society's loud speaker the message was heard with remarkable clearness all over the hall.

Hon. Secretary and Treasurer: D. V. Briggs, 5, Llwynmadoc St., Pontypridd.

New Clubs.

A new club called the Otley and District Wireless Society has been formed.

Hon. Sec.: N. Weston, 24, Guycroft Road, Otley.

* * *

The Sunderland and District Amateur Radio Society's name and address has been changed to Y.M.C.A. Radio Society, and all communications should be sent to Mr. H. Burnley, 8, Briery Vale Road, Ashbrook, Sunderland.

* * *

It is proposed to form a Wireless Club for Doncaster. Will all those interested and who live in the district please communicate as soon as possible with H. Slack, 35, Flowitt Street, Doncaster.

* * *

A Hereford and District Radio and Scientific Society has been formed at Hereford. The inaugural meeting was held on July 31st.

Hon. Sec.: c.o. Y.M.C.A., Hereford.

The Wireless and Experimental Association.*

The usual weekly meeting of the association was held at Central Hall, High Street, Peckham, on July 19th.

The question as to the purchase of a wavemetre was discussed, and carried forward to the annual general meeting to be dealt with then.

The functions of fixed and variable condensers then came up for discussion, and Mr. Hersey ably dealt with the subject, explaining the value and action of each type used in wireless practice.

After the interval, Mr. Hersey gave further particulars of his amplifying panel described a fortnight ago, and the wiring diagrams, including that of a 3-valve amplifier; also the methods of connecting up the panels. This occupied the remainder of a most enjoyable evening.

On Wednesday, July 26th, in the absence of the chairman during the first part of the evening, Major Webb was asked to occupy the chair.

The meeting was of a more or less informal character, and did not follow the usual routine. General questions were invited in order to gather matter for the agenda, and a number of very interesting points on wireless work noted up for subsequent elucidation.

New members benefited by an explanation of the elementary principles of wireless given by Mr. Joghlin. Commencing with the simplest crystal circuit, he went on to deal with the mysteries of condensers, fixed and otherwise.

The exact meaning of the word "potential" seemed to puzzle a good many members, and Mr. Voigt endeavoured to make the meaning clear. He stated that potential was merely another name for voltage.

On reassembling after the usual interval, the chairman announced that it was proposed to make a present of a set of the photographs taken at the recent public demonstration given

(Continued on next page.)

WIRELESS CLUB REPORTS.

(Continued from previous page.)

by the association to each member of the committee, which gift was much appreciated.

An interesting discussion on the multiple use of an aerial, and an explanation by Mr. Voigt of the use of a counterpoise earth, brought the evening's business to a close.

Intending members please note that the meetings of the association are held every Wednesday at 7.30 p.m., at the Central Hall, High Street, Peckham.

Newcastle and District Amateur Wireless Association.*

A general meeting of the above association was held at headquarters on Monday, July 24th.

Dr. Smallwood was present for the first time since the last general meeting, and gave thanks to the assembly for his election as president of the association. The president then called on Mr. Dixon, the chairman, to read out certain alterations to the existing rules. The amendments then proposed, seconded, and carried were:

1. That all candidates must be over 21 years of age, and to fulfil the conditions as stated in the P.M.G. licence.

2. All applicants to send in cards with applications and proposal forms to the committee, stating name and address, at least one week before the next committee meeting.

3. No visitor to be admitted more than three times per year, either by one member or more than one member.

Copies of the amended rules will be supplied to all members. It was then proposed and seconded that Mr. M. C. Jones should be appointed assistant secretary.

Mr. Dixon then gave his lecture upon wavelengths and wave-meters in general. After dealing with the advantages obtained by using a wave-meter, Mr. Dixon went on to describe the Park wave-meter. He explained in detail the method of using this instrument to tune the receiving set preparatory to receiving another transmitting station. He then went on to describe the honey-comb inductances contained in the meter, which, he stated, were effective to 8,000 metres, dealing at the same time with the combinations possible with parallel fixed condensers.

With the aid of diagrams, Mr. Dixon explained in a most interesting manner the method of calbrating external inductances by cutting out the internal inductances, and of calibrating condensers by comparison with the standard condenser contained in the wave-meter.

He then went on to deal with the static potentiometer method, describing with diagrams the method of tapping the inductances by connecting between two condensors in series across the inductance. He demonstrated how different capacity condensers affected the position of the tapping, and observed that he had obtained very satisfactory results on wavelengths as high as 25,000 metres.

After further explanation of the large capacity grid condenser and the low resistance grid leak to prevent howling, the method of using the meter as a separate heterodyne was put forward.

The members were then informed of the case of the local amateur who was using a valve receiving set without the P.M.G. licence. Owing to his instrument howling incessantly, he was located from the Berwick and Stockton-on-Tees direction finding stations, illustrating the remarkable amount of damage which a badly handled valve set could do.

Hon. Sec.: Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

Aberdare and District Wireless Society.

A meeting of wireless enthusiasts of the Aberdare district was held at Cwmaman Public Hall on Thursday, July 27th, when it was unanimously decided to form a society under the above name.

Mr. A. E. Hay (2 K.G.) of "Glendale," College Street, Aberdare, was elected to the chair, and under his able direction a very profitable evening was spent. A membership of 19 was registered, but in view of the fact that 18 to 20 prospective members were unable to attend, it was decided to hold an official inaugural meeting at a later date.

In the meantime, Mr. Hay, Mr. J. Owen Lewis, Mr. Parry, and Mr. Duffy are appointed to act as chairman, hon. secretary, and committee of two, pro. tem., until the first official meeting, which is to be held at Aberdare, on Thursday evening, August 10th, at 7 o'clock.

The society is extremely fortunate in having secured the active interest of Mr. Hay, who, as the founder of the South Wales Wireless Society, is well known as the pioneer of amateur wireless work in Wales, and who has achieved some records in amateur transmission.

The society has been offered the use of an excellent lecture hall in the main thoroughfare of Aberdare, and it is anticipated that the meeting, which will be held there on August 10th, will be a "bumper" one, as up to the time of writing upwards of 50 applications for membership are to hand, and all local electrical workers are keenly interested in the new society. The place of meeting will be announced locally about two weeks prior to the meeting.

A vote of thanks was tendered to Mr. Ray of the Cwmaman Public Hall for his kindness in having placed a room, free of charge, at the disposal of the meeting.

Candidates for membership can obtain all particulars from the Hon. Sec. (pro. tem.): J. Owen Lewis, "Alltyblacca," Danyderi Street, Godreaman, Aberdare.

Stoke-on-Trent Wireless and Experimental Society.*

At a meeting of the Stoke-on-Trent Wireless and Experimental Society on Thursday, July 27th, it was unanimously decided to change their headquarters to the New Y.M.C.A. Building in Marsh Street, Hanley. Since the Wireless Exhibition held under the auspices of the society a few months ago the membership has nearly trebled, and it has been felt for a long time that their present headquarters were far from satisfactory. The Y.M.C.A. have kindly offered us the use of their lecture room for our meetings and experiments, and the offer has been accepted.

It was also decided to send a delegate to the conference of the Midland Wireless Societies, to be held at the end of August, in order to arrange the interchange of lecturers.

Mr. W. J. Forster (member) then read a paper on "Electrical Measuring Instruments."

After first elucidating some of the more common electrical terms, the lecturer explained the working principles and construction of various types of ammeters, voltmeters, Watt-meters, and energy-metors as used in modern power station practice and by consumers. He clearly pointed out the difference between pressure measuring instruments, and some actual instruments were available, the inside of which the members were able to inspect for themselves, and note the difference.

In the subsequent discussion the importance of measuring instruments in wireless work was emphasised, for without them we should not know what the exact conditions were in our circuits—especially for transmitting stations—and progress would hardly have made such rapid strides without their use. It was also remarked that Mr. Forster had not touched upon galvanometers, and the hope was expressed that Mr. Forster would give us a lecture on what was perhaps the most widely used measuring instrument among wireless amateurs.

A vote of thanks, carried unanimously, brought the meeting to a close.

Guildford and District Wireless Society.

On Saturday, July 29th, the members of the above society gave some demonstrations in aid of Chiddingfold Hospital Saturday Fund. On the whole, the day proved successful. Mr. J. A. Love, of Guildford (2 HX.) very kindly gave three transmissions of music in the afternoon, and at 7 p.m. Hon. Sec. R. T. Bailey, 46 High Street, Guildford.

RADIOTORIAL

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

Now that the "Daily Mail" have arranged for broadcast concerts from the Hague, many hundreds of new readers are asking the important question: "How can I get a wireless set?"

For the benefit of all those who ask themselves this question, I am giving away a little booklet called: "Everybody's Wireless."

In it you will find the satisfactory solution to many problems connected with the purchase of a wireless set; the various types and costs of apparatus, etc.

This booklet will be sent free of any charge if you send a postcard, giving your name and address, to Gough House, Gough Square, London, E.C.4.

This week I am offering three prizes of £1 each to readers who send in the best postcard criticism of POPULAR WIRELESS WEEKLY. I do not want my readers to praise the paper indiscriminately. I want them to point out what they consider to be its weaknesses—for there is nothing perfect on this earth, although POPULAR WIRELESS WEEKLY aims at this desirable attainment.

Address your postcards to:

The Editor, POPULAR WIRELESS WEEKLY,
Fleetway House,
Farringdon Street,
London, E.C.4.

Postcards must reach me not later than August 27th.

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS WEEKLY, I have decided to reply individually by post. A weekly selection of questions will, however, be printed on this page, together with the answers, for the benefit of readers of POPULAR WIRELESS WEEKLY in general. Questions should be clearly and explicitly written and should be numbered and written on one side of the paper only.

All questions to be addressed to: POPULAR WIRELESS WEEKLY, Queries Dept., Room 131, The Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send necessary postage for reply

L. K. N. (Cork).—Is there any means whereby I can receive the C.W. messages sent by Carnarvon on my crystal set?

Yes. The simplest method is to place a buzzer in the receiving circuit so that the make and break of the armature makes and breaks the circuit.

* * *

"SPARKS" (Bradford).—There is a large generating station very near to my aerial. There is considerable disturbance caused, so I am told, by the leakage of the electricity from the power mains to earth. As it seems impossible to hear telephony with this interference, can you tell me how to cut it out?

You should arrange what is known as a capacity earth. This will be wires similar in length and number to those used in the aerial, carried in the same direction a few feet above the ground. It is necessary to use insulators and a lead-in exactly as in the case of the aerial. This will cut out the disturbance, to a great extent.

* * *

"RECRUIT" (Rhondda).—Is a condenser required for a crystal receiving set; if so, will layers of glass and tinfoil do?

Condensers are not essential, but a variable condenser across the inductance will permit finer or sharper tuning to be obtained, while a fixed condenser across the 'phones will improve the quality and tone of the received signals. For the latter the materials you mention would serve, although mica or paraffin-waxed paper would do better than glass for two reasons. In the first case not so many plates would be required, owing to the thinness of the dialectric; and, secondly, the glass is apt to fracture easily if handled carelessly.

Would one slider be sufficient on a tuning coil?

Yes; although two give a finer variation of inductance, and can be employed in auto-coupled circuits.

Are the aerials better drawn tight than left slack?

Yes, because of the increased height, apart from any other reason. Do not place too great a strain on the wire and fixtures, because some play is essential to allow for "tautening" due to temperature and other variations.

* * *

"GASEOUS" (Bridlington).—In a great number of diagrams there appears to be only one connection from the filament of the valve to the general circuit, and no battery is shown. I have a valve the filament of which has been broken; could this be used?

The low-tension accumulator and resistance are frequently omitted from diagrams for the sake of simplicity, the position so seldom being varied. The fundamental principle of the action of the valve centres round the heated filament from which electrons are ejected, so obviously a valve would not function without a heated filament.

* * *

"CURIOUS" (Exeter).—Why am I advised to place two pairs of telephones in series and not parallel, seeing that it will increase the resistance of the circuit?

Placed in parallel it is obvious that each telephone receiver will receive (it is taken for granted that they are of similar resistance) but one-half of the current flowing in the circuit, the current dividing. On the other hand, by placing them in series, the current flows through each in turn. The increased resistance will by no means reduce the current 50 per cent., because the high resistance of the crystal must be taken into consideration. Suppose, for instance, the resistance of each telephone receiver is 4,000 ohms. The detector, be it valve or crystal, may have a resistance of 50,000 ohms, therefore it can be seen that the addition to the circuit of 4,000 ohms will not have that effect; it would take a further 50,000 ohms to do so.

* * *

"ACCUMULATORS" (Durham).—I have a N.U.T. motor-cycle fitted with dynamo and 6-volt accumulator, which latter is always fully charged. Could I, by connecting this direct to a 4-volt accumulator for about a quarter of an hour every night whilst my bike is in the garage, keep the smaller accumulator charged without in any way damaging the larger?

No: by doing so you would merely short the two accumulators, because an accumulator has a very low internal resistance. It would be necessary to have a resistance or lamp in direct series, of suitable ohmage, to cut down the current to the charging rate of the smaller battery. A quarter of an hour would not be a sufficiently long period to efficiently charge, and it is doubtful if the larger accumulator itself could be kept sufficiently charged to fulfil that work.

* * *

A. J. B. (Rodley).—I am thinking of constructing a loose coupled receiver, size of primary 6 ins. by 6 $\frac{1}{16}$ ins. diameter, secondary 6 ins. by 5½ ins. Would this size be quite efficient?

Yes.

What size of wire and number of turns would be required?

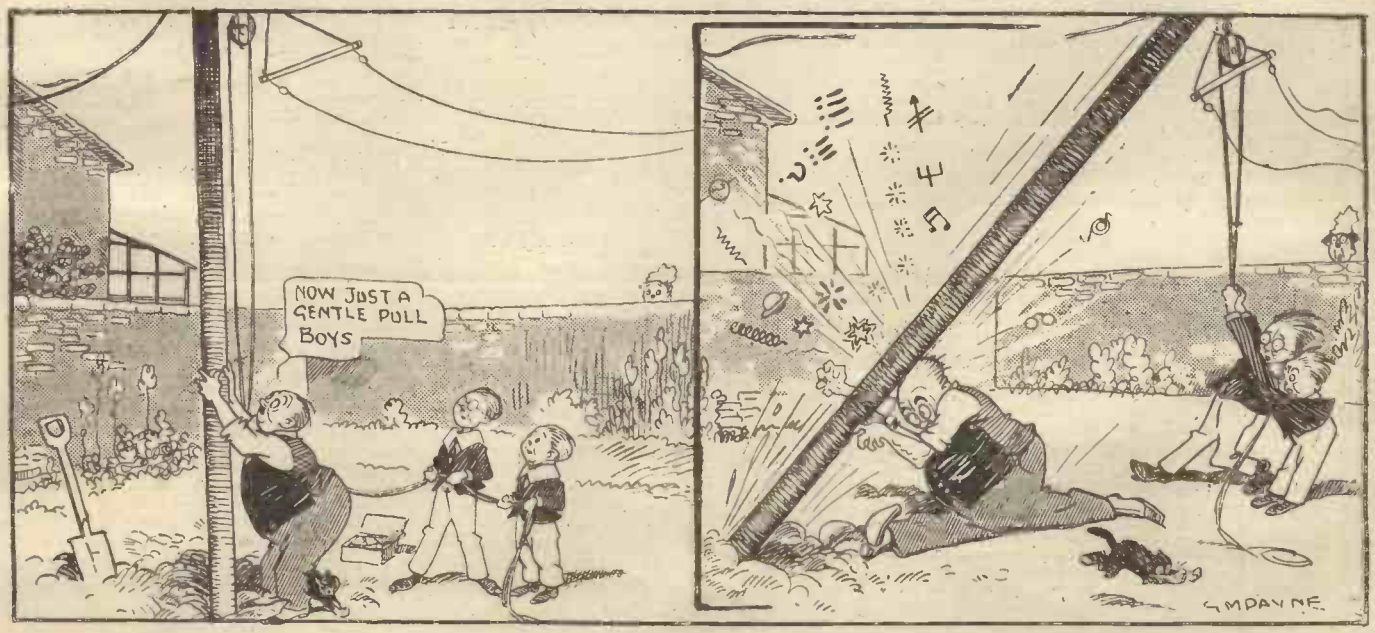
Primary, 200 turns of 22 S.W.G.; secondary, 300 turns of 28.

What size variable condensers should I use, and are they necessary?

With a loose coupled tuner, variable condensers are more or less essential. Primary ·0005 mfds, secondary ·001 mfds.

(*Continued on page* 206.)

FATHER VERSUS GRAVITY.



RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 204.*)

I intend to use 3 or 4 valves; what would be the range of such a set?

For telephony, 300 miles or so for medium powered stations. You should hear the Hague with an efficient outdoor aerial. With a regenerative circuit, using a reaction coil, you should hear the American coastal C.W. stations.

* * *

"PHONOGRAM" (Euston).—With the "35/-" receiver mentioned in No. 1, what would be the greatest distance I could receive messages from?

From the more powerful spark stations, using a good outdoor aerial, some hundreds of miles. It is quite impossible to state a definite maximum, because so many factors will contribute to increase or decrease the range of reception. At night, extraordinary ranges have been recorded for quite simple crystal detector sets. Numerous readers report excellent signals have been received on the set in question from Norddeich, in Germany, at night.

Do I require a licence for the above receiver?

Yes, that is essential.

* * *

E. H. S. (Loughton).—Is electric light flex suitable for lead in and earth connection?

This can be used, although it is as well to remember that the insulation can be reckoned as practically nil for the high frequency currents received, and, therefore, in the case of the aerial lead-in, it should be treated as bare wire, and highly insulated at the point of entry to the building, and at any point where it might be absolutely necessary for it to come into contact with a wall. The earth lead does not require such careful treatment.

What stations should I be able to hear with a crystal set and a 50 foot twin aerial?

You should hear telephony from Marconi House, with careful crystal adjustment and fine tuning. If your set will tune to 2,600 metres, you should have no difficulty in receiving the Paris time signals from Eiffel Tower.

* * *

"PUZZLED" (Birmingham).—My aerial is near 50 telegraph wires, being 30 ft. away in one place and 50 ft. in another. I am using a single valve set. Will these wires have any effect?

If the aerial does not run parallel to these wires, there will be little or no interference, although it is probable that there will be some slight curtailment of your range of reception owing to absorption.

* * *

E. A. B. (Carshalton).—What wave-length can I get with a coil of 4 in. diameter wound with 160 turns of 30 S.W.G. with a 60 ft. twin aerial?

1,300 metres.

Would I get satisfactory results with my aerial 30 ft. high at one end and 16 ft. the other, the lower end being the leading-in end?

Results should be fairly good, although it would be advantageous to have the down lead at the higher end, and to increase the height of the lower.

* * *

"AMATEUR" (Ripley).—Would an aerial 50 ft. long and 23 ft. high at one end and 22 the other do for a single valve receiver?

Yes; but it cannot be too high within the limits allowed by the P.M.G., and every inch of increased height will add to its efficiency.

To what wave-length could I tune, using an inductance 3 ins. diameter with half-pound of 22 S.W.G. enamelled wire, and using this aerial?

1,300 metres.

Will bell wire do for making connections?

Yes, quite well.

Would 60 turns of the wire similar to the enclosed specimen, on an inch diameter former do for a filament resistance?

This wire is 25 S.W.G. copper, and such a coil would have a resistance of but .30 of an ohm, whereas a filament resistance should have a resistance of at least 8 ohms. The best wire to use for this purpose is "Eureka" resistance wire. This can be obtained from any of the wireless firms.

* * *

"AMATEUR" (Longton).—Must I obtain a licence before I erect an aerial, and if so from whom?

Yes; a licence must be obtained beforehand. Apply to the Secretary, G.P.O., London.

How much will the licence cost?

10s. per annum.

Must a lead-in from a twin aerial be exactly in the middle?

Not at all. For the more common inverted "L" type of aerial, the down lead is taken from one end, preferably the higher end. By having the down lead in the centre, the aerial comes into the category of "T" types aerials. For the limited length allowed by the P.M.G., the inverted "L" type is preferable for amateur stations.

Will a telephone wire 3 ft. above the aerial interfere with receiving?

If the wire crosses at right angles, there will not be any great interference, although it would be as well to erect the aerial so that the telephone wire is some greater distance away than that. Endeavour to do this without losing height.

Is it necessary to have more than one insulator at each end of the aerial?

It is not essential, but the aerial cannot be too highly insulated. Even with two insulators there would still be leakage. Remember that the received current is more than an ordinary small flow of electricity, and can be almost regarded as a static charge.

N. E. P. (Warminster).—I have a small loose coupler. The inner tube is 1⅝ ins. by 8 ins., and outer 2⅝ ins. by 8 ins., wound with gauge 20 enamelled wire. My aerial is 50 ft. long. What is my wave-length?

700 metres. You will obtain but poor results with such coils. In the first case, variable condensers across each are more or less essential. The diameters should be larger, say 5" and 4" at least, and the secondary should be wound with a finer gauge wire, such as 28 S.W.G.

Are there any broadcasting stations I can receive?

Not unless you employ valves.

Is there any large station I can receive?

No, not with such a limited wave-length.

* * *

"SPARK" (Watford).—Would a coil 3 ins. in diameter, wound with 100 turns of 24 S.W.G., be sufficient for a crystal set?

This would give you but a limited wave-length. Increase the diameter to 5", and the number of turns to 250.

Could I receive messages with an aerial 100 ft. twin, or a 60 ft. single?

The 100-feet twin would not be allowed by the P.M.G. Make it 100 feet single, obtaining as much height as possible, and you should have a very efficient aerial.

* * *

L. E. L. (Cornwall).—With a one valve set shall I be able to hear concerts from Holland and New York plainly?

No, such a set under the best of conditions will receive telephony from a distance of only 50-80 miles.

If one is limited to length of wire used for the aerial, what will be best—a single or double?

The P.M.G. is at present limiting amateur aerials to 100 feet in height and length. It is advisable to make the best of this with a single aerial.

(*Continued on page 208.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from page 206.)

"CAPACITY" (Glasgow).—Can you give me a formula for calculating the capacities of variable and blocking condensers ?

The following formula will be found to be quite accurate for all types of flat vane or plate condensers :

$$K = \frac{Ak}{11310000 \times d} \text{ mfds.}$$

A.—Total area of working sides of plates connected to one terminal in square cms. In the case of variable condensers, that will be the area of overlap of vanes.

k.—Specific Inductive Capacity. Air—I, Paraffin waxed paper—2, Mica—5.

d.—Thickness of dialectic in cms. Waxed paper is generally about ·002. In the case of variable condensers, this will be the distance separating the fixed from moving plates.

* * *

H. D. (Sheffield).—Which is the nearest broadcasting station to Sheffield, and will a crystal set do ?

Chelmsford, and you would require two valves at least.

* * *

"DETECTOR" (Forest Gate) submits a diagram for criticism.

The connections are not quite correct. The crystal and telephone receivers should be placed across the moving arm of the inductance and the aerial lead. The earth lead will go direct to the moving arm.

* * *

L. V. B. (Chelsea).—Will a banana crate, 50 ft. up, receive messages on a crystal set ? If so, how can I erect this aerial ?

We presume that the banana crate will have wire wound upon it. An aerial arranged in that manner would have but the efficiency of the down lead for reception. It will be far better to confine the aerial to the orthodox twin or single wire of the horizontal type.

Can I use two inductance tubes 8 ins. by 3½ ins. and 7 ins. by 2½ ins., instead of one 12 ins. by 4 ins. ? If so, how can I place them in series ?

The one larger inductance would be more efficient. To place two inductances in series, merely join one end of the wire from each together. See that the turns of both coils wind in the same direction.

* * *

C. H. C. (Leeds).—With a frame aerial shall I require a crystal or valve set to hear the nearest broadcasting station ?

Chelmsford or Marconi House being your nearest, you would require 4 or 5 valves in these circumstances.

D. L. E. (London).—What wave-length would I have with an inductance 4 in. in diameter, wound with 300 turns of 24 S.W.G., using a standard aerial ?

1,400 metres.

Does the direction in which the aerial runs affect reception ?

Yes, the leading in end will point to the direction from which loudest signals will be received.

At a distance of about 30 yards, and running at right angles to my aerial, are 28 telephone wires. Will these seriously affect a 2 valve L.F. set ?

No, in these circumstances there will be little or no interference.

* * *

B. O. B. (London).—What wave-length could be using an inductance 6 inches long, and 6 inches in diameter, wound with 28 S. W. G.?

6,500 metres on a P. M. G. aerial.

What phones should I purchase ?

For a crystal set, 4,000 ohms is a useful resistance.

* * *

F. H. (Mitcham).—Will I hear good telephony from Croydon, using 120 ohm phones ?

It is very improbable. High resistance telephone receivers are essential, unless a telephone transformer is used.

* * *

"NOTT-OUT" (Nottingham), asks various questions with regard to a loose coupled tuner he has constructed.

You will not obtain any results, unless you have a variable condenser across the secondary at least. With such a set, two variable condensers should be used, one of ·0005 mfds. capacity across the primary coil, and another of ·001 mfds. across the secondary.

* * *

"INDUCTA" (Mellor).—Can you tell me the wave-length of a 5½ in. diameter inductance coil wound with 298 turns of No. 22 S. W. G., using the standard 100 ft. aerial ? Also of a coil 4 in. diameter wound with 450 turns of No. 24, using a similar aerial ?

1,900 and 2,350 metres.

* * *

J. N. (Croydon).—A set of parts are advertised for constructing a receiving set for £1 1s. Will that include the telephones ?

No.

* * *

E. C. O. (Portsmouth).—What wave-length can be obtained by using a coil 2 in. diameter by 9 in. long, wound with 22 S. W. G.?

About 700 metres.

Using an aerial 80 feet long, and 35 ft. high, can I receive telephony from Writtle, using a single valve set ?

No.

WIRELESS PHOTOS.

The Editor will pay 10/6 for every photo used in POPULAR WIRELESS sent in by amateurs. If the photo is used as a cover plate, £2 2s. will be paid.

O. E. R. (Merio).—Is it feasible to use a seven cored cable as formerly used for submarine mining cable, for a subterranean aerial laid horizontally in a disused slate quarry level, 2,000 feet below sea-level and driven through a spur of Silurian slate rock, average top rock over it 100 feet high. ¼ to ½ a mile long. The idea being to pick up signals from South Australia through the substance of the earth, thus saving distance by going direct, and not round the circumference of the globe. Would the absorption of etherial waves through the solid earth necessitate a larger and more costly initial transmitting energy in Australia ?

Yes, and moreover, there is not the slightest doubt that the waves would eventually follow the curvature of the earth, much energy being lost by absorption and dissipation caused by mineral substances.

* * *

W. H. A. (Heywood).—How much 30 gauge wire will it take to wind a coil 3 x 11 ins., and how much will it cost ?

A quarter of a pound. About 3s. 6d.

* * *

"AMATEUR" (Gt. Yarmouth).—How do I connect a tuning inductance to a frame aerial ?

Generally speaking, a frame aerial must be constructed for a certain limited range of wave-lengths, the tuning being obtained by placing a variable condenser across the ends of the wire where they leave the frame. However, a small loading inductance coil may be employed to slightly increase the wave-length range. This should be placed in series with the frame and the condenser, the detector circuit being connected across the condenser.

* * *

D. H. (Croydon).—I notice that in a previous issue you state that one detector is better than two. Can I, therefore, take it that one valve is more efficient than two ?

No. When two valves are used one acts as a detector and amplifier, but the function of the second will be to amplify but not to detect.

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REGISTERED AT THE G.P.O. AS A NEWSPAPER.

No. 12. HOW WIRELESS MAY DEVELOP: Special Article in this Issue

POPULAR WIRELESS

3d.

No. 12. Vol. 1.
Aug. 19, 1922.

Weekly

EVERYBODY'S READING "EVERYBODY'S WIRELESS"

SEND FOR FREE BOOKLET AT ONCE

An Article on
HOW WIRELESS MAY DEVELOP
By
P. J. Risdon, F.R.S.A.
appears in this issue.

Popular Wireless

TOPICAL NEWS AND NOTES.

New Series of Articles on WIRELESS CONTROL begin in this issue.

A Newport Innovation.

THE Coliseum Cinema, Newport, has installed a fully-equipped wireless set into the popular hall.

* * *

Wireless on Trawlers.

THE question of the advantage and cost of wireless on trawlers has apparently been one of the subjects discussed on Lowestoft Trawl Market during the week, according to a correspondent. Opinions vary as to its expediency, but the prevailing idea is that the present-day trade conditions do not justify the outlay, for if installed an operator would have to be shipped.

* * *

Senatore Marconi.

SENATORE MARCONI has returned to London from a voyage of wireless discovery to America. He had an enthusiastic reception from the wireless men in America, whom he found to be remarkably keen, and he brings home the John Fritz medal, which was conferred on him by the unanimous vote of the leading engineering societies of the United States, "in recognition of his distinguished services in radio communication." The medal is conferred very rarely; the only other holder in this country is Sir Robert Hadfield. Lord Kelvin, Edison, and Wilbur Wright were among the honoured recipients in the past.

* * *

Empire Wireless.

MR. ROBERT DONALD, Chairman of the Council of the Empire Press Union, who presided at the annuel meeting of the Union recently, described the recent statement of a new policy by the Postmaster-General as somewhat of a surprise. Under the new policy the long-distance stations would be erected first, and the secondary stations afterwards. While the British Government had announced that it would erect a station in India for direct communication with England, that policy had not yet been sanctioned by the Indian Parliament. Mr. Hughes, the Prime Minister of Australia, had made good his threat to act independently. He lost all patience with the British Post Office, and the Commonwealth Government had entered into a contract with the Australian Marconi Company to establish direct communication with England, the Australian Government keeping control in its own hands.

The Government of Canada had so far not informed the British Government what its Empire Policy would be, but it had granted a contract to a Canadian Company—a Marconi affiliation—for erecting stations at Montreal and Vancouver. The Union Government of South Africa had decided in favour of private enterprise, but had not yet entered into a contract. They were thus threatened with two or three systems of wireless in the Empire, not one of which would be a complete chain in itself.

Viscount Burnham was re-elected President of the Union, and Viscount Northcliffe Treasurer. Sympathetic references to Lord Northcliffe's illness were made by the Chairman and other speakers.

* * *

At Long Last.

MR. KELLAWAY, the Postmaster-General, stated in the House of Commons the other day that there was at last a prospect of the firms interested in wireless broadcasting coming to an agreement regarding a company or companies—he hoped there would be only one—to run the services. He hoped agreement would be reached within a fortnight.

Profits, Mr. Kellaway added, would be limited to 7½ per cent., and he had great difficulty in persuading the firms to agree to such a "drastic limitation."

A Well-known Amateur.

ONE of the best-known research workers in the North is Mr. G. W. G. Benzie, of Peterculter, Aberdeenshire, who assisted Mr. William Le Queux in his long-distance telephone experiments between Guildford and Aberdeen.

He uses five valves for reception, and has heard clearly the telephony of 2 A W, 2 I Q, 2 J Z, 2 F Q, and 2 K D, and the Morse of 2 L W, 2 O M, 2 C V, 2 S Z, 2 D M, 2 O N, and also 8 A B (Nice).

These stations will probably be interested 2 A Z, (Mr. Le Queux's station) is, up to the present time, the furthest telephony he has heard on low power—namely six hundred miles.

* * *

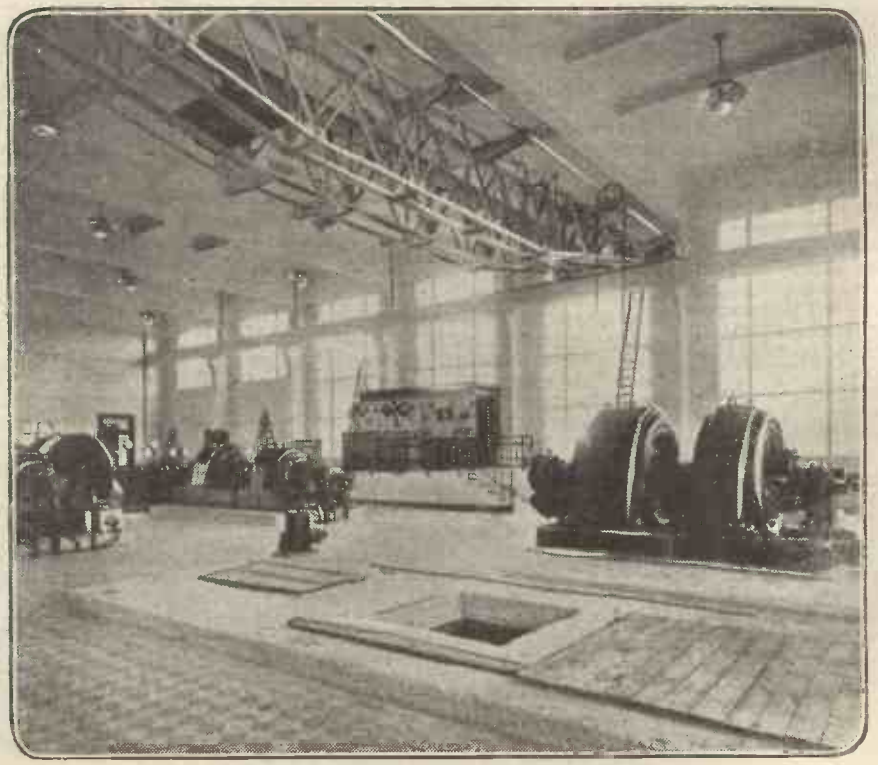
The Radio Exhibition.

THE forthcoming Radio Exhibition will afford facilities to manufacturers to bring their goods before radio enthusiasts, who will be able to compare their manufactures with others, and also before the general public just at the moment when they have seen the interesting side of wireless, and are potential buyers of apparatus.

The Central Hall, Westminster, is most advantageously placed to secure the attendance of buyers and the public. It is opposite the Abbey, and is situated a few minutes' walk from Westminster Station on the Underground, and served by a large number of motor-bus routes.

The organisers of the exhibition have organised exhibitions for over forty years, and manufacturers may feel confident that the exhibition is already an assured success. No effort will be spared in the matter of advertising, and in the arranging of meetings, conferences, and demonstrations, which will add to the interest of the event. The wireless societies throughout the country are expected to take a very keen interest, and although it is impossible at the moment to give any sort of programme, there is every reason to believe that their demonstrations, etc., and influence will bring good business to the exhibitors.

Spaces for stands in the Central Hall are being rapidly booked up, and to secure best positions advertisers would be well advised to get in touch with the



The Power Room at the Saint-Assise Station, Paris.

NEWS AND NOTES.

(Continued.)

organisers without delay—Messrs. Dale, Reynolds & Co., Ltd., at No. 46, Cannon Street, London, E.C.4, who will be pleased to send along prospectus and plan.

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New French Station.

ACCORDING to "The Times," direct communication between France and New York has been established from the great wireless station at Sainte-Assise. The first message despatched was from M. Millerand, the President of the French Republic, who sent cordial greetings to Mr. Harding, the President of the United States.

Lord Hambleton broadcasting a speech at Marconi House on behalf of the hospitals.

In making communication each day easier and more rapid between the United States and France (M. Millerand said) science will increase the friendship of the two peoples, and enable them to co-operate more efficaciously than ever for the happiness of humanity. No one will rejoice more than I at such a result.

A few minutes after the message had been despatched, New York announced that it had been received at the rate of eighty words a minute.

* * *

Too Bad.

UNTIL the arrangements for wireless broadcasting have been completed with the various wireless manufacturing firms, the Postmaster-General has decided not to issue any licences for the reception of wireless matter in any public place of entertainment.

This means that the manager of a theatre, kinema, restaurant, or hotel, will not be able to fix up a loud speaker.

It is stated that it is unlikely that the rule will be relaxed until the position of the broadcasting firms has been definitely established.

This present restriction, of course, does not affect the issue of wireless receiving licences to private individuals.

* * *

"Radio-France."

THE new wireless station at Sainte-Assise is the most powerful in the world, and it is claimed that the system used is several years in advance of that of America or Germany. The station is situated near Melun, not far from the Forest of Fontainebleau, and has been named "Radio-France." The wires are supported on seven pylons 820 ft. high. The Sainte-Assise installation is 50 per cent. more powerful than that of Bordeaux, hitherto the biggest in the world. Three new sets of apparatus are shortly to be erected at the Sainte-Assise station, which will then be four times more powerful than the Bordeaux station, and thirty-five times more powerful than the Eiffel Tower station.

From Sainte-Assise five or six messages to other parts of Europe and to other continents can be despatched simultaneously, at an average rate of one hundred words per minute per message. Thus it is computed that Sainte-Assise can send thirty-six thousand words an hour, or nearly one million words a day.

* * *

Broadcasting Problems Settled.

AT a meeting held at Marconi House last Friday of manufacturers of wireless apparatus, the formation of a single broadcasting company was formally approved.

The memoranda and articles of association are in course of preparation and the company will shortly be registered.

Broadcasting programmes will be put in operation in the London area as soon as the permission of the Postmaster-General has been obtained, and in all other areas as expeditiously as possible.

* * *

Observatory Wireless.

AN example of the increased usefulness of wireless telegraphy is furnished by the proposal to equip the observatory of the Pic du Midi, in the Pyrenees, with a wireless installation. Recently the terrace forming the foundation of the observatory buildings suddenly gave way, and there was no means of asking the outside world for immediate aid.

Wireless telegraphy also will form this year a subject of competition at the annual Concours Lépine, which was founded by the late Prefect of the Seine in 1901, and at which competitions of industrial inventions are held. There will be exhibitions on the Champ de Mars from August 25th to October 2nd of all kinds of wireless receiving apparatus and of processes of manufacture, and lectures on wireless telegraphy will be given by experts.

* * *

French Amateurs.

THE departmental committee appointed by the French Under-Secretary of the Post Office to inquire into the regulation of wireless installations have drawn up their report, says "The Times." It is expected that rules based on their recommendations will shortly be issued.

The broad principle followed is that receiving apparatus may be freely used after formal registration, while sending apparatus can only be installed by private individuals on the authorisation of the Under-Secretary of State acting on the advice of a mixed committee of officials and experts. Sending installations will be divided into five classes—private stations, stations for financial news, scientific stations, mobile stations (*e.g.*, of ships), and amateurs' installations. There will be a limit of wave-length.

Major Phillips.

* * *

Wireless Control.

THE new series of articles by Major Raymond Phillips, I.O.M. (whose photo you see above), will attract a good deal of attention.

To control a model by wireless is fascinating in the extreme.

Major Phillips mystified music-hall audiences 12 years ago with his wireless-controlled airship, and his articles will give full details as to how this is done.

Major Phillips is a late member of the Inter-Allied Commission of Control, and has done fine work in the Army in connection with wireless work.

ARIEL.

Broadcasting Programmes

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

THE "Daily Mail" concerts have vastly improved of late, and reports from all over the country indicate the general satisfaction felt by listeners-in.

The power has been considerably increased, and a new aerial system devised.

The only flaw we have to find is with the announcer at the station. His voice is not suited for broadcasting, and many of his speeches are unintelligible.

However, the main thing is that the musical items are excellent—the modulation being especially fine.

It is stated that manufacturers of wireless apparatus intended for the reception of broadcasted music, etc., must limit the wave-length range from between 300 to 500 metres, and that if valves are used, they must be arranged in such a way as to prevent the aerial from being energised. Although this seems a little drastic, and may cause manufacturers considerable trouble, it is only fair that the novice should not be allowed to indiscriminately interfere with his more experienced brethren.

Further, many people will find this a blessing because they will not be confused with many adjustments.

Experienced amateurs, of course, may use what apparatus they like.

It is taken for granted that they know better than to let their valves oscillate to the confusion of other listeners-in.

Laymen are advised to make quite clear, when applying for a licence, exactly what they want it for—the concerts or for experimental purposes.

TELEPHONY TRANSMISSIONS.

Station.	Call Letters.	Wave-length.	Remarks.
Croydon	.. GED ..	900 metres ..	Throughout day to aeroplanes.
Marconi House, London	.. 2LO ..	360 metres ..	Between 5 p.m. and 6 p.m. (not regular).
Writtle, England ..	.. 2MT ..	400 metres ..	Tuesdays, 8 p.m. (B.S.T.).
Paris	.. FL ..	2,600 metres ..	Daily, 5 p.m. (B.S.T.).
Königswusterhausen	.. LP ..	2,500 metres ..	Daily, 7 and 10.30 a.m. (G.M.T.).
The Hague	.. PCGG ..	1,085 metres ..	Sundays and Thursdays 8 to 9 p.m. (B.S.T.).

WIRELESS CONTROL

By Major Raymond Phillips, I.O.M., late Member of the Inter-Allied Commission of Control.

PART I.

THE control and operation of mechanism by means of wireless waves open up a field with vast possibilities, and a remunerative harvest for the successful experimenter.

Tele-mechanical control has engaged the attention of scientists for many years, and experiments have from time to time been made in connection with the wireless control of torpedoes, boats, etc.

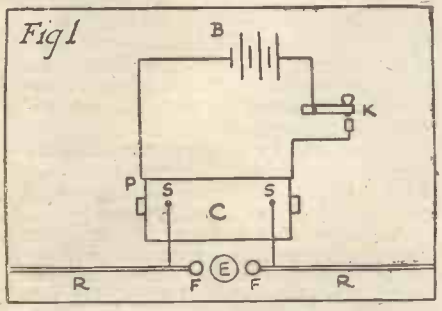
Many have no doubt seen, or heard, of the well-known wireless-controlled airship which I invented, and first publicly exhibited at the Hippodrome and Coliseum, London, twelve years ago; also the playing of three pianos, which were "wirelessly" controlled simultaneously with the manœuvring of my airship.

The magnitude of the latter fact created much comment, and the late Professor Silvanus P. Thompson, F.R.S., examined my apparatus, and subsequently issued a certificate to the effect that it was a genuine example of wireless control.

No Licence Required.

These demonstrations naturally caused a sensation at the time, when wireless telegraphy and aviation were practically in their infancy.

My recent experiments include the construction of a wireless-controlled quick-firing gun, and an aerial mail fitted with a syren, thus showing that the scope for experimenters is practically unlimited.



It is my intention to write a series of articles giving details of experimental apparatus suitable for wireless control, and based upon my own practical experience with such work. The Postmaster-General raises no objection to such experiments, and a licence is not required, provided the apparatus involved conforms to certain requirements, and is not intended for connection to an aerial, *i.e.*, those used for wireless telegraphy and telephony, and earth.

It is, however, always advisable before commencing any experiments with wireless control, to first communicate with the Secretary (Wireless Section), G.P.O., London, E.C., giving details of what you propose to do, and at the same time asking if there is any objection to such proposals.

No Tuning.

For the reasons already set forth, I shall only give details of experimental apparatus with a range of not more than 50 yards when used in conjunction with a modified Hertz spark coil for transmitting purposes.

It may probably surprise many readers when I state that I never fitted tuning devices to any of my tele-mechanical controlled apparatus used for public demonstrations. I have often been asked to explain how tuning was effected, but it will be understood that when controlling by wireless the playing of three pianos, or manœuvring an airship at such short distances as exist in theatres, or public buildings, tuning would be impracticable, if not impossible.

Many years ago I designed a special coherer, which, for my experiments, has always proved more reliable in its action than the glass tube type. The latter, apart from its liability to breakage during de-cohering, generally needs very fine adjustment in conjunction with a potentiometer, and it will be realised that experimental apparatus used for public demonstrations must not only function perfectly, but also without difficulty, especially in the case of a wireless-controlled airship, where it would not be possible to effect adjustments once such a craft is in flight.

Good Apparatus Needed.

In my system of direct and ordinary selective control, some of the circuits are complicated. A reliable coherer is therefore imperative. A good relay is equally important.

Those who contemplate experimenting with the wireless control of mechanism will be well advised to use only the best appliances. Do not be led away by offers of cheap apparatus and then expect results which can never be justified.

I have many times examined so-called "Laboratory Receiving Sets" which would not work satisfactorily after every conceivable type of adjustment had been made. It can be better imagined than described what the effect of such apparatus would be in the hands of an inexperienced enthusiast.

Tele-mechanical control should not be confused with wireless telegraphy, and telephony. The latter science involves the use of extremely sensitive and delicate devices, which would speedily be put out of action if applied to relay control of mechanism subjected to vibration. These, and other difficulties, will, no doubt, be overcome in time.

A Simple Experiment.

Jamming, *i.e.*, interference from other transmitting stations, is, of course, a contingency always to be reckoned with. The present restrictions in regard to wireless transmission give one some idea of the extent to which the evil exists. Most people, therefore, so far as wireless telegraphy and telephony is concerned, have to be content with indulging in the fascinating habit of listening in.

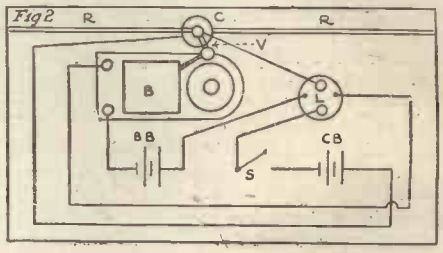
For beginners, one of the simplest but, perhaps, most popular experiments with tele-mechanical control, is wireless control of an ordinary electric bell fitted with a 4-inch or 6-inch gong. All the apparatus necessary for such an experiment can be neatly mounted upon suitable base boards, and when properly constructed the set will be found useful in a house or office where it is desired to communicate between rooms, thus avoiding the necessity of running insulated wires, as would be the case in connection with the installation of an electric bell in the ordinary way.

The transmitting and receiving circuits for such a simple method of bell control could be arranged as shown in Figs. 1 and 2.

The transmitter, as shown in Fig. 1, consists of an induction coil C with primary and secondary terminals marked PP and SS (the trembler and other circuits of the coil are purposely omitted for the sake of simplicity), an ordinary telegraph key K, a large brass ball E, and two rods RR (which represent an aerial), at the ends of which are brass balls FF.

For satisfactory experiments over short distances it is advisable to construct the transmitter with an induction coil which (when its primary circuit is connected to a battery with an E.M.F. of 4 volts) can produce a spark one inch long between two small metallic balls attached to the end of its secondary circuit.

The two rods RR should be mounted upon insulated supports, and should preferably be of aluminium or brass tube, 30 inches long by 3-16th inch diameter. The brass balls FF and E should be highly polished, the former being ½ inch diameter. The latter 1 inch in diameter should also be mounted upon an insulated support. Arrangements should also be made for the rods RR to slide in their supports so that the distance (normally ⅛ inch) between the ball E and balls FF may be adjustable.



It will be observed that an inductance is not included in the transmitter or receiver circuit for reasons already explained.

The receiver, as shown in Fig. 2, consists of a large electric bell B, a relay L, coherer and support C, switch S, coherer battery CB, bell battery BB, and two rods RR.

For this experiment it is advisable to use a good quality electric bell fitted with a 4-inch or 6-inch gong. The hammer of the bell should be drilled and tapped, and a circular piece of vulcanised fibre, ½ inch long by 3-16th inch diameter fitted to same as marked "V" in Fig. 2.

Small Power Needed.

It will be observed that the object of fitting the circular piece of fibre is to enable the bell hammer on its return stroke to strike the coherer C, thus effecting de-cohering. The bell may of course, be either "single stroke" or "trembling" type, the latter, perhaps, making the more "showy" demonstration.

Any suitable coherer and relay may be tried for this experiment, but in subsequent articles I purpose giving details of the coherer and relay which have been used with such success in connection with my public demonstrations.

The switch S may be of any simple type. The two rods RR should be the same length as those fitted to the transmitter, and preferably of the same type.

Any suitable dry battery may be used in connection with the coherer and bell circuits of the receiver.

An ordinary 3½ volt pocket-lamp battery was sufficient to work a wireless-controlled electric bell which I constructed many years ago.

Having now shown what a simple matter it is to construct the apparatus illustrated in Figs. 1 and 2, I shall, in subsequent articles, give details of more complicated circuits for "direct" wireless control of mechanism without the necessity of selecting in sequence.

(To be continued.)

HOW WIRELESS MAY DEVELOP.

By P. J. RISDON, F.R.S.A.

AS generally happens when some revolutionary invention comes to the fore, speculation is being indulged in as to future developments of wireless and their effect upon other things, in consequence of the tremendous, world-wide, popular enthusiasm over wireless. In this article we propose to deal more especially with the possible effect of present and future developments upon members of the theatrical profession and upon newspapers.

It is stated that the number of amateur receiving sets already sold in the United States alone runs well into seven figures, and, allowing a set for, say, only one family in every four in Great Britain, the number of sets in use here before long may easily amount to two and a half million. That probably means that the enjoyment of listening to concerts, plays, speeches, and broadcast news by means of amateur receiving sets will be extended to nearly half the population. In addition, in time to come there will no doubt be halls and theatres set apart for the accommodation of those desiring to listen to wireless music and other things from all parts of the world.

Effects of Progress.

What effect will all this have upon members of the theatrical and musical professions, and upon newspaper proprietors ?

There was a time when expensive paintings by artists were the only means of handing down to posterity the features of a person or the impression of a beautiful landscape or seascape. Then came the camera and the three-colour process, with the consequence that we now number artists by tens where we should presumably otherwise number them by the thousand. Yet photography did not kill the *artist*, and a beneficial result has probably been to place the painter's art on a much higher plane, for anyone in his right senses would prefer an excellent photograph, coloured or uncoloured, to an inferior production by a second-rate artist. Another and broader aspect is that photography and the three-colour process have brought beautiful pictures before almost countless millions of persons who would otherwise have been denied enjoyment of them.

Arousing Scientific Interest.

A second illustration is that of music. How many of us, nowadays, would care to be dependent upon the ability of a comparatively few individuals who happen to be accomplished in the playing of a piano, fiddle, or harp ? Yet it would be untrue to say that the mechanical piano-player and gramophone have killed the taste for original music and the real artist's touch. What it has done, as in the case of the painter, is to eliminate from the ranks of true musicians and singers a vast proportion of incompetents. A well-handled piano-player is charming compared with the monotonous performance of the average amateur pianist, though not to be compared with that of the true musician.

If another instance were needed, it is that of the cinema. Here, again, the effect on the stage has, in the main, really been beneficial, for ordinary persons prefer a good play at the cinema to a theatrical performance by pseudo actors and actresses, and the result is that, whether drama or comedy, a piece must be good and well acted if it is to attract. Unfortunately the cinema has been grossly abused, and that abuse has brought retribution upon producers themselves, who are now rightly paying the penalty by a crisis they are passing through of so dire a nature that few would have ventured to predict its possibility.

But now, what of the effects of wireless ?

Are we going to be content to give up the pleasure of a play occasionally, of a cinema, of the opera, or even of looking in at a concert to hear a selected item or two ? We venture a reply in the negative—to prophesy that, at any rate, in its present stage of development, wireless is not going to militate against anything else to a serious extent—certainly to nothing like the extent that the other inventions discussed did. It is simply going to add to the joys of home life—perhaps to give pleasure in many cases where none was available before—and to arouse an interest in the wonders of science hitherto felt by but a few.

Invisible Waves.

In the first issue of POPULAR WIRELESS WEEKLY, the editor referred to the possibility of wireless pictures. So far as the writer is aware, the secret of transmitting pictures by true wave impressions has not yet been discovered, but that it will be there can be but little doubt. This is no mere idle speculation, but a prediction founded upon scientific facts. Light—the light from the sun—reaches us in waves or vibrations through what we call the ether. Different colours, which are merely the constituents of so-called white light, are merely the result of different effects produced by different wave-lengths of light. All the waves travel at the same speed—186,000 miles a second—the same speed as that of electro-magnetic waves, by means of which wireless telegraphy and telephony are carried on.

When we see a red house or a green tree, or any other coloured object, the colours that appear are those of different light rays, some of which are reflected and others absorbed, according to the different pigments in the objects we are looking at, which, in themselves, merely possess substance and form.

Now the colours of light form but a small portion of the spectrum—what we call the visible portion, as seen in the rainbow, or when light is split up by a prism. And we only see them because those particular wave-lengths affect the retina and optic nerve, producing the sensation of light. Above and below the visible portion are many invisible rays; thus below the red we find infra-red rays that produce the sensation of heat. There are also ultra-violet (invisible) light, and X-rays, and there are probably many others of which we have no knowledge at all. Among those known are electro-magnetic waves—indispensable for wireless work.

A Possible Conversion.

Every reader is aware that electro-magnetic waves vary enormously in length, but it is not so well known that if we could produce them of the same length as light waves they would become visible, and we should then call them light waves.

In other words, the constituent portions of the spectrum may be said to be related from end to end, and thus we see the similarity between electro-magnetic and light waves.

Why should it not be possible to effect the conversion above suggested—to evolve an instrument by means of which rays of one kind can be received and converted into rays of another kind ? It has already been proved that light waves are deflected by gravitational or electro-magnetic influences. It has also been proved that the reflection of light from the eye is capable of moving a delicately suspended solenoid.

It may be that by some other means the propagation of pictures by wireless will be effected, but they are not easy to suggest. But once the conversion of ether waves from one form to another is achieved, and light waves are thus virtually rendered directable, the transmission of images would naturally follow; and, after that, the transmission of coloured pictures should present to wireless experts of the future a less difficult problem than did the question of colour photography to photographers.

"Wireless" Plays ?

What the effect of wireless then would be upon our everyday life and pleasure is not difficult to foresee. The prospect of sitting in one's drawing-room, listening to a play, seeing it in colour, witnessing every expression and movement of the characters, may appear at first sight to offer all that one could desire in the histrionic line. Yet there is an element—a powerful one, too—that has to be taken into account.

The ordinary human being is essentially a sociable creature, although not necessarily so at home ! Indeed, that is no criterion, for home life only too often inspires a deeper longing for mixing with outsiders.

The time may come when almost everybody will possess a wireless receiving set. Owners will use them and derive much benefit and satisfaction from them, such as listening to and witnessing a play; but that will not eliminate the desire to see the original—to mix with other people in the theatre itself—any more than the cinema has done. Everything boils down in the end to the natural craving for the personal element, and the best possible reproduction must after all be a picture.

To witness even such an ideal wireless reproduction of a play as that outlined would rather prompt a craving to see the original—much as a wireless reproduction of a seascape in a hot room in London would prompt a desire for a holiday by the sea. Plays will still be produced, and actors and actresses must be found to act the parts, so that the "profession" has little more to dread from wireless developments than from the cinema.

The Ideal Set.

What effect will broadcast wireless have upon newspapers ?

The answer to this question can best be found by again considering the human element. If I possessed an ideal receiving set that enabled me to pick up broadcast news from all over the world, time would necessarily enter into account. I could only use it out of working hours. And I could not even then receive more than a fraction of all the broadcast throbbing through the ether.

It could not be more than a pleasure and recreation, and I should be as dependent upon my morning newspaper, at breakfast and in the train, for the world's news as I ever was—in order, for instance, to see the daily drop in the prices of my stocks and shares, the rise and fall of the metal market, and the hundred and one items of other news I could not otherwise ascertain.

In conclusion, it would appear that the only cases in which possible future developments of wireless seem likely to have an adverse effect are those of the ordinary telegraph and telephone, and ultimately, perhaps, that of the cinema; but in any case there is no necessity for alarm. There is plenty of room for all.

NEW SERIES FOR BEGINNERS

By E. BLAKE, A.M.I.E.E.

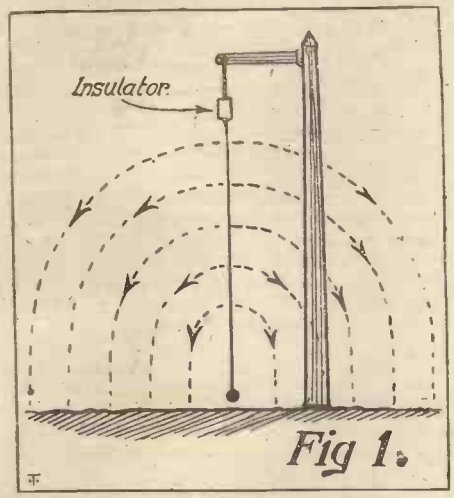
PART 5.

SUMMARY OF LAST ARTICLE.

A magnetic or electromagnetic "field" is represented graphically by lines called lines of force, which are conceived as having a certain "direction." This direction alters with the circumstances, but is that in which a north magnetic pole would be urged if placed in the field.

Strength of field is judged by the number of lines of force which pass through a unit area of it.

When a magnetic field is cut by a conductor a momentary E.M.F. is set up in the latter, so that if the conductor forms a complete electrical circuit a momentary current will flow therein, its



strength being according to the rate at which the lines of force are cut.

The direction in which this current will flow depends upon the "direction" of the field. If the wire were to cut a field which continuously varied in direction, an alternating current would flow in it.

Before passing to the subject of æther-waves, I want to present as clearly as possible a few more ideas concerning the state of affairs in the space around a conductor in which an alternating or a high-frequency oscillating current is flowing. The less confused our conceptions are in this respect the easier it is for us to understand wireless.

When an oscillating current is set up in a wire (by methods to be described later), it begins at zero strength—that is to say, *no* strength because *no* current—and then rises more or less gradually to a maximum.

The speed at which it rises to a maximum determines the *frequency* of the current; that is, the number of times it oscillates per second. Think of the oscillating current as a piston; if the piston has to move to and fro in the cylinder ten times a second, it must obviously move faster than when it moves the same distance five times a second.

The strength to which the current rises depends primarily upon the electromotive force and the nature of the circuit in which the current flows.

Having reached its maximum strength *in one direction*, the current begins to decrease. Why? The answer is, in everyday language, "Because it has to see about changing its direction"; it has to turn round and re-trace its steps, so to speak. Now, when a moving thing has to reverse the direction of its movement, there comes an instant of time, between when it has finished moving in one direction and started moving in the opposite direction, when it is quite stationary.

This instant of time may be so slight that the stoppage of movement may be imperceptible to the eye, but the stoppage occurs none the less, and if you think it out you will realise that this must be so. I should like to see the cinematograph camera applied to the demonstration of this and many other scientific facts, rather than to the posturings of Californian caricaturists.

Suppose you place the point of your pencil on the paper and run it backwards and forwards in a straight line. If you sufficiently reduce the velocity at which you do this you will reach a velocity so small that you will be able to grasp the fact that just at the moment when it is "turning round to go back" your pencil-point is still.

Returning now to the oscillating current, please try to realise that this is a mass-movement of particles which are moving to and fro, and that when they have to reverse their direction of motion they must for an instant be stationary. Now, in a rhythmical movement of this kind—"harmonic motion" it is called in physics—there is a gradual slowing-down of velocity preceding the turning point.

The velocity of a piston or pendulum is greatest at the mid-point of the stroke and zero at the beginning and end of the stroke, and between the mid-point and the maximum of the stroke in either direction the velocity gradually falls. It is the same with an oscillating current.

After reaching a maximum strength in one direction it gradually decreases until it dies out for an instant, and then it begins to grow up again *in the opposite direction*, till it once more reaches a maximum strength. Then the whole cycle recommences and continues so long as there is an E.M.F. to sustain the current, or until all the energy has been frittered away.

Now at the moment before the current starts the wire is electrically charged; the electrons, so far as any "drift" is concerned, are stationary. The energy in the wire at this moment is *potential* or *electrostatic*. An electrically-charged wire is surrounded by a field of force, called an electrostatic field.

The electrically-charged wire in which we are most interested is the wireless aerial. A simple vertical-wire aerial when charged would possess a field something like that shown in Fig. 1. The direction of the electrostatic field in the region of this aerial is almost vertical, and therefore at right angles to the electromagnetic field, which sets itself at right angles to the direction of the current.

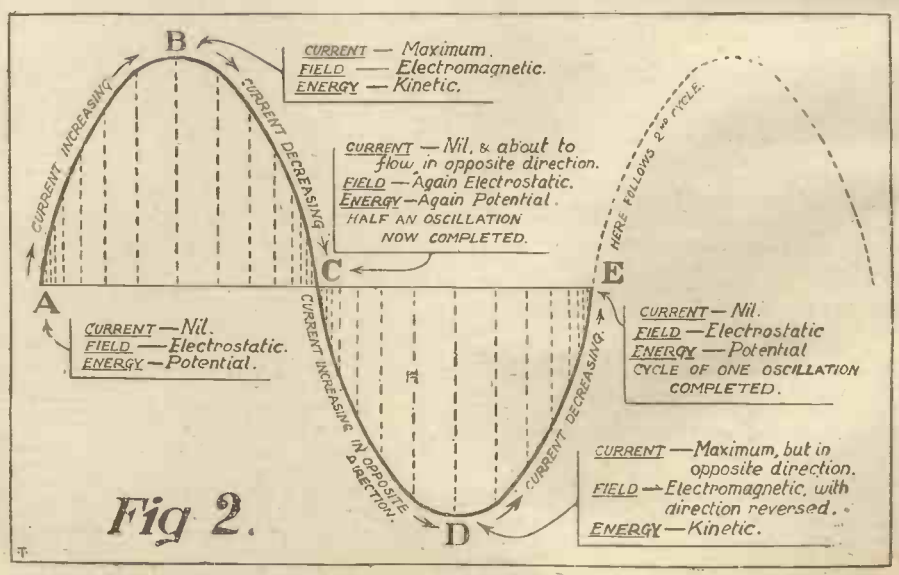
Resuming our analysis: Directly the current starts the potential energy begins to change into kinetic energy, the energy of the moving electrons, and an electromagnetic field begins to grow up round the wire. As the current grows stronger the electrostatic field diminishes and the electromagnetic field increases until, at the moment of maximum current, all the energy is electromagnetic.

Having reached its maximum strength, the current gradually decreases, the electromagnetic field following suit, until at the moment the current stops there is only an electrostatic field associated with the wire. Then the current begins to flow again, but in the opposite direction, and the electrostatic field begins to die away as the electromagnetic field grows. This process must be imagined to be quite continuous and each complete cycle of changes to occur many thousands of times per second.

Fig. 2 is a graphic representation of one complete cycle of oscillating current, and is self-explanatory. If you will regard the vertical distance between any point on the wavy line and the horizontal line as a measure of the strength of the current at a certain moment, you will understand why I say the current at the points A, C and E is nil, and at the points B and D at a maximum.

The present article and No. 4 should be studied most carefully, because, as I have said before, the clearer the ideas about the changing current and the alternating "fields," the easier it is to picture mentally the mechanism of the production and propagation of wireless waves.

The latter we shall study in the next article.

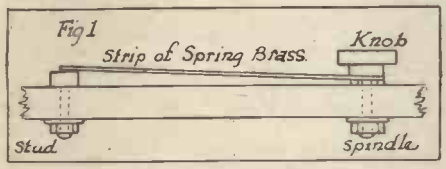


ELEMENTARY CONSIDERATION OF SWITCHES

By GEORGE SUTTON, A.M.I.E.E.

IT is really surprising how seldom we trouble about studying the details of the operations of some of the apparatus we are daily using. We are quite content, in the main, to turn a knob and "tune in" if we wish to receive wireless signals; and even if we know what is under the knob, we very often do not trouble to study how the rotation of it will make any difference to the sensitiveness of our set or the range of reception of our apparatus.

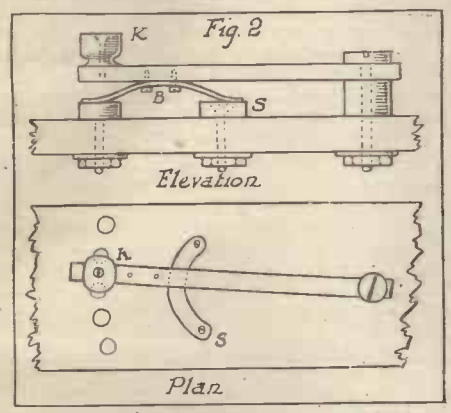
Manufacturers are often to blame for this. Nothing seems to please them better than to



produce apparatus in a sealed box, resplendent with lacquered brass and polished ebonite, and so guarded against inspection that in endeavouring to reach the interior one is really fearful of breaking some form of tacit covenant, as well as spoiling the appearance of the slots in the brass screws.

Certainly, if the case is never opened, neither the owner nor anyone else having access to it can do the interior mechanism any damage, except such as might eventuate by rough handling; but it is feared that in some instances the poor quality of the contents may be the reason for keeping the case sealed up.

On the cheapest as well as the most expensive receiving apparatus is almost certain to be found some form or other of switching



gear, and the writer hopes that a fuller study of the design and construction of switches will result in an added realisation of their importance in wireless working.

"Water Hammers."

One of the first things which is noticed by the observant user of switches is that frequently the breaking of a circuit by opening a switch gives rise to a spark, and, generally speaking, such a spark is a sign that something is wrong. Either the circuit or the switch is badly designed, or is being badly used, and certainly the presence of a spark shows that the switch contacts are being burnt to a greater or lesser degree; for a spark at metal surfaces means that a portion of the metal, minutely small though it may be, is being volatilised by heat.

Now, when current is flowing freely in a circuit—namely, in a circuit not possessing much resistance—it is similar to the passage of water through a free pipe, in that it has something which is closely akin to momentum. The use of the word momentum is only one way of describing a weight moving in a straight line with some degree of speed, and the weight, multiplied by the velocity with which it is moving, is a measure of the momentum.

If we have water flowing rapidly through a pipe, and we check its flow suddenly, the water strikes a blow, as with a hammer, against the sides and stopped end of the pipe. So like a hammer sound is it that plumbers describe it as a water-hammer. This, if bad, may actually burst the pipe, and the water authorities do not encourage the use of plug taps, for the reason that the water can be "turned off" more suddenly by the plug tap than by the "screw-down" variety.

An intermittent water-hammer may be caused by a loose valve even in a screw-down tap, and most of us have heard the hammering pipes sounding through the house.

Contact Sparking.

When we "break" or open a switch in a wire through which electricity is flowing, we stop the flow of electricity in the wire in a manner similar to that in which water is stopped from flowing in a pipe by means of the tap. If a strong flow of water be stopped suddenly in a pipe by a plug tap, it may burst the pipe, as previously described. In other words, its flow will not immediately come to a standstill because of its momentum.

The same reason applies to a strong flow of electricity. When the switch is opened, the flow of electricity, if it is powerful enough, will not immediately cease to flow, but will spark across to the switch in an endeavour to continue along the path it has been following.

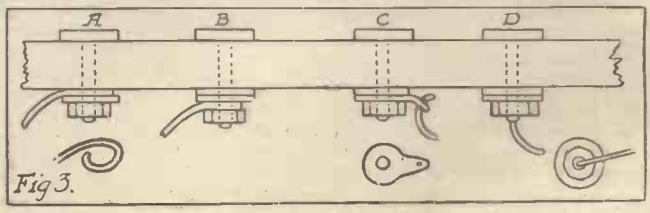
It is presumed that few of our readers will attempt to make their switch studs, as they can be bought for about one shilling per dozen with washers and nuts complete. Switch handles can also be procured at a price which makes them unprofitable to make, though if one is at all handy with his tools he might like to try to make a switch with a piece of flat spring brass and an ebonite knob, as indicated in Fig. 1.

This pattern, however, has to rely upon one contact being made to a movable switch-arm pivot, and perhaps the best way to arrange for that would be to cut a washer with a little tag as indicated in C (Fig. 3), in addition and underneath the one shown under the spindle nut.

Connecting Up.

Fig. 2 shows an improvement in this type made by providing a segment of brass (S, as shown in elevation and plan in the figure), to which one end of the circuit is connected, while the tappings are made off to the studs as usual. A strip of spring brass, B, is screwed up under the massive arm, and is kept in contact with both the stud and the brass segment. The knob, K, had better be of ebonite, to avoid complications which might arise if the bare fingers touched any part of the metal work of your circuit.

Fig. 3 shows alternative methods of connecting the wires to the studs. At A the end of the wire is bent round to form an "eye," which is placed over the shank of the stud before the washer is put on, and the nut then screws home tight without displacing the wire. If put between the washer and the nut, the movement of the latter might displace it as it was being screwed up tight. This would be certain to happen if the eye on the end of the wire was turned round the other way; that is, the nut, in turning, would tend to loosen instead of tightening the coiling of the end, and it would slip and make doubtful contact.



Secrets of Good Wiring.

The little washers, stamped out or cut out with lugs at one side, as at C, can be procured cheaply by the gross, and the end of the wire just poked through the hole at the end of the tag and soldered makes quite a good joint. Another good way is to drill a hole a little way up the stem of the stud, such hole being slightly larger than the wire, and, putting the end of the wire into this hole, secure it with a blob of solder.

All soldering of wires on to switch studs should be done with a very hot iron, so that it may be done before the heat runs up the body of the stud and softens the ebonite; and, as an added precaution, the other end of the stud should have a wet cloth applied to it, to keep its head cool. This will probably avoid loosening the stud with the heat from the soldering iron. Clean studs, clean wire, and a clean and well-tinned and very hot iron are the secrets of a well-soldered job of switch wiring.

It should not be forgotten that the studs should be placed so close together that the springy switch arm cannot drop down in between adjacent studs, but glide from one to the other. The other opposite should also be avoided—of having the studs so close together that dirt and dust can accumulate between their heads, and also make the washers and nuts underneath difficult to manipulate because of crowding.

Last Hints.

If a switch arm cuts or grates in working, a slight rubbing on the wearing surfaces with a soft blacklead pencil will often put matters right. Ebonite, or some other good insulator, should always be used for constructing switches, as the principle of the switch is that you bring in a series of points in a circuit into close juxtaposition for convenience in working, while electrically they should be as far away from each other as possible.

If wood must be used, it should be "bushed" with ebonite or some other good insulator. Bushing means surrounding the metal with a sleeve of insulating material to keep it from contact with the wood.

If it is desired to put your high-tension battery on to a switch, in order easily to select the best plate voltage, every other stud must be left disconnected, so as to make it impossible for the switch arm to touch two "live" studs at once, else the section of the battery embraced by the two studs will be short-circuited and soon made useless. If every other stud is connected up, the possibility of such short-circuiting will be avoided.

Massive double pole switches—or even ordinary electric light switches—are hardly the things for use on a receiving set. Neat switches, and tidy and careful connections improve the gear immensely.

STEP BY STEP IN WIRELESS.

THE PRINCIPLE OF THE GRAPH OR CURVE.

NOTE.—This series of articles will in future be of a more advanced nature. Beginners will, however, find these articles of interest.

No. 12.

THERE are undoubtedly many amateurs who in endeavouring to follow the theory of wireless are continually reading in their text-books about the "characteristic curve" of some piece of apparatus, such as a crystal or thermionic valve, without troubling their heads in the least as to what is meant by the expression "curve."

Yet it is probable that if one-half of them studied intelligently the manner in which such curves, or "graphs," are compiled, they would derive more knowledge from this source during a few hours' study than could be assimilated from mathematics in the same number of days.

Graphs are absolutely essential to all kinds of electrical work, be it an electric motor, the "efficiency" of which is generally "plotted" as a graph, or the ordinary crystal detector, the "characteristic curve" of which is drawn in a similar manner.

The Benefit.

"But," says the amateur, "why should I be worried by the tedious reading or studying of graphs, which are unintelligible curves or lines on squared paper? They convey nothing to me."

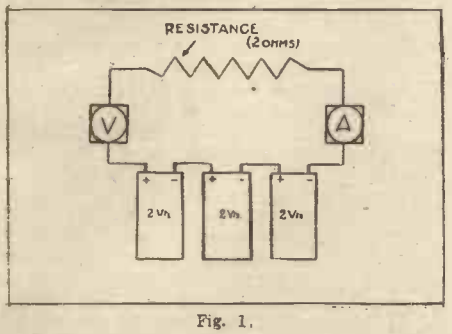


Fig. 1.

That is so, but if he had not learned to read, would he refuse to do so because his first glance at the printed page conveyed nothing intelligible to him? Another question he might ask would be, "How do I benefit by it?"

The amateur benefits because such a study will impart a great deal of knowledge and a much better understanding of the powers and limitations of his set. Additional knowledge means additional efficiency; and next time you wonder why it is that the fellow next door can always receive clearer signals possibly over a greater distance than you can, although his set is inferior to your own in construction, do not wonder any longer.

He simply knows more about wireless than you do, and the probability is that he also knows something about graphs. It is the intention of the writer to place as simply as possible before the readers of POPULAR WIRELESS the manner in which some of the simpler graphs are evolved and drawn, so that when next a graph appears, as it is sure to do, in the course of your studies, it will prove a help instead of a hindrance.

A graph is invariably drawn on squared paper—that is, paper ruled over both horizontally and vertically—with equidistant parallel lines. These lines are usually pale blue or grey in colour, and their intersections form a considerable number of comparatively faint squares on the surface of the paper.

The lines are purposely subdued in tone, so that they will be secondary in strength of line to the ink graph when it is marked on the paper, and not cause unnecessary confusion. Several different varieties of squared paper can be procured, but one of the most useful is a paper with lines spaced every 1-10th of an inch, every fifth line being printed thicker than the four lines on either side of it.

The paper is therefore divided into squares of 1-10th of an inch, and also into larger squares, denoted by the thicker lines, of half an inch.

"Plotting."

The graph shown in Fig. 2, was plotted on this type of paper, but to avoid confusion the smaller squares have been eliminated. This is because the graph is reproduced on a smaller scale than the original drawing. After an electric motor, or a thermionic valve for that matter, has been constructed, it invariably undergoes a test, to see if it is as efficient practically as theoretically, and also to obtain information regarding its characteristics.

Machines possess certain characteristics just the same as individuals. Now let us suppose that a certain direct-current circuit has been constructed, as shown in Fig. 1, the applied pressure or voltage of which is to be 6 volts, and the current flow or amperage 3. We will presume that the resistance of the whole circuit is fixed at 2 ohms.

Before we can compile a graph for the circuit it will be necessary to obtain some figures on which to work, and these figures are procured from the ampere-meter and voltmeter included in the circuit.

Obviously, when no current is flowing in the circuit, there is no voltage or amperage. If an electro-motive force of 4 volts is passed into the circuit, however, we shall naturally see 4 volts registered by the voltmeter, and 2 amperes by the ampere-meter. If the voltage is then increased to 6, the amperage will increase to 3. We thus have the following figures, which show the relationship between voltage and current in the circuit at two definite values:

Volts	4	6
Amperes	2	3

The figures alone are not very helpful, but if we can portray *graphically* what they represent, *i.e.*, the relationship between the voltage and amperage, the mutual relationship will be portrayed in a much clearer manner.

The two quantities when thus shown graphically are said to be *correlated*, or mutually related as shown by the curve. For any known value of voltage between zero and 6 applied to the circuit we can easily ascertain the amperage from the graph, as can be seen from Fig. 2.

The Principle.

The fundamental principle underlying the graph is as follows. Each pair of figures read from the circuit, namely 4 and 2, and 6 and 3, is marked by a dot upon the squared paper. The position of the dot is found in the following manner.

In the bottom left-hand corner of the squared paper a point is made representing the zero point, and marked 0. This, of course, represents nothing, unless it stands for the disconnected circuit which has no electrical values. Two lines are drawn from this point at right angles to each other, one vertically and one horizontally.

Supposing the horizontal line to represent 6 volts, as shown in Fig. 2, and the vertical line to represent 3 amperes, the manner in which the graph is plotted can be followed from the illustration. The horizontal line if divided into 6 equal parts will show the line as representing individual volts. The vertical line, similarly divided, will also show the same thing, only for amperes.

In this case we will say that one volt = ½ inch, which was actually the case in the original graph, and one ampere = ½ inch, thus keeping the graph simple in construction. Every graph, of course, has to be drawn to some scale or other, but to give scales here for all of the various graphs would obviously be impossible. Now let us consider our first pair of figures, 4, which stands for volts, and 2, which stands for amperes. We can easily find the point representing 4 volts on the horizontal line of our graph, and the point representing 2 amperes on the vertical line is no more difficult to discover.

Avoiding Arithmetic.

If two dotted lines are drawn from these two points at right angles to the lines on which the points are marked, they will eventually meet on some part of the squared paper, and where they meet a dot is placed.

We now pass to the second pair of figures, 6 and 3, which is the maximum output of the circuit, and by following exactly the same procedure as before a second dot may be marked on the squared paper where the two lines meet. The dots are then joined up by a line which commences at the zero point.

It is this line which is known as the graph or curve. Peculiarly enough, as will be seen from Fig. 2, the graph for a direct-current circuit is a straight line. When the "curve" thus takes the form of a straight line, it denotes that the magnitude of one factor to the other is directly proportional.

In practice, of course, considerably more than two pairs of figures would be needed to enable a correct graph to be drawn; it would therefore be necessary to take more readings from the measuring instruments, because every additional point placed on the paper adds to the accuracy of the graph when it is being drawn. The value of the graph can now easily be seen.

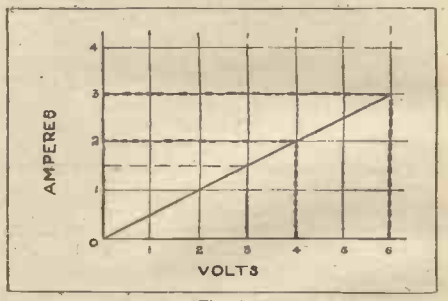


Fig. 2.

Assume that three volts were applied to such a circuit as is shown in Fig. 1, which had neither voltmeter or ampere-meter in circuit, but for which a graph had previously been prepared, as shown by the broken line in Fig. 2, the amperage is easily read from the graph as 1·5 amperes.

On the other hand, given 1·5 amperes, it is quite as simple to calculate the voltage. It is then but a step to see that given any voltage value between zero and 6—that is, anything between the minimum and the maximum voltage which the circuit is capable of carrying—we can evaluate the corresponding amperage, and vice-versa, without having to resort to arithmetic.

Wireless in Germany

THE German wireless station at Nauen has always prided itself on being the finest in the world.

Its huge building—more like a factory than a wireless station—was built during the war, and wireless operators at sea will remember the nightly code sent out to submarines, and the strangely sweet tone of the signals, so much at variance with the murderous orders transmitted.

The call sign of Nauen is P O Z, and it is a call sign that has gathered about itself more odium than that collected by all the other call signs in the world.

Improvements at Nauen.

Since the war there has been great activity at Nauen.

Experts have been engaged in research work which has yielded practical contfibutions to the improvement of the station.

As was stated recently in POPULAR WIRELESS, the Trans-Radio Co. has decided to raise additional capital of 25,000,000, marks (nominally £1,250,000) for the improvement and extension of the station. The plans include the erection of seven new masts, each 700 feet high, and the dismantling of four of the existing masts.

Nauen is also blossoming forth as a wireless telephony station.

About a year ago a distance of 2,697 miles was covered, which is equal to the distance from Nauen to St. John's, Newfoundland, and since then the range has been greatly increased.

The new masts will be built so that sections of the aerial system may be used separately. The two largest sections of the aerial are each connected with a long wave 400-kw. transmitter, both alternators having almost the same wave-length (12,600 metres and 13,000 metres respectively), differing only enough to enable them to be distinguished at the receiver.

The new aerial system will operate at any voltage up to 120,000 volts, and using such energy Nauen will be able to communicate with Argentina.

With this object in view another station is being built at Buenos Aires, using a 400-kw. high-frequency alternator.

Telephony transmission from Königwasterhausen, near Berlin, using only 10 kw., has been heard 3,600 kilometres from the station, and these results have been so excellent that the new telephony transmitter at Nauen will be built with a view to effecting wireless telephony range over thousands of miles.

Prior to the outbreak of hostilities between the U.S.A. and Germany in the Great War, the high-power station at Nauen was the only direct means of communication between the two countries.

The importance of Nauen as a "broadcaster" of German opinion to the world at large was also realised to the full by the German authorities.

They availed themselves of the opportunities presented by so powerful a station to radiate thousands of words of war propaganda, and also to send hundreds of words daily to New York.

Communication between the two countries was, of course, interrupted by America's advent into the war; but with the return of peace, Nauen once again started to communicate direct with America, and may be heard dealing with Transatlantic "traffic" at various times of the day.

The "Falsetto" Type.

The station also transmits a "news" programme.

The clear "note" of the Nauen station needs no description to those who have long-wave receivers, capable of receiving continuous wave. It is one of the best-known notes in the ether.

Of a high pitch, rather of the falsetto type—and we may be excused for ventilating a bad pun by saying that the news sent out from "P O Z"—during the war, at any rate—was often of the "falsetto" type too.

It may be of interest to readers of POPULAR WIRELESS to know that the British Marconi Company have recently successfully competed with a German company for a contract to erect stations in Austria. This fact is all the more gratifying, as the Germans have come to regard themselves (in Middle Europe, at least) as unassailable in the world of wireless.

Nauen transmits regularly at 6, 8 and 9.15 a.m. on 9,400 metres cw, and at midday on 3,100 metres, spark.

Also at 6 p.m. on 9,400 metres cw; 11.30 p.m. on 12,600 cw; and 11.55 on 3,900 metres, spark.

Königswasterhausen sends frequently. Telephony is transmitted regularly twice daily, at 7 a.m. on 2,500 metres, and at 10.30 a.m. on 2,500 metres. Other German stations that work fairly regularly are Metz (Y C); Frankfort-on-Main (F R); Borkum (K B M); Berlin (D L); Swinemünde (K A W); Strassburg (C 3); Norddeich (K A V); Eilvese (O U I).

The coast stations at Norddeich and Swinemünde send important warnings to ships, as required, on the 600 metre wave.

Eilvese deals extensively with trans-Atlantic traffic at all times of the day on a wave length of 14,400 metres.

Nauen also works trans-Atlantic traffic at all times on 12,600 metres cw.

Telefunken Sets.

The chief system of wireless in Germany is the Telefunken.

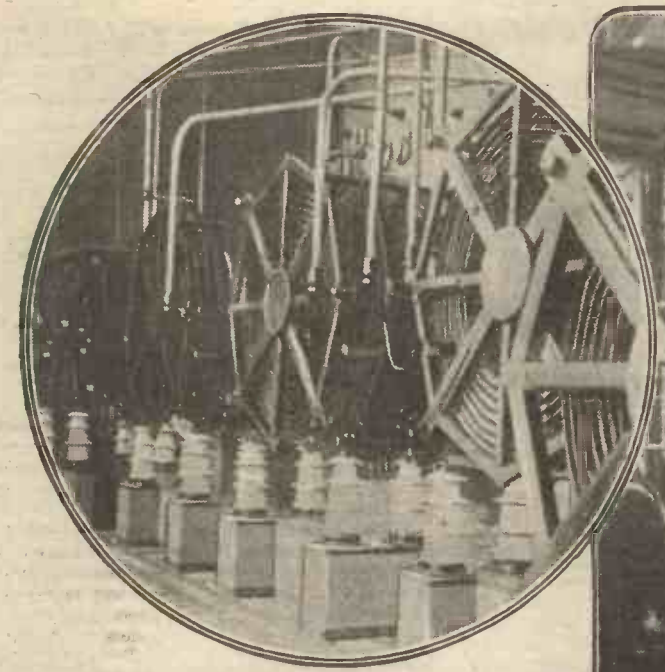
The ship sets are chiefly remarkable for their compactness, shoddy appearance, but effective working. A "quenched" spark gap is used, the resultant note in the telephones of the receiver when the transmitting key is pressed being a very pure musical and high note.

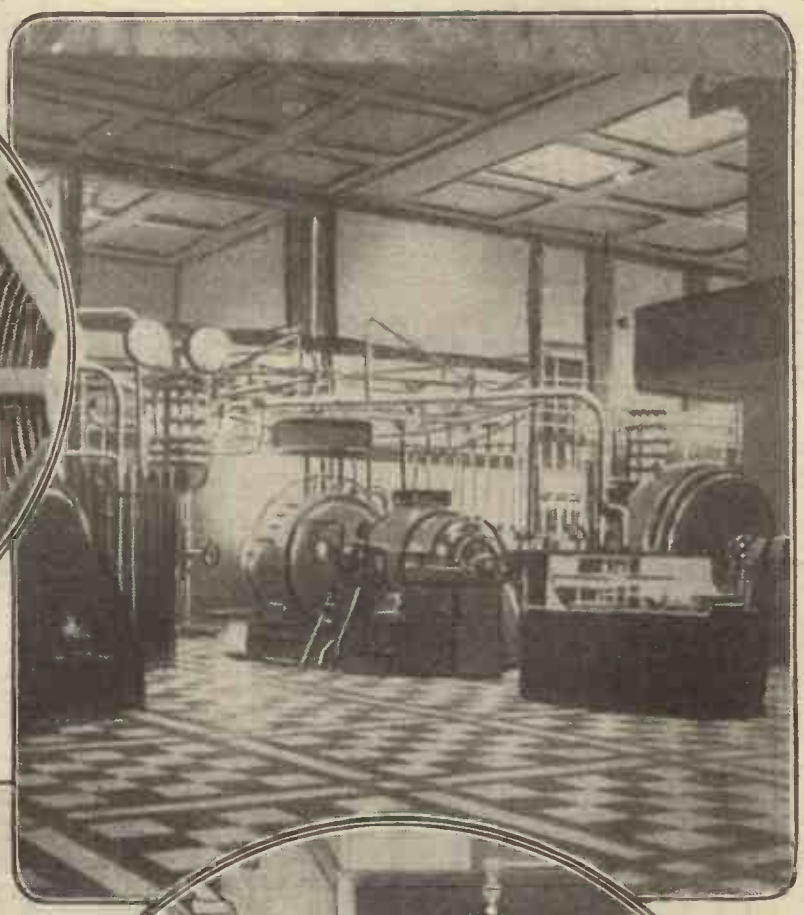
At the outbreak of war many ships, fitted with Telefunken gear, were taken over by the British India Office, and the writer, on being appointed operator in charge of one of particular vessel, found the German operator had considerately filled the Edison accumulators with engine oil and had sprung a very nasty "fault" on the motor generator.

Every time the D.C. switch was closed, a miniature arc flashed and spluttered. It took four days to dismantle the generator and locate the fault. Fritz was nothing if not thorough!

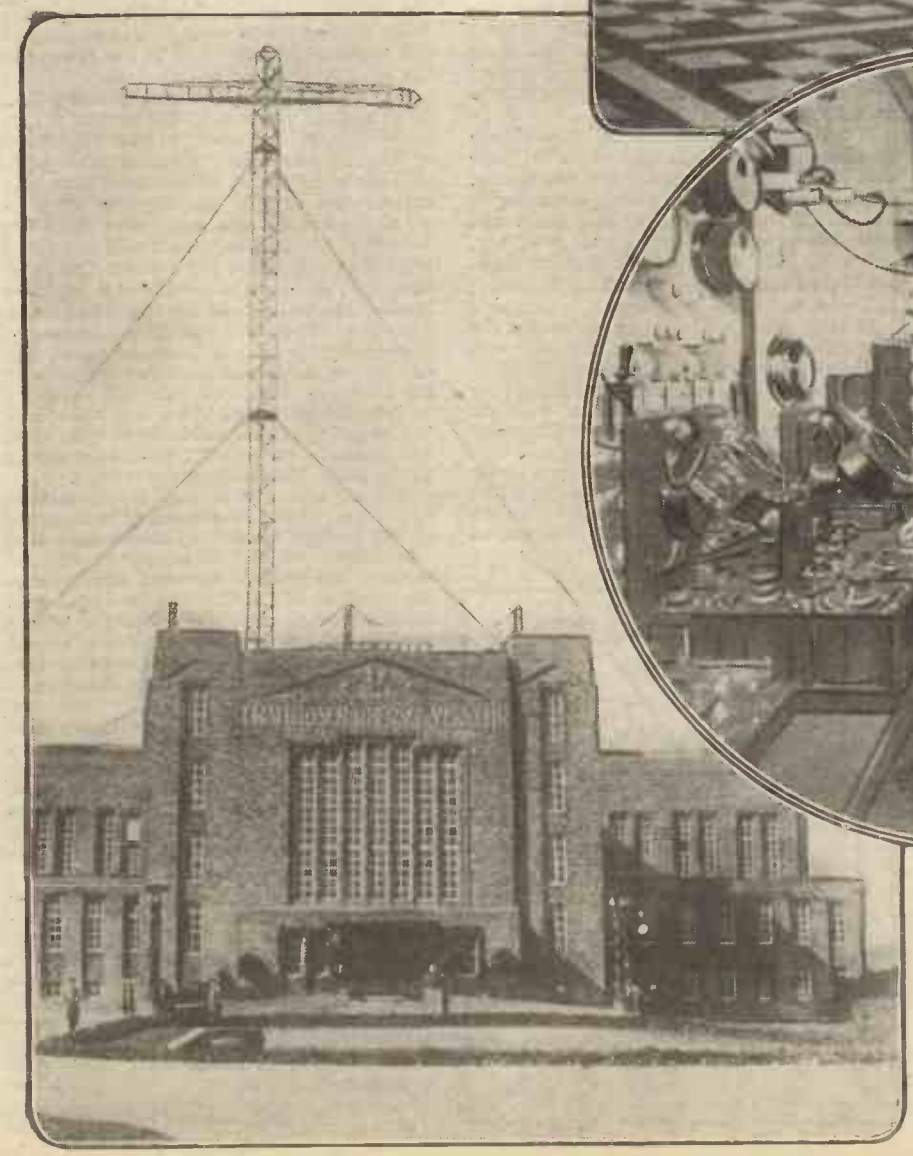
However, to give the Telefunken people their due, their apparatus—especially the transmitting gear—gave excellent results.

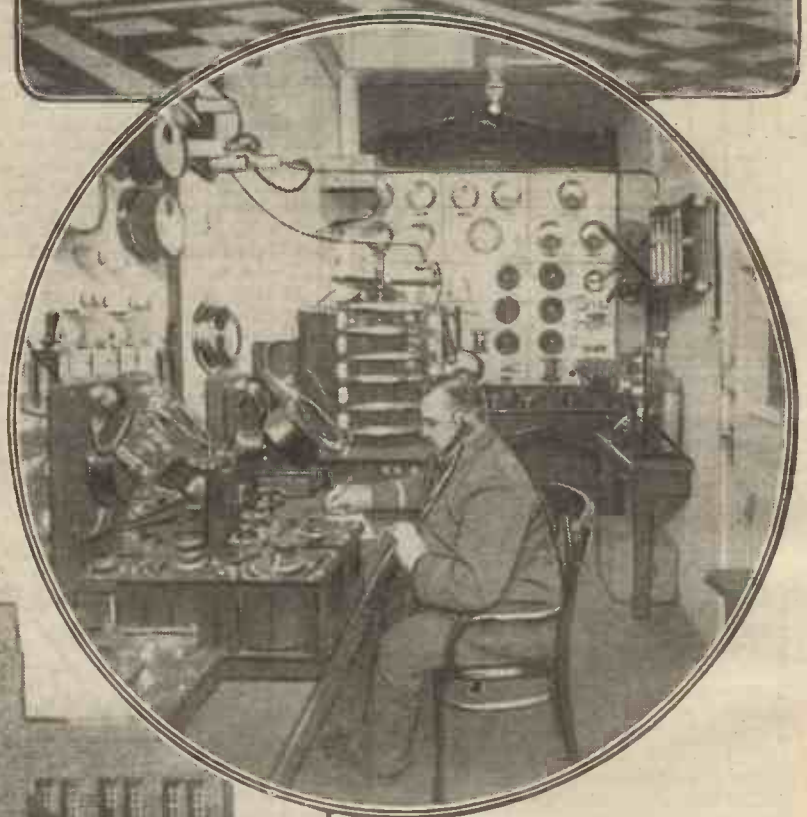
One particular transmission was effected in Australian waters over a distance of 1,200 miles, the input power being only ½ k.w.





The photo in the circle shows a "little" inductance used at Nauen. The photo on the right shows the main generating power plant. The alternators develop 400 kw. and the aerial system operates at a voltage as high as 120,000 volts.





The photo in the circle shows the interior of a German station, with the operator busily decoding a message. The station building at Nauen, seen in the photo on the left, is built more like a factory than a wireless station. The actual station building covers many acres of ground.

Nauen's call sign is P O Z, and the station may be heard working at practically any time of the day on a 14,500-metre wave-length to America. The chief German system of wireless is the Telefunken, and its typical gear may be seen in the photo in the circle. Recently, the British Marconi Co. secured a contract for the erection of wireless stations in Austria, thus beating the Germans in field of competition they have come to regard as their own—in middle Europe at least.

HOW TO MAKE A SHORT-WAVE RECEIVER.

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E

PART 4.

When the tuning coil has been completed in the manner described last week, a support must be cut for fixing it to the ebonite panel. This support may quite well be made of hard wood, ¾ in. thick, cut to the shape and dimensions shown in Fig. 1.

Through this, two holes, $\frac{5}{32}$ in. diameter and ¼ in. apart on the surface of the upper curved face, should be drilled, as indicated by the dotted lines A, B in Fig. 1. The lower ends of these holes should be drilled out to ¼ in. diameter to form recesses to accommodate the heads of the screws which will be passed through these holes. A length of approximately ⅜ in. should be left of the original hole, as indicated on the sketch.

The end of the coil former that has been left free as described is used for mounting it on this support. The end of the coil tube in

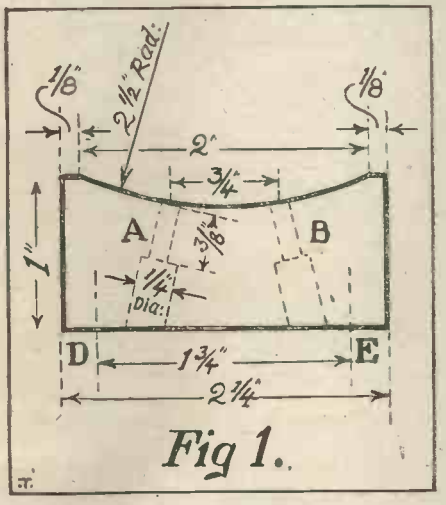


Fig 1.

position on the supports is shown by the dotted lines in Fig. 1. Two round-headed brass screws 6 B A by ⅝ in. long, should be used for securing the tube to this saddle; the heads of the screws, with a brass washer, should occupy the enlarged lower ends of the holes A, B in the saddle.

The holes in the tube should be drilled by holding the support securely in position, and then passing the drill through the holes that have already been made in the wood support.

The holes in the tube can thus easily be made to register with those in the saddle, so that the screws will easily pass through. If screws ⅝ in. long under the head are used, and the coil tube is not more than ⅛ in. thick, there should be ample room for a nut and a washer to be put on to the screws inside the tube.

Two holes $\frac{1}{16}$ in. diameter, and 1¾ in. apart, should be drilled a short distance into the under-side of the wood, as indicated by the dotted lines D, E (Fig. 1).

Fixing the Tube.

These will be used for securing the coil on to the panel. When fixing the coil tube to its support it should be so placed that when looked at so that the wood support is on the right-hand side and in its proper place underneath the coil, the ends of the winding and the tapping wire (which should be in line with the ends) are on the farther side of the coil, as indicated in Fig. 2.

This arrangement will keep the connections to the coil as short as possible, and avoid the necessity for their crossing over the coil in order to reach the points to which they are to be connected.

Similar considerations as were given in the last instalment of this description with regard to the self-capacity of the tuning coil, apply in the case of the reaction coil. The self-capacity of this coil in co-operation with the inductance of the winding, forms a closed oscillation circuit which has a natural frequency and wave-length of oscillation.

"Lag."

Now, when alternating currents are flowing through a circuit containing inductance, capacity and resistance, the actual current flow will generally not be in phase with the applied voltage which is producing it, but may either be in advance of it or lag behind it.

The alternating voltage applied to the circuit is of course continually varying in direction and intensity, since it is reversing many times per second, and is therefore repeatedly growing up to a maximum value in one direction, then decreasing again, reversing, increasing to a maximum in the opposite direction, again decreasing, reversing and so on. When, say, this voltage is increasing from zero up to its maximum value in one direction—which direction for the moment we will call positive—the current that flows in the circuit to which the voltage is applied does not necessarily grow up with the voltage and at the same rate.

When both current and voltage change together, the current is said to be in phase with the voltage; but when it does not do this, they are said to be out of phase. Reverting to our circuit having capacity, inductance and resistance when the applied voltage is, say, increasing from zero up to its positive maximum, the current is not necessarily increasing too.

It may have a stationary value for the moment—it may be decreasing, or it may even be flowing in the opposite direction. Which of these things is happening depends mainly upon the relative magnitudes of the electrical constants of the circuit—inductance, capacity and resistance.

If the circuit should contain practically all inductance and very little resistance, the current will rise up to its maximum after the applied voltage, and it is said therefore to "lag" behind the voltage.

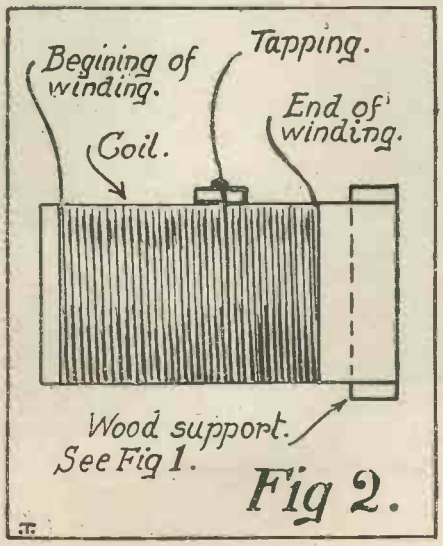


Fig 2.

The less the resistance in the circuit, the more will the phase of the current lag behind the voltage up to a maximum lag, when the current will not rise above its zero value until the voltage has reached its maximum positive value, and the current will not reach its own maximum until the voltage has fallen to zero again. A lag of this magnitude is usually expressed by the phrase that "the current lags 90 deg. behind the voltage."

Should, however, our circuit contain mainly a condenser, the reverse process will take place, *i.e.*, the *voltage* changes will lag behind the *current* changes, the lag being greater the less the resistance of the circuit, up to a maximum of 90 deg. as before.

To say that the voltage changes lag behind the current changes is equivalent to saying that the current changes take place before or in front of the voltage changes or, in other words, that the current *leads* the voltage.

Capacitive Effect.

We therefore see that the effects of inductance and capacity upon the phase of the current relative to the applied voltage are in opposite directions. The former tries to make the current lag behind the voltage, while the latter endeavours to make it lead in front of the voltage. If both qualities are present in the circuit, it is evident that they will be acting against each other, and therefore that what actually happens in the result depends upon whether the effect of the inductance or that of the capacity predominates.

If the effect of the inductance is large, the current will lag; if the capacity effect is large, the current will lead. Now both the inductive and the capacitive effects depend upon the frequency of the electromotive force that is applied to the circuit—the inductive reactance increasing with increase of frequency, and the capacitive reactance decreasing. Hence, as these two effects oppose each other, and one increases and the other decreases as the frequency is raised, there will obviously be some frequency at which the two effects will be exactly equal, and being in opposition, will neutralise each other. This, of course, is the resonant frequency of the circuits.

The important point that it is wished to emphasise, however, is the change in the phase of the current relative to the voltage that takes place as the frequency is changed through the natural resonant frequency of the circuits. For a simple series circuit with an inductance, when the frequency of the applied voltage is lower than the natural resonant frequency of the circuit, the capacitive effect will predominate, and the current will lead on the voltage.

When the frequency of the applied voltage is higher than the resonant frequency of the circuit, the inductive effect will predominate and the current will lag behind the voltage. These changes in phase are of great importance in considering the effect of the reaction coil. In this case, we have the inductance of the winding shunted by the self-capacity of the coil itself, which combination gives to the reaction coil a natural frequency or wave-length oscillation as has already been explained.

There will also, in this case, be changes in the phase of the current flowing through the whole coil which are analogous to those described above, but will be inverse in sense because the inductance and the capacity are here in parallel instead of being in series as there described.

(Continued on next page).

FROM OUR NEW YORK CORRESPONDENT.

EVERY week enthusiastic radioists turn the art to fresh uses. We now hear of a dentist in New York who has installed a receiving set in his waiting-room, to beguile the time of waiting for his patients. And also possibly, comments a sufferer, to drown the screams of those undergoing the torture!

Motor-cars are beginning to appear on the roads bearing aloft antennæ. Motor-camping is a very popular summer pastime in the United States, and radio makes an ideal adjunct to it.

Then there is the New York Theatre, which has installed a set in its box-office to receive bookings from out of town, which incidentally includes the passengers on incoming steamers.

The Inventive Craze.

Harder still, perhaps, than keeping track of all the new uses for radio, is keeping up with the new achievements and inventions which are being made at a perfectly bewildering rate. There are, for example, over a thousand applications for patents before the United States Patent Office at the present moment. Not all of them, by any means, will be granted, but it can be seen that new ideas are being developed all the time. A very interesting piece of apparatus is that produced by a young New York amateur, who has evolved a detector tube which requires no batteries. It consists of an evacuated glass tube containing a synthetic chemical substance with suitable electrodes.

The inventor claims that not only will it give, with one stage of audio-frequency amplification, results equal to the ordinary detector with two stages, but that it is free from all rectifier distortions common to the regular triode tube.

Cinema Wireless.

But the radio invention with the most astonishing possibilities is that produced by Mr. C. Francis Jenkins for sending photographs by wireless. This is a conservative description of the apparatus, because Mr. Jenkins states that, although he has not yet accomplished the feat, it will transmit moving pictures equally well. The ultimate possibility is for two men, holding a wireless conversation, to have each a picture of the other before them as they talk! And, of course, it will be possible to receive moving pictures in the home, just as concerts and speeches are received at present.

The apparatus is complicated, but remarkably ingenious. Its whole working depends upon a peculiar glass prism, made in the following way. A bar of optical glass, about three feet long, one inch wide, and half an inch thick, is ground with a bevel at each end, each bevel being in the opposite direction to the other. The surfaces between the bevels are ground so that the change from one prism to the other is gradual. Then the finished rod is bent round the periphery of a flat disc of glass or metal. When the prism is rotated and a beam of light is projected through it, the image produced on the screen beyond oscillates up and down.

For projecting the photograph by radio, two prisms are used, one rotating 100 times faster than the other, and so positioned that one causes the image to move up and down, and the other from side to side. The result is as if the photograph were divided into a hundred narrow strips. The photograph is brilliantly illuminated, and the light reflected from the strips as they are picked up by the prisms is projected into a selenium cell which, as is well known, has the power of varying its electrical resistance according to the amount of light falling on it. The varying currents flowing from this photo-electric cell are led to a vacuum tube, where radio-frequency currents are set up and sent out through an aerial.

At the receiving end, they are converted to audio-frequency in the usual way, and are led to a glass tube wound with many turns of fine magnet wire, and containing a secret chemical. It is thus a solenoid with a chemical core. The radio impulses cause a magnetic field of varying strength to be set up within it. The solenoid is placed end on between two prisms made of iceland spar, the three objects all being in front of a powerful arc light. The first prism polarises the light from this arc lamp. It was discovered many years ago that if a ray of polarised light be passed through a second prism no light passes beyond it. But if a transparent substance through which lines of magnetic force are passing be interposed, light will pass, in volume varying with the magnetic field.

16 Pictures a Second.

The radio impulses received in the antennæ are led to the chemical-core solenoid between the two prisms, setting up a magnetic field in the former, and thus amounts of light varying with the impulses are permitted to pass. They are passed through a lens, and then through a pair of prisms exactly similar to those at the transmitting end, and which lead the rays to their proper position on the screen.

This is the apparatus for sending one picture at a time. By altering the design of the prisms so that there are eight or ten in one circumference of the disc, the inventor believes that it will be just as easy to transmit 16 pictures a second, the rate at which most moving-pictures are projected.

Ever since the Dempsey-Carpentier fight, every ring contest of importance which has taken place in New York has been reported by radiophone from the ringside. The blow-by-blow accounts of the battles are heard for hundreds of miles around. The reporter's voice is carried through a telephone loud speaker over the ordinary telephone wires to the broadcasting station, and thence into the ether. Not only the general applause, but individual shouts of encouragement to the combatants are clearly heard by listeners-in, adding greatly to the realism of the story. The light-weight championship bout between Benny Leonard and Lew Tendler will have been described to thousands of eager radioists by the time these lines appear in print.

It will probably be of interest to British amateurs to know that their American brothers are gradually coming to adopt the loop aerial as the standard for all ordinary purposes, particularly since the use of regenerative and super-regenerative sets has so much increased. The latter is particularly suitable for use with the loop aerial.

The owner of a large block of flats in New York has just turned the directional effect of the loop aerial to good account. He has wired every flat in the building for radio reception with two separate circuits, each connected to a loop aerial in the upper part of the building. Each aerial is arranged to receive from a different station, so that the tenants have always a choice of two programmes simultaneously, and can plug in to which ever they wish. The wiring for radio of large apartment-houses in New York, by the way, is proceeding apace.

A New Loop Aerial.

Speaking of loop aerials, Doctor J. M. Miller, of the Radio Research Laboratory of the U.S. Navy, has invented a remarkable coil aerial which for portability and general convenience, puts the ordinary loop aerial in the shade. It consists of a coil only five inches in diameter which is described as resembling, to a casual observer, an abbreviated induction coil. You simply lay it on the table and go ahead. It is used by the inventor with a special amplifying set. Exact details of the latter are withheld for the present, as it is under consideration for adoption by the navy.

But it embraces a range of wave-lengths between 800 and 20,000 metres, and employs a special type of vacuum tube. The set giving five stages of radio-frequency amplification, and two of audio enlargement requires only two amperes filament current at two volts, and the plate supply is only 22.5 volts. Even though further details are kept secret, the partial description is interesting as an instance of the enormous strides that are being made in radio development.

HOW TO MAKE A SHORT WAVE RECEIVER.

(*Continued from previous page*).

Considering this case more in detail, when the frequency of the voltage applied to the coil is lower than the natural wave-length of the winding, part of the current will flow actually through the winding, and the remainder will pass across the effective self-capacity of the coil.

This latter part will be smaller than the part flowing through the turns of the winding, since at the lower frequencies the reactive effect of the capacity is large, and that of the inductance is small. Since most of the current is flowing through the inductance, the current will lag in phase behind the voltage, this lag being nearly 90 degrees in most cases.

If the frequency of the applied voltage is varied so as to approach the natural frequency of the winding, the proportion of current passing through the effective self-capacity will become greater, so that the total current will lag less behind the voltage. When the frequency becomes the same as the natural frequency of the coil, the current will become in phase with the voltage; whereas for still higher frequencies most of the current will flow through the capacity, and will therefore lead the voltage.

As the frequency of the applied voltage approaches and passes through the resonance valve, the phase of the current will change over from lagging to leading.

The voltage induced back into the grid circuit of the valve by the reaction coil depends, however, upon the *current* flowing through the coil, rather than upon the voltage across it. Hence the phase of this feed-back voltage will likewise change over—a change which is equivalent to a *reversal* of voltage.

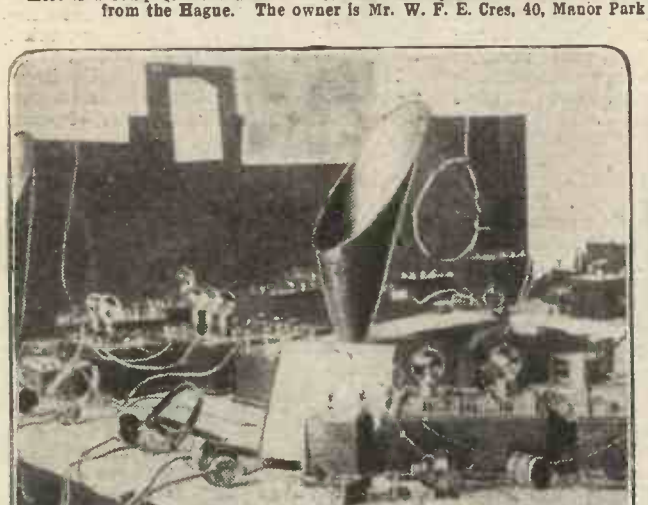
Therefore on passing through the resonance frequency the effect of the reaction coil reverses in direction. Such a change is undesirable, as it would mean that for some wave-lengths the connections to the coil would need to be reversed from the normal arrangement used for other wave-lengths. This complication can be avoided by designing the reaction coil so that its natural wave-length is smaller than the shortest wave-length for which it will be used. It will then always behave as an inductance, and the current through it will lag behind the voltage.

To attain this result the self-capacity of the coil must be kept down by using a single-layer winding; and the diameter of the coil must also be kept small.

(*To be continued.*)

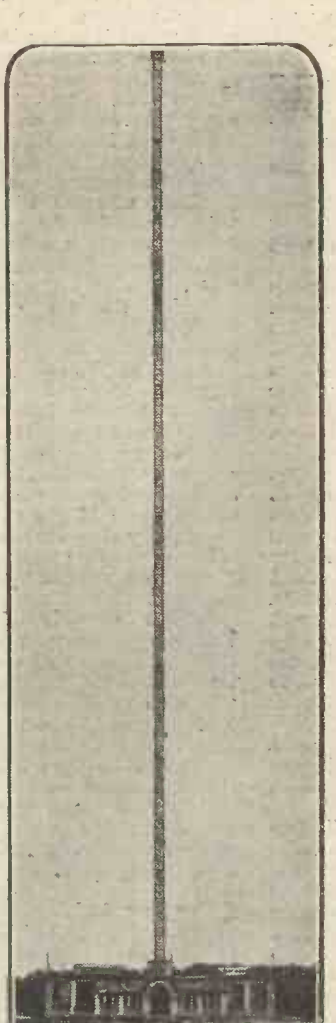
A FOUR VALVE RECEIVER.

Here is a compact four-valve receiver with loud speaker—a sound set for receiving the "Daily Mail" concerts from the Hague. The owner is Mr. W. F. E. Cres, 40, Manor Park Road, Harlesden, N.W. 10.



Apparatus installed at the recent wireless exhibition given by the Thanet Radio and Experimental Society at the Margate Pavilion and Winter Gardens.

POPULAR WIRELESS is known pretty well all over the world by now. Here is a photograph sent in by a reader in Malta, showing an automatic Morse machine used for speed tests.



Another view of the Sainte-Assise station, near Paris. This gives a good idea of the towering mast over the main station building.

£5,000 WORTH

There is £5,000 on this table, in the shape of vacuum tubes. College, New York, with his collection of the oldest and new 1915 valve. On the table may be see

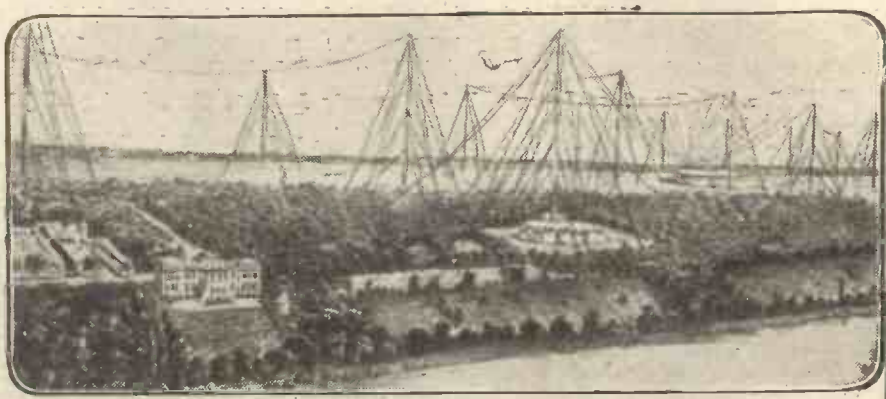
Some members of the Manchester Wireless Society. Earl American amateurs, using only 1 kw. They have lately erec them the best of luck in

OF ALL SORTS!

The photograph shows Professor Alfred N. Goldsmith, of the City vest vacuum tubes. Professor Goldsmith is holding an old-fashioned n a varied collection of "wonder bulbs."

y in the autumn the society will attempt to communicate with cted a new 88-foot mast. Amateurs all over the country will wish their forthcoming experiment.

THE LATEST WIRELESS GIANT.



A panoramic view of the new giant station of Sainte-Assise, near Paris. The aerial system will cover many acres of ground when completed, and the station will have a world-wide range. The station even now is more powerful than the Radio Central in America, and 35 times more powerful than the Eiffel Tower Radio.

In America, Radio is being used extensively for lecture purposes. The above photograph shows players taking a course of instruction in the game, via the loud speaker.

Mrs. J. H. Vickers, of Broadfield School, Station Road, Beaconsfield, Bucks, gets the wireless concerts from London on the 35s. receiver described in No. 1 of POPULAR WIRELESS. Croydon weather reports also come in well.

HINTS ON PRACTICAL WORK

By WARING S. SHOLL, A.M.I.E.E., A.Inst.A.E.

QUITE a number of readers, no doubt, having read the constructional articles that have already appeared in POPULAR WIRELESS, are anxious to try their hand at making their own apparatus, but are handicapped by want of proper equipment and guidance as to the selection and use of such tools.

In the present article the writer desires to offer a few practical hints, the outcome of many years' workshop experience, in the hope that they may prove of real service to the beginner to whom these lines are addressed.

Proper work cannot be done without suitable tools, but that does not imply that the would-be instrument maker should rush off and purchase an expensive outfit: he will do well to take stock at first of what tools he already has and supplement these by degrees, the idea being to purchase additional tools as required and not "on spec."

First and foremost we shall require "cutting" tools for "roughing out" our work from the bulk material; the following items being the indispensable minimum:—

A List of Tools.

Hacksaw, preferably adjustable, and one dozen blades 10 in., half 24 teeth to inch and half 32 teeth to inch—the latter for cutting tube, price about 2s. 6d. for the frame and 1s. 6d. per dozen blades.

Cold chisel, 9d.; light riveting hammer with "cross pane," 1s. 9d.; tinman's snips, preferably with "scissor" handles, 3s. 6d.; pliers, cutting, 10 in., 2s.; pliers, gas, 6 in., 2s.; hand drill taking drills up to $\frac{3}{8}$ in., 12s. 6d. up to 17s. 6d.; twist drills from $\frac{1}{16}$ in. to $\frac{3}{8}$ in. by sixteenths; files 8 in. to 10 in., "bastard," "second," and "smooth," flat and half round, also one or two smaller triangular, rat tail, and half round *with* handles.

It is impossible to do accurate work without handles, as without a proper grip of the tool it is difficult to keep the file flat on the work, which is essential in obtaining a true surface.

A scriber, for marking out work, can easily be made by sharpening up the end of a knitting needle; a centre punch will also be required for locating the positions of drilled holes.

A long shank screwdriver will be necessary for getting at awkward screws, and the larger sizes of bradawls will also serve as most useful screwdrivers.

An Important Item.

Among the most indispensable of all items is a soldering outfit, as one can hardly move a step in electrical work without having recourse to soldering. Do not buy a complete set, and don't be tempted to waste money on "fancy" soldering irons either.

Strange as it may seem, the best way to purchase this class of tool is by *weight*; in the trade an iron is sold by the weight of the copper "bit," and the size known as a "four ounce" will cover pretty well all the worker's requirements.

Tiny irons for very small work may be easily made from $\frac{3}{8}$ in. copper rod drilled transversely and riveted into a $\frac{3}{16}$ in. steel shank which is fitted into a wood handle.

The copper "bit" should then be heated up to a good red and the tip hammered down to a wedge-shaped point; copper should not be wasted in a case like this, and it is much better and easier forged than filed away to waste.

In the same way a groove may be made across the copper bit to receive jointed wires ready for soldering, so instead of filing the groove heat up the copper and drive a piece of steel rod, such as a wire nail, into the softened metal, which will produce the groove and greatly facilitate the soldering of joints in wires.

When tackling soldering the first essential is to have a well tinned "bit," and secondly, where possible, well tinned work, as it is otherwise impossible to get a ready "flow" of metal and a neat job.

To "tin" a new bit heat it up to just on red, give the end a touch with a coarse file, dip it into soldering fluid or rub it on a lump of sal ammoniac, then take a piece of clean tin—inside the lid of a fluxite tin will do—and rub the bit on the tin, at the same time applying solder from the end of a stick which has been dipped in fluxite.

At once a fine silvery coat should flow all over the copper, and once this condition has been obtained it should be preserved by refraining from overheating the bit, which condition is revealed by a green flame surrounding the iron, and requiring its instant removal from the heating agent, otherwise the tin will be burnt off and the iron rendered useless until re-tinned.

Moreover, the iron must be clean when applied to the work, and it is advisable to have a piece of coarse rag, folded several times and secured to the bench with a tack, upon which to wipe the bit when removed from the flame.

Solder Hints.

The variety of solder known as "blowpipe solder"—in thin, semi-round sticks—is the best to use, as the thicker kind takes the heat out of the bit too quickly for small work. Here again the article is sold by weight, about 1s. 3d. per lb., and it is much more economical to buy, say, half a pound than to purchase in sticks at so much a time.

A very handy paste solder may be made by filing some solder into a dab of fluxite and applying the mixture to small joints; a hot iron should then be brought up from underneath the work, and a final touch will run the whole joint into a neat and sound job.

Solder in the molten state is easily controlled by wiping with a rag smeared with a little of any good flux; this method is particularly useful when large surfaces have to be tinned.

"Clams."

Let us require to tin a brass strip $\frac{1}{2}$ in. wide by 12 in. long.

We first clean it up with emery cloth, next apply a little flux, and then hold it in a clean flame, touching it now and then with a stick of solder until the latter begins to run, upon which the solder should be sparingly applied in several places.

The strip is now removed from the flame and with the prepared rag gently wiped from end to end, upon which a beautifully thin and evenly tinned surface will be produced.

Turning once more to actual equipment, a vice will be found absolutely essential, and the variety known as the "parallel jaw" type will be the best for light work generally, and 2$\frac{1}{2}$ in. to 3 in. jaw will be a convenient size. It should be borne in mind that these smaller vices are largely of cast-iron, and will therefore not stand unlimited "slogging"; they should not be used for holding heavy work which involves the use of a hammer and chisel to any great extent.

Nothing looks more slovenly than a finished surface, such as ebonite or brass, that has been marred by being held in the vice jaws without some form of protection. For this a pair of "clams" are required, and are very easily made by cutting out two pieces of copper the width of the vice jaws and about 1$\frac{1}{2}$ in. deep by $\frac{1}{16}$ in. thick.

One piece is screwed up tightly in the vice with about $\frac{1}{2}$ in. projecting, and this portion is hammered over flat on the top of the jaw; the other piece of copper is treated similarly, and the result is a pair of L-shaped "clams" which will hold our work securely without disfiguring it.

Lead "clams" are also very useful, particularly for holding small screwed work without injury to the threads; for larger screwed work it is advisable to run some nuts over the threads and lock them up on each other, which will afford a good hold in the vice without bruising the screwed work.

When dealing with saws it should be borne in mind that these tools—also files—are designed to cut on the *down* stroke only, so the blade must be put into the frame with the teeth pointing *forward*, and the cut must be made on the forward stroke and "relieved" on the up stroke. Keep the blade tight in the frame and take a slow full stroke, keeping the saw straight, or broken blades will result as soon as the saw gets down to its work.

A very good tip, where a rather wider slot is required, is to put two blades into the frame side by side and use as one; this will be found a handy means of cutting slots in which switch blades or levers of detectors are required to work. For "roughing out" work coarse files should be used, as also for soft metals such as lead or solder; never use a fine file for such work or it will speedily "fill" and spoil both itself and the job.

"Fiddling" Screws.

Don't use new files on rough castings, as the sand in the rough "skin" will ruin a good file in no time; when filing aluminium keep the file dipped in water, which will obviate clogging to a surprising degree.

Files may be supplemented by flat sticks of a convenient length on which are glued strips of emery cloth in varying degrees of fineness; these will be found most useful in bringing up surfaces to a fine finish, and a number may be made in an hour and kept handy for use.

If the worker is fortunate enough to have a workshop to himself he will do well to fix up a good solid bench with a working edge of 2 in. stuff on good solid uprights, and if possible the metal working tools should be kept apart from the woodworking operations.

Screwing and tapping are rather advanced jobs for the beginner, but a quite satisfactory compromise may be effected by soldering screws into drilled rods, or nuts to portions in which the screw is desired to work.

In dealing with small and elusive machine screws the following tip will be found a great saver of time and language; instead of fumbling about with the finger and thumb tear a piece of paper to a point and push the screw through the paper up to the head.

Now hold the point of the screw over the tapped hole, and having given it a start with the screwdriver, tear away the paper—and "there you are." As a general recommendation the worker is advised to acquire a few comparatively simple tools and master them first before laying out further money on more ambitious articles.

He will do well to shun "combination" tools or devices of a "fancy" order: the proficient workman's tools are often of the simplest description. He should take care of his gear and not spoil good stuff by negligence.

In finishing ebonite panels get a good matt surface with emery or pumice, and take particular care to get any pencil markings out, otherwise the experimenter may find "unofficial" high resistance "leaks" cropping up in unexpected places.

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 reports if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An asterisk denotes affiliation with the Wireless Society of London.

Tuxford and District Amateur Wireless Society.

A most successful public meeting was held at the headquarters of the above society on July 27th, the chief speaker being Mr. J. G. Jackson, B.Sc. of the Sheffield and District Wireless Society. His subject was entitled "The Benefits of a Wireless Society," and the lecturer dealt with it in a very clear and lucid manner.

He pointed out the great mutual benefit obtained by wireless amateurs who were able to gather together and discuss their various failures and successes in the pursuit of their hobby. Also the help obtained by beginners in the choosing and purchase of their apparatus, and instruction given for its assembly and manipulation.

Another way in which a Wireless Society would be a great boon in the future would be in the tracking down and possible elimination of the ignorant "listener-in" who will persist in keeping his valve or valves oscillating when other people are trying to receive broadcast telephony. He urged all societies to affiliate with the Wireless Society of London. By so doing, every amateur had a voice in all matters appertaining to his hobby.

Mr. Ford (the Chairman) thanked Mr. B. Clarke for the use of the room, and the meeting closed at 9-0 p.m. Six new members were enrolled, which brings the roll of the society up to 40.

There is still plenty of room, however, for many more members.

North Middlesex Wireless Club.*

The 96th meeting of the club was held on Wednesday, July 26th in Shaftesbury Hall, Bowes Park. The chair was taken at 8.30 p.m. by Mr. G. Evans, who introduced Mr. Haynes, who had kindly consented to lecture on the "Johnson-Rahbek Loud Speaker."

Mr. Haynes had brought to the Hall the instrument which formed the subject of his lecture, and this was on view during the evening. He described the action of the instrument, and illustrated his remarks by diagrams drawn on the blackboard. He also explained the construction, more particularly with regard to the agate cylinder which forms an essential part of the instrument, and drew the attention of the audience to the importance of obtaining even electrical contact between the agate cylinder and the steel spindle on which it is fixed.

The instrument was then set in operation, and a demonstration given of its capabilities. The principle on which it works, which has already been described elsewhere, is most interesting, quite apart from its possible commercial application, and it was evident from the questions put to Mr. Haynes at the close of his lecture that several members had already decided to experiment in the same direction.

Particulars of the club may be had on application to the Hon. Sec., E. M. Savage Nithsdale, Eversley Park Road, Winchmore, Hill, N.21.

The Fulham and Putney Radio Society.

The monthly meeting of above society was held at their temporary quarters, 232, Putney Bridge Road, on August 3rd. The attendance was well represented, and several new members were enrolled. A long and interesting discussion took place amongst the members, and one or two gave their experiences with Wireless during the War. At our next meeting, if possible, we propose to have a 3-valve set working and to receive some amateur transmissions.

Hon. Sec.: J. W. Dewhurst, 52, North End Road, West Kensington, W.14.

Stoke-on-Trent Wireless and Experimental Society.*

At a meeting of the Stoke-on-Trent Wireless and Experimental Society, on Thursday, August 3, it was decided to admit the members of the Y.M.C.A., in whose building the Society have made their headquarters, at a special reduced annual subscription.

There was no meeting on August 10, owing to the holidays, but a committee meeting has been called to forward, as rapidly as possible, to effect the erection of an aerial, and the fitting up of the clubroom to suit the Society's needs. It is hoped to have everything ready by the end of the month, when the clubroom will have a formal and, probably, public opening.

The next meeting will take place on Thursday, August 17, when all members are requested to attend. Hon. Sec.: F. T. Jones, 360, Cobridge Road, Hanley.

The Hornsey and District Wireless and Model Engineering Society.

On Tuesday, August 1st, a successful meeting was held at 29, Felix Avenue, Weston Park, Crouch End.

A 2-valve resistance capacity set was tried out, and the reception of C.W. and spark signals were loud and clear.

Also, a single valve set was demonstrated, and music and telephony from several amateur stations were listened to with interest, including 2 M.T., who are to be congratulated on their splendid transmission.

Several new members were enrolled, and others are heartily invited, all particulars from the Hon. Sec.: Mr. H. Davy, 134, Inderwick Road, Hornsey, N.8.

Sutton and District Wireless Society.

The Secretary begs to announce that, owing to a considerable increase in the number of members, a larger room has been engaged for the meetings.

This necessitates a change from Thursday to Wednesday, commencing on August 9th (8 to 10 p.m.).

This new room is in the same building, namely, the Adult School, Benhill Avenue; and with the increased facilities a special effort will now be made to help the beginners.

Will all interested in wireless, both beginners and experts, please come along and thus ensure the continued success of the Society.

Hon. Sec.: E. A. Pywell, "Stanley Lodge," Rosebery Road, Cheam, Surrey.

Devonport Y.M.C.A. Wireless Society.

A Wireless Society has been formed at the Y.M.C.A., Devonport.

The "Lion" Radio Club has been formed in Shoreditch. Will all interested please write or call. Hon. Sec.: (pro tem.) A. V. Turner, 35, Aske Street, Pitfield Street, N.1.

Mr. L. F. White has now taken over the duties of Hon. Sec. for the Bristol and District Wireless Association.

A wireless set has been fitted up at the Linton House School, Holland Park Avenue, London.

RADIOTORIAL

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

It only seems a few weeks ago that the American newspapers were full of their latest and most wonderful wireless station ever created—the Radio Central.

Statistics were quoted, assertions were made, comparisons were almost hysterically spread over pages of paper—the upshot being that Radio Central was accepted as the world's greatest wireless station.

And now the Sainte Assise station, near Paris, claims the proud title. Who will be next? It seems almost incredible, but no sooner is one "world's greatest" completed before another has sprung up, soon, in turn, to be dethroned from pride of place.

Older wireless men will remember the breathless awe caused by the erection of the Poldhu station. Later, when Clifden was built; then, again, Carnarvon, Leafield, Lyons, Cairo, Bordeaux . . . . . One wonders when the race will end.

The recent announcement of Dr. Irving Langmuir, of America, that he has discovered a tube which will render the high frequency alternator obsolete, will—possibly, if its claims are justified—quickly render the latest addition to the ranks of the world's greatest stations out of date.

Meanwhile, readers may take a dark hint from me and look to Germany for the next "Radio Giant."

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have decided to reply individually by post. A weekly selection of questions will, however, be printed on this page, together with the answers; for the benefit of readers of POPULAR WIRELESS in general. Questions should be clearly and explicitly written, and should be numbered and written on one side of the paper only.

All questions to be addressed to: POPULAR WIRELESS, Queries Dept., Room 131, The Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send necessary postage for reply.

G. E. C. (Stratford).—For a long while I have been wondering what was causing a peculiar interruption while listening in on my set for telephony. (I have a three valve set employing a reactance circuit.) It generally commences at the beginning of one or other of the concerts and carries on intermittently throughout, spoiling all chance of hearing the music clearly. I have, at last, come to the conclusion that it is a neighbour using a buzzer to tune his instrument. Is that likely to be the case, and if so, is there any means of cutting this annoying interference out?

In all probability it is caused in the manner you suggest. You will be unable to cut it out, unfortunately, as no doubt this neighbour is endeavouring to tune in to the concert himself. This will mean that his set will be adjusted to a similar wave-length, and will be transmitting buzzer signals while he is adjusting his closed circuit or crystal. In any case, his aerial will be no great distance from you, and your should locate him and explain the circumstances tactfully. What with amateurs, who will allow their circuits to oscillate and those who will insist upon tuning in with a buzzer in circuit while some station is "broadcasting," it becomes more and more difficult to hear the programme out uninterrupted.

* * *

"COUPLED" (Brighton).—I have a "Megger" that will measure high resistances to 5 Megohms. What wire shall I use and how much to construct an intervalve resistance for coupling circuits in cascade?

Wire is not used for that purpose. Lengths of slate pencil should be measured for, say, five stages of resistance from 30–80,000 ohms, and arranged so that a switch will bring each alternately into circuit.

* * *

"CONDENSER" (Ilfracombe).—Why is it that the transatlantic stations transmit on very long wave-lengths. I have been told that the length of the wave will affect neither its speed or the distance to which it will travel?

A station of the type you mention will have an enormous aerial system covering some considerable area. It therefore stands to reason that the fundamental wave-length of such an aerial will be very long, running into thousands of metres. To reduce the natural wave-length of an aerial it is necessary to place capacity in series. That would cause great loss of energy.

* * *

F. B. (Bristol).—I have a flat in London situated so that it is impossible to erect an outdoor aerial. Will it be possible to hear the "Daily Mail" concerts from the Hague using a frame aerial?

Yes, quite; but at least four valves will be required

* * *

"CURIOUS" (Oxford).—Will it be possible to hear Leafield broadcasting on a crystal set?

No, for the simple reason that Leafield is not a broadcasting station. The traffic is purely commercial and being C.W. will be out of the scope of a crystal set.

* * *

"RADIO" (Manchester).—Is there any ratio between the wire used on the primary and the secondary of a loose coupler?

Not directly. For coils wound to 1,000 metre ranges 20 or 22 should be used for the primary and 22 or 24 for the secondary. Above that, use 22 for the primary, and 28 or 30 for the secondary for greatest efficiency.

(*Continued on page 229.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page 226.*)

What resistance should a potentiometer be ?

About 400 ohms.

* * *

"SPARKS" (Liverpool).—What resistance should a filament resistance for a one valve set be ?

Six to eight ohms.

Could I put three crystals in one cup and still retain the sensitiveness of each ?

Yes.

I have a crystal set, and wish to add another condenser. The one I have has 11 fixed and 10 moving vanes with $\frac{1}{8}$ in. spacing washers. Is it advisable, and what should the capacity be ?

No useful purpose will be served by the addition of another condenser to your set. The variable condenser in this case is for the purpose of fine tuning.

* * *

C. H. F. (Wembley).—My garden is 70 ft. long, and the room to which I wish the down lead to extend is on the ground floor. For a 2 valve set I propose to have a single aerial of 70 ft., not including the down lead. What would be the lowest height of the aerial to ensure good reception ?

Doubtless results would be quite good at 20 feet, but they would be better at 30.

Which is the most important, the higher aerial and longer down lead, or lower aerial and shorter down lead ?

The higher aerial. Make the most in height and length of the 100 feet allowed by the P.M.G., and endeavour to keep the down lead well clear of walls or other obstructions.

* * *

"A. B. 2" (London).—Can you give me information as to the using of a crystal set with a frame aerial ?

Crystal sets are not sufficiently sensitive to give results on frame aerials.

Could an ordinary electric bulb be used for a valve ?

No.

Would a twin aerial be more efficient ?

Not in these circumstances.

* * *

"RADIO" (Derby).—I propose to erect a set capable of receiving time signals, Hague concerts, etc. My aerial cannot be more than 35 ft. long or 20 ft. high, while the earth lead must be 16 ft. long. Can I hope to attain good results ?

Fair results. Run two or three wires to earth to reduce the resistance of the earth connection, and make the most of every possible inch of height.

Without going to the expense of valves, would a crystal set meet my requirements ?

Hardly. See the reply to B. D. in this issue.

What is the minimum voltage that I shall require ?

There is no applied pressure required for the ordinary crystal set, and in the case of valves it would vary with the number used. Four volts supplied by an accumulator for the filament, and 45–60 volts supplied by dry batteries for the plate circuit is necessary for a single valve set.

* * *

G. A. B. (Catford).—Can No. 30 S.W.G. wire be used for an aerial ?

Yes, it can be used, but a stouter gauge, such as 16 or a stranded such as 7/22, would give far better results.

Can an aerial be erected before having a licence ?

No ; the licence must be obtained first.

* * *

"AMATEUR" (Glasgow).—I live in the top flat of a three-storey building. How can I fix an outside aerial ?

As you supply no details of the building in question that is a difficult question to answer. If the roof is fairly large and accessible it should be possible to erect an aerial between the chimney stacks. If this cannot be arranged, perhaps you could run a wire from a staple fixed in the wall above your window to some point at a convenient distance, such as the roof or wall of an obliging neighbour. You would not be permitted to run it across a public footpath or thoroughfare.

* * *

H. R. D. (Rinella) submits a diagram of a valve circuit, the high tension of which is supplied by an induction coil, the current passing through a rectifier.

As has been stated before in these columns, this scheme has been unsuccessfully attempted. It is found that the irregularity of the spark discharges renders it unsuitable.

Is it possible to have a condenser of too great capacity across the 'phones ?

Yes. There is no need to trouble about the exact capacity of a telephone condenser, but it should not exceed ·01 mfd. for the amateur set that confine itself mostly to the shorter wave-lengths.

* * *

G. R. (Leeds).—Should I receive any messages using a crystal set in Leeds ?

With a good outdoor aerial and a set capable of tuning to 3,000 metres, you should be able to hear plenty of the more powerful spark stations working.

* * *

C. V. P. (Chester).—What is the condenser for ?

The principle function of a variable condenser is to give fine tuning by the gradual addition of capacity. Fixed condensers are employed for many purposes. The ability of a condenser to store electricity is useful at a point in a circuit where, for instance, it is necessary to reduce the frequency.

What is the life of the dry batteries ?

That varies considerably with make and usage. Some will last but a few months, while others—and, in fact, most reliable makes—will last six to nine months with careful handling. We have had a set in constant use for the last eighteen months, which still shows no signs of giving in. When it does, the wax will be removed from the top, the zinc containers punctured, and the whole battery will be immersed in a weak solution of sulphuric acid for a short period. The cells will then be carefully wiped, and the wax replaced, and the battery will again be placed in commission.

What is the life of an accumulator, and how long will it last per charge ?

With careful handling an accumulator should last many years. See that it is always placed in efficient hands for charging, and that the voltage is not allowed to drop below 1·8 volts per cell on closed circuit at any time. The actual frequency of charging will depend upon the capacity of the accumulator. Depreciation should not exceed 10 per cent. per year.

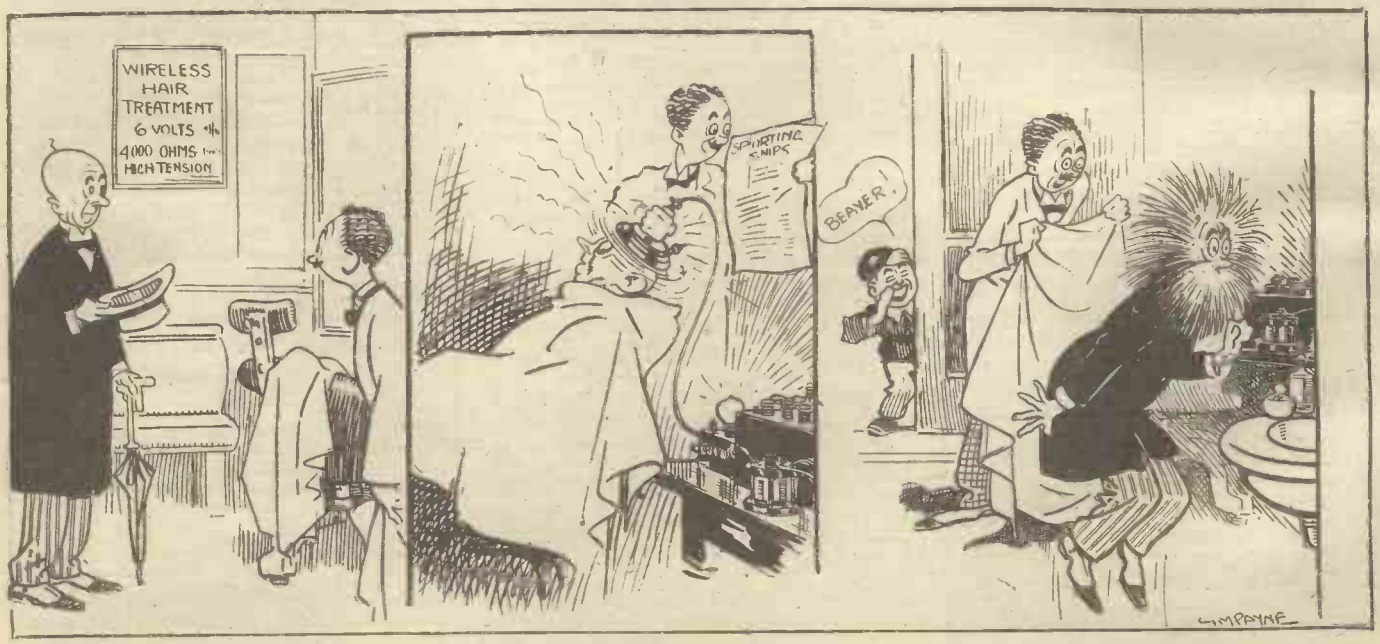
* * *

P. L. (Highgate).—I often hear Marconi House concerts on my crystal set, but cannot understand what is meant by "carrier wave." I have never heard anything but just the voices and music.

The carrier wave referred to is a continuous train of waves upon which the audio frequency is superimposed, as it were. The amplitude is modified at certain intervals to a certain extent corresponding with the variations caused by the sounds received by the microphone. It is only these variations, which are naturally of low or audio frequency, that would be received on a crystal set. For that reason very excellent telephony can be received on such a set within a limited range.

(*Continued on page 230.*)

A TONSORIAL TRAGEDY.



RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 229.)

"EX-SERVICE" (Crewe).—I have obtained a Mark 3 ex-service short wave-tuner, minus the condensers. It has a callibration card, but what should be the capacity of the variable condensers to comply with the wave-length tuning adjustments?

·0005 mfds for the "standby" or open circuit, and ·0015 mfds for the closed circuit.

* * *

"SPARKS" (Nottingham).—You say that a crystal set has a limited range for the reception of telephony, and on the other hand it is stated that a certain station has a range for the transmission of telephony of 1,000 miles. I am well within 1,000 miles of the said station, therefore will not the current from this station be received on my aerial?

In all probability it will, but it would be such a very weak current that a crystal would not be sufficiently sensitive to detect it.

Again, if my range of reception is 20 miles, and the range of transmission of that station 1,000, does it not mean that if the two radii cut signals will be received?

No. The normal range of transmission of a station indicates the approximate distance over which it could work uninterruptedly with a suitably equipped receiving station. In this case yours is not a suitably equipped station, an efficient valve set being required before it could be classed as that.

* * *

O. L. K. (Manchester).—I have invented an idea for the recording of wireless signals. In short, a strap that is covered with steel filings passes across the poles of a magnet that replaces the 'phones in the receiving circuit. Each filing becomes magnetised to a certain extent as the magnet is actuated by the received signals. These filings will retain their magnetism because they are steel. That is how the signals will be recorded. In order to reproduce the signals, this strap will be passed through a coil, each filing as it passes will cut the lines of force and generate a certain small amount of current in the coil. This coil will be in circuit with a valve receiver, which will reproduce the signals exactly as received. Is the idea practicable, and is it original?

Unfortunately, it is neither.

* * *

"ARTES" (Hednesford).—Will the current received on the aerial actuate a delicate relay? If so, can the relay be connected straight to the aerial, or must a detector be employed? Would a crystal or valve be most suitable for this purpose?

In order to actuate a relay, the current must be unidirectional, and therefore a detector is necessary. Several stages of valve amplification are necessary to increase the strength of the received current in order to operate the most delicate relay.

* * *

J. H. T. (Darlington).—Can you tell me the nearest broadcasting stations, and also whether I would be able to hear telephony from those stations with a crystal set?

Marconi House, London, and Writtle. To receive from these stations you would require an efficient valve set.

* * *

"WIRELESS KID" (Northampton).—Can I, by adding two variable condensers and one fixed condenser, increase the range of reception of a crystal set for telephony above 20 miles?

If your set is a single circuit receiver, there will be no useful purpose served by the addition of two variable condensers. One, if placed across the coil, will enable finer tuning to be obtained, but will not materially increase the range of reception. The fixed condenser can be placed across the telephone receivers in order to improve the quality and tone of the signals.

* * *

A. T. H. (Streatham Hill).—What is the construction and working of a Noden Valve for charging accumulators from the A.C main?

The action of a Noden Valve is that when a plate of aluminium and a plate of lead are immersed in a certain solution, the positive current can pass from the lead to the aluminium, but not in the other direction, owing to a film of gas that collects on the aluminium. The construction is very simple. A glass container should be obtained (a three-pound jam-jar will do) and fitted with a wooden cap that has been well soaked in paraffin wax. A lead plate is bent round the inner circumference of the jar and attached at a convenient point to a terminal screwed into the cap. Two feet of aluminium rod should be procured and treated with a hot solution of caustic soda to render the surface suitably "mat." This rod must then be coiled into a spiral, taking its position in the centre of the container with a suitable terminal in the centre of the wooden cap. Finally the container should be filled to within two inches of the top with a saturated solution of bicarbonate of soda. One cell constructed on these lines will allow one ampere of rectified current to pass through. Two points should be remembered. First that the valve will not operate directly it is attached to the main, and therefore it should first be placed in circuit with a lamp or resistance; and secondly it ceases to rectify if the temperature of the solution rises above 50 degrees cent. It is therefore advantageous to stand the cells in a tank with a continuous flow of water circulating for cooling purposes.

* * *

"CELLED" (Portsmouth).—I have purchased a number of accumulators second-hand, but I have discovered that they are not the bargains I thought at first they were. One cell in particular is supposed to have a capacity of 40 ampere hours, but it runs down after only an hour or two's discharge, although it has been charged carefully. There is a peculiar white substance on the plates. Is that likely to be the cause of the trouble?

Yes, that is the cause of the trouble. Evidently the cell has been neglected and the plates have sulphated. Do not endeavour to remove the white substance. The cell should be given a long continuous charge of 40 hours or so at half the usual charging rate, continuing the charge for some long period after the plates have commenced to gas. If that does not prove effective, run off the acid and refil with acid of about 1.95 specific gravity, and repeat the process. Subsequently the acid should be renewed.

(*Continued on page* 232.)

RADIOTORIAL.

QUESTIONS AND ANSWERS

(Continued from page 230.)

H. K. (London).—What apparatus should I need to use a loud speaker with a single valve set ?

No extra apparatus is necessary, the loud speaker merely taking the place of the telephone receivers. At the same time it must be mentioned that only the very strong signals will give satisfactory results, and therefore the range of such a combination will be small. One stage of amplification would greatly improve results.

* * *

M. N. (London).—What capacity condenser shall I have across my coil ?

·0005 mfds. would seem suitable.

What is the best wire to use for the aerial ?

7-22-gauge stranded bare copper or phosphor bronze.

Will the enclosed specimen do for the aerial ?

This, 28 S.W.G., could be used, but the wire mentioned above would prove far more efficient.

* * *

"MAC" (Shepherd's Bush).—How much wire would I require to wind a single layer of 28 S.W.G. on a former 7-in. long and 6-in. diameter ?

6 ozs.

How much 32 on a former 7-in. long and 5-in. diameter ?

4 ozs. It would appear that you intend to construct a loose coupler. The most suitable gauges for formers of the sizes mentioned is 22 S.W.G. for the primary and 28 for the secondary.

* * *

"DISCHARGED" (Birmingham).—I have obtained a large number of old batteries, including some 30 single-cell accumulators. Can I take these to pieces and get together the plates that are in fairly good condition, and make up some complete cells ? How is the celluloid repaired ?

Yes, you can certainly do that. Pick out the plates that show the least sign of sulphation. This can easily be detected by the white substance that adheres to the plates when in that condition, and the positive plates that still retain their paste. For repairing the celluloid, use acetone. This liquid will dissolve the celluloid, making it possible to obtain perfectly acid-tight joints in the casing by running a little along the edges of the fracture. Care must be taken in this work, as both the celluloid and the acetone are extremely inflammable.

* * *

"ENQUIRER" (March).—Can I hear stations on every stud of my inductance at any time during the night or day ?

As you have a crystal set with but a limited range, it is extremely improbable.

S.G. (Cardiff).—It has been stated that a crystal set is useless with a frame aerial. But could I not accomplish just a ½-mile range for telephony using these ?

Most probably you could, and that would be about the limit.

* * *

T. W. (Mitcham).—What is the capacity of a variable condenser having 25 fixed plates of 3-in. radius and 24 moving plates spaced ⅛-in. ?

The most important measurement is the radius or diameter of the moving vanes. This is presumably about 2½-in. The capacity would be .011 mfds. If you intend the 3-in. to represent the diameter and not radius, and the moving vanes have a diameter of 2½-in. .0022 mfds.

* * *

A. W. (Londer's End).—What would be the resistance of a coil wound with 32 turns of 16 S.W.G. on a 4-in. former ?

·15 ohm.

What would be the wave-length using a 20-ft. twin ?

·95 metre.

Are the connections of my set correct ? (Diagram enclosed.)

No. A lead from the earth side of the 'phones must be taken to the beginning of the coil.

* * *

"AMATEUR" (Streatham).—States that he is having trouble with his single-valve set. Apparently he cannot cut out insistent "howling."

That may be due to an unduly "soft" valve and the application of too much H.T. More probably it is caused by capacity effects. The reaction coil may be too large or the variable condenser used may be of too great capacity. This latter should not exceed ·0005 mfds. for your set. Separate all internal wiring, and see that there are no twisted leads. Try the effect of a small two-plate fixed condenser connected directly between the plate and earth. If the trouble continues, send a detailed diagram of your set along with the most minute particulars possible.

* * *

"WORRIED" (Folkestone).—I am informed by the P.M.G. that I must not employ a circuit that in operation will energise the aerial, even temporarily. I understand from what I read in POPULAR WIRELESS, that any circuit that employs reaction will energise the aerial even if the reaction-coil is coupled to the secondary and not primary of the tuner. Therefore, it seems that I am debarred from receiving messages from C.W. stations, and will also suffer limitations of range for the reception of telephony. Is that the case ?

No, you can use a separate heterodyne. This will not cause radiation if coupled to the plate-circuit of the detecting valve. Although you will have to use another valve, and separate H. and L. T. batteries it will greatly improve your set in point of selectivity.

"ROYAL OAK" (East Ham).—Can I have an aerial of two sets of four wires arranged on cross-pieces ?

In view of the limitations in the length of wire that can be used, you would be restricted to about 10 ft. in length. For amateur stations the most efficient aerial is a single wire, taking as much advantage as possible of the 100 ft. combined height and length that is allowed.

* * *

"LAURELS" (Highgate).—The nearest waterpipe is 35 ft. from my set. It is also 35 ft. to the ground. There is a strata of clay about 1 ft. down, and, therefore, the ground is always damp. Which earth will be the better ?

What is the exact meaning of "connecting across." Does it mean connecting in parallel ?

Yes.

The direct earth to the ground by far. You should bury a plate in the clay, soldering the lead if possible. Run three or four wires of heavy gauge to reduce the resistance of such a long earth connection.

I am going to use 8,000 ohm telephones with a crystal set. Would I get better results with lower resistance 'phones with a telephone condenser ?

You are confusing the functions of a condenser with those of a transformer. The higher resistance telephoned will give the loudest signals, and the placing of a condenser in parallel will improve the tone of the signals, but will not appreciably affect their strength.

* * *

"DOUBTFUL" (Cleethorpes).—My aerial will run parallel to telephone wires for a distance of 55 ft. and 5 ft. away. Will that cause trouble as I intend to use valves ?

Yes, it is probable that there will be considerable interference. You should endeavour to keep the aerial as far away, and as far from the parallel, to these wires as possible.

Is it permissible to run a wire from my bedroom window to that of a friend's across a passage some 80 ft., for the purpose of communicating by means of a key and buzzer ?

Not if the passage is a public footpath.

* * *

H. J. P. (S.E.12).—I have about 110 ft. of 13 S.W.G. copper wire ; would this do for my aerial ?

Yes.

I can arrange a 100 ft. single wire : would this be better than the shorter twin aerial ?

Yes.

Must the lead-in wire lead in from the same direction as the aerial, or would it matter if it left at 90 degrees ?

To the contrary, the latter is to be preferred.

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POPULAR WIRELESS WEEKLY. August 26, 1922.

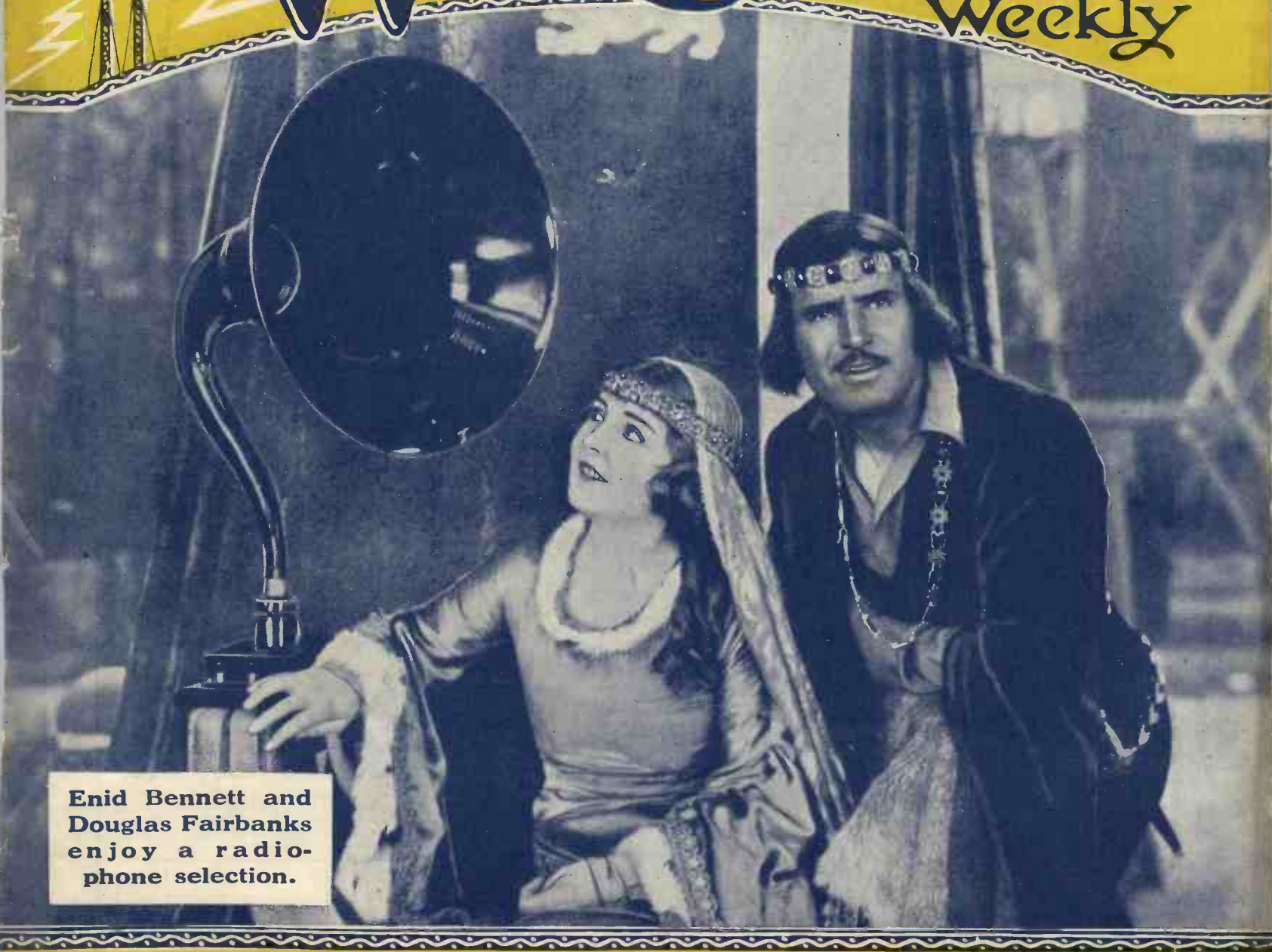
REGISTERED AT THE G.P.O. AS A NEWSPAPER.

No. 13. A HOME-MADE CONDENSER: SPECIAL CONSTRUCTIONAL ARTICLE THIS WEEK

POPULAR WIRELESS Weekly

3d.

No. 13. Vol. 1.
Aug. 26, 1922.



Enid Bennett and Douglas Fairbanks enjoy a radio-phone selection.

SPECIAL FEATURES IN THIS ISSUE

Psychic Phenomena and Wireless

Wireless Control

New Series for Beginners

Does the Eye "Wireless"?

Hints to Amateurs

How to Make a Short-Wave Receiver

"A HOME-MADE CONDENSER,"

Special article by

George Sutton, A.M.I.E.E.,

of interest to all amateurs making their own sets, appears in this issue.

Popular Wireless

TOPICAL NEWS AND NOTES.

"PSYCHIC PHENOMENA & WIRELESS,"

an absorbing article by

P. J. Risdon, F.R.S.A.,

appears in this issue.

This article will be widely discussed, as it deals with a theory of universal interest.

A Wireless Colony.

I HEAR that the Marconi Company are establishing a big wireless colony at Ongar, in Essex, which will cover over a thousand acres. Here will be built a series of stations for long-distance work; in fact, so extensive is the scheme that it will be a wireless centre of an unprecedented nature.

* * *

A Wireless Melody.

YOU have all heard of "The Peep-Show"? Well, any of you who have seen this pretty revue will remember the echo song, which is sung in the "Valley of the Echoes" scene. This lyric was the first that has ever been transmitted by wireless, for it was composed in mid-ocean by the late Mr. J. W. Tate, and wirelessed to this country.

Major Raymond Phillips's wireless controlled airship. Major Phillips is contributing an interesting series of articles on Wireless Control to POPULAR WIRELESS.

Improvements at Boulogne.

EXTENSIVE improvements are being carried out at Boulogne, which will greatly help shipping of all sizes. At present the station has four pylons of 46 metres height, supporting two emitting antennæ and two fixed receivers of 3,000 sq. metres each. Messages can now be sent 300 miles in a northerly direction, and 400 in a westerly direction.

* * *

The Question of Licence Fees.

MR. MILTON BLAKE SLEEPER, the American radio expert, who has just left this country after a visit of inspection of English wireless methods, declared before he left that the United States found it would not be advisable to tax wireless receiving sets, and he thinks that this country is making a great mistake in imposing the present ten shilling fee.

The trouble of taking out a licence always deters a lot of people, who dislike anything in the shape of an official form, especially as it generally is more difficult than an exam. paper. As broadcasting days are still in their youth, let every encouragement be given to amateurs, and when broadcasting is in full swing, then a small licence might be imposed.

* * *

Masts over 800 Feet.

I HAVE told you before that the Government intend to erect a new transmitting station at Bourne, near Spalding, Lincolnshire, in connection with the Imperial Wireless Chain round the world. There are to be eight steel masts, each 800 ft. high.

Steel is a conductor, and therefore may easily cause loss of electrical energy, so that the masts will have to be insulated in sections. They will have concrete bases, and will be built to stand a horizontal pull of ten tons at the top, and a wind load of 60 lb. per sq. foot.

The transmitting station will be in the centre, whilst the eight masts will be grouped all round in a square formation. Thermionic valve sets capable of transmitting continuously at ninety words a minute, to be received as far distant as Poona, Johannesburg, etc., will be used. The new receiving station at Banbury, which I have also mentioned before, is the end of the imperial chain, and will be built on similar lines to the station already in existence, which deals with the Leafield-Abu Zabal (Egypt) link of the chain.

* * *

A Wireless Typewriter.

EXPERIMENTS are now being carried out at the Post Office with a machine known as the teletype, which is nothing more or less than a wireless typewriter. Messages are sent out on an ordinary typewriter keyboard, and are picked up automatically and are delivered, typewritten, at their destination on slips of paper very similar to those used in tape machines. Forty-five words a minute can easily be sent out and received.

One of the greatest attractions of the invention is that it is impossible for ordinary receiving stations to pick up these messages. There are five bars underneath the keyboard by which the operator has 120 codes at his disposal, and the wonderful part of it is that the receiving apparatus at the other end automatically decodes the messages as they arrive. This has already been tried successfully in this country before, but Morse code has only been employed.

Demonstrations are being given by the Murray Printing Telegraph Systems, at 55, Goswell Road, E.C., of this clever American invention.

* * *

Marconi Looks Ahead.

"THE new industry of wireless telephony, from which we contemplate a very considerable revenue, should provide remunerative employment for some tens of thousands of men and women who have been so long suffering from the severe depression in trade."

This statement was made by Senatore G. Marconi in his presidential address to the shareholders of Marconi's Wireless Telegraph Company at Connaught Rooms, London, W.C., the other day.

Senatore Marconi then announced that, although the profit—£275,361—was smaller than last year's, the rate of dividend would remain unchanged.

"In the early future," added Senatore Marconi, "this company and others will take part in opening up telegraph services between South and North America and between South America and European capitals."

Mr. Godfrey Isaacs, the deputy chairman and managing director, said that hitherto the company had been compelled to look to foreign Governments for support.

"We have now," he continued, "in the broadcasting system a public with whom we have every prospect of doing a very large business."

* * *

The Proposed Service.

"THE broadcasting service," says: "The Times," is intended to provide a six-hours' programme every evening from 5 till 11, with the exception of Sunday, when the programme will occupy practically the whole day, beginning with a sermon in the morning by one or other of the leading preachers.

"Other details of the broadcasting programme are receiving consideration. No decision has yet been taken with regard to the character of the news to be transmitted. In order that the wireless may not compete directly with the newspaper, 'live' news will not be sent. As to where the line is to be drawn between 'live' news and 'dead' news, the Postmaster-General has intimated that he will take the representatives of the newspapers into his councils.

"The name of the new company will be the British Broadcasting Company. Though it has been objected that broadcasting is an inelegant term, none equally expressive has been devised, and it is the one that has now been officially adopted by the Post Office. There will probably be six manufacturers on the board of directors, with an independent chairman. A well-known public man has been invited to become chairman."

A Marconi Direction Finder (Marine type).

NEWS AND NOTES,

(Continued.)

Wireless and Cable.

OWING to the partial interruption of the cable service to the United States, caused by the Irish rebels seizing the cable stations on the west coast of Ireland, a large amount of Press work has been diverted to Leafield, the Post Office wireless station at Oxford.

This station has for some time been conducting a limited Press service to Halifax, Nova Scotia—an average of 2,000 words a night. During the past week about 8,000 words a night have been signalled to Halifax.

* * *

Humours of Wireless.

"LISTENING-IN is not without its moments of humour. There is the classic joke, hoary amongst pre-war wireless men, of the junior operator, who, muddled about call-letters and mistaking the coast station of Ushant for a ship, signalled, 'Where are you bound for?' The operators on dozens of ships hugged themselves on hearing this, but when, after profound thought, the French operator replied, 'Mister, I am Ushant. I do not budge,' they enshrined the incident in their hearts together with the story of the Japanese operator who gave a general call, and added, 'All gentlemans, honourable embarkery affixed muddily and unable to coming out,' meaning that his ship had stuck on a mudbank and could not get off.

"Working down among the ships on 600 metres can be made very interesting by the use of a frame aerial with which, as has been explained in earlier articles, one is able to determine the direction from which signals arrive. In fact, given favourable circumstances, it should be possible for an amateur with a frame aerial, a good compass, and a map, to trace roughly the progress of a ship along the coast by means of careful observations made at intervals of a few hours."—(Mr. E. Blake, in "The Daily Mail.")

The Sign on the Door!

Wireless Exhibition.

OWING to late arrival it was not possible to print an advertisement of the Wireless Exhibition and Convention, to be held at the Central Hall, September 30th to October 7th, in this issue. The advertisement will appear in the next number of POPULAR WIRELESS, giving the names of 55 exhibitors.

* * *

New Swedish Station.

THE new Swedish wireless station which is to be completed next year on the West Coast will be erected by the American Radio Corporation. There has been much competition for the work. The station will cost 3,700,000 crowns, of which the Americans will receive a little over a million for their work.

* * *

Clifden Freed.

A GALWAY message in the daily Press states that the town of Clifden and the Marconi wireless station have been freed.

National troops landed in two columns at dawn, and, after a running fight lasting thirty-five minutes, the Irregulars fled, leaving all their stores and an ammunition dump. The bridges at the approaches to the town had been mined, but none of the mines was exploded, the outposts being taken by surprise.

* * *

An Apology.

THE following appears in the issue of the "Wireless World," dated August 19th:

"To the Organisers of The Radio and Wireless Exhibition and Convention.

"We desire to express our deep regret that the advertisement inserted by us in the 'Wireless World and Radio Review' contained a very serious reflection on the Exhibition to be held at the Central Hall, Westminster, on the 2nd September, by the Radio and Wireless Exhibition and Convention. We failed to realise its full significance at the time, but we realise now the injury which it was calculated to occasion to the Radio and Wireless Exhibition.

"We undertake not to repeat it, and we also undertake to publish this apology in the next issue of the 'Wireless World,' in as prominent a manner as our advertisement, and to pay the costs.

"We are,
"BERTRAM DAY & Co., Ltd.,
"(Signed) BERTRAM DAY,
"Managing Director."

"Important Public Warning."

THE following also appears in the "Wireless World":

"We regret that in the advertisement columns of our issue of the 12th August we inadvertently published a statement under the above heading, which we now realise was a very injurious one to the forthcoming Exhibition of the Radio and Wireless Exhibition and Convention, which is to be opened at the Central Hall, Westminster, on September 2nd.

"We desire to express our regret at the inaccuracy of such advertisement, and for any injury or damage occasioned.

"(Signed) W. H. BREWSTER,
"For THE WIRELESS PRESS, Ltd.,
"11th August, 1922."

Mr. George Sutton, A.M.I.E.E., a Popular Contributor to *Popular Wireless*.

The Broadcasting Co.

JUST before going to Press I hear that the committee of manufacturers who are at present engaged in creating the Broadcasting Company state that the memorandum and articles of association of the company are in course of preparation, and as soon as these are approved the company will be registered, and the board appointed. Thereafter a full statement will be issued.

ARIEL.

Broadcasting Programmes

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

THE announcement that a broadcasting company has at last been formed brings daily telephony and music programmes within measurable distance, and it is quite possible that by the time these words are being read the Marconi station will have commenced a regular service. During any evening amateurs may be heard working. Musical selections are frequently transmitted by the latter.

At present the following stations are to be relied on for telephony transmissions:

TELEPHONY TRANSMISSIONS.

Station.	Call Letters.	Wave-length.	Remarks.
Croydon	.. G E D ..	900 metres ..	Throughout day to aeroplanes.
Marconi House, London ..	2 L O ..	360 metres ..	Between 5 p.m. and 6 p.m. (not regular).
Writtle, England	2 M T ..	400 metres ..	Tuesdays, 8 p.m. (B.S.T.).
Paris	F L ..	2,600 metres ..	Daily, 5 p.m. (B.S.T.).
Königswusterhausen ..	L P ..	2,500 metres ..	Daily, 7 and 10.30 a.m. (G.M.T.).
The Hague	P C G G ..	1,050 metres ..	Sundays and Thursdays, 8 to 9 p.m. (B.S.T.).

WIRELESS CONTROL.

By Major Raymond Phillips, I.O.M., Late Member of the Inter-Allied Commission of Control.

PART 2.

IN my previous article I referred to a special coherer, which I designed many years ago for use in connection with my experimental apparatus.

A coherer is generally classified as an "imperfect contact detector," and though now obsolete for the detection of wireless telegraph signals, it still has many advantages for the control of mechanism at short distances.

It seems curious that, although so long ago as 1835 it was discovered that the passage of a high-tension electric discharge through a loose mixture of metal filings rendered the latter conductive to electric currents, it was apparently not until 1890 to 1896 that the discovery attracted sufficient attention to

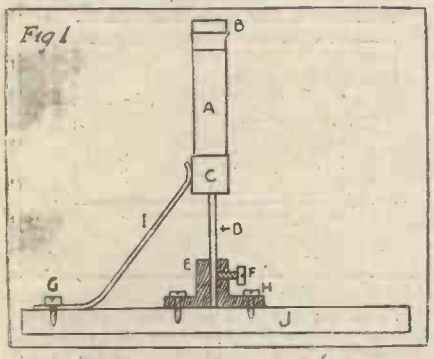


Fig 1

cause serious experiments to be conducted in connection with wireless telegraphy. The term "coherer" appears to have originated from a theory that incident wireless waves caused the filings, or particles of an imperfect contact detector, to "cohere." There may probably be some truth in such a theory, as the art of "tapping" a coherer causes the filings, or particles contained therein, to decohere, thus restoring such into a non-conductive condition.

A New Coherer.

As the "tapping" device involved complications, it led to a number of inventions for "self-restoring" imperfect contact detectors. The latter appeared to need such extremely fine adjustments, that at the time the coherer with "tapper" held the field.

In the construction of a coherer for telemechanical control the first consideration is certainty of action.

Large contact surfaces tend to make a coherer very sensitive, but sometimes "sluggish" in de-cohering. Such a detector for experimental apparatus would be a source of annoyance when connected with a relay, on account of its tendency to develop "pumping" in the latter. The smallest electric current possible (consistent with efficient working) should be permitted to pass through the filings and contacts of a coherer.

The "selective controller" attached to the wireless-controlled airship, as described in the specification of my British Patent No. 6316 of

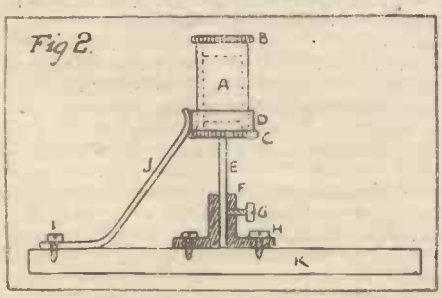


Fig 2.

1910, was at first fitted with a vertical type of coherer as shown in Fig. 1. It consisted of a glass tube A, plug B, brass cap C, supporting rod D, base E, clamping screw F, terminals G and H, also contact spring I. The whole being mounted upon a non-conducting base J.

The interior contacts of the coherer are connected to the exterior of the cap C, and supporting rod D; a mixture of nickel and silver filings being contained in the glass tube A.

This coherer proved more reliable than the "horizontal" glass tube type, but strenuous conditions called for a more substantial detector, which led me to design the coherer as shown in Fig. 2. It consisted of a vulcanised fibre tube A, screwed plugs B and C, contact ring D, supporting rod E, base F, clamping screw G, terminals H and I, and contact spring J. The whole being mounted upon a non-conducting base K.

Useful for Experiments.

The interior contacts of the coherer are connected to contact ring D and supporting rod E; a mixture of nickel and silver filings being contained in the vulcanised fibre tube A.

This coherer proved most reliable, and useful for experimental apparatus. Its sensitivity could be adjusted to a nicety by simply unscrewing the plug B and adding or removing filings as desired; whilst the interior contacts could be examined without removing the filings by unscrewing the plug C, whilst holding the device with the supporting rod E pointing upwards.

This coherer has been used in connection with all my experimental apparatus, and was fitted to the selective controller attached to my wireless-controlled airship, which during its flight released imitation bombs over the artificial lake in the Empress Hall, at the Imperial Services Exhibition, Earl's Court, in 1913.

A Simple Circuit.

The coherer was connected to a relay wound to a resistance of 100 ohms, the armature of which was mounted upon a vertical pivot.

A simple circuit for use with the coherer just described is shown in Fig 3. It consists of the coherer with base A, de-cohering device B (which is similar to an ordinary electric bell with gong removed), relay C, relay contact D for closing the circuit connected with the electro-magnet E (which may, for example, operate "step by step" mechanism), contact F for closing the circuit connected with the de-cohering device B, G G, metallic rods (which represent an aerial) H, relay battery I, coherer battery J J, insulated supporting pillars for rods G G.

In operation it will be observed that on the coherer A detecting a wireless wave, current from the battery I will energise the relay C, closing contact D, thus admitting current from the battery H, which will energise the electro-magnet E, closing the contact F, and causing the de-cohering device B to tap the coherer, which latter would then be restored for detecting further wireless waves.

If the electro-magnet E were to operate "step by step" mechanism, the system would be "simple selective control," *i.e.*, control by "sequence."

If the coherer A and rods G G were removed, and the contacts of a very sensitive relay (forming part of one of the latest valve receiving sets for tele-mechanical control) were connected with the points J J, it would be possible to control the electro-magnet E from a considerable distance, provided the valve receiving set was not subjected to vibration, as I explained in my previous article.

For controlling model airships, boats, etc., the circuit shown in Fig. 3 will be found useful, more particularly so in the case of small airships, where "weight by apparatus" has to be carefully considered.

It will be observed that a "potentiometer" is not required to be connected in series with the coherer (as shown in Fig. 2) when used in conjunction with a relay wound to a resistance of 100 ohms.

It will be recognised that such a device enables an operator to keep "cool" whilst wirelessly controlling a model airship in flight.

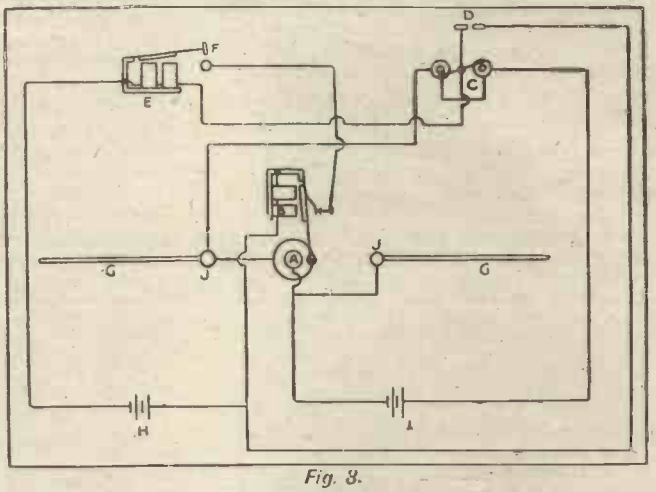


Fig. 3.

Vast Possibiltiies.

Another method of control is "direct selection." This involves somewhat complicated circuits. I shall show diagrams of these in subsequent articles.

It may interest readers to know that ten years ago I constructed a wireless-controlled carillon. I used a "selective wireless transmitter" which was fitted with a keyboard, and it was possible to play an "air" on the carillon by pressing certain keys on the transmitter. One afternoon in 1912 the late Professor Silvanus P. Thompson, F.R.S., tested the apparatus. The test was carried out with the transmitter and receiver 100 feet apart.

It seemed quite "uncanny" at the time, on pressing a certain key of the selective wireless transmitter, to observe the corresponding bell note, and that note only sound in the receiver.

I mention this experiment merely to indicate the vast possibilities open to wireless enthusiasts.

The first four articles of this series are intended as an outline of the possibilities of wireless control. In No. 5 the author will explain how the amateur can, at very little cost, control a toy train by wireless.

HOW TO MAKE A SHORT-WAVE RECEIVER.

By PHILIP R. COURSEY, B.Sc., F.Inst.P., A.M.I.E.E.

PART 5.

As was stated in last week's article, the reaction coil for use in this set should be in the form of a single layer solenoid of small diameter in order that its self-capacity may be as small as possible. The inductance of the winding needs to be fairly large, or there will not be sufficient coupling between the two circuits of the valve for the coil to be effective.

The single layer winding should therefore be constructed of finer wire than that used for the main tuning coil.

An ebonite, paxolin, or cardboard tube should be obtained, 1⅞ inches outside diameter by 2¼ inches long by about $\frac{3}{32}$ to ⅛ inch thick. A piece of hard wood 1⅞ inches square by ⅜ inch thick should be turned or cut with a chisel to a circular disc shape approximately 1½ inches diameter so as to fit tightly into one end of the above tube.

Winding of the Coil.

It should be secured in position by means of three small brass countersunk-head wood-screws through the tube into the edge of the wood disc, so that the outer face of the disc is quite flush with the end of the tube.

Next, at a distance in of approximately ⅛ inch from the open end of the tube, two small holes about $\frac{1}{32}$ inch diameter should be drilled through the wall of the tube about $\frac{3}{16}$ of an inch apart.

These should be used for securing the end of the wire for winding by passing it through one hole from the outside of the tube back to the outside through the next hole, and back inside again through the first hole. A length of four inches of wire should be left inside the tube to be used subsequently for connection purposes. A suitable wire to use for this coil is No. 28 S.W.G. double-silk-covered copper wire. A length of the order of 45 feet of wire will be required for the coil.

Eighty turns should be wound on, commencing from the above-mentioned securing holes, and the end of the wire fastened in place by passing it through two similar holes $\frac{3}{32}$ inch diameter drilled through the tube just clear of the end of the winding, so as to leave a length of wire of about 4 inches inside the tube for connection purposes.

Assembling Instructions.

A strip of wood 5½ inches long by ¾ inch wide by ¼ inch thick should now be cut, and one end screwed into the outer face of the wood disc which has already been secured into the end of the reaction coil.

Two countersunk-head brass screws can be used for this purpose (Fig. I.). When this strip of wood has been secured in place two holes $\frac{3}{32}$ inch diameter should be drilled through the wood disc at the end of the coil, one on each side of the wood strip in the positions marked A and B in Fig. I. Into each of these holes a short piece of Sistoflex insulating sleeving should be pushed so as to form an insulating tube through the wood through which the ends of the coil winding can be passed.

Next prepare a piece of ebonite 1½ inches long by ¾ inch wide by $\frac{3}{16}$ inch thick, and through it drill two holes ⅜ inch apart through which two screws and nuts can be passed as indicated at H H in Fig. I. No. 5 B.A. countersunk-head brass screws ⅜ inch long will be suitable for this purpose.

Their heads should be countersunk into the ebonite so that they sink about $\frac{1}{32}$ inch below the surface. These screws should be fitted with two nuts and a washer each. The ends of the coil winding can be secured under these nuts, taking care to thoroughly clean the wire before the nuts are screwed up tight.

The Reaction Support.

The outer nuts will serve subsequently for connecting flexible leads to the coil so that current can be led into and out of it in whatever position the coil may be used. This ebonite block with its screws should be fixed on to the wood strip attached to the coil at 2½ inches in from the end of the strip furthest from the coil as indicated by G in Fig. I. Two brass screws J J should be used for fixing the ebonite block in place on the wood strip.

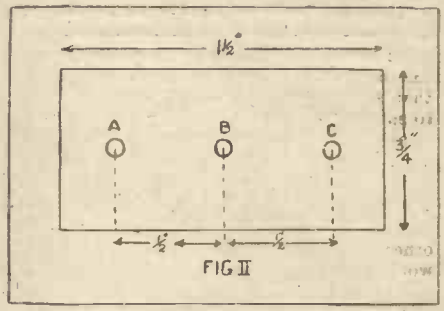


FIG II

In order to support the completed reaction coil on to a rotatable spindle by means of which its coupling with the main tuning coil can be varied, a block of hard wood C, Fig. I, 1½ inches by 1¼ inches by ¾ inch, should be prepared.

Final Hints.

This, when ready, should be glued and screwed on to the end of the wood strip remote from the reaction coil as sketched in Fig. I, using three long thin brass screws K K K for the purpose. A hole D, ¼ inch diameter, should be drilled through this block 1 inch from the face attached to the wood strip.

A piece of brass strip 1½ inches by ¾ inch by ⅛ inch should be filed up, and have three holes drilled through it in the positions indicated by A B C in Fig. II. The holes A and C should be drilled to fit any convenient wood screws that are available of about $\frac{3}{32}$ inch diameter. These screws should have countersunk heads and be approximately ⅝ inch long.

The heads of the screws should be countersunk into the brass. This piece of brass is screwed on to the block C, Fig. I, on its face remote from the wood strip as shown at E. The centre hole B in Fig. II should be drilled and tapped for a No. 4 B.A. screw.

This hole should be continued into the wood block C, Fig. I, in order that a 4 B.A. cheese head brass screw F, Fig. I, may be screwed through the brass right into the hole D. The screw will need to be ½ inch long under the head for this purpose.

This screw will be used to secure the wood block with its attached reaction coil on to a brass spindle ¼ inch diameter which will be fitted into the hole D, the brass plate through which the screw is passed being necessary in order that the screw may be able to exert sufficient force on to the spindle to hold the wood block and coil securely in position.

(To be continued.)

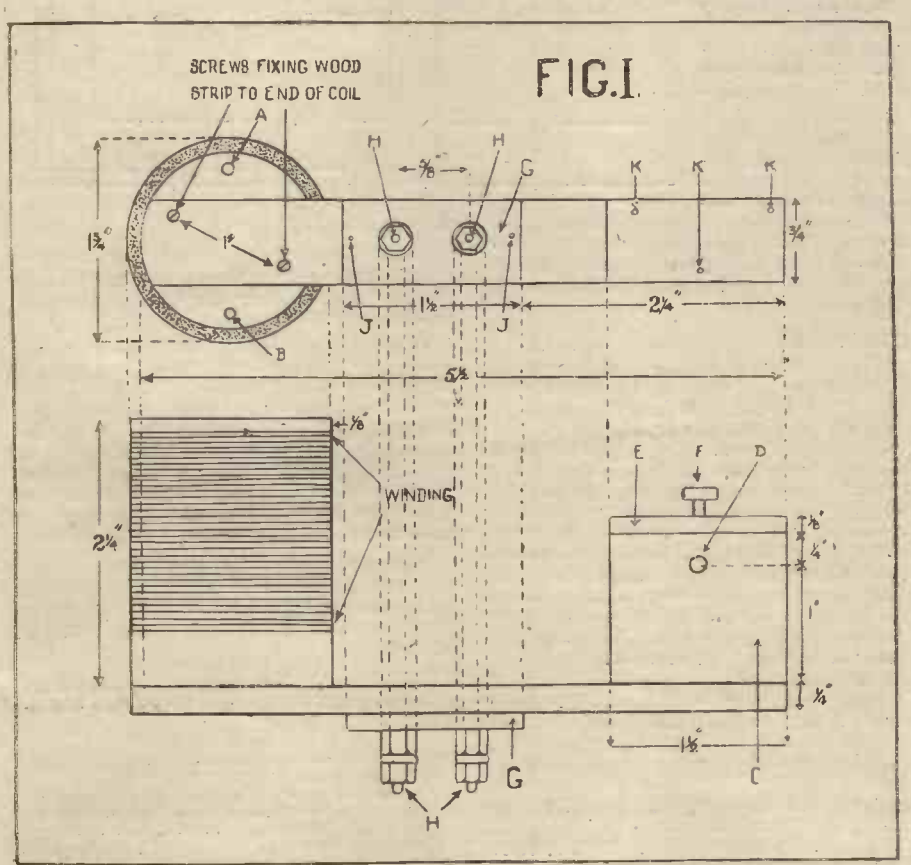


FIG. I.

PSYCHIC PHENOMENA AND WIRELESS.

Note: Mr. Risdon has written an impartial review of the theory that wireless may possibly assist in effecting communication with the spirit world, believed to exist by psychic investigators. This article must be regarded purely from a scientific standpoint. The theory is an interesting one, and as such has been discussed considerably both in this country and in America.
POPULAR WIRELESS expresses no opinion on the subject, and Mr. Risdon's article is in the light of a statement setting forth the scientific aspect of a theory lately expounded by Sir Arthur Conan Doyle and others.—EDITOR.

By P. J. RISDON, F.R.S.A.

IT is not unnatural that the now universal interest in wireless should lead to the question, "Will wireless constitute a means of communication with the departed?"

A well-known spiritualist has expressed the view that wireless is going to be of assistance in this respect, and bases his opinion on a theory that spirits are vibrations of the ether. If they are, there appears to be no reason why their images should not be recorded on photographic plates—that is one of the successes claimed by him—and if their images can be thus received, communication by means of other ether vibrations—namely, wireless—does not at first sight seem beyond the bounds of possibility, always supposing that spirits are familiar with and susceptible to such vibrations.

There is no present means of judging as to whether electro-magnetic waves would constitute the means of such communications, or whether some other form of wireless apparatus, capable of transmitting and receiving other vibrations, such as those of telepathy, would need to be evolved.

Moreover, since the existence of the ether and of spirits has not yet been conclusively proved, the whole question involves a problem bristling with difficulties, a preliminary survey of which is essential before one is able to realise even what the problem entails. Certainly it is useless to attempt consideration of the possibilities of wireless in this direction until these difficulties have been considered.

Honest Research.

Unfortunately, in the space at command, it is impossible to do more than touch upon the various aspects, but, subject to this limitation, the object of the present article is to discuss them impartially and from different points of view.

Innate in every human being is a constraint to recognise a Supreme Power responsible for the natural order of things—for every event in the universe. It matters not whether it be a case of religious upbringing or that of a poor savage "whose untutored mind sees God in clouds or hears Him in the wind." An equally spontaneous and universal belief is that the body is but a temporary abode of a soul that cannot die, even although it must suffer eclipse in a worldly sense.

It may be argued that these two beliefs prove nothing, and that they are due to "the wish being father to the thought."

The only reply to such a contention is that they are universal, and independent of any religious doctrine or belief, and of education and will-power; that they constitute, directly or indirectly, the mightiest force in human affairs, and, moreover, that the second, if not the first, is a *sine qua non* in respect of the subject under consideration.

Although, on the one hand, we find certain religious faiths nominally opposed to psychic research—*i.e.*, the investigation of phenomena, real or apparent, that do not fall under any of the other recognised sciences—on the other hand, many extremely religious persons, who are not avowed spiritualists, are firm believers in supernatural manifestations, such as visions of departed relatives with whom they claim to have held communion, and the Bible is frequently quoted in support of such events.

And since we are endowed with desire for knowledge, it is difficult to see why honest research and investigation should be condemned as contrary to the precepts of true religion. The more deeply one explores the realms of science, the more one is impressed and sobered by the wonders revealed.

There appears to be nothing inherently impossible in the conception of a spirit world, or in that of departed spirits communicating with the living. And if from the army of "spiritualists" we weed out the impostors, we still have left a few who are generally regarded as sane men of unimpeachable integrity, and whose testimony leaves us little choice but to believe that strange manifestations take place for which no conclusive scientific explanation is as yet forthcoming.

Normal and Abnormal.

Briefly, the creed of "Spiritualism" is that death merely opens the portal to another stage of existence in a sphere of which that portion nearest the world is denoted as the "Astral Plane," whence departed spirits can communicate with those left behind. It is a very ancient creed, probably as old as any religion.

Included in the alleged experiences of spiritualists are "clairvoyancy," or second sight, the mystery of the planchette, table tilting and turning, "levitation" (the raising of animate or inanimate objects by other than ordinary force or mechanical means), crystal gazing, the observation of "aura" (the seeing of coloured emanations from a human being, the different colours being supposed to represent different characteristics of the subject), "control" (such acts as writing, drawing, dancing, etc., under the influence of a spirit that temporarily takes possession of a person), and "projection," during which the spirit of a person is supposed to leave the body and become visible beside it, returning to it when the spell is broken.

The theory of Transmigration of Souls is that after death the spirit assumes another bodily form according to its deserts. Thus, a person of certain evil habits may take the form of a worm or of some other lowly creature, and undergo another course of evolution before he gets his chance again. It is claimed that this constitutes just retribution for wrong-doing, and the belief in reincarnation is largely held in India and the East.

It is quite possible for a person, other than a certified lunatic, either to dream or to imagine the occurrence of events that do not actually take place. And it must be remembered that the normal shades imperceptibly into the abnormal.

Possible Use of Valves.

Whatever the source and means of propagation may be, hypnotism is a power which certain persons are unquestionably capable of exercising over others to such an extent that the subject loses his mental identity, and the merest suggestion ensures immediate and entire obedience. That this power has been grossly abused is common knowledge.

By telepathy is meant the transmission of thought images, or sensations from one mind to another, independently of conscious sense or will-power, and irrespective of distance. Such experiences are so common that it is unnecessary to give instances. Premonition of an impending event may possibly be due to telepathy, although some prefer to class it as a communication from a spirit world. We shall presently have more to say about telepathy.

It is stated that Dr. Baraduc has already satisfied himself, as the result of experiments, that thought waves are projected by human beings, and, if this be true, there is nothing impossible in the suggestion that instruments, corresponding in their function to that of the thermionic valve, may be invented for magnifying such thought waves, either for transmission or reception or for both.

In this connection may be mentioned an invention of the late Dr. Waller, which has an important bearing upon the subject. The writer spent many hours with the doctor in his laboratory investigating and testing the apparatus which faithfully records, by rapid changes in the electrical resistance of the human body, the effects of thought and sensation.

The Sub-conscious Mind.

If we are to believe the evidence of our senses, we are forced to the conclusion that every normal person possesses a dual mind: the conscious and sub-conscious.

The conscious mind is that which regulates and governs active thought and deed. The sub-conscious is that which receives impressions either from the active mind or from some extraneous source direct.

The sub-conscious mind is capable of spontaneously imparting information to the conscious and occasionally, but not always, the conscious is apparently capable of tapping the sub-conscious.

Thus we may be asked for certain information and our active mind at once turns to our sub-conscious mind for it. It may be imparted instantly and we give the reply, or it may be that it is not imparted, although we know it is there: then we say we cannot remember. The next day—or it may be a long time afterwards, when the incident is forgotten—the sub-conscious mind suddenly and unexpectedly imparts the desired information.

If we may so express it, the sub-conscious mind lies quiescent but ever on the watch, and, when the conscious mind becomes vacant, takes possession. I leave home daily, enter a train and go to my office; but my active mind is in the ascendant. I do not consciously think of the office, but my sub-conscious mind directs my footsteps there.

Not Proven.

Walking in one's sleep may be another instance of the exercise of the sub-conscious mind, unless it be attributable to purely galvanic action. The sub-conscious mind receives and stores impressions, and it is probably the transmitting and receiving station for telepathic phenomena.

Quite distinct from the dual mind is multiple personality—the existence in the same body of two entirely different identities or personalities. It is stated that there is medical evidence of cases where there has been a prolonged struggle between two such indentities for possession, resulting in one ousting the other. This may or may not be true; if it be true, it has an important bearing on the subject generally. It must not be confused with ordinary conflicting emotions that everyone (unless devoid of conscience) experiences when about to take some step that his better nature proclaims as unworthy.

(*Continued on next page.*)

HINTS TO AMATEURS

By A. W. DRANSFIELD.

DO not be careless about your lead-in tube for the aerial. A good way to lead in is to get a piece of old discarded or broken boiler gauge-glass tube, drill a hole in the window frame, and wedge the tube in with a small wedge of wood.

* * *

When drilling holes in ebonite, the drill gets very hot and "binds." This is very bad for the drill, and you are likely to break it off. The remedy for this is to keep the drill wet with cold water.

* * *

If you have trouble with your testing buzzer at the contact-breaker points, this will probably be caused by an inferior metal having been used. The passing of the current has the effect of causing fusion of the metal. This will easily be observed by looking at the contact when the buzzer is in use. Should the sparking be heavy and very bright, make a very small condenser and put it "across" the make and break; this will have the desired effect, *i.e.*, all sparking will disappear.

* * *

An article easily made, and most useful for many purposes, can be made in the following manner. Get a piece of wood about an inch wide and a foot long, and glue to each side a strip of fine emery cloth; it is better to have, say, No. 0 on one side and No. 1 on the other. You can sharpen your trimming knife, polish up the faces of terminals, or polish up any metal part requiring a clean up.

A good plan is to take the trouble to make the article out of a piece of one-inch square wood, and put a different grade of emery cloth on each of the sides.

* * *

Screws that have become very tight may often be easily removed by applying heat. A good plan is to heat up the soldering iron and place it on the metal or the head of the offending screw and screw out whilst warm. Do not apply too much to the screw if it is brass; brass breaks very easily when hot.

* * *

When using flexible wire for your leads, a good plan is to clean back the insulation for about an inch, scrape the wires as clean as possible, roll them between the fingers with powdered resin, twist together tightly, and dip them in some solder melted up on a gas-ring in an old iron spoon or ladle. This will make the ends quite solid and they may be made into the form of a hook, or left straight, as you desire. This is well worth doing, and saves a lot of bother when terminals are close together.

* * *

When melting down paraffin wax always do it in a vessel that is surrounded by water, similar to a glue-pot. Use a tin that is fairly large, to enable paper or small coils to be easily dipped in; you will find a small tin a nuisance.

* * *

If you find it necessary to drill sheet glass, you will find that it is quite easy to drill if you keep the point of an ordinary drill wet with turpentine. If a large hole is desired, say 3-8ths of an inch—get a piece of copper tube slightly smaller, about 5-16ths inch, then make a clean hole in a piece of thick wood that will act as a guide for the tube. Lay the wood on the glass, and let the hole in the wood correspond where the desired hole is to be, drop some powdered emery (No. 0) down the copper tube (which you should place in the hole in the wood after you have set it right), then drop some turpentine in the copper tube on top of the emery, and you are ready to drill the hole. Should the copper tube be too large for your drill, have the wood a good thickness, and solder a piece of wire, cranked to form a handle, to the top of the tube.

* * *

When experimenting with different methods of wiring sets up, a good plan is to make a board with a set of terminals on that will take all your various leads. Procure a piece of ebonite and place, say, 6 terminals on each of the long sides, mark each terminal and bring all your leads to the board. It will be seen how easy it would be with short pieces of flexible wire to make all sorts of combinations.

* * *

Ordinary iron wire will do for a resistance or potentiometer. Get fine wire similar to that used by florists to tie up flowers. Do not wrap it round ebonite; the wire warms up when used as resistance, and a fair amount of current is going through. A piece of slate is quite good, and is easily cut with a hack-saw. Care must be taken as slate is very brittle.

* * *

When drilling copper, always use oil. A good maxim to remember is:

Oil for copper and not for brass;
Oil for wrought and not for cast.

The last line applies to iron.

* * *

Cycle valve rubber makes a very fine insulating medium for all the "under the panel" wires. Cut the rubber a little too long; it will then spring out towards the connecting screws and stop all danger of short circuits, etc.

* * *

A small drilling machine may be used to advantage if fastened up in a vice. The chuck may be used to hold small articles, such as terminals, for re-polishing, and small things may even be turned up just as in a small lathe.

* * *

Aerial wire that is not quite straight may soon be put in order very easily by making a draw-board for it. All that is wanted is a piece of fairly stout wood with a few nails driven in not quite in a straight line. Zig-zag the wire to be straightened between the nails and pull; the wire will come out quite straight. Too many nails will make the work pretty hard if the wire happens to be stiff.

PSYCHIC PHENOMENA AND WIRELESS

(*Continued from previous page*)

Sifting all the foregoing and other considerations carefully as we may, we are still left in doubt. There may be a spirit world, and it may be possible to communicate with spirits, but neither of these things has yet been proved.

Spiritualists, whether they be right or wrong, certainly have not proved them. As we shall endeavour to show, alleged results claimed by them as proof may, with one exception, be due to what may be termed "material causes." The one exception is that, in certain cases, communication is stated to have been established with spirits of individuals, specified by name, but since no convincing evidence or satisfactory public demonstration of this is forthcoming, we are perforce compelled to relegate such assertions to the realm of doubt, and to fall back upon known facts on which to build a theory.

Let us now consider the processes that render our bodies capable of harbouring and sustaining life.

Some nine-tenths of every human body consists of pure water. The remaining tenth comprises many different substances, including acids and metals. It has been likened to an engine; but we may go further, and liken it to a combination of a motor and an accumulator for storing and supplying the energy to drive complicated mechanism that automatically collects and consumes fuel which it converts into energy wherewith to replenish the accumulator.

By some mysterious agency the accumulator is given an initial charge, which is thereafter automatically maintained. Ultimately, however, like all other accumulators, it deteriorates—largely according to the degree of care, neglect, or abuse to which it has been subjected. Then it is no longer capable of storing and maintaining the energy that we call "life," which is finally discharged, when the mechanism stops.

Whence the human accumulator derives its initial charge, and whither it departs when death supervenes, is the problem that confronts us.

It is insufficient to say that the initial charge is derived from parents—they are merely the physical and mechanical means adopted by Nature for constructing a suitable habitation for the separate life entrusted to them. Nor can we even say that they are instrumental in increasing this initial life. The virility of a newly born child is notorious, whilst a blow or a bullet in a vital spot will kill the strongest man as quickly and easily as it will a baby.

Physical development may provide greater protection, but that is another matter.

As a healthy individual, I cannot, on retrospection, think of any time, in point of age, when my virility was greater than at any other.

Regarding ourselves in this light, it is not difficult to realise that each of us may generate a species of magnetic field of force. Now magnetic fields of force are theoretically infinite in extent, the distance to which they extend, practically, depending upon the degree of sensitiveness of detecting instruments.

Again, electrical disturbances in our bodies may quite conceivably set up electro-magnetic or other waves that are also theoretically infinite in extent.

If this theory be tenable, we have at least a partial explanation of telepathy, and of most of the phenomena falling under the head of spiritualism, so that what are taken as responses and manifestations on the part of spirits may actually be those of living persons.

If we accept the Spiritualist's creed that spirits of the departed not only exist but are willing and anxious to communicate with us, what grounds are there for supposing that "wireless" is going to assist?

Surely in such case we may assume that spirits are so sensitive that they could better be communicated with by such delicate means as telepathy than by the *comparatively* clumsy methods of wireless?

Are we to imagine invisible wireless transmitting and receiving sets in spirit land? Or are we to place our own at the disposal of the spirits?

In the latter event, it would appear, on the face of it, that wireless would be superfluous and would merely add complications to a problem already complicated enough.

NEW SERIES FOR THE BEGINNER.

By E. BLAKE, A.M.I.E.E.

PART 6.

SUMMARY OF LAST ARTICLE.

An oscillating current begins in one direction at zero strength, rises to a maximum, decreases to zero and grows up in the opposite direction to a maximum, and decreases again to zero. This sequence then continues, the number of times per second the complete cycle takes place being called the "frequency" of the current. The maximum strength of the current depends primarily upon the E.M.F. producing it, and the nature of the circuit.

When the current is at a maximum, its energy is electro-magnetic (or kinetic); while the current is decreasing or increasing some of its energy is electro-magnetic and some electro-static (or potential). The direction of the electro-static field round a charged single-wire vertical aerial is almost vertical, and the electro-magnetic field appears at right-angles to the wire.

WE now come to the subject of the ether of space, the universally distributed medium in which wireless waves move and have their being. Before going further, it is highly desirable to point out that the practice of wireless is considerably in advance of the theory.; things are done first and explained afterwards, like shooting in Arizona.

In order to explain the mechanism—or shall I say mode?—of wave-propagation through space, certain theories have been made to fit the known facts, and whether those theories are quite correct or not (and it may be assumed they are not) does not matter very much, so long as they enable us to understand the subject a little better.

The question to ask of a theory is, "Does

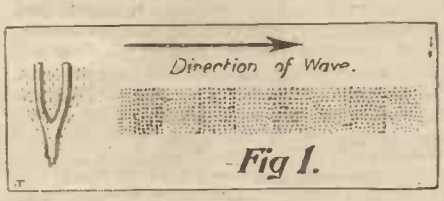


Fig 1.

it help?" not "Is it completely proven?" Theories will always be contested, and life would be very strange for scientists were they not; indeed, I think many would be impelled to go out of the business. Certainly theory making and breaking greases the wheels of scientific progress.

Now, the ether theory helps, but there may be no ether; for other is a hypothetical thing. Sir Oliver Lodge believes mightily in the ether; Dr. Steinmetz, of the General Electric Co., apparently does not believe in it at all. Nevertheless, the great body of scientific opinion, although not unanimously agreed on all points concerning ether, yet holds to the necessity for postulating its existence. But, in spite of this, we ought not to believe that we are dealing with an axiom. We must not think that ether is as established as the sea and the air and the solid earth. It is the *name for something* which scientists think exists.

A Wrong Impression.

Further, we may not hope to achieve a clear mental picture of ether waves; and here I warn readers against the evil of imagining them to be mere hills and dales on an invisible ocean. We write and speak so glibly of them flitting across the earth; we represent them so casually by means of wavy lines, that many people are led to believe that they are actually "up and down" disturbances, just like waves on water. Nothing could be more remote from what is understood by the mathematical physicist when he refers to them. So let us clear our minds of hastily gathered ideas on the matter and begin afresh.

Transferring Energy.

One may go so far as to say that no direct communication between two points in space can be effected without the transference of energy between them. You nudge the man sitting next to you; that is communication, and energy passes from your elbow to his ribs. You speak to him; energy is conveyed from your vibrating vocal cords on sound waves in the air to his ear-drum, which vibrates in response. By the energy of light we see. Now, is this energy sent across space like a bullet or a letter through the post, or is it conveyed by the co-operation of some special medium?

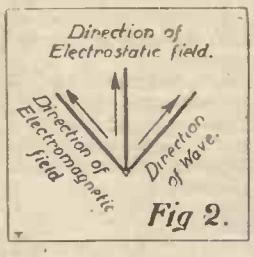


Fig 2.

Let us first think of sound waves in the air. The sound-making body vibrates and produces alternate compression and rarefaction of the air; the particles of the air are crowded together, then separated, then crowded together again, and so on in a series, as roughly shown in Fig. 1. The particles move in the same direction as the sound travels, hence sound waves are called "longitudinal." The medium which conveys the energy of sound is matter; sound waves cannot pass across a vacuum.

What is the Ether?

Now let us refer to waves of light. The glowing filament of an electric lamp is the centre of the radiation of the energy of the electrons in the filament. Between the filament and the walls of the bulb there is a vacuum. Yet the energy from the filament undoubtedly passes across the vacuum, because it passes through the glass and across the space between the bulb and your eye.

Light also passes from the sun to earth across nearly ninety-three million miles of space practically devoid of matter. Light passes through solids and liquids.

If, then, the energy of light is carried by a wave-motion, light waves must exist in *something* which completely inter-penetrates material things. If light is not a wave-motion, we are thrown back upon the old corpuscular theories, or must imagine the energy as being conveyed from place to place like a postal packet. Well, scientists are generally agreed that light *is* a wave effect, and can show conclusive experiments in support of their contention; and the medium in which the waves occur they call "ether."

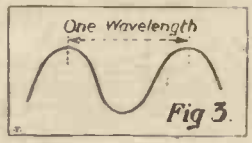


Fig 3.

The ether, according to present theory, is something underlying material creation. Several crude analogies occur to me, each one falling short of the *idea* in one respect or another.

We may compare the ether to the canvas on which all material existence is painted, but it is more than that. We may compare it to the fabric of which a tapestry is woven, but it is more than that. We may liken it to the string upon which pearls are strung, or to the mortar which holds the universe together, but it is more.

Ether is conceived as filling the universe, not only so-called empty space, but the space which is occupied at the same time by material bodies, whether planets, suns, or stars, or houses or men or molecules.

A world floating in the ether is like a sponge or net submerged in water; the ether inter-penetrates it like a breeze passing through a wood. The movements of material objects of atomic or larger dimensions do not disturb the ether; only electrons can do that.

Various Wave-Lengths.

Ether waves are described as "transverse," in contra-distinction to sound waves, the disturbance occurring at right-angles to the direction in which the waves are propagated (see Fig. 2). When we come to consider the production of wireless waves, we shall understand more about that.

Ether waves all travel at the same velocity—viz., about 186,000 miles per second—but differ in length.

Light waves are exceedingly short; waves of radiant heat are longer, but still very short compared with wireless waves, which range from 100 metres to 25,000 metres in length, according to the station. The length of the waves is controlled by apparatus in the sending station.

I have already mentioned the fact that the number of times per second a complete oscillation occurs is called the *frequency* of the wave. If we divide the velocity of the wave (300,000,000 metres per second, or 186,000 miles per second) by its length, the answer is the frequency.

$$\text{Wave-length (in metres)} = \frac{\text{300,000,000 (metres per sec.)}}{\text{Frequency (per sec.)}}$$

$$\text{Frequency (per sec.)} = \frac{\text{300,000,000 (metres per sec.)}}{\text{Wave-length (in metres)}}$$

Wave-length multiplied by Frequency = Velocity.

Series of Changes.

The length of a wave is often said to be the distance between its crest and that of the wave preceding or following it (Fig. 3). However, as I have been at pains to emphasise the fact that an ether wave has no crest and trough, or sides, or any physical dimensions whatever relating to shape, I must explain the term "wave-length" otherwise.

An ether wave is a regularly repeated series of changes in the condition of space. These changes occur in cycles, as I have described, and are in the nature of strains and stresses of the ether, caused by the alternation of an electro-static field with an electro-magnetic field, one decreasing as the other increases, one reaching its maximum as the other

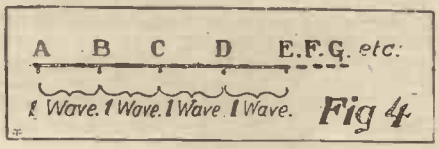


Fig 4

NEW SERIES FOR THE BEGINNER.

(Continued from previous page.)

reaches its minimum. These linked and pulsating fields are propagated in all directions with the speed of light. Looking at the matter in this way, we may understand a wave-length to be the distance between successive points in space where similar stages in the cycle of oscillation occur.

In Fig. 4 the points A, B, C, and D are separated by equal distances. Imagine the waves to be propagated along the line AD. At a given moment there exists in the ether at A a certain set of conditions, perhaps the beginning of an oscillation or the end, or some intermediate stage, such as half or quarter cycle.

By the time the wave-effect has reached B the same stage of the cycle is recurring, and the distance AB represents one wave-length. At C and D, and at equal distances DE, EF, FG, the same state of the ether thereafter recurs, always at a constant distance—namely, one wave-length.

If we consider a distance of 100 miles, and imagine that a station is sending across it waves each 10 miles long, it is clear that at any instant there will be a chain of ten complete waves over the 100-mile course. Suppose the engineer then doubles the *frequency* of the waves—that is, sends them out twice as quickly—then, at any instant over the same tract, twice as many waves will exist. Hence they must be only half as long as the first set of waves. Remember the rule, "As frequency *increases*, wave-length *decreases*, and *vice-versa*."

With next week's article will commence a general survey of wireless communication, but we shall return to the subject of waves when the principles of transmission and reception are studied.

CORRESPONDENCE.

To the Editor,
POPULAR WIRELESS WEEKLY.

Dear Sir,—In the issue of the POPULAR WIRELESS for July 29th, one of your contributors very kindly refers to my work in connection with the production of rectifiers for charging accumulators from alternating current supplies, and I note that by some mistake I am suggested as indicating that ammonium sulphate solution would be satisfactory for use in an aluminium rectifier.

I would ask you to correct this mistake by indicating that the solution should be a concentrated but not quite saturated solution of either sodium, potassium, or ammonium phosphate.

In the interest of historical truth, I should also like to make a further correction by stating that I am not the author of the "Grisson" valve, and that the improvements which I have introduced took place some considerable time after the "Grisson" valve had been placed on the market, which was in itself a considerable improvement over the older "Noden" type.

I should also like to take this opportunity to compliment you on publishing Mr. Sutton's article, and also to thank Mr. Sutton for his article on Wireless Club Rules. It is very inspiring to me to know that the rules which were drawn up for the "Wireless Society of London," by Mr. Klein, the late Mr. Russell Clark, and myself, have stood the test of time.

I think that it would be of great help to the amateur wireless experimenters in this country, if they would give very careful consideration to Mr. Sutton's remarks.

Yours faithfully,
L. F. FOGARTY,
Hon. Treas. Wireless Society of London.

DOES THE EYE "WIRELESS"?

MOST of us have heard it stated that it is possible to hold a wild lion in check by a steady gaze from the human eye. Whether that be true or not, it is a fairly safe statement to make without fear of contradiction, since there are exceedingly few who have the opportunity or inclination to put it to the test.

Conceivably it may have been done and placed on record as a feat that may be practised with impunity. For our part, we should certainly require an ultimate safeguard before trying it.

Nevertheless, many readers will have noticed that it is almost impossible to "catch the eye" of a lion in captivity for more than a fraction of a moment, which seems to show that the human eye is capable of exerting an influence that the lion cannot endure.

To bring the matter nearer home: there is probably hardly a man, woman, or child who has not experienced an intolerable sensation under the prolonged stare of another person's eyes. Even the knowledge of being watched is almost unbearable in many cases. If two persons look into each other's eyes, one or other of them will at last be obliged to avert his gaze.

It is interesting here to note that certain ancient philosophers believed that some power or even particles proceeded from the eye to an object seen, although how they made their report and returned to communicate it to the brain was not clear.

Interesting Experiments.

Having studied the effect of the gaze of one person upon another, a certain London physician set himself to ascertain whether or not emanations are thus projected.

It is, of course, evident that light rays are reflected by the eye, otherwise we should not see the eye of another person at all. It is also known that light is the effect of energy, and possibly consists of almost infinitely small material particles, since Einstein has definitely proved that it can be deflected by certain influences. Moreover, light produces certain chemical effects in addition to those on photographic plates. Finally, in the spectrum we have ultra-violet and X-rays, and X-rays, though invisible, will, as everyone knows, penetrate 12 inches of wood or a bar of steel, and even then light up a fluorescent screen.

It seems, therefore, within the bounds of possibility, and even probability, that the eye may be capable of refracting and reflecting, and, perhaps, modifying rays of energy other than those we call "light rays." This theory appears to be more or less borne out by Dr. Russ's experiments, but our readers should not confuse it with what daily newspaper reporters have given the public to understand is the power of the human eye to project rays or waves of force independently of other influences.

In a Lady's Eyes.

For instance, if that were possible, the influence of the eye should be felt in utter darkness, but Dr. Russ does not appear to have yet succeeded in obtaining any definite results in darkness, although he has experimented in that direction.

In this connection, the writer personally made quite a simple and interesting experiment with the help of a lady, who was unable to return his gaze for more than a few moments under ordinary conditions. By arrangement beforehand, whilst looking into her eyes, he switched off the light. This was repeated several times, and curiously enough every time she guessed wrongly as to whether he had moved his eyes or not. A similar test with another lady had precisely the same results.

It would be tedious to relate details of the whole series of Dr. Russ's experiments, and we therefore confine ourselves to the following description of a simple form of the apparatus he employs, gleaned from his own technical report on the subject. It is interesting to note that he describes it as "an instrument which is set in motion by vision," and that he lays no further claim at present for his invention.

In a metal box 36 inches long by 8½ inches by 7 inches, a delicate solenoid is suspended, consisting of fine copper wire wound upon a celluloid cylinder. Above the box is a glass tube with a cork stopper. From this stopper an unspun silk fibre depends, with a small metal yoke at the lower end, on which the solenoid is hung.

Eye Waves.

Above the yoke, or attached to it, is a fine wire magnet, the object of which is to bring the solenoid to rest after it has been set in motion. One end of the box is covered by a pane of glass, but at the other end only a narrow slot, covered by thin glass or celluloid, is provided, through which the observer looks. If his gaze be directed to one end of the solenoid, that end begins to move—generally away from him. If he look at the other end, it is that end that moves away. If he look at the centre, the solenoid remains stationary.

Doubt at first was expressed as to whether the effect was not influenced by the radiation of heat from the body of the observer, or by electric influence other than that produced by the gaze. This doubt was enhanced by the fact that, when the hands were placed in contact with the box, movement of the solenoid took place. Various experiments were made that disposed of the idea of external electrical disturbance and heat influence. Another instrument was made in which a jacket of water or liquid paraffin was interposed between the solenoid and the observer, and the apparatus was coupled up with a Leyden jar and earthed. By this means, *after passing through the fluid*, the observer's gaze, directed on to the motionless solenoid, caused it to move through an angle of more than 30 degrees.

Another Mystery.

To enable the observer better to watch the effect, light from a condenser is focused upon a tiny mirror attached to the yoke on the silk fibre. The beam is directed on to a graduated scale, the whole being placed in front of a mirror before the observer.

Although in an experimental stage, the invention has aroused considerable interest among medical men and physicists, who, so far, have been unable to refute what Dr. Russ claims to have done. Should further tests in utter darkness prove successful, the natural conclusion would be that the eye is a transmitter of a form of energy wave generated in the body, and we should be faced by a phenomenon akin to the mystery of telepathy, and one with which wireless may some day be associated.

A HOME-MADE CONDENSER.

By GEORGE SUTTON, A.M.I.E.E

A VARIABLE condenser, though not indispensable with a crystal receiving set, is always a very desirable acquisition, and often brings in signals otherwise unobtainable, or renders those you have more readable.

Several reasons may prevent some of my readers from purchasing a ready-made article of the standard pattern, but provided care is exercised in the process, a reliable one of home manufacture is not at all difficult to construct.

Fortunately the required amount of variable capacity in wireless practice is usually very small, and a couple of pieces of zinc about three or four inches square, with a thin sheet of mica in between, to prevent metallic contact while lying flat on the table, so that the top piece of zinc may be slid about relatively to the other, and have a varying surface opposed to it, is quite sufficient for most needs.

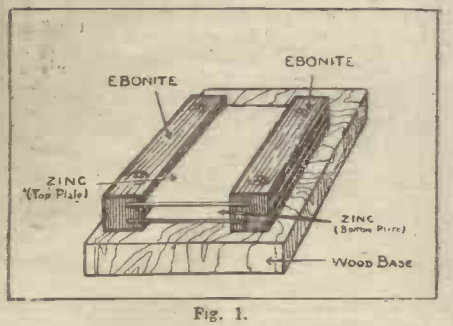


Fig. 1.

Such an arrangement, though efficient, is inconvenient, untidy, and suffers from the disadvantage that by touching it with the fingers while adjusting, or even by bringing the hand near to it, you may make a lot of difference in the resultant effect. This may be got over by moving the top zinc plate with an ebonite knitting needle. This needle might be fastened to the top plate, and then the increment or decrement of capacity may be made very gradually. Take care to see that your fine and finished adjustment is not upset as soon as made by an inadvertent knock on the long handle.

Simple and Efficient.

To avoid this the top plate might be made to slide in grooves in a frame, the bottom one being fixed in the frame. Then you may leave the space in between occupied only by air, or the capacity could be increased by filling in the space with mica. The air condenser would have less capacity, but the mica might have other less desirable qualities with its increase of capacity.

Such a condenser is illustrated in Fig. 1.

The slips in which the zinc plates slide had better be made of ebonite if at all possible.

One of the more easily made variable condensers is of tubular form. This consists of two tubes of brass, one sliding inside the other,

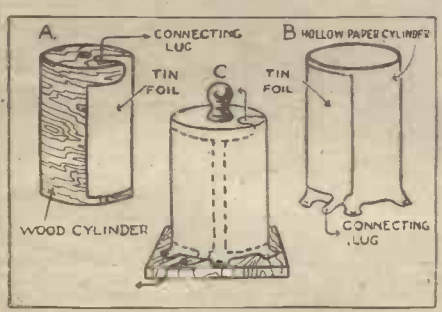


Fig. 2.

and kept from contact by means of thin ebonite or waxed paper, wrapped round the inside one. An old telescope might easily provide the concentric tubes, and with thin ebonite between them they would slide in and out of one another without metallic contact. If paper is used it should be pasted on to the outside of the inner tube, and when thoroughly dry, dipped into hot melted paraffin wax. The outside tube should be provided with lugs soldered on, so as to fasten it down to a board, and the inner tube should have a handle to permit of its being moved in and out of the larger tube.

One of the writer's most successful little variable condensers was made from the thin ebonite cylinder of an electric gas lighter, lined with tinfoil, and sliding in and out of a zinc tube. It made a tight sliding fit on the outside.

Another easily made condenser is built up as follows. A cylinder of wood four inches long and about three inches in diameter (see A, Fig. 2), has a piece of tinfoil pasted upon one side, and covering half of its cylindrical surface. The tinfoil has a lug which is connected under a round-headed screw and washer to a flexible copper wire connection. The cylinder is now wrapped round tightly with two thicknesses of thin, tough paper pasted on. When the paste is quite dry, dip it into hot melted paraffin wax, and your movable part is finished.

Now wrap a piece of dry paper round the movable cylinder, and take care that it does not stick, as this is the packing upon which you are to build the stationary portion of your condenser.

Varying the Capacity.

This stationary part is now built up by, first of all, two thin sheets of similar paper to that used for covering the tinfoil on the movable cylinder being pasted together so as to form a complete casing

On the outside of this casing paste a piece of tinfoil, similar to that on the inside cylinder, leaving a lug for attachment of the wire as before (Fig. 2, B). Then paste a few more sheets of stiff paper on the outside of this, making lugs as shown in the figure, and these lugs fortified with rag, so as to fasten the case, when completed, down to the base board as shown. You will see that by turning the one cylinder round inside the other you will vary the capacity very gradually.

When the two sheets of tinfoil are lying one inside the other close together, the capacity is

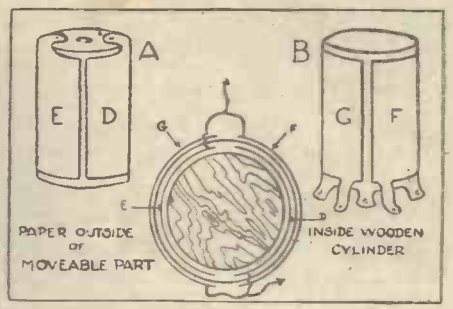


Fig. 3.

at its maximum, and when on opposite sides of the cylinder, the capacity is at its minimum, shown diagrammatically at C, Fig. 2.

Now by a slight alteration of the same method of construction, you may double the capacity of the condenser at its maximum, without greatly increasing its minimum, a very desirable quality in a condenser.

Take two pieces of tinfoil slightly smaller than the one you pasted on the movable cylinder (A, Fig. 2), and paste them on opposite sides of the cylinder with lugs coming out on top as at A, Fig. 3.

In making up the case as before (B, Fig. 2), use two pieces of tinfoil instead of one, but be sure that they do not touch, B, Fig. 3. A space of a quarter of an inch should separate the nearest edges of the two sheets of tinfoil both on the cylinder and also on the case.

Care Needed.

When connecting up with flexible wires, D and G should be connected together, and E and F should also be connected together. When in the position as shown in the diagram their capacity is at its minimum. If the inside cylinder is now turned round half a revolution, so that D is closest to G, and E closest to F, the capacity will be at its maximum. The flexible connections will allow of the rotation of the inside cylinder, and you will have a piece of apparatus which will be efficient, and which will show to advantage if care be exercised in its manufacture.

In bringing down your connections from D and G and E and F to terminals on the base, see that the terminals are well insulated. Do not rely on the wood, but use a strip of ebonite in which to mount the terminals, or "bush" the holes in the base with ebonite bushes, to prevent the metal from coming into contact with the wood. All such carefulness as this is amply repaid by the results obtained.

BOOK REVIEW.

"The Construction of Wireless Receiving Apparatus." By Paul D. Tyers. (London: Radio Press, Ltd. and Sir Isaac Pitman & Sons, Ltd. Pp. 76, illustrated. Price, 1s. 6d. net.)

THIS little book is perhaps the only complete collection of constructional details which has ever been published. Every component of a valve and crystal set is given very full consideration, and the author has not in any case confined his remarks to one method of construction alone. He states that he has written for the amateur who has neither lathe nor expensive tools, and many of the methods described are extremely ingenious.

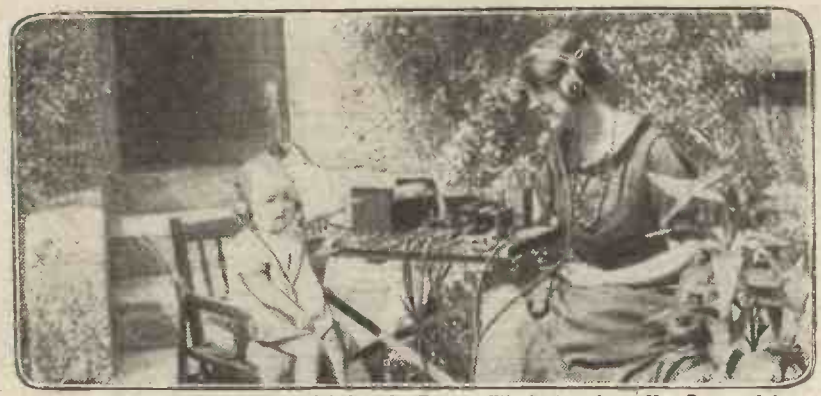
In Chapter II., which deals with inductances, no less than eleven different types of coils are discussed, and a winding machine for each is discussed. Chapter IV. contains some very useful hints on the maintenance and use of filament accumulators, and this should prove very helpful to those who are using cells for the first time. Three forms of filament rheostats are dealt with in another chapter, the type for panel mounting being most interesting. The wire is wound on a plaster circular former, over which a contact moves. The complete resistance can be made for about a shilling, and the necessary tools are a fretsaw, file, and soldering iron.

Another interesting feature of the chapter is a potentiometer made from a lead pencil.

It is not often that one finds constructional details of high tension batteries, but here again four types are fully described.

The author is to be congratulated on this excellent little book, which appears to be ideal for the man who wants to make his own wireless components. Every reader who spends the modest sum of 1s. 6d. will be more than amply rewarded.

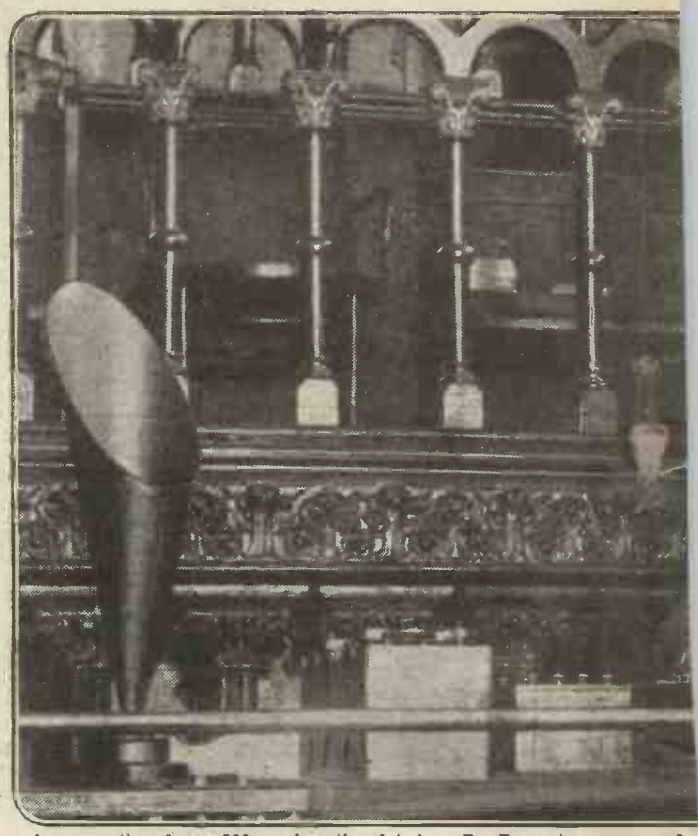
THE INITIATION



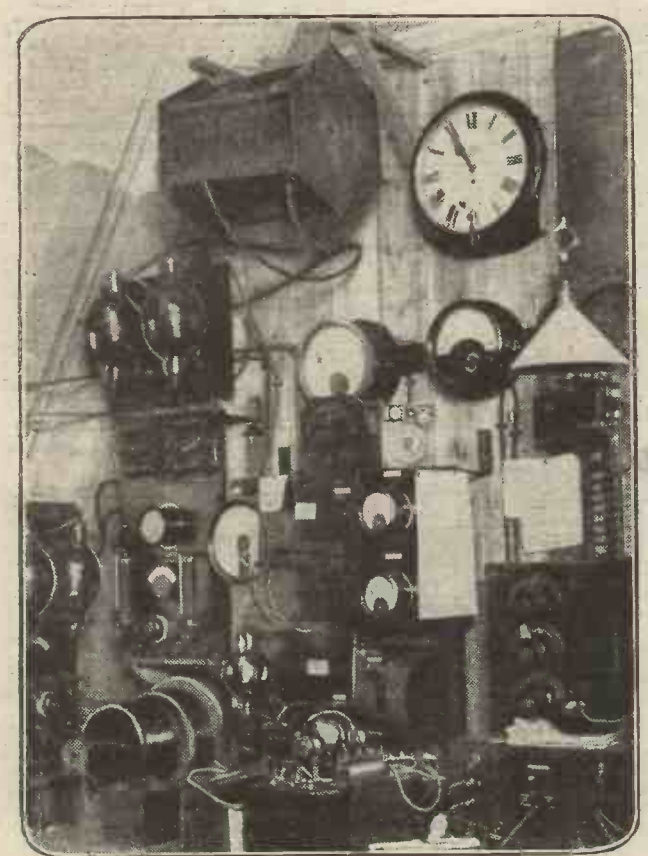
This photo, sent in by Mr. G. Dyer, of 9, Crowden Terrace, Winchester, shows Mrs. Dyer and her little child listening-in on a home-made crystal set.

Mr. F. E. Ives and his friends listening to "The Daily Mail" concert from the Hague at the National Sanatorium, Benenden, Kent. Mr. Ives, who is recruiting his health and is debarred from the pleasures of town, finds wireless a great boon.

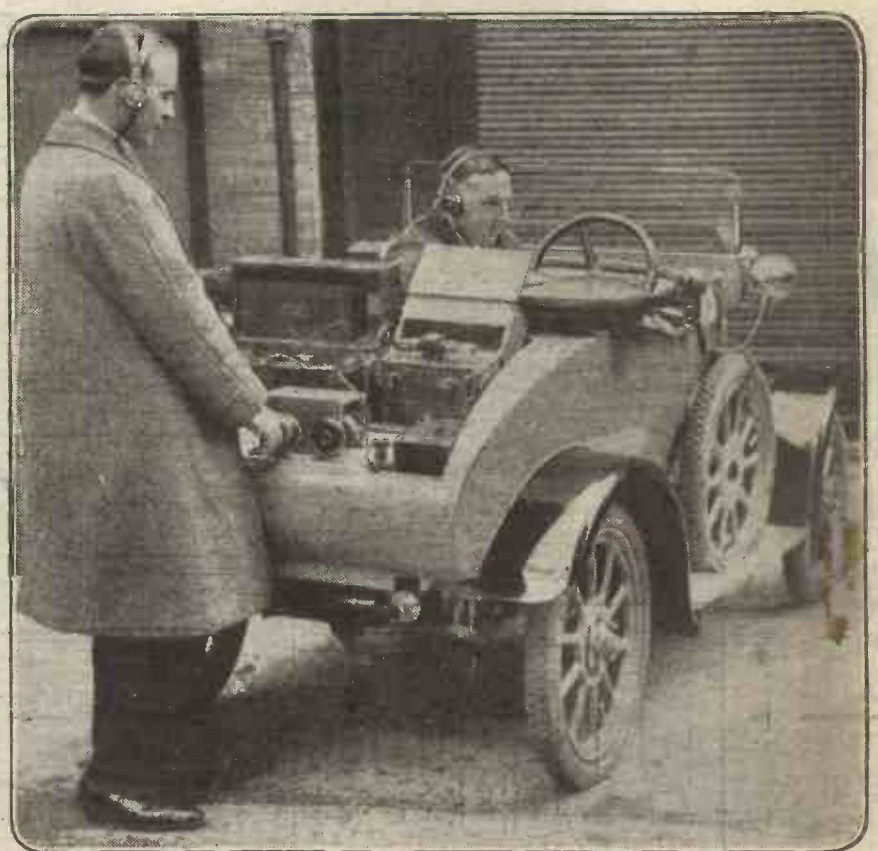
A SERMON BY W



A congregation of some 300 people gathered to hear Dr. Boon give a sermon by Blackheath, and people in Bexhill heard every



The India House wireless telephone set. The call sign of this station is G F A—familiar to listeners-in.

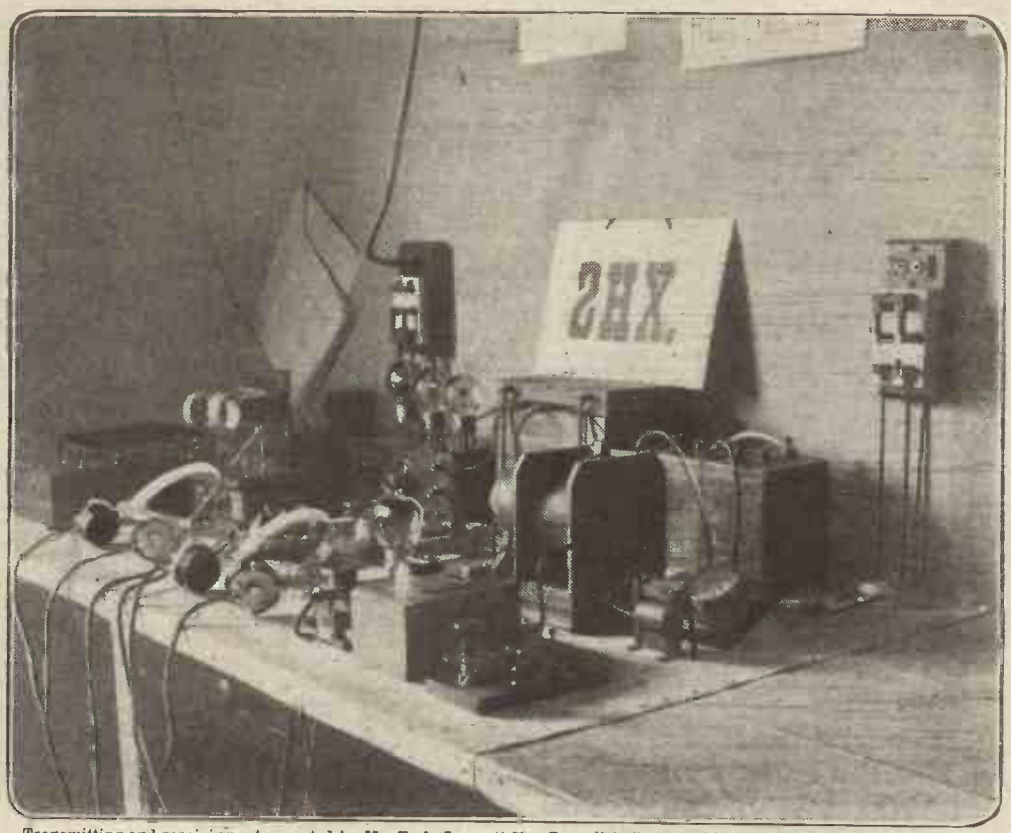


At a demonstration given by the Jowett Light Car Social Club the other day, a wireless set was fitted to a two-seater, and experiments were carried out. Good signals were received while the car was travelling at a fast speed.

IRELESS

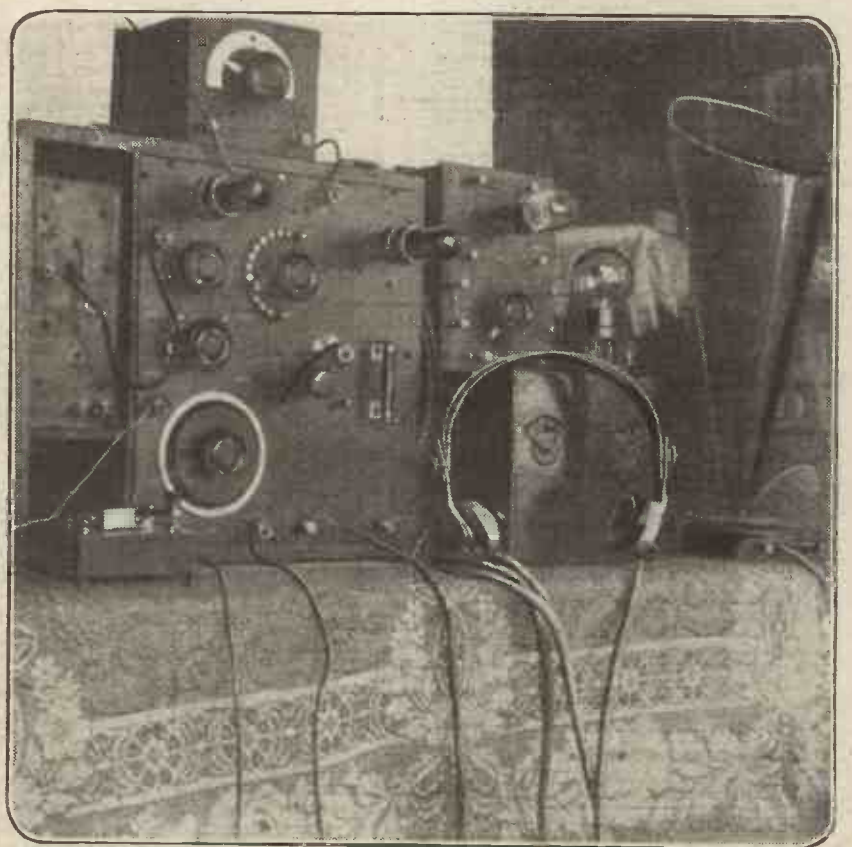
AN AMATEUR TRANSMITTING SET

wireless the other day. Dr. Boon spoke from word of his address.



Transmitting and receiving set operated by Mr. F. A. Love, "Clay Dene," Guildford Park Road, Guildford, Surrey. Power is supplied for the transmitter by a 600-volt generator, and modulation is effected by the grid control system. The set was originally installed to check the transmissions from 2 A Z—Mr. William Le Queux's set.

This photo, sent in by Mr. C. Smith, of 55, Sheals Crescent, Maidstone, shows a wireless set fitted on a scooter by a Boy Scout. Although the receiving range is limited, good telephony has been heard.



Mr. W. T. E. Crief's set, at 40, Manor Park Road, Harlesden, N.W.10. Good telephony is received from the Hague, Brussels, etc., using two valves only. Although resistance coupled H.F. amplification is employed, Mr. Crief gets excellent results on 350 metres.

SUBMARINE WIRELESS.

THE next naval war will be decided by the submarine, says Thomas Edison, the great American inventor: and in anticipation of the fulfilment of his remark America is paying particular attention to the development of this type of marine craft.

The latest from "over there" is the discovery of a method for sending wireless messages to and from submarines while they are submerged. Previously, it has always been necessary for submarines to come to the surface in order to use the wireless, and during the late war the very warm reception which they frequently received on appearing at the surface was not in accordance with their desires.

A New Discovery.

For many years now it has been known that wireless waves on striking the surface of the sea are stopped and reflected back in the direction from which they came. This is founded on the wireless law that all electrical conductors, such as water and metal, interrupt the passage of wireless waves.

If, for instance, your transmitting apparatus upsets the sensitiveness of the receiver, you place a metal screen between the two—with the result that the transmitter will no longer affect the receiver's sensitivity. This is because the metal screen reflects back the wireless waves of the transmitter, just as a high stone wall will throw back your voice if you shout against it; or as a metal reflector in a motor-car lamp reflects back the light from the lamp. In this respect it is interesting to note that sound waves, light waves, and wireless waves are all subject to the law of reflection.

It has been discovered, however, that the amount of waves reflected back from the surface of the sea is not as great as it should be—some waves are missing. After much investigation these waves were found to be penetrating beneath the surface of the sea, and herein lay a new discovery in wireless. The reason why this phenomenon has not been found out before is because the instruments used have never been sensitive enough to detect the presence of these waves, which are very minute.

Peculiarities of the New Waves.

Experiments have proved that these waves will penetrate further into non-electrical conductors, such as glass, than they will into electrical conductors, such as the sea.

A more useful discovery, however, is that long waves penetrate further beneath the surface of the sea than do short waves. For example, a wireless wave measuring 1,000 metres from the crest of one wave to the crest of the next penetrates to a much greater distance than a wave measuring only 100 metres from crest to crest.

A Unique Aerial.

Except that a long wave-length is used the wireless apparatus for sending to the submarine from a ship or shore station is practically the same as that of the ordinary wireless transmitter, but the apparatus for the submarine is rather unique.

In the first place, the submarine uses as an aerial its own metal body, and, in addition, two copper wires which run from the wireless installation up a short mast erected on the outside of the periscope, to either end of the vessel. One wire is electrically connected to the body of the submarine at the stern, and the other wire is electrically connected at the bows. These wires run through insulated tubes and make no connection with the sea. This peculiar type of aerial has the same properties as the ordinary loop or frame aerial.

Perhaps the strangeness of this aerial will be realised when it is remembered what infinite precautions are taken to prevent ordinary aerials from touching chimney-pots and drain-pipes and consequently "earthing"; whereas the submarine aerial is always touching "earth"—if for once we may call the sea "earth."

By means of this type of aerial and by employing valve amplifiers (for increasing the strength of the wireless waves received) it is possible to hear land and ships stations some considerable distance away.

Most Marvellous of All.

Many doubtless know that the loop aerial is rarely used for sending on land or sea, even under the best conditions—principally because it will not radiate wireless waves at all well. Yet, although the aerial on the submarine is, to all intents and purposes, the same as a loop, it is possible to send from one submarine to another while both are under the water. This is done by employing exceptionally high power and the longest convenient wave-length.

With the advent of submarine wireless new problems have naturally arisen. Amongst many others, one of the most interesting is the question of the ether of space, and whether it is confined to space alone.

In our use of the word space, the belt of atmosphere around the earth is usually included, and as the difference between our atmosphere and the sea is only a matter of density (there is also a very slight chemical difference), ether may also be intimately connected with the ocean of water just as it is with the ocean of air or space.

WIRELESS BEFORE WIRELESS.

THE wireless of to-day is not the first means by which messages have been sent across immense distances without the aid of wires, messengers, or any other visible means of transmission.

A person with any knowledge whatever of Africa will tell you of the almost incredible rapidity with which "bush wireless" will carry news between natives in widely separated areas.

Sometimes the method employed can be partly understood. Drumbeats are frequent signals, smoke is also employed, and, in some parts of the Gold Coast, whistling. But there are other means which are neither visible nor audible, which Europeans have never been able to explain, by which tribes can "broadcast" news over very large areas with a speed that has actually been known to be quicker than line telegraph!

Their wireless messages are secret—at least from the ears of white men. Even the European who has heard the far-away drums swelling out their sound over the vast countryside has tried in vain to sort out the unintelligible beats that mean so much to the natives.

Yet by "bush wireless" the natives know when the White Baas starts on his tax-collecting round; that same tax-collector may meet a crowd of natives on their way to a distant village, where, they have learnt by wireless, there will be a night of celebration at the next full moon; he may be warned to beware of lions who—so the bush wireless says—are making their way towards the neighbourhood.

The natives have put their wireless to many purposes of daily utility for a great number of years past. We have got to go a long way before our wireless is so completely at the disposal of the "man in the kraal."

STEP BY STEP IN WIRELESS.

Note: Under this heading will appear a weekly article for the more advanced amateur.

No. 13.—THE HETERODYNE.

IT is the purpose of this article to instruct the amateur to graphically represent exactly what takes place when an alternating current of a certain frequency is superimposed upon another alternating current of a slightly different frequency. If these instructions be conscientiously followed, and a careful drawing made, the underlying principle will be thoroughly understood; moreover, owing to the fact that the work has been personally done, the reason for the electrical phenomenon known as the Heterodyne need never be forgotten.

It must be pointed out that the most common and, in fact, the best idea of the "frequency" or "beats" of an alternating current is obtained by visualising the current as acting in the form of a wavy line, the "beats" being represented at each "wave-crest" and "wave-trough."

In Fig. 1 is illustrated two alternating currents, the one having a slightly different frequency to the other; it will be seen that for every five "beats" in current A, there are six "beats" in current B. Thus the two currents exactly correspond at certain regular intervals, and at these points they are said to be "in phase."

The Curve.

Now in the diagrammatic representation of an alternating current it must be understood that the value of the current *above* the imaginary line XY is positive, while *below* the line the value is a minus one. Wherever the line of current crosses the XY line, the current has no value at all.

At any point on the line representing the current, a definite value of the current at that point may be determined; this is obtained by measuring the vertical distance from that point on the current line to the XY line, always remembering that above XY values are plus, and below XY values are minus. (In actual practice a current curve would, of course, be set down to a known scale, so that a measurement taken would mean a definite value.) All such vertical distances are called vertical ordinates of the "current line," or, as we shall henceforward call the latter, "the curve."

In Fig. 2 will be seen our two curves, which we shall call A and B, these curves representing two alternating currents of a slightly different frequency; and it is our purpose to illustrate the curve or current resulting when these two currents are superimposed or combined with each other. It will be seen that parallel lines have been drawn through the two curves, these lines being perpendicular to and crossing the XY lines of A and B. They thus form vertical ordinates wherever they cross the curves.

For the actual draughting out of these curves, squared paper may be used, and is, in fact, indispensable where the drawing-board,

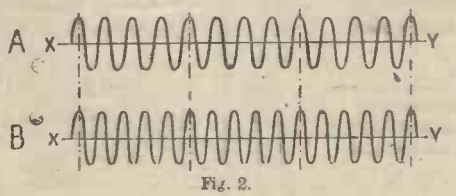


Fig. 2.

T square, and set square are not available; but if the ability of the draughtsman warrants it, he would be well advised, and perhaps his instruction more complete, if he uses plain paper and all drawing done by means of the T square and set square.

For greater accuracy and clearness, all straight lines should be drawn with a fairly hard pencil, say HH, sharpened to a chisel edge; for the drawing of the curves, however, a softer pencil may be used to advantage, say HB or F, sharpened to the usual point.

The three XY lines should first be set down in much the same relative positions as indicated in Fig. 1. Proceed by opening the dividers to a convenient measurement, and prick off equidistant points along the XY line of Curve A; through all these points draw perpendicular lines, standing slightly above the XY line of Curve A and continuing downward, crossing the XY lines of Curves B and C.

The First Section.

Now as to the drawing of Curve A; make a careful drawing of one section of this curve, comprising the crest of the wave (above the XY line) and the trough of the wave (below the XY line). This complete wave must occupy four spaces between the perpendiculars already drawn; commencing on the extreme left on the XY line (Curve A) and rising to the crest of the wave exactly on the first parallel line, which now becomes a vertical ordinate, dropping down and crossing the XY line exactly on the second parallel line, continuing below the XY line and forming the trough of the wave exactly on the third parallel; the curve now rises and once again crosses the XY line on the fourth parallel.

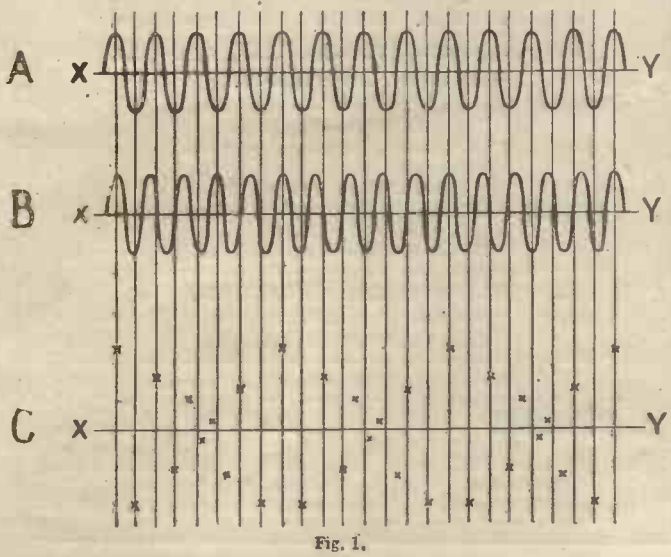


Fig. 1.

The measurement of the plus vertical ordinate at the crest of the wave must be equal to the measurement of the minus vertical ordinate at the trough of the wave, thus making the curve symmetrical about the XY line.

The first complete section of the Curve A having been satisfactorily drawn, the continuance of the curve may be most conveniently done by tracing this first section and repeating until the required length of curve is obtained.

Curve B may be drawn in an exactly similar manner, remembering that a fresh set of equidistant points must be pricked off along the XY line (Curve B), six of them exactly occupying the same space as five of those in Curve A, since six beats correspond to five beats in B and A respectively. Let the height of wave-crest and depth of wave-trough be equal to those of Curve A.

Our two Curves A and B are now drawn complete, and are relatively perpendicular to one another. Curve C may now be plotted, showing how the independent and varying values of Curves A and B are combined, and the form of the resulting curve. This must be accomplished in the following manner:

At the first vertical ordinate both curves show a plus value; these two vertical ordinates must be added together (by means of the dividers) and their combined measurement be plotted on the corresponding perpendicular line on Curve C. Thus the first point of our required curve has been obtained.

Joining Up.

In this first measuring of the ordinates of curves A and B both of them happen to be of the same sign, and are therefore *added* together; further along the curve, however, one ordinate may be plus and the corresponding ordinate on the other curve minus, in which case the lesser measurement must be *subtracted* from the greater, and the *difference* plotted on the Curve C. If the greater measurement be a plus one, then the difference must be plotted on Curve C *above* the XY line; if the greater measurement be a minus one, the difference must be plotted *below* the XY line.

If the two ordinates are both minus, their *sum* must be plotted *below* the XY line on Curve C.

If this method be carefully followed throughout the whole curve, the plotted points of Curve C should appear as in Fig. 2. On these plotted points being joined up by a curved line, the Curve C illustrated in Fig. 3 should be the result.

A Fundamental Principle.

In a nutshell, the principle may be stated thus: When two alternating currents are superimposed, at certain definite regular intervals the energy of the resulting current is much increased by the fact that the two individual currents at these points are of like sign, and their energy is therefore added; at other definite regular intervals the currents are of unlike sign, the energy of one neutralising the energy of the other; thus the resulting energy at these points is zero.

This causes very pronounced periodic beats in the resulting current, occurring at a much lower frequency than the original frequency of either of the two currents employed.

Needless to say, if two currents be used, whose frequency differs very little one from the other, say of the order of 99 compared with 100 (instead of 5 to 6), the resulting frequency is very low indeed.

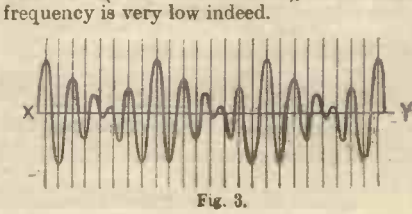


Fig. 3.

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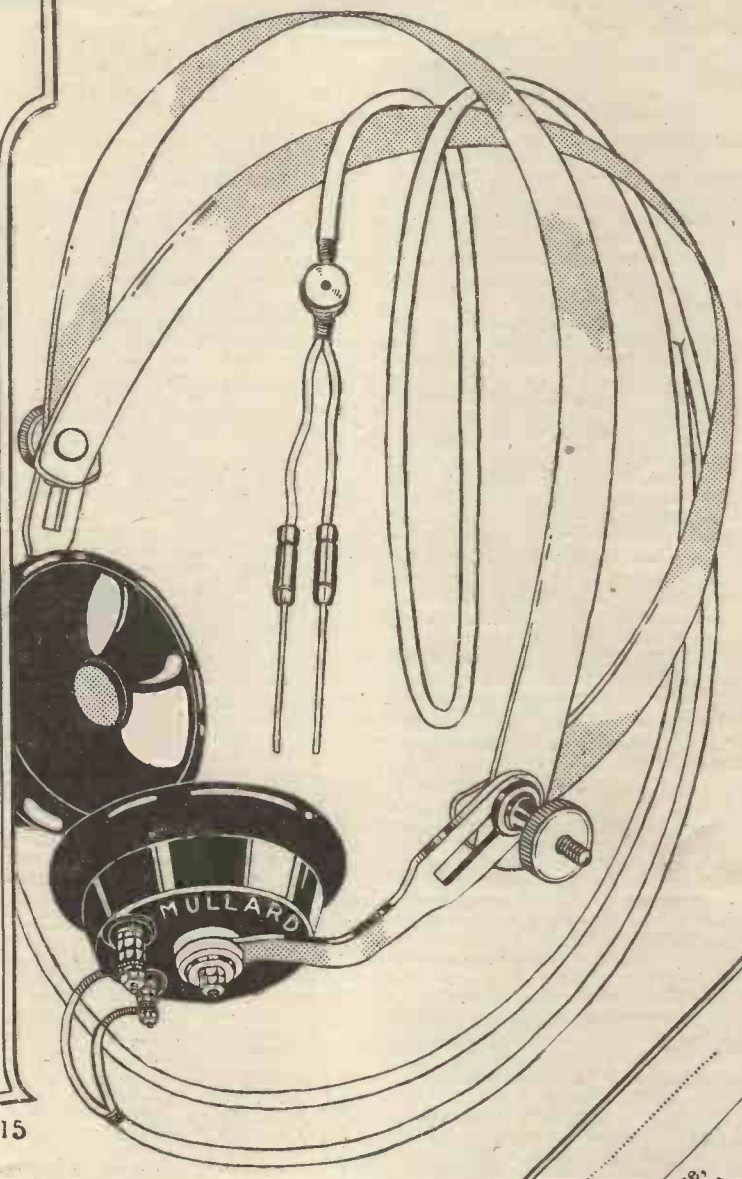

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WIRELESS CLUB REPORTS.

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

The Durham City and District Wireless Club.

The third meeting of the above club was held in the Rose and Crown on Friday, August 4th. Considering the fact that a large number of the members were on holiday, the attendance was quite large. Several new members were enrolled.

The meeting was a great success. The chair was taken by Mr. F. Sargent, F.R.A.S., of the Durham Observatory. After the minutes were read and passed, a lecture was given by Mr. G. Barnard on "The Electro-Magnetic Theory and Its Application to Wireless Telegraphy."

The lecturer commenced at the very beginning, so that no-one would be left behind. At the termination of the lecture a hearty round of applause was given, after which the hon. secretary made some important announcements, among which were the following:

The headquarters are definitely fixed at the Y.M.C.A., Claypath, Durham, where a receiving station will be very shortly installed.

Affiliation with the Wireless Society of London is well under way.

A question box is to be fixed in the club-room for the benefit of members too shy to speak at the meetings.

A full list of officers, it is hoped, will be ready to submit to the next meeting.

Membership cards are now ready.

Mr. Kelly (hon. treasurer) presented the club with a very fine, loud-sounding buzzer of the open type. This kind action was greeted with hearty applause. Mr. Nurthen, who is on the committee, has undertaken to take charge of the buzzer class, having had considerable transmitting experience. The chairman here made some very interesting remarks. He was glad the lecturer had mentioned Dr. Gilbert as one of the founders of electro-magnetism, and pointed out the wonderful achievements of Britishers in the science of wireless.

The hon. secretary takes this opportunity of inviting all who are interested to come along to the next meeting, failing which he will be pleased to receive any names and addresses of any persons, of either sex, desirous of becoming members, so that he may submit them as candidates for election to the club. The hon. secretary's address is 3, Sowerby Street, Sacriston, Durham.

Blackpool and Fylde and Lytham St. Anne's Wireless Societies.*

Thanks partly to the interest taken by the general public in the broadcasting scheme, but chiefly due to the energy of the executive committee, the society has now entered upon an era of prosperity. Membership is still going up steadily, and an assistant hon. secretary was appointed a short time ago to help to cope with the business side of the society's affairs.

In June last a branch was opened in the south-west area of the Fylde district for the benefit of members who otherwise would have to cover upwards of ten miles to reach the Blackpool headquarters; and although Blackpool is comparatively of humble proportions, the society finds support from a district quite as extensive as either Manchester or Liverpool.

This departure, when made, was very much overdue, and twenty-five members were automatically transferred from the Blackpool headquarters. This number has since been doubled by new members joining.

The society is well upholding their town's motto of "Progress." A transmitting licence for the Blackpool headquarters is daily expected, and, when it arrives, a broadcasting service is to be inaugurated for the benefit of its members and others, and also for an interchange of messages with the Lytham St. Anne's station.

On July 13th Mr. B. D. Taylor, the hon. librarian, submitted for inspection a home-made loud speaker, an adaptation of a motor-car petrol-filler; and on July 20th Mr. Taylor demonstrated the capabilities of a home-made but very well constructed and compact one-valve set.

On August 3rd Messrs. J. V. Potter and B. D. Taylor, after considerable trouble and patience, evolved an ingenious three-valve amplifier which should equal, if not excel, the well-known four-valve variety, as the clarity and intensity of the signals heard by means of this instrument amply justify the claims made on its behalf.

The society believe they are the first in this country to require and open out what is really a branch. The executive committee, whilst fully realising that mere numerical strength is not everything, encourage the bashful but enthusiastic amateur to their doors.

One of the many problems which the society is tackling is the evolving of a circuit, the use of which will prevent badly manipulated amateur stations causing interference, which at the present time is causing so much trouble and annoyance to other amateurs, as well as to the powers that be.

If this disregard for the consideration of others continues, the amateurs generally will undoubtedly find themselves in disrepute, due to the unsportsmanship of a few, and eventually some of the privileges which they now enjoy may be curtailed.

Hon. sec.: C. S. Doeg, The Poplars, 6, Seventh Avenue, South Shore, Blackpool.

Fulham and Chelsea Amatuer Radio and Socia. Society.

On August 1st an informal meeting took place at the Stanley Ward Conservative Club, 428, King's Road, Chelsea. Mr. Oliver explained the reasons of the meeting. Discussion was then invited as to the advisability of forming a local wireless society, and finally the following proposition was proposed by Mr. Scutt and seconded by Mr. Paterson:

"That this meeting take the necessary steps to form an amateur wireless society in Fulham and Chelsea."

This was carried unanimously, on the proposition of Mr. Cox, seconded by Mr. Wood.

A committee of management was then formed of the following gentlemen: Messrs. Scutt, Flood, Fildes, Martin, Paterson, and Roberts. This committee being elected unanimously, a discussion then took place on a suggested title, and finally it was agreed to call the society The Fulham and Chelsea Amateur Radio and Social Society.

It was then agreed that the next general meeting be called after the committee had sat to consider the necessary rules and details. A vote of thanks was then proposed by Messrs. Gray and Gauntlet to the Stanley Ward Conservative Club for allowing us their room. Messrs. Martin and Roberts proposed a vote of thanks to the chairman, both of which were duly carried, the meeting then being closed with expressions of appreciation on the forming of a local wireless society.

Attendance, 70, ladies also being present at the above meeting.

Hon. sec.: Mr. R. S. V. Wood, 48, Hamble Street, Fulham, S.W. 6.

RADIOTORIAL

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

It may be said that patience is a virtue possessed by at least some thousands of wireless amateurs.

The exasperating delays in the formation of a broadcasting combine, and the contradictory reports issued from time to time in the daily Press with regard to the future of broadcasting, have been enough to try the patience of a Job, let alone wireless amateurs, who have studied the art of patience when listening in for P C G G.

However, a general sigh of relief has risen from the radio ranks at the welcome, if belated, announcement that the broadcasting company has at last been formed.

Its members, no doubt exhausted by arduous debates and passionate appeals for "protection," certainly deserve a long holiday.

Let us hope the broadcasting service will be set fairly on its legs first.

As I write these words—some five days before my readers will be able to scan them—it has been stated in the Press that broadcasting will commence at Marconi House in one week's time.

So that by the time these words are read the service should have been sampled from the Marconi House station by some thousands of amateurs.

And from what I know of the activities at 2 L O, the service will be an exceptionally good one. However, there is many a slip 'twixt cup and lip, and I can only hope that another last-minute delay will not crop up and disappoint the expectant thousands.

To all responsible amateurs I would again issue a word of advice: Do everything in your power to instruct the novice in the proper adjustment of his valve.

Interference from amateur valve adjusters will have disastrous consequences unless the evil is quickly remedied.

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have decided to reply individually by post. A weekly selection of questions will, however, be printed on this page, together with the answers, for the benefit of readers of POPULAR WIRELESS in general. Questions should be clearly and explicitly written, and should be numbered and written on one side of the paper only.

All questions to be addressed to: POPULAR WIRELESS, Queries Dept., Room 131, The Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send necessary postage for reply.

C. E. L. (Palmer's Green).—To what wave-length will an inductance 4 in. diameter by 11½ in. long, wound with gauge 21, tune to with a 70 ft. long 26 ft. high aerial?

About 1,200 metres.

* * *

B. D. (no address) gives details of his crystal set, asks from what distance he should receive telephony and spark, and how he should improve his range.

Range of reception depends upon so many factors, not the least being the power of the transmitting station, that it is impossible to give definite figures. Generally speaking, a crystal set is limited to 15–20 miles or so for the reception of telephony. In the case of signals from spark stations, however, the range of such a set is most elastic. Hundreds of small stations equipped only with simple crystal detector receivers receive Eiffel Tower time signals at night over distances of thousands of miles. Ships in the far Atlantic and small outposts in the deserts of Egypt can all hear F L's mathematically precise signals on "carborundum" or "perikon." That is at night, when every amateur station—in Great Britain, anyway—should be able to receive these and numerous other signals from spark stations on their home-made sets with the greatest of ease.

As the sun gradually rises in the east, so will signals become gradually weaker, until only the more powerful stations can be heard. This phenomenon has been the cause of much annoyance in the past. During the days of the Great War the news transmitted by the now retired Poldhu was the cause of much winding of milk and cocoa tins, these being the basis of a series of loading coils to step up the wave-length of the now famous Mark 3 short-wave tuner.

It was not difficult to hear Poldhu when he started over ranges of two or three thousand miles even with this primitive apparatus, but towards the end of his carefully transmitted Press messages the sun would begin to rise and signals would become unreadably weak, finally becoming inaudible, the last readable words generally indicating that the "chef d'œuvre" had been contained in the last unobtainable few words.

* * *

F. H. O. (Ealing).—I wish to re-set a crystal; will the heating of same be harmful?

Most harmful if ordinary solder is used. Use "Wood's Metal," an extremely soft solder, and no flux. Carefully clean the cup, and run in a few drops of the metal, melting it over a small spirit lamp, and carefully press in the crystal.

* * *

T. I. (Bradford).—Can you tell me what size wire to wind my inductance with if I use 1,000-ohm telephones, and what should I use if I have 4,000-ohm telephones?

There is no particular rule to be observed. In any case use 22 or 24 S.W.G. for the inductance coil. The 4,000-ohm telephone receivers will be the more useful.

* * *

F. G. L. (Colchester).—Mr. Blake states in his articles that the electrons flow from the negative pole of a battery through the circuit to the positive pole. I have always been given to understand by all the standard text-books on the subject that the current flows from the negative element in the battery itself to the positive element and thence leaves the cell by positive pole.

You mean from the positive element to the negative element, the latter being the positive pole. Mr. Blake is quite correct in his statement from the point of view of the electron theory. It is much more consistent with the practical applications of this latter to say that the current or stream of electrons flows from the negative point. Although for years past, and indeed many years before the electron theory was evolved, it has been said that current invariably flowed from a positive point, there is really no reason why a statement to the effect that the current leaves a primary cell from the negative pole should not be a fact.

* * *

W. R. G. P. (Barham).—If the aerial goes to a two-way switch, one of the contacts of which is connected to the aerial terminal of the set and the other to the earth, will it be sufficient for earthing?

Yes, but the switch must be mounted upon an ebonite base to prevent leakage from the aerial to the earth lead that would be brought into such close proximity.

* * *

H. D. (Rotherham).—What will be the wave-length of a coil 4 in. in diameter by 12 in. long wound with 380 turns of 28 S.W.G. used with 100 ft. aerial?

1,600 metres.

Is it better to have one or two sliders on the coil?

Two, if no variable condenser is used.

(*Continued on page* 251.)

LITTLE WILLIE IS LUCKIER THAN MANY AMATEURS!

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 250.*)

"SHORTWAVE" (Middlesbrough).—My short wave set ranges from 160—600 metres. The primary is wound with 3 oz. of Number 24 S.W.G., D.C.C., and the secondary with 1½ oz. of Number 36 D.C.C. How can I increase the range of this set to about 10,000 metres?

You could place loading coils in series with both the primary and secondary inductances, but that would be both inefficient and we should think unnecessary. Apparently it is a crystal set, and there is little that would be received upon a wave-length above 3,000 metres. In any case, if you desire to range to a wave of such length and still be able to receive the shorter wave-lengths, it will be necessary to have interchangeable inductances, because one coil wound to tune to 10,000 metres would not tune down to 160. This is due to the fact that the turns not in use and generally styled the "dead end" of the coil will have very considerable capacity effects.

* * *

"KNOW NOWT" (Manchester).—I propose fitting a single aerial about 100 ft. long. The receiver to be in an old house, rather damp and not quite weather-proof. Is that unsuitable?

Highly unsuitable. Damp and deterioration, without mentioning the fact that current leakage will be serious, go hand in hand.

What sort of crystal will be best?

The "perikon" combination of zincite pressing against copper pyrites is as good as any.

The nearest water pipe is about 24 ft. away. Is that suitable, or could I do without an earth?

An earth of some description is essential. Judging by your first question, it would necessitate but a very short lead to enable you to obtain a direct earth by burying a metal plate or driving a metal rod into the ground. Such an earth is always to be preferred.

The telephone wires to a private house are about 10 ft. away. Will that cause trouble?

Using a crystal set there will be little or no interference, but in case you intend to extend to valves in the future it would be as well to erect the aerial as far from the parallel to these wires as possible.

* * *

"READER" (Earlsfield).—Will a cardboard former answer the purpose as well as ebonite or wood for the inductance coil to be used with the simple valve set described in Number 3?

That can be used, but it must be well shellacked or soaked in paraffin wax before winding.

Is Gauge 22 wire suitable?

Quite.

* * *

"AMATEUR" (Brighton).—I heard a station call the enclosed stations all at the same time; for what purpose would this station wish to communicate with so many other stations and yet not be in a position to send out a "C Q" signal?

If the list of 50 or so three-letter groups were station calls we find that the stations would extend from Australia (V K A) to China (X S C) and various other rather distant parts of the world covering several continents, so we therefore come to the conclusion that it was merely a code message that you intercepted.

* * *

"COBBY" (Keighley).—I have obtained two coils to make a loose coupler and I have been informed that the reaction coil must be placed so as to be in opposition to the other coil. How do I do this?

A reaction coil in a valve circuit would be coupled with the secondary coil. It would, however, be in no way in opposition, but must on the contrary be so arranged that the turns of wire wind in the same direction as those of the coil to which it is coupled.

* *

T. A. S. (Chadwell Heath).—Is it possible not to use tinfoil with silicon crystal?

Certainly, but some method must be adopted whereby the crystal is held firmly in the cup with a good metallic connection to the external circuit. Small set screws can be used. Better still, the crystal can be embedded in "Wood's Metal," an extremely soft solder. Ordinary solder should on no account be used, as the heat necessary to melt it will burn the crystal and render it useless. It is not advisable to use even "Wood's Metal" in the case of galena.

How do I fix a 4-volt battery to a carborundum detector in a simple crystal circuit?

A potentiometer is necessary. Place this by one end of the winding and the slider in series with the crystal and 'phones. The 4-volt battery will be connected across each end of the winding. Do not forget to disconnect the battery when the set is not in use, otherwise it will continue to discharge through the winding of the potentiometer.

* * *

R. G. H. (Hammersmith).—I contemplate the erection of a twin aerial 60 ft. in length on a flat-roofed building about 50 ft. high, but I shall require a down lead of about 60 ft. Will this be too long?

It will not only be too long, but will not be allowed. For an aerial such as you describe the P.M.G. limit is 140 ft. of total wire used, including all the down lead to the terminal of the set. It will be advisable to endeavour to instal the apparatus in an upper room. The lead-in should follow the straightest line possible to the set, being kept well away from walls and other likely points of leakage.

* * *

H. T. (Birmingham).—When I hang my telephones on the wall the diaphragms go rusty. How can I prevent that?

Obviously you should not hang them on the wall, but should discover a drier and safer place.

* * *

"SPARKS" (Torquay).—I wish to take the aerial and earth leads to a plug so that I can plug my set on in either of two or perhaps three rooms. Will that be possible?

Certainly it could be arranged, but you should not expect any but the very poorest of results. Such essential rules as taking the aerial lead the straightest line from the aerial to the set, reducing the earth lead to a minimum, keeping the aerial and earth leads and other wiring as far apart as possible, would all necessarily be broken and contribute to inefficiency.

* * *

C. E. H. (Barnes).—Where can I obtain a list of the amateur stations in and about London?

There is no complete list obtainable. The Wireless Year Book gives a fairly good list.

(*Continued on page 252.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 251.)

D. W. B. (Ricky).—Can you tell me the capacity of a variable condenser having 12 fixed plates 3¼ in. in diameter and 11 2¼ in. diameter, the fixed and moving plates being separated by 1-16th of an inch ?

·004 mfds.

Also, the maximum and minimum wave-lengths of an inductively coupled tuner having a primary of 3¼ in. diameter and wound with 92 turns of 28 D.C.C., S.W.G., copper wire, and a secondary 2¼ in. diameter wound with 175 turns of 36 D.C.C., S.W.G., with the above condenser and an aerial whose natural wave-length is 95 metres ?

It is presumed that the above condenser will be placed across the secondary. The capacity of this, by the way, is too great for a tuner of the dimensions mentioned; ·0005 mfds. would be more in proportion. Without knowing the actual values of the aerial it is impossible to give but a very approximate figure, as everything will depend upon the capacity and inductance in relation to the inductance of the leading coil. Thus a single wire aerial of a certain length will have more inductance and less capacity than a double aerial of slightly less length, although the natural wave-length may be the same. An inductance loaded upon the aerial with the greater capacity will give a greater wave-length range. Assuming the aerial in question to be a single wire of some 70 ft. in length, the wave-length range would be up to 630 metres.

* * *

"AMATEUR" (Sheffield).—Will the using of a potentiometer in conjunction with a crystal detector and a 21 plate condenser be of any advantage ?

Unless the potentiometer is used with dry cells in order to apply an initial potential to a detector consisting of a carborundum and metal combination, no useful purpose will be served by its addition to the set in question.

What wave-length signals will be received on a crystal detector set the tuning coil of which is formed of a 3½-in. former with 11 in. of wiring, the wire being 26 S.W.G. ?

Assuming that the wire is single cotton-covered or enamelled and that there are some 450 turns and that the aerial is the standard single P.M.G., 1,600 metres.

Of what advantage is a filament resistance ?

It has several very great advantages. Perhaps the most important and the least known is that by gradually applying the current by means of such a variable resistance to the filament the useful life of a valve is very much lengthened. As more and more current is allowed to pass through the wire of the filament, so does the temperature of the wire rise gradually. If no resistance is used and the full current allowed to pass through the wire of the filament, immediately the accumulator is placed in circuit, the sudden rise in temperature will have a weakening effect on that wire. Also it might well be mentioned that it is not conducive to the long life of the accumulator to start its discharge at maximum, but this point is of minor importance. The second useful purpose the filament resistance serves is to regulate the temperature of the filament so that the valve functions to its greatest advantage. There is a point in the rise of temperature, evidenced by the brightness of the filament, above which a further increase would be disadvantageous. That is known as the saturation point.

* * *

T. F. (Chiswick).—Have aerials ever been patented ?

Yes; there are numerous patents covering various arrangements of aerial systems. These are mostly in connection with wireless direction finding.

I notice that there is very little actual metallic connection between the two sets of lines on a railway. Would it not be possible to use these for communication by means of high-frequency currents, thus saving the expense of erecting at least a number of telegraph lines ?

No; it would not be possible unless the lines were properly connected at each fishplate as are electric railway lines, and highly insulated. Even were this done it is more than probable that the friction of the wheels of the trains would generate such a quantity of electricity that communication over even short distances would be impossible.

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