POPULAR WIRELESS WEEKLY. October 7, 1922. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

No. 19. HOW TO MAKE BASKET COILS.

POPULAR WIRELESS

3d

No. 19 Vol. 1.
Oct. 7, 1922.

Weekly

The 3rd Kingston Scouts listening to PCGG.

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A CRITIQUE OF AMATEUR WORK. GLOSSARY OF RADIO TERMS.

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Popular Wireless

TOPICAL NEWS AND NOTES.

NOTES ON THE EXHIBITION

THE 20-KW. TUBE

THE WIRELESS SOCIETY OF LONDON

The Prince of Wales and Wireless.

HIS ROYAL HIGHNESS THE PRINCE OF WALES has graciously consented to "broadcast" by wireless telephony from York House, through Marconi House, London, on the evening of October 7th, an address to the Boy Scouts of Great Britain. This address will be specially directed to those scouts who for various reasons are unable to be present in the afternoon of that day at the Great Rally being held in his honour at the Alexandra Palace, London.

The Prince will speak by wireless between 7.30 and 8 p.m., the Marconi House station wave-length being 360 metres, and the call letters 2 L O.

In order that a maximum number of scouts may listen in on this occasion, special arrangements are being made with the wireless societies throughout Great Britain whereby they place their services at the disposal of local troops.

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Floods at Towyn.

UNUSUAL flood scenes were witnessed recently at Towyn, Merionethshire, owing to the river embankment being washed away. The Marconi experimental station at Towyn was flooded, the water mounting in the engine-room to a depth of three feet. Operators had to engage boats to perform their duties.

* * *

Marconi Concession in Austria Ratified.

THE Reparations Commission having ratified the Austrian Government's concession to Marconi's Wireless Telegraph Company, the final documents relating to that concession have been signed and are now in London.

By this concession the Marconi Company is given the sole right to erect, and to work for thirty years, wireless stations for public traffic between Austria and all other countries.

* * *

A New "Stunt."

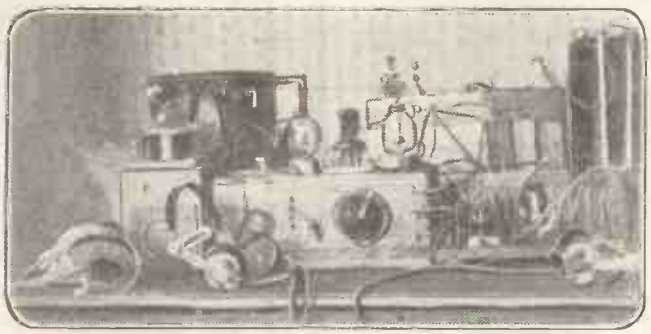
A STRANGE use of wireless is reported from Chicago, where at the Cook County Fair a horse named Radio has been trained to circle the track at top speed, riderless and driverless, but accoutred with a wireless receiving outfit in place of ordinary harness.

The owner and trainer of the horse sits in the grand stand and sends all his commands by wireless.

It looks to me as if the jockeys will soon be jobless. Fancy a Radio Derby!

Weather Forecasts.

SPEAKING before the Mathematical and Physical Science Section of the British Association recently, Dr. G. C. Simpson, director of the Meteorological Office, said, in connection with the weather forecasts by wireless, that a scheme had been prepared for distributing the "general inference" by wireless telephone instead of by the Morse code, and would be put into operation as soon as there was an organised scheme for broadcasting in this country. Mr. M. A. Giblett, the assistant superintendent of the forecasting service at the Meteorological Office, read a paper describing the present methods of gathering and disseminating weather information.



Mr. J. P. Carter's set at Wroxham House, Wethycombe, Exmouth.

* * *

Progress at Nauen.

IT is stated by "The Engineer" that good progress is being made with the extension of the radio station at Nauen, Germany, and it is expected that by the beginning of next year it will be possible to establish permanent communication with the new Argentine station at Monte Grande, near Buenos Aires. Four of the existing masts at Nauen, which are over 390 ft. in height, have been removed and replaced by a series of seven towers 688 ft. in height, which provide four additional antennæ circuits, each of which is served by a high-frequency alternator. The new aerial will be used for American, Asiatic, African, and European services, and for distant stations (such as the South American station); two or more aerials may be used in combination with each other. The transmitting installation has been improved and enlarged, and the system of earthing connections has been extended.

* * *

Professor Branly's Fears.

PROFESSOR BRANLY, whom the French generally describe as the inventor of wireless telegraphy, recently issued a serious warning against the unlimited granting of permits for the use of private wireless transmission stations.

"The future of wireless telegraphy," Professor Branly states, "is almost realised, and all that remains is to extend its application to mechanism operating at a distance, such as steering ships, aircraft, etc. The only regrettable feature of the development of the new form of transmission seems to me to be that it has been thought fit to authorise private users to instal transmission posts. Terrible consequences that may result from this in the way of spying, sabotage, and various kinds of attacks coming from the frontiers or interior of a country, may easily be imagined.

"It is no secret that aircraft can now be steered by wireless without the aid of a pilot. Suppose such an aircraft be fitted with wireless antennæ. By this means its exact position could be constantly ascertained. Suppose, further, that such an aircraft were loaded with explosives. Its burden could be exploded over any depot of munitions, fortified position, or other important point that was selected by its operators."

This all tends to suggest that, if too many individuals are allowed to possess sending plants, anything in the way of effective surveillance will be impossible. "This is," added the scientist gravely, "the price we have to pay for progress."

* * *

A Correction.

In a recent issue we stated that Mr. A. Greenslade obtained the third prize in the Amateur Transatlantic Tests. This is not so, the third prize winner being Mr. W. F. F. Corsham (2 U V), of 104, Harlesden Gardens, N.W.10.

* * *

Various Items.

THE new radio station in Warsaw, which is being erected by the Radio Corporation of America, is nearing completion, and it is anticipated that it will be in working order next month.

* * *

The Radio Corporation of America has secured orders for the erection of five radio stations, each of which will have a sending radius of more than 2,000 miles. Three will be in Central America—in Honduras, Nicaragua, and Panama respectively—and the other two in the United States.

* * *

Sir William Vicars has been appointed chairman of the Australian Amalgamated Wireless Company.

NOTES AND NEWS.

(*Continued from previous page.*)

The Chase Motor Co.

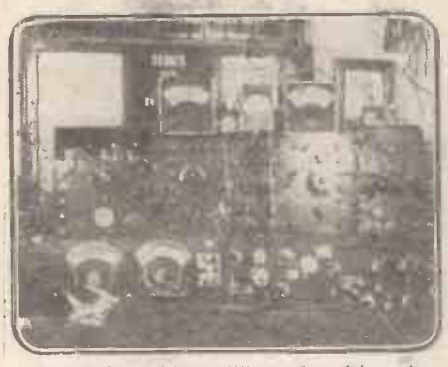
THE Chase Motor Co., Ltd., of Newcastle-on-Tyne, ask me to point out that they do not possess a broadcasting licence, but only an experimental one, and that all their transmissions are in the nature of experiments.

* * *

Broadcasting.

CONSIDERABLE progress has been made in the negotiations between the Postmaster-General and the Broadcasting Committee on the one hand and between the Wireless Manufacturers and the Marconi Company on the other.

The Postmaster-General is looking after the interests of the public, and I understand he has succeeded in getting certain modifications made in the articles of association of the new company as well as in the agreement between the company and its members. Only one or two small matters are outstanding, and it is certain that early agreement in regard to these will be secured.



The experimental transmitting and receiving set owned by Mr. H. Carter-Bowles, 51, Gunterstone Road, West Kensington.

The Chairman.

IT has been agreed that the chairman of the company shall be a well-known public man not connected with any of the wireless companies. I hear that Lord Gainford is likely to be the first chairman. The choice is an excellent one, and under his presidency the business of the company should be well managed.

Six of the directors will be representatives of the six chief companies, and there will probably be two more directors elected by the other manufacturers in the Broadcasting Company, so that the interests of the smaller manufacturers will be safeguarded.

It is probable that when the Broadcasting Company has been formed the directors will agree that, as a temporary measure, the transmitting installation at Marconi House will be utilised for broadcasting in London. This will mean an early commencement in the London area. It is hoped that some existing stations in the provinces will be available as temporary broadcasting stations. In any case, I feel certain there will be no avoidable delay on the part of the new company in the erection of permanent broadcasting stations.

It is understood that the maximum wavelength to be allowed for broadcasting will be 700 metres.

Exhibition Items.

OWING to late delivery of copy it was not possible to mention the exhibits of Messrs. Hambling, Clapp & Co. in our last issue.

This firm have shown during the week at the All British Exhibition a very comprehensive selection of wireless accessories. An entirely novel item is their O.K. Scout Set, which has a waterproof canvas case for the tuner and other useful features.

* * *

Half-hour telephony transmissions on 360 metres, daily at 11, 3, 6, and 8 o'clock, have been a welcome feature this week. The transmissions were arranged in connection with the exhibition.

* * *

It is gratifying to learn that applications for membership to the Radio Association "poured" in during the progress of the exhibition.

* * *

And it is equally gratifying to learn that POPULAR WIRELESS was in great demand, and that record numbers were sold. Everyone appeared to think the special number a useful guide to the exhibition.

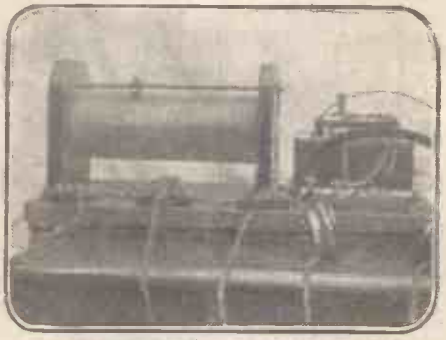
* * *

Mr. John Scott-Taggart, our chief technical adviser, had a very appreciative audience at his lecture.

* * *

As we go to press, I hear that the exhibition has been a great success.

The exhibition was opened by Sir Henry Norman, Bart., M.P., and the following well-known radio scientists have assisted:



Mr. W. G. Cotterell's home-made crystal set at 27, Burlington Road, Small Heath.

Sir H. B. Jackson, Admiral of the Fleet; A. A. Campbell Swinton, F.R.S., M.Inst.C.E., M.I.E.E., M.Inst.M.E.; Frank Hope-Jones, M.I.E.E.; Maurice Child; G. P. Mair, A.M.Inst.C.E., M.Inst.Mech.E.; G. G. Blake, M.I.E.E., A.Inst.P.; E. Blake, A.M.I.E.E.; Philip R. Coursey, B.Sc., A.M.I.E.E., F.Inst.P.; W. R. H. Tingey, late Royal Corps Signals, T.F.; R. Clinker; John Scott-Taggart, M.C., A.M.I.E.E., F.Inst.P.; Lt. H. Walker, A.M.I.E.E.; H. R. Rivers-Moore, A.M.I.E.E., B.Sc.

ARIEL.

Broadcasting Programmes

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

TELEPHONY TRANSMISSIONS.

Station.	Call-sign	Wave-length in metres.	Remarks.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Marconi House, London	2 L O ..	360 ..	Not regular.
Writtle	2 M T ..	400 ..	Tuesdays, 7 p.m. (G.M.T.).
Paris*	F L ..	2,600 ..	(See foot-note.)
Königswusterhausen ..	L P ..	2,500 and 4,100 ..	Daily, 7 and 10.30 a.m. (G.M.T.).
The Hague†	P C G G ..	1,085 ..	Sundays, 2.30 and 5.30 p.m., and 8 to 9 p.m. Thursdays, 8 to 9 p.m.
Messrs. Burnham (Blackheath) ..	2 F Q ..	440 ..	About 9 o'clock any evening.

NOTE.—The Bar Lightship, Liverpool, sends telephony at 6 a.m., 8 a.m., 2 p.m., 4 p.m., 6 p.m., 8 p.m. (G.M.T.). Wavelength 440 metres. Calls "Liverpool." When answering Liverpool calls "Bar Light."

* The hours of the telegraphic and telephonic communications transmitted from the Eiffel Tower have been altered on the reversion to "winter-time." The official notification of their changes is as follows:

3.20 a.m. to 3.30; 9.20 to 9.30; 15.20 to 15.30; 20.20 to 20.30; meteorological report for France by wireless telegraphy in code. 4.50 and 12.15, telephoned forecasts of weather. 12.30 to 12.45, weather report over Europe generally in code.

10.23 to 10.30; 11.33 to 11.49; 23.36 to 23.49, time-signals, preceded by the usual code and message afterwards.

18.16. Weather forecast in plain language by telephone, followed by a gramophone concert, the latter always with the experimental idea. All reports of the latter throughout Europe and from ships in the Atlantic are valuable. England being in the known radius, English reports are welcomed, but naturally are not sufficiently far-distant to be of any great research value.

Mr. Le Queux reports that perhaps amateurs have heard the concerts which have been transmitted daily to the Concours Lépine at 17.00. They continue until October 5th, but will probably be still continued for experimental purposes, with orchestra and opera artists. If any of these concerts are still given, they will be announced after the weather forecast at 18.16, and any other warnings of experiments.

The wave-length of all is the usual 2,600 metres.

Mr. Le Queux adds that when at Lafayette recently he was told that very shortly some highly interesting experiments will be made with trans-Atlantic telephony, on much higher power than those from Poldhu in 1921. Concertina solos are, among others, to be made the subject of experiment.

† The times of the Thursday transmissions are liable to sudden alteration.

Many amateurs may be heard of an evening on 440 metres, also as low down as 40 metres.

SOME SCIENTIFIC ASPECTS OF WIRELESS.

By P. J. RISDON, F.R.S.A.

NOTE : This article is the substance of a lecture delivered by Mr. Risdon at the Radio Exhibition held at the Central Hall.

AN average wireless operator may be perfectly efficient, and an average amateur may derive immense enjoyment from his receiver without necessarily having studied deeply the scientific side of wireless. To such, the real wonders of wireless are unknown. When for the first time an operator—amateur or otherwise—picks up wireless music or speech he may feel a thrill of wonder, but that soon wears off, and is replaced by a feeling of impatience at the lethargy of the powers that be in the matter of providing broadcast concerts and other things for his edification.

In a general way he can tell you that wireless music and messages are borne on electro-magnetic waves that traverse the ether with the speed of light, that are generated by electricity flowing in an aerial, and that follow the curvature of the earth. But it is comparatively few who go deeper into the scientific aspect than that.

Production of Waves.

In the use of wireless we have to deal with at least two distinct and entirely different kinds of waves, namely, electro-magnetic or ether waves, and air or sound waves. Some day light waves or some other kind of wave may enter into the question—in fact, we need to consider light waves to some extent now because of their similarity to electro-magnetic waves in certain respects. For instance, their speed is the same, and both can be reflected.

Sound, light, electro-magnetic, and all other waves are produced by the expenditure of force or energy. Sound and light are both sensations experienced as the peculiar result or effect of such energy, whilst electro-magnetic waves make themselves manifest in other ways, with which all of you who are interested in wireless are familiar.

Imagine a man who from birth possesses no auditory and no optic nerves; such a man would be absolutely deaf and blind, and sound and light would be meaningless expressions to him, since there would be no nerves to convey the vibrations of sound and light waves to his brain.

If we strike a flint with a hammer, we may produce at least three distinct kinds of waves, namely, light, sound, and heat waves, all of which are perceptible to our senses. Probably we produce many other kinds of vibrations, such as electro-magnetic waves, as well.

The Medium.

We know that sound proceeds as air waves because, if a disturbance be made inside a closed vessel, such as ringing a bell, if the vessel be gradually exhausted of air, although the cause of the disturbance may continue, the sounds themselves will die away. In other words, you cannot make a noise in a vacuum. And we know that light does *not* proceed as air waves, because light from the stars reaches us through billions of miles of space devoid of air. Moreover, air tends to obstruct light.

Now, it has always been assumed that in order for waves to exist at all there must be a medium. Thus the medium for sea waves is water, and the medium for sound waves is air. What, then, is the medium for light and other waves, in the vast spaces between solar systems, and between suns and planets ?

A Deep Sea Example.

Scientists have hitherto assumed a medium which, by its nature, would comply with the conditions necessary for the passage of such waves. This medium was rather unfortunately called the ether—unfortunately, because ether, in another sense, indicates a volatile spirit, much more like pre-war whisky than the medium we are thinking of—whereas the modern view of the ether of space is that it is extremely dense—a million times denser than the hardest steel—a condition necessary for the transmission of light waves. At the same time, the ether must obviously be transparent, and of a fluid-like nature, in order that matter, whether gaseous or in the form of suns and worlds, may move through it freely.

Now, if we imagine any form of matter immersed in such a medium, it is not difficult to realise that its enormous pressure would cause it to permeate such an object through and through.

That is the view of the ether—that it permeates all matter, which exists in it in a form that is quite gossamer-like compared to the ether itself.

This conception is rendered easier by thinking of deep-sea life. At a depth of a mile, the water pressure is equal to about one ton to the square inch, yet at even greater depths, where the pressure increases more and more, there exist fish and jelly-like forms of life which we can only assume are permeated by the water; creatures which, whilst capable of sustaining within and without them such a great uniform pressure, could be crushed quite easily under foot.

Ignoring the Ether.

I have recently received from Professor Bridgman particulars of some extraordinary tests he made with water, at pressures of 150 tons to the square inch. One astounding result was that a piece of steel, immersed in the water at that pressure, was found to change its character to such an extent as to twist and bend about, and to flow, as it were, with the movement of the water—much as a bunch of some soft substance accommodates itself to the motion of the water in an eddying stream, apparently indicating that the density of water at such high pressures is such that it can permeate the microscopic interstices of the metal.

Of course, I do not suggest that either of these instances constitutes a strictly scientific analogy, because water under compression possesses molecular structure, whereas the ether could not. Nevertheless, such known facts assist to a comprehension of the possible effects of ether upon matter.

I ought perhaps to mention here that there are other scientists who hold that the phenomena of light and electro-magnetic waves need no such hypothesis as the ether but are attributable to magnetic fields of force or energy in space. They may be right, but, pending further evidence, the conception of the ether fulfils our purpose.

Bearing in mind what has been said about the supposed density of the ether, think of an aerial wire as a gossamer thread (comparatively speaking) suspended in it, into which an electric charge courses with the speed of light. The aerial wire is not set in motion, unless, of course, it happens to be moved by the wind, which is beside the point.

The Spectrum.

Without going into the question as to the nature of an electric charge or current, it is sufficient to say that it is believed to set up a strain in the ether, as the result of some effect produced by the flow of electricity, and thus to cause a wave of energy to spread out from the aerial in all directions. The message is thus delivered by a series of interruptions in the aerial current, corresponding to the Morse code.

According to the school which asserts that there is no ether, what happens is that the magnetic field set up by the charged aerial induces a corresponding current in the receiving aerial, the interruptions, of course, corresponding to those in the current oscillating in the transmitting aerial.

I should like to say a few words here on the subject of the spectrum, because it has a distinct bearing upon a subsequent portion of this article.

White light—sunlight—consists of a combination of all the colours of the rainbow. If, to take a time-honoured example, we hold a glass prism, such as one of the triangular pendants from an old-fashioned glass ornament, in the sun's rays, the rays are refracted by it so that the different colour rays emerge on the other side at different angles, and appear on a shaded surface like a section of a small rainbow.

Different Wave-Lengths.

That is called the visible portion of the spectrum. But above and below that visible portion are many other rays, such as electro-magnetic, ultra-violet, and X rays, that do not directly produce the sensation of light. There are also big intervals between these known portions of the spectrum in which presumably there are other rays as yet unknown, the discovery of which may conceivably have an influence upon our present methods of wireless.

It is obvious to everybody that from the sun—that vast, seething mass of energy—we derive everything that makes life possible on earth—warmth, light, and other things, of some of which we are ignorant. These benefits, we assume, are conferred upon us by means of ether vibrations, and differ according to the wave-length of such vibrations. Thus, the different colours in the visible portion of the spectrum are the result of different wave-lengths which affect the eye and brain differently and so cause the sensation of various colours.

(*Continued on next page*).

SOME SCIENTIFIC ASPECTS OF WIRELESS.

(*Continued from previous page.*)

But just as the different colours merge imperceptibly, the violet rays into the invisible ultra-violet, and the red rays into the infra-red or heat rays, so it is reasonable to suppose that other rays, in order, merge imperceptibly. Between heat waves and electro-magnetic waves, and between ultra-violet and X rays, there are great unexplored portions of the spectrum.

Some day, no doubt, means will be discovered for detecting these intermediate rays and their effects, and then, possibly, instruments may be devised for converting other waves of one kind into other waves of another. In wireless transmission of speech we already convert sound waves, which travel at only 1,100 feet a second, into electro-magnetic waves which travel at 186,000 miles a second—893,000 times as fast—and reconvert them again, thousands of miles away, and can magnify the signals they convey thousands of times.

The Magnetic "Screen."

Of course, the difficulties may be enormous, when we consider that the mean wave-length of light is $\frac{1}{50000}$th of an inch and its frequency something like 500 billion, whereas the length of electro-magnetic waves, as used for wireless at present, varies from a few feet to several miles. Nevertheless, although this is only a suggestion of my own, I do not doubt that such conversion will be effected some day. And it must be remembered that, although we speak of wireless as having "come of age" in point of years, in reality it is still in its cradle.

If we could produce electro-magnetic waves of short enough wave-length they would begin to be visible, and we should then call them light waves, and if efficient means could be devised for converting light waves into electro-magnetic waves and vice versa, it would appear that the problem of wireless pictures by true wave impression would be practically solved.

Passing to another phase. Why should electro-magnetic waves generated at an aerial follow the curvature of the earth?

A theory—attributable, I believe, to Professor Fleming—is that some thirty miles above the earth there is a layer of the atmosphere, laden with electrically charged microscopic dust projected from the sun, and that this dust serves as a magnetic screen or deflector, so that as the waves, generated at an aerial, spread out, they are prevented from passing further upwards by this screen and are magnetically deflected and compelled to conform to the contour of the earth's surface. Nevertheless, supposing that such a screen exists and exerts such an influence, could we but produce electro-magnetic waves of such short length as to approximate to those of light, and of sufficient power, we may assume that they would penetrate this screen and be projected into space.

A Vexatious Problem.

This brings us to a constantly recurring topic, namely, the possibility of communicating with another planet. Strange signals are occasionally recorded that cannot be accounted for, and poor Signor Marconi is subjected to the ordeal of an interview.

"Are the signals from the Martians?"

Signor Marconi smiles as he steps aboard his yacht, and the daily newspapers thereupon announce that he is off to the Mediterranean to solve this vexatious problem.

Why to the Mediterranean, Heaven only knows!

As most of us are aware, the world is about 93,000,000 miles from the sun, Mars being about 141,000,000, or, say, 48,000,000 miles from the earth at its nearest.

In the present state of our knowledge we can only think of two methods of communicating with the inhabitants of Mars—if there be any inhabitants on that aggravating planet. One is by means of light signals, and the other by means of electro-magnetic waves.

Let us consider the question of light signals.

Just Suppose——

Mars (like other planets) already signals to the earth the fact of its existence by means of the sun's rays reflected from it. The planet virtually constitutes a heliostat. Now in order to give us every advantage, let us imagine that the earth passing directly between the sun and Mars could cause a total eclipse to the Martians so that the whole surface of Mars would be obscured by the earth's shadow, and the sun would be invisible to the Martians. (Of course, this is a purely hypothetical supposition and quite impossible.)

The two planets would then be at their nearest to each other—48,000,000 miles distant—and the surface of each, exposed to the other, would be in darkness. It would then be up to the inhabitants of each planet to produce light or other signals capable of penetrating first the atmosphere of one, then 48,000,000 miles of intervening space, and then the atmosphere of the other.

Why Marconi Smiles.

But when we consider that our own atmospheric blanket lessens the power of the sun's rays so that those that reach the earth's surface have lost about half their power, and that a little extra moisture in the form of clouds almost turns day into night, what is going to happen to the mightiest light that man could possibly produce in its passage through two atmospheres and 48,000,000 miles of space?

In the next place, the strong presumption is that to produce electro-magnetic waves of sufficient strength would require as much, if not more, energy than would be required to create sufficiently powerful light signals.

Finally, supposing that by some colossal expenditure of energy it were possible, under such imaginary ideal conditions, to produce light or electro-magnetic or any other waves which would perform such wonders, what about the vast torrent of rays of all wave-lengths that pours continually from the sun—waves of such power as to extend many millions of miles beyond the radius of Mars' orbit and beyond the confines of our solar system? One can only suppose that by them our feeble manufactured waves would be swamped before they could even properly begin their journey.

No wonder Signor Marconi smiles!

He knows what his interviewers do not know—that they flatter even his genius.

BOOK REVIEWS

Wireless Valves Simply Explained. By John Scott-Taggart, F.Inst.P. (London: Radio Press, Ltd. Pp. V. 134. 56 illustrations. Price 2s. 6d. net and 3s. net cloth.)

The last few years have produced a vast amount of wireless literature, a large portion of which has been devoted to the consideration of the thermionic valve. Volumes which have dealt with the subject at length have been chiefly of a mathematical nature and, therefore, they are perhaps somewhat advanced for the average experimenter. Mr. Scott-Taggart, our Chief Technical Adviser, in presenting this new book, has fully realised the needs of the amateur, and has explained the working of valves and valve circuits in a manner which can be understood by the veriest beginner.

The book is well illustrated and logically arranged. The opening chapters deal with the rectifying action of the two electrode valve, and then pass on to the rectifying action of the three-electrode valve. Chapter 3 introduces amplification, which is further considered in the following chapter. The explanation of self-oscillation developed from the theory of reaction amplification is extremely clear, two chapters being devoted to the subject, preparing the way for the seventh chapter, which deals very fully with the more usual methods of continuous wave reception. The concluding chapter is devoted to valve circuits suitable for broadcast reception, and the broadcast enthusiast will no doubt find this very useful.

It is an excellent book for all, and can be unreservedly recommended.

Working Diagrams of Valve Amplifying Receiver Circuits. By H. W. Sullivan. (Winchester House, Old Broad Street, E.C.2. 4th Edition. Price 1s.)

This book of diagrams should make a very big appeal to amateur experimenters. We have seldom seen a more useful book for the modest sum of one shilling.

All the circuits shown, original and new, can be so modified that there is no reaction coupling direct to the aerial. In all, an excellent shillingsworth.

Tracked by Wireless. By William Le Queux. (Stanley Paul & Co. 7s. 6d. and 2s.)

The wireless enthusiast is unfortunately placed with regard to fiction about his favourite hobby. There are so very few authors who have had the experience of wireless that is necessary to enable them to write a really convincing yarn that is, above all things, technically correct.

Therefore, the news that Mr. William Le Queux (whose articles for this paper have been so popular) has published a novel, entitled "Tracked by Wireless," will be received with acclamation.

Geoffrey Falconer, the hero in "Tracked by Wireless," is a young engineer and inventor stationed at the wireless station at Chelmsford. His clever inventive abilities draw him into numerous adventures, all the more exciting because they are distinctly possible, and not mere chaotic episodes of an impossible kind.

Mr. Le Queux has written an excellent yarn, and has proved to the hilt his right to the title, "Master of Mystery." The book is published by Stanley Paul & Co. at 7s. 6d., and a cheap edition at 2s.

HOW TO MAKE BASKET COILS.

By PAUL D. TYERS.

(Assistant Editor to Radio Press Publications.)

ALMOST everyone who writes about wireless has at some time or other given instructions for making basket coils. Strangely enough, no two people ever make their coils exactly like any others, and, therefore, if the following description contains some novel ideas it will not have been written in vain. Of course, all basket coils are more or less similar when they are finished, but the difference lies in the type of former on which they are wound.

The former described on this page is made without the use of very many tools, and the cost involved is not more than a few pence. Another feature of this particular former is that it can be used with any number of spokes, which is a very desirable feature, as will be explained later. For the benefit of those who are not familiar with basket, or pancake coils, as they are sometimes called, a short explanation will no doubt be of use.

Materials Required.

The name "basket" is derived from the fact that the coil not only resembles a basket, but is constructed on somewhat similar lines. The bottom of a round basket consists of a number of radiating spokes around which the cane is wound. To make a basket coil, therefore, it is necessary to arrange some form of hub into which a number of spokes can be placed to serve as a former for the wire.

Basket coils are very useful for a variety of purposes; in fact, whenever an inductance is required in any particular circuit, it is nearly always possible to use a pancake coil. A basket coil has the additional features of being both efficient and easily and cheaply constructed, since it is quite self-supporting. As soon as the coil is wound the former is removed and is then ready for making another coil.

Speaking broadly, the only thing required to make the coil is the wire, and if the method indicated below is adopted practically all tools are unnecessary.

The particular former to be described consists of a number of metal rods clamped between two wooden discs fitted with thick felt washers. Some $\frac{3}{16}$ in. three-ply wood is procured from which two discs, $1\frac{1}{2}$ ins. diameter, are cut with the aid of a fret-saw. The discs are placed together, and a hole about $\frac{1}{8}$ in. diameter is drilled through the centre of both. A metal threaded screw about 2 ins. long, together with a nut to fit, should be procured of such a size as to fit easily in the hole.

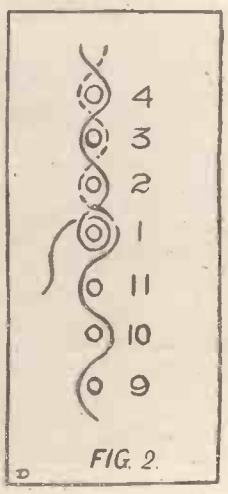


FIG. 2.

However, it is more convenient to use a piece of threaded brass rod, and purchase two wing nuts to fit it, as shown in Fig. 1. The hub is now complete with the exception of two felt, or thick flannel washers, which are cut to the diameter of the discs, a hole, of course, being made through each.

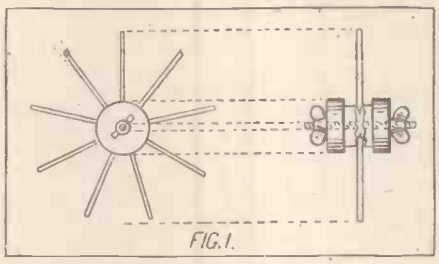


FIG. 1.

The next consideration is the number of spokes, which is determined by the size of wire with which the coil is to be wound. If thick wire is to be used on a small-sized coil nine spokes are sufficient, but this should be increased to eleven or thirteen for larger sizes employing finer wires. The chief point to remember is that the number of spokes must be odd, as otherwise the coil will not take up a basket formation; in fact, it will be impossible to wind it unless this rule is observed.

Winding.

A useful size of coil for general purposes is wound on eleven spokes to a diameter of $4\frac{1}{2}$ ins. with a centre hole of $1\frac{1}{2}$ ins. Having decided upon the number of spokes to be used, some means must be devised whereby they can be fixed equidistantly around the periphery of the hub.

This can be accomplished very simply by drawing a circle on a piece of white paper and marking it into eleven equal parts by means of a protractor. One of the discs is placed over the centre of the circle, and where the radiating lines cut through the circumference a small pencil mark is made on the edge. The pencil marks are afterwards made permanent by copying over with Indian ink or paint. The spokes consist of eleven pieces of rod, about $2\frac{1}{2}$ to 3 ins. long, and not more than $\frac{1}{8}$ in. thick. They can be of any metal, but wire nails with the heads removed perhaps answer the purposes as well as anything.

The two discs with the washers between them are mounted on the screw or threaded rod, and the nuts screwed up very loosely. If possible, it is convenient to clamp the arrangement by one of the nuts in a vice, as the process of assembling the spokes is then somewhat simplified. About six of the spokes are placed more or less equidistantly round the edge of the disc between the two felt washers, and then the nut is screwed up a little more tightly.

It is now possible to add some more of the spokes by repeating the process, until all are finally between the discs. It only remains to fix the positions of the spokes with the aid of the marks on the edge of one of the discs, and screw up the nut tightly.

The object of the felt washers, of course, is to enable the rods to be held firmly between the two pieces of wood. The accompanying diagram should make the details of the winder quite clear.

In winding the coil it is convenient to devise some means of holding the former. It is a good plan to solder a strip of thick brass on to one of the wing nuts, to serve as a handle, or alternatively to clamp one of the nuts in a small hand vice, such as is used by watchmakers. Failing both these methods, it only remains to hold the apparatus in the easiest manner possible. The winding operation is commenced by making about two turns of wire round one of the spokes, leaving at least 6 ins. of free end for connecting purposes.

Fixing.

We will call this spoke No. 1, and assume that looking at the edge of the former, at the ends of some of the spokes, the wire is on the left of the spoke. The wire is then taken round the right of No. 2, the left of No. 3, the right of No. 4, and so on, until spoke No. 1 is again reached. It will be found that this time the wire is on the opposite side, and therefore continuing the winding produces the spider web or basket appearance. When the desired width of winding is reached, two or three turns are made round one of the sopkes, and the wire cut off from the reel, leaving as before about 6 ins. for connecting purposes. All the winding details are shown in Fig. 2.

The simplest way of permanently fixing the coil is to set it in paraffin wax, obtained by melting down a number of candles in a shallow tin. The wound former is placed in the melted wax and then taken out, the superfluous wax being shaken off and allowed to set quite hard. Only sufficient wax to make the coil rigid should be left between the winding, as an excess tends to increase the self-capacity of the coil, which, of course, is not desirable. Beeswax is frequently used instead of paraffin wax, and perhaps makes a firmer coil.

When the wax is thoroughly set, the former is unscrewed and the spokes carefully pulled out. To prevent the free ends of wire from unwinding, it is usual to tie them off with a length of cotton. It is not advisable, however, to bring the two ends close together, as this slightly increases the capacity of the coil, at the same time bringing together the parts of the coil where the potential difference is greatest.

NEW SERIES FOR BEGINNERS.

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

PART 12.

THE term "capacity" needs no definition. Used in its most general sense, it is a measure of how much of anything some container can hold, and that will do very well for our purpose when referring to capacity in an electrical sense. An electrical condenser is an arrangement for the storage of electricity, though it must not be confused with an accumulator or storage battery. A condenser acts as a receptacle for electricity, whereas an accumulator is actually a generator of electricity.

A condenser consists essentially of two conductors separated by a non-conductor. The two conductors are generally known as the "plates" of the condenser, and

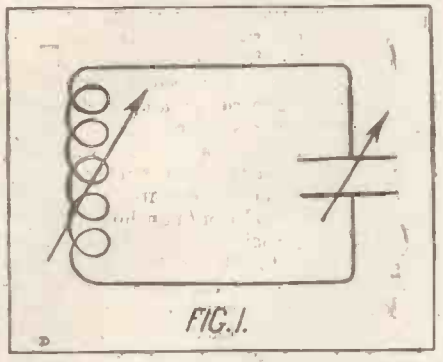


FIG. 1.

the non-conductor as the "dielectric." Such simple components being required, it follows that very numerous types of condensers can be made. The dielectric may be of mica, ebonite, glass, oil, or air, each of these materials having an arbitrary numerical value as a dielectric. This value is called the "dielectric constant" of the material, and the scale of values is arrived at by assuming the constant to be 1 in the case of air.

Sometimes the plates are metallic sheets, and sometimes they take the form of metal deposited electrically upon glass, like the plating on a fork.

Kinetic Energy.

Most of the condensers used in ordinary wireless receiving sets are variable. As you turn the knob, you increase or decrease the condenser's capacity, but only between the minimum and maximum capacities of that particular instrument.

If an electro-motive force is applied to a condenser—say, by connecting a battery across its plates—the condenser will be charged with electricity, the amount of electricity constituting the charge depending upon its capacity. If this charged condenser has its plates connected in a circuit, a current will flow in that circuit. Let us examine a few of the details.

When a condenser is charged, energy is put into it. This is potential energy in electro-static form, and it exists in the dielectric in the form of a strain. When the plates of the condenser are joined by a wire, the electric charge moves; in other words, the potential energy stored in the dielectric changes into kinetic energy, which is manifested by the current in the wire, the electro-magnetic field round the wire, and the wastage of energy in the form of heat and radiation.

But there are two ways in which a condenser may be discharged. Firstly, if the resistance of the circuit connecting its plates is equal to or greater than the square root of the value obtained by dividing four times its inductance by its capacity, the current which flows will be a direct current. Otherwise, the current will be oscillatory.

Controlling Frequency.

All that seems confusing, perhaps, especially as sensible people know one cannot divide an inductance by a capacity, any more than one can divide twelve oranges by six apples, let alone find the square root of the result. But what cannot be done by horse sense can be done by algebra. However, leaving formulæ aside, we may say that if the circuit is of a certain nature, the discharge of the condenser through it will be oscillatory, and the current will be of high frequency. The frequency will depend, as you know, upon the amount of inductance and capacity in the circuit.

If, therefore, we have a variable inductance coil connected across the plates of a condenser (also variable, if you please), we have a closed oscillatory circuit—which, by the way, will radiate ether waves, but not so well as an open circuit. Fig. 1 shows a closed oscillatory circuit.

If the condenser is designed so that its capacity is variable—by a turn of a switch, for instance—and if the inductance also is variable, then we have the means of controlling the frequency of the oscillations which take place when the condenser is discharged; and thus we can, if it is a transmitting circuit, regulate the length of the waves radiated.

Coming now to the use of the condenser in reception, it must be pointed out that if this instrument is connected *in series* with the aerial circuit, the wave-length of the latter is decreased; if in parallel, the wave-length is increased. Figs. 2 (A) and (B) show the condenser in series and in parallel.

Just as in the case of inductance, the variable condenser offers a convenient means of varying the wave-length of the aerial. In practice, the variable inductance

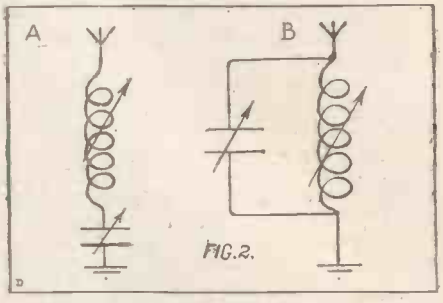


FIG. 2.

is used as a rough tuning device, and the variable condenser as a fine adjustment.

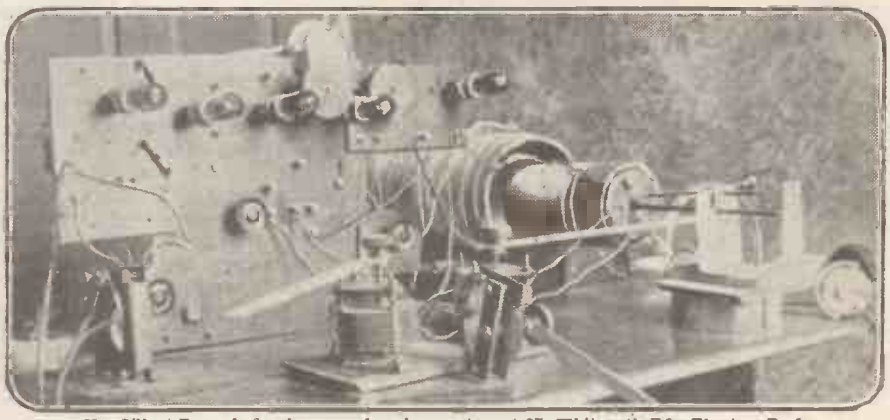
The Farad.

There is an economic limit to the capacity of a condenser inserted in the aerial circuit for the purpose of reducing the wave-length, but in practice the fundamental wave-length of the aerial may be reduced by fifty per cent. by that means.

It will now be understood how, by means of variable condensers and inductance coils, a circuit may be tuned in a simple and expeditious way to the frequency of the incoming signals. The two essentials of an oscillatory circuit, both of which are possessed by the aerial alone, are associated with the aerial in, as it were, a concentrated form.

A fairly simple formula connects the wave-length of a circuit with its inductance and capacity, which will be one of the first things you will learn when you begin to study wireless in earnest. Put into words, the formula means that if we multiply the inductance by the capacity and extract the square root of the product, the answer is the wave-length.

The unit of capacity is the *farad*, called after Michael Faraday. This, like the unit of inductance, the henry, is very large, and a sub-unit, the micro-farad (one-millionth of a farad), is employed in practice.



Mr. Gilbert Brown's fine home-made valve receiver at 27, Whitworth Rd., Ilkeston, Derby

A CRITIQUE OF AMATEUR WORK

By WARING S. SHOLL, A.M.I.E.E.

HAVING had the opportunity of examining a number of pieces of amateur work in the capacity of a judge at the recent Radio Exhibition at Westminster, the writer has thought it may be helpful to workers in general if he gives a short account of the exhibits submitted under the competition section arranged for the encouragement of amateur workers in wireless.

The first prize in the senior section went deservedly to the builder of a fine three-valve set, comprising one-stage high-frequency amplification, rectifying valve, and one-stage low-frequency amplification.

While the greater part of the set was admittedly composed of purchased components, the lay-out of the circuits was well carried out, and the work showed an appreciation of the proper principles involved. The general construction displayed a painstaking adherence to detail, which is a point upon which many amateur workers are prone to fail by reason of their desire to "get the job done" in too much of a hurry, and to seek results on the insecure foundation of hasty work.

Careful Work.

The receiving set under review was enclosed in a neat case, which served the dual purpose of affording protection and providing portability, the advantage of which was apparent when, after a long railway journey, the set acquitted itself satisfactorily on the reception of both telephony and telegraphy.

The completeness of the set was manifested by the enclosure of a plan of the circuit and the Postmaster's licence attached to the false back of the case which housed the H.T. battery. The worker who is desirous of securing public recognition in the shape of awards will do well to bear in mind that it was thoroughness which gained the coveted first place.

"Make haste slowly" is the idea which should be first and foremost, and next to this the elimination of scattered units connected up with a profusion of untidy wires and contacts of doubtful efficiency.

Second prize went to a two-valve low-frequency amplifying set, in which either one or two stages were available at option. This was more or less of an assembled set, but here again the general excellence of the work was so apparent as to justify the award, the apparatus approaching the standard of professional work.

The next exhibit ran the second place very close indeed, the set being a good example of a combined crystal and one-valve receiving set, very nicely arranged in a polished mahogany case; the workmanship of the radial switches for tuning was of a high order, and displayed not only a skilled worker, but a real appreciation of the requirements involved. The third prize, awarded after a very careful comparison with the other exhibits, was well deserved.

Among the "special" entries was a loud speaker of novel design, in which a large shell was used in place of the customary metal or fibre horn; on trial with a two-stage low-frequency set the result was distinctly good, the tone pure, and loud enough for the average room.

Junior Section.

In the junior section—for workers up to 16 years of age—the first place was secured by a well-made crystal receiving set, with radial switch inductance and variable condenser.

On test the set gave excellent reception of signals and telephony; and the ebonite instrument board was quite creditably engraved by the young worker, whose keenness had led him to provide a plug for the insertion of a loading coil for the reception of the Eiffel Tower time signals.

A special award was made to two other junior entries, sent in by workers of 13 years and 7 years of age.

The first of these exhibitors submitted a crystal set with carborundum detector, potentiometer, single slide tuning inductance, and variable condenser mounted in a lock-up case. As an example of actual constructive ability from the raw material, the set called for favourable comment, as the young worker had evidently taxed his skill to no small extent in making everything bar the headphones and the terminals.

It would have been more advisable, however, if the exhibitor had attempted a rather less ambitious type of apparatus, as the potentiometer was obviously of too low a resistance, and the use of a fine wire "cat whisker" not suitable for contact with a carborundum crystal. Also the use of paint containing a lead base is not advisable for mounting terminals, etc., upon, owing to the poor insulation afforded.

The youngest aspirant for wireless honours must indeed have worked hard to produce the modest little set entered in his name.

The "Also Rans."

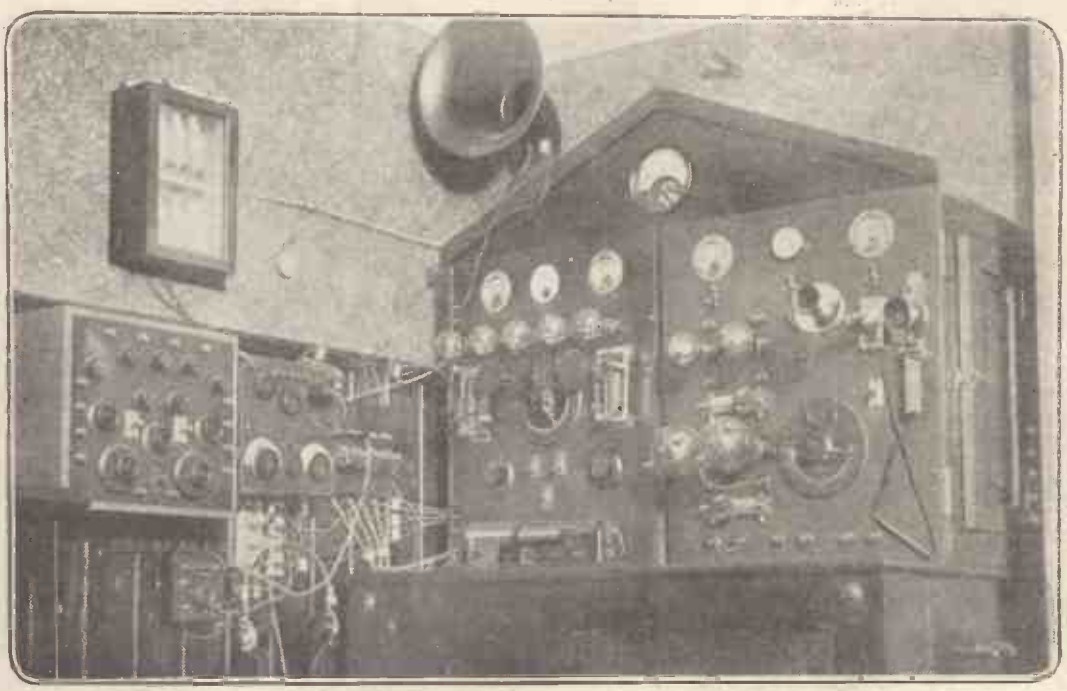
The inductance comprised a novelty in the shape of a radial contact slider, the terminals were properly marked, and a diagram of the circuit included. The type of detector, while very simple to construct, was not of a good type theoretically, owing to the inclusion of capacity at an undesirable point in the circuit.

In general this entry showed a most praiseworthy effort on the part of so young a worker, and it is hoped he will continue to gain in experience and proficiency in proportion to his years.

As to the "also rans," the exhibits were either too hastily constructed, or the makers were not sufficiently aware of the necessity of good workmanship and efficient contact mechanically and electrically.

The exhibitor should bear in mind that the critical eye of the judges will not look kindly upon twisted or badly soldered joints, defective insulation, control knobs that drop off at the slightest attempt at adjustment, and switches that "show daylight" between the arms and the control studs.

And also let the worker lay to heart that oscillatory currents are a harder judge still; it is these subtle elements that will be the final arbiters, not for a day, but for all time.



The private experimental station of Mr. Leslie McMichael, the Hon. Sec. of the Wireless Society of London.

THE TWENTY-KILOWATT TUBE.

By DR. IRVING LANGMUIR.

THE three-electrode vacuum tube, which first appeared as the De Forest audion, is now universally used not only for the receiving of radio messages, but is coming into more widespread use in connection with the transmission of such messages. The original De Forest audion did not have a particularly high vacuum and, because of the ionisation of the residual gas, could not be operated at more than 30 or 40 volts, or at more than a few milliamperes of current.

First Knowledge.

Several years ago, in connection with a study of the Edison effect in incandescent lamps, I noted that, in lamps with a very good vacuum, the Edison effect was nearly absent. In other words, although there was a difference of 11 volts between the two ends of the filament, very little electron current flowed across the vacuum space between. In the presence of a little gas, however, such big currents were obtained that the currents might lead to the formation of an arc, with resulting destruction of the lamp.

At that time it was not at all understood why these currents should become smaller as the vacuum was improved, and a great many scientists believed that if a perfect vacuum could be made no current at all would flow across it. Although the Edison effect in well-made lamps thus caused no difficulty in their manufacture, for it practically did not exist, yet it was a point of very great scientific interest to learn why their currents were so small in a good vacuum.

Basis of the Tube.

It was in connection with these studies that we discovered a "space charge effect." We then understood that in a high vacuum the electrons got in each other's way so that the electrons that had already left the filament repelled, because of their negative charge, the electrons which followed and tended to drive them back into the hot filament which emitted them. In the presence of gas this effect did not exist, because the gas formed both positive and negative ions, and the accumulation of the slowly moving ions in the space neutralised the effect of the negative electrons.

As the result of these studies it gradually became clear how it would be possible to construct vacuum tubes which would operate at high voltages and at high currents. One of the early applications of this new knowledge was made by Dr. W. D. Coolidge, who utilised this in the development of the Coolidge X-ray tube, an X-ray tube which has gradually displaced practically all of the older, so-called gas tubes.

Another application was found in the kenotron and pliotron. The kenotron is a vacuum tube rectifier, having two electrodes like the Fleming valve, but capable of operating up to voltages of several thousand volts and with currents comparable with an ampere or more. Tubes of this kind have found application for smoke precipitation, for various electrical testing devices, and in connection with the regulation of the electric generators used for the radio transmitting outfits on aeroplanes during the war. The development of the kenotron into a thoroughly practical device for these purposes is largely the result of the work of Dr. Saul Dushman.

The pliotron bears about the same relation to the De Forest audion that the kenotron does to the Fleming valve. It is a device which contains three electrodes, namely, a filament, grid, and plate, like the audion, but it is capable of being operated at high voltages and currents, so that considerable amounts of power may be controlled. Tubes of this sort are now finding widespread application for transmitting radio messages, particularly for radio telephony. The ordinary radio telephone outfit used for broadcasting generates from ½ to 5 kw. of high-frequency power, which is used to feed the antenna.

The design and construction of tubes of this type has been carried out principally by W. C. White.

Its Construction.

It has long been realised that, following out the principles made use of in the smaller tubes, it would ultimately be possible to construct tubes of large power. There have been many difficulties to overcome, however. After years of work in the Research Laboratory by W. C. White and H. J. Nolte, they have succeeded in designing and perfecting pliotrons which are capable of generating about 20 kw. of high-frequency current. In principle, these tubes resemble the smaller tubes which are now usually called radiotrons, in that they also have three electrodes. These large tubes are used in circuits much like those used by amateurs when they cause the tube to generate oscillations. In the construction, however, there are many differences.

The 20-kw. tube has a very large, rugged filament many times the diameter and length of the ordinary radiotron. The grid is in cylindrical form and surrounds the filament, and the plate is a metallic cylinder about 1½ ins. diameter and 8 ins. long, which is sealed directly to a glass tube, through which pass the leads carrying current to the filament and grid.

The Future.

Thus the plate, instead of being inside the tube, as in ordinary radiotrons, forms a part of the outside wall of the tube. In order to dissipate the relatively large amount of energy liberated at the plate, the plate is water-cooled, which is rendered particularly easy by the fact that part of its surface forms a part of the wall of the tube.

These 20-kw. tubes are ordinarily operated with about 20,000 volts d.c., which is obtained from ordinary 60-cycle alternating current by rectification, using two or more kenotrons, together with large condensers for smoothing out the rectified alternating current.

A bank of ten tubes of this kind operated in parallel is capable of generating 200 kw. of power, which is about all that is required for most trans-oceanic radio communication. It is probable that outfits of this kind will displace the larger and more expensive alternators, the most successful type of which has been the Alexanderson alternator.

The 20-kw. tube merely marks one stage in the development of still larger tubes. It will undoubtedly be possible, when the need arises and when the necessary development work has been completed, to construct tubes of many hundreds, or even thousands, of kilowatts. Such devices will probably be used not merely for radio purposes, but may ultimately play an important part in such problems as the electrification of railroads and the transmission of power to long distances by means of direct current.

Mr. A. F. H. Baldrey and a friend recently went camping and conducted some interesting experiments with a portable set. Details of these experiments will be given in another issue. Mr. Baldrey is seen here tuning in the Hag concert.

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CONTROLLING MODELS BY WIRELESS.

By MAJOR RAYMOND PHILLIPS, I.O.M., late Member of the Inter-Allied Commission of Control.

PART 3 (New Series).

IN my previous article I stated that a small ignition coil—as fitted to motor-cars—could be used in connection with the construction of a modified form of Hertz oscillator for transmitting purposes.

I used such a transmitter to control mechanism—including that connected with my well-known wireless-controlled airship—which was exhibited during my lectures and demonstrations at the recent International Radio Exhibition and Wireless Convention, Central Hall, Westminster, London.

The fact that ignition coils are generally fitted with three instead of the usual four terminals—found on other types of small

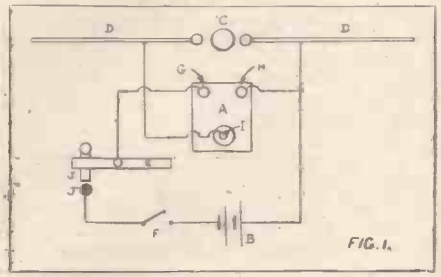


FIG. 1.

spark coils—appeared to puzzle many amateurs who attended my lectures, until—with the aid of a blackboard and explanatory diagrams of circuits—I fully explained the construction of such coils.

For the benefit of those amateurs who were unable to attend my lectures, and in response to many requests, I have decided in this article to so describe the construction of such a transmitter that any amateur should be able to construct it.

The transmitter when completed will be found quite suitable for controlling the wireless-controlled electric train receiving apparatus, which will be described in subsequent articles. Fig. 1 shows a diagram of circuits and apparatus suitable for the transmitter in question.

It consists of an ignition coil A—the trembler fitted to the coil is not shown—accumulator (4 volts) B, spark gap C, antenna rods D D, Morse key E with contacts J J, switch F, terminals G, H, and I.

It will be observed that the primary winding of the ignition coil is connected to terminals G and H, whilst the secondary winding is connected to terminals H and I.

In operation it will be apparent that on depressing the Morse key E (closing contacts J J) and closing switch F, electric current will flow from the accumulator B through the primary winding and trembler—the latter not shown—of ignition coil A, causing a "high potential" discharge to jump across the spark gap C from the secondary winding connected with terminals H, I and antenna rods D D, thus causing etheric or wireless waves to be radiated from the latter.

The construction of such a simple form of transmitter presents no difficulties, as the principal component parts can be purchased ready made.

For instance, a good second-hand ignition coil should not cost more than 10s. or 12s., and sometimes—as stated in my previous articles—such coils can be picked up for as small a sum as 5s. Such an opportunity occasionally arises when a dealer is anxious to dispose of surplus stock.

For the spark gap three brass balls will be required, two of which may be either $\frac{1}{2}$ in. or $\frac{3}{4}$ in. in diameter. The other may be 1 in. in diameter.

For efficient working of the transmitter these balls should be kept clean and polished, more especially at the point where the spark discharge takes place.

The spark gap can be mounted upon a baseboard as shown in Fig. 2.

The baseboard can be made of $\frac{3}{4}$-in. white pine, with two lathes 3 in. wide by $\frac{1}{4}$ in. thick secured at either end. The latter will prevent the baseboard warping, and, at the same time, admit of nuts and washers being used under the board to secure the various components mounted thereon.

The baseboard should either be shellac varnished or french polished. An ordinary 5-ampere tumbler switch—as used for electric-light installations—will suffice for opening or closing the primary circuit of the ignition coil, which together with a Morse key can be mounted in any convenient position on the baseboard.

Two lengths—each 18 in. long—of high-tension flexible wire will be required for connecting the secondary terminals of the ignition coil to the antenna rods, as shown in Fig. 1.

The outside diameter of the rubber insulation of such wire should not be less than $\frac{3}{8}$ in. Its cost per yard is approximately 1s. 4d.

For connecting up the primary circuit of the transmitter, flexible cord—such as that adopted for electric-light installations—may be used.

The conductors of the flexible cord should be composed of 70, or, better still, 130 strands of No. 40 gauge high conductivity copper wire. The two small balls forming part of the spark gap should be so adjusted that there is a clearance of not more than $\frac{1}{16}$ in. between the large centre ball and each of the smaller ones.

Referring to Fig. 2, it will be observed that the antenna rods are supported by terminals attached to rods, the ends of the latter being preferably screw-threaded to engage in the corresponding female screw-threads in the small brass balls.

The terminals in question can be easily "made up" by simply soldering together two large standard terminals, but those amateurs who possess a lathe will easily be able to make the appliances as shown.

Large standard terminals can also be used for connecting to the ends of the brass rods which are inserted in the ebonite or vulcanised fibre tubes, the latter being $\frac{1}{2}$ in. outside diameter as shown.

Better insulation of the supports for the spark gap could, of course, be obtained by using solid ebonite or vulcanised fibre rods, instead of tubes as described. The former method would involve boring holes and cutting female screw-threads in the ends of the rods in question, also fitting screw-threaded studs to same; or male screw-threads could be cut at the ends of the rods. In either case the general arrangement would be the same.

The method I have described appears to be the simplest, and is quite satisfactory in general use.

I fear I shall not have much space in this article to describe relays and other mechanism for constructing a suitable receiver for use in connection with the wireless control of a model train.

I might add, though, in conclusion, that a coherer, relay, and simple selector—*i.e.*, selection by sequence—will be required.

The simple circuit described in No. 13 of POPULAR WIRELESS will also be used in conjunction with others equally simple, which I shall fully describe in subsequent articles.

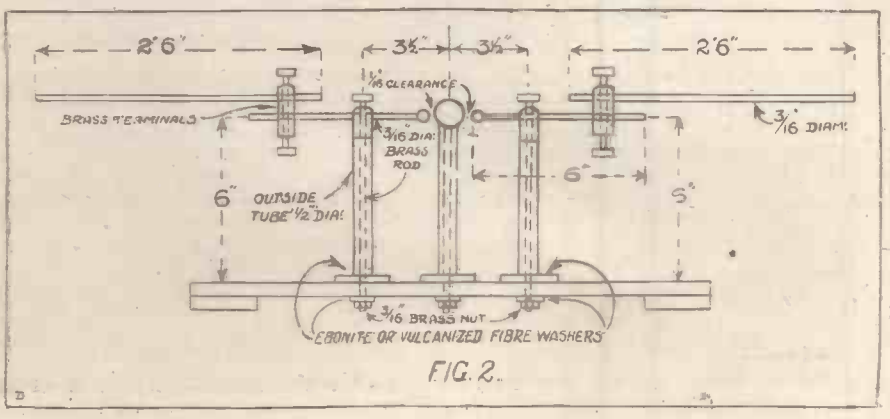


FIG. 2.

A GLOSSARY OF RADIO & ELECTRICAL TERMS.

MAGNETOMOTIVE FORCE (M.M.F.).—The driving force behind magnetic flux. A magnetomotive force is necessary to produce magnetic flux, and the amount of flux produced by a given magnetomotive force depends upon the reluctance of the magnetic circuit, just as the current produced by a given electromotive force depends upon the resistance of the electrical circuit. The magnetomotive force produced by a solenoid is equal to 1·257 times the number of ampere-turns in the coil.

MEGOHM.—The unit used for measuring high resistance, being equal to 1,000,000 ohms.

MICROFARAD.—The practical unit of capacity, equal to one millionth of a farad.

MICROPHONE.—A device forming part of a transmitting telephone, which enables mechanical vibrations of a diaphragm (due to sound waves) to produce corresponding electrical vibrations or oscillations, usually by varying the contact resistance of carbon granules.

MILLI-.—A prefix denoting one-thousandth. Thus, a milliampere is one-thousandth of an ampere, a millivolt is one-thousandth of a volt, and so on. One-thousandth of an inch is called a *mil*.

NATURAL FREQUENCY.—The natural frequency of a circuit is the frequency with which an electric discharge, as from a condenser, will oscillate when no external electromotive force is applied. Two circuits having the same natural frequency are said to be in tune with one another.

NEGATIVE.—See Positive.

OHM.—The unit of electrical resistance, being that resistance which will limit the current produced by a pressure of 1 volt to 1 ampere. 1 yard of No. 28 S.W.G. iron wire has a resistance of 1 ohm.

OHM'S LAW.—The law which states the relations existing in any circuit between current, voltage, and resistance. These relations are as follows: Amperes = Volts ÷ Ohms. Volts = Amperes × Ohms, and Ohms = Volts ÷ Amperes. Thus, for example, 36 volts are required to send a current of 4 amperes through a resistance of 9 ohms.

OSCILLATIONS.—High-frequency alternating currents.

PARALLEL.—Two or more conductors or pieces of apparatus are in parallel when they are so connected that the current in the circuit divides, and part goes through each of them. Cells are connected in parallel when the required current is equal to the sum of the currents which can be given by each individual cell, and the voltage required is that of a single cell. See Shunt.

PERMEABILITY.—The capability of a material for conducting magnetic flux. The permeability of air is taken as unity, so that the permeability of any material is the ratio of the flux density produced in the material by a given magnetomotive force, to the flux density that would be produced in an air path of the same length, by the same magnetomotive force. The permeability of magnetic substances decreases as the flux density increases; for instance, at a flux density of 10,000 lines per sq. cm., the permeability of transformer stampings is about 2,000, while it is only 200 at a flux density of 17,500.

PHASE.—In an alternating current or voltage, the fraction of a complete cycle which has elapsed at any instant under consideration. Two alternating phenomena are said to be in phase when they are exactly "in step" with one another. If they are of different frequencies, they are out of phase except at periodic intervals, as in heterodyne reception.

PLATE.—The anode of a thermionic valve, consisting usually of a small metal tube surrounding the filament and grid.

PLATE CIRCUIT.—The circuit which externally connects the filament and plate of a valve, and is completed internally by the electron stream between them.

PLATE CURRENT.—See Anode Current.

POSITIVE and NEGATIVE (+ and —).—Names given to distinguish the terminals of a source of electric supply. Current is assumed to flow round a circuit from positive to negative, although it actually consists of an electron stream flowing from negative to positive. Positive and negative terminals are often distinguished by the colours red and blue or black respectively.

POTENTIAL DIFFERENCE (P.D.).—The difference of potential, or electrical pressure, between two points is the electromotive force trying to send current from one point to the other.

POTENTIOMETER.—A device for adjusting the voltage supplied to a circuit. It consists of a resistance joined across the supply terminals, from which tappings are taken off to supply the circuit. A potentiometer wastes a large amount of energy, and so should not be used if a plain rheostat is suitable.

POWER.—The electrical power in a circuit is measured in watts, and is given by the product of the amperes flowing and the volts applied. Thus, if 4 volts are driving half an ampere through a valve filament, the power being used is 2 watts. 746 watts are equivalent to 1 horse power.

PRESSURE, ELECTRICAL.—See Potential Difference.

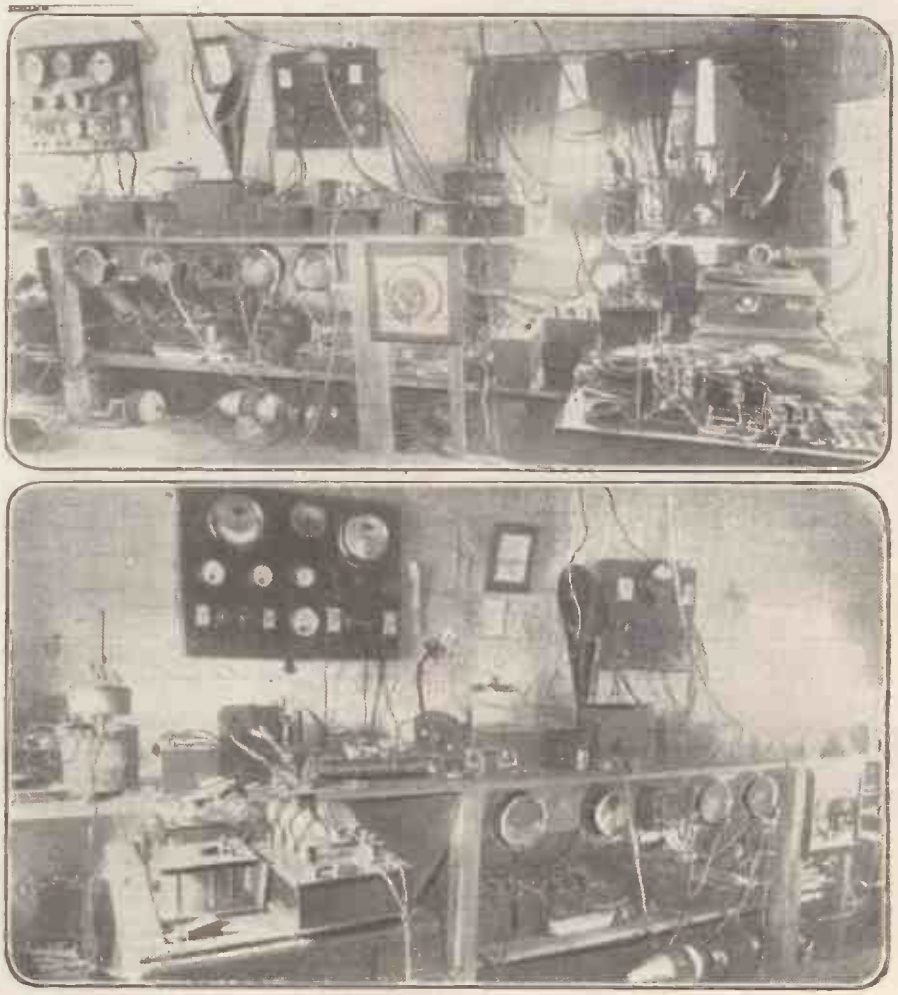
QUANTITY.—When an electric current flows, a certain quantity of electricity is moved round the circuit per second. This quantity is given by the product of the amperes flowing, and the time, in seconds, for which they flow. The unit of electrical quantity is the coulomb, which is the quantity of electricity moved by 1 ampere in 1 second.

QUENCHED SPARK.—In a transmitting set, a spark the duration of which is made as short as possible, and which is prevented from forming an arc by the use of electrodes of large heat-dissipating capacity.

REACTANCE.—The opposition offered to a varying or alternating current by capacity or inductance. The reactance due to an inductance is given by $2\pi \times$ frequency $\times$ inductance in henries. The reactance due to capacity is given by

$$\frac{1}{2\pi \times \text{frequency} \times \text{capacity in farads}},$$

both results being expressed in "apparent ohms." In a circuit containing an inductance and capacity in series, the reactance is given by the *difference* between these two values.



Two views of the fine experimental workshop built by Mr. H. G. Treadwell (2 N P), of Middleton Cheney, Banbury.

INAUGURAL MEETING OF THE RADIO ASSOCIATION.

The aims of this Association were published last week in "Popular Wireless," the official organ of the Association. Readers are urged to write to the Hon. Sec. with the view to becoming members as soon as possible.—Editor.

AT the inaugural meeting of the Radio Association, held at the Hotel Cecil on September 27th, a large number of manufacturers and amateurs and other interested persons enthusiastically welcomed the formation of the Association.

Professor Low was in the chair, and among those present were Mr. C. L. Malone, M.P., Mr. William Le Queux, Mr. Neville Maskelyne, Major Raymond Phillips, Mr. Alexander Sharman, Captain Harris, Mr. Percival Marshall, and many others.

A letter from Sir Oliver Lodge was read, expressing the warmest sympathy with the Association.

Mr. S. Landman, hon. secretary *pro tem.*, said the association would probably never have come into existence but for the way in which the question of broadcasting had been treated. A promising British industry was being held up by inexplicable official delays. Thousands of potential amateurs had been refused licences though well qualified to have them, and some hundreds of manufacturers of instruments and parts, who were quite within their rights in attempting to supply a popular demand, were threatened with infringement actions.

Mr. Kellaway's Letter.

Mr. C. L. Malone, M.P., said that if the Association were to do any good they must produce a demand for 150,000 receiving sets. He supposed the boom would come in the course of the next week or two. The service given by the broadcasting companies must include home and foreign news, stock market closing prices, and the result of the 3 o'clock and the 3.30 races. When that was done they would get a very large public. The receiving apparatus should be looked upon as the poor man's tape machine.

Mr. Malone read part of a letter from the Postmaster-General in regard to the position under the broadcasting scheme of persons who desired to make their own receiving sets. Mr. Kellaway said it had been suggested that persons who made their own receiving sets or obtained them from other sources than firms who were members of the Broadcasting Company should pay a somewhat higher licence fee.

It would, however, be difficult to distinguish this class of person from *bona fide* experimenters who might have no wish to receive the broadcast programmes; and if the fees paid by the latter were increased as well as those paid by the former class; this might be regarded as putting a handicap on experimentation and research.

"In these circumstances," the Postmaster-General said, "I am disposed to retain in all cases the present fee of 10s. for a receiving licence, and to require from the person who does not propose to buy his set from a member of the Broadcasting Company some evidence that he has a sufficient knowledge of the subject to justify his being granted an experimental licence. The term 'experimenter' will be interpreted in a liberal sense." Mr. Malone said that he thought that on the whole the letter was not unsatisfactory.

A resolution was also passed unanimously deploring the delay in concluding the broadcasting arrangements and expressing regret that the negotiations between the Postmaster-General and the few privileged firms had been conducted in secrecy.

Mr. William Le Queux said false advertising was being done by unscrupulous firms.

He told an amusing story about a certain firm who were selling a one-valve set supposed to receive telephony from New York!

The Chairman said a lady recently asked him whether it would be possible for her to get a set for £2 10s. by which she could speak to her son in Italy. When he told her she could not, he had to listen to a stream of abuse for ten minutes, because she had been told by a firm that this was possible.

The meeting closed about 8 p.m., and the general feeling was that the formation of the Radio Association was a blessing long waited for. Every resolution put at the meeting was carried unanimously. All those present showed a keen interest in the aims of the Association, and many useful suggestions were put before the Chairman.

It was suggested that an entrance fee of 2s. 6d. should be fixed for amateurs, and a slightly higher fee for manufacturers. The Hon. Sec., Mr. S. Landman, M.A., 9, Southampton Buildings, Chancery Lane, will be pleased to hear from all those desirous of joining the Association. Mr. Landman will supply fullest details on application.

THE WIRELESS SOCIETY OF LONDON.

ADMIRAL of the Fleet Sir Henry Jackson, President of the Wireless Society of London, presided at the opening meeting of the society for the winter session, held at the Institution of Electrical Engineers on September 27th. Owing to indisposition, Mr. Marconi was unable to be present.

The Chairman said that the Secretary of the General Post Office, on behalf of the Postmaster-General, with Captain Loring and Mr. Shaughnessy, recently received a deputation, introduced by himself (the chairman), representing the experimental wireless amateurs of the country. They were anxious as to the future of the amateur experimentalists and as to broadcasting licences.

Post Office Attitude.

They had a long, amicable, and straightforward talk, and, while strongly holding that their rights must be fully considered, the members of the deputation were much impressed with the difficulties which the Post Office had to meet in attempting to satisfy all parties concerned.

Mr. E. H. Shaughnessy, representing the Post Office, said that in the past licences had been granted freely to all serious experimenters. There was no reason why there should be any change now, but there was some difficulty in distinguishing between the real experimenters and those people who simply wanted broadcasting. The question of broadcasting involved very serious consideration. If the state of affairs which now existed among the skilled amateurs who already possessed licences were to be extended, broadcasting would be a failure.

With regard to broadcasting apparatus, the Post Office was going to test every type of apparatus sold. They were going to issue licences which would enable people to buy only harmless apparatus, which was just as efficient as harmful apparatus. Also, there must be no oscillation on the aerials. The wave-length band on which broadcasting would take place was very limited; the wave-length band on which amateurs had worked was unlimited. The Post Office thought that it was only fair that the manufacturers of amateur apparatus should be afforded scientific and technical protection. In future the Post Office would stipulate that during broadcasting hours and between the wave-lengths of three hundred and five hundred metres no valve with an adjustable reaction on to the aerial should be used. They would ask the amateurs, who, after all, were bound by their licences, to see that they caused no such oscillation as would interfere with each other and interfere with the broadcasting people. In fact, the Post Office authorities were going to impose the condition, and, if it were loyally observed by the amateur experimenters, the authorities would not be inclined to say that no reaction whatever might be used at any wave-length.

No Monopoly.

The authorities wanted to give serious experimenters every opportunity of experimenting with the view of improving the listening conditions. The authorities were compelled to examine all applications for licences, but their attitude was not one of opposition to the experimenters. They had always taken a very generous view of applications for receiving licences, and there had been no change in that attitude.

Personally, he felt that those people who were earning their living by the art of wireless telegraphy often had not time to trouble about the inventive side of the question. It frequently happened that the man of leisure, who took up an art as a hobby, was able to pursue some particular point which might yield very valuable results.

Captain Phillips, as a member of the committee of the new broadcasting company, said that it was not proposed that the company should, in any way, be a monopoly. For broadcasting to be a success somebody had to do it, and, in a little place like England, it was impossible for unlimited people to be allowed to broadcast.

Anybody was perfectly free to join the broadcasting company and to make apparatus. He could not be refused. That destroyed any question of monopoly. The real object of the broadcasting company was to provide that the apparatus used for broadcasting in this country should be of British manufacture.

STEP BY STEP IN WIRELESS.

"FREAK" WIRELESS TRANSMISSIONS.

PERHAPS the most inexplicable phenomenon in wireless until quite recently was "freak" wireless transmission.

A wireless station which during the day can only be heard for 150 miles can, on certain nights, be heard for a distance of nearly 2,000 miles.

For example, ½-kilowatt transmitters having a normal range of 120 miles have been heard right across the American continent from the Atlantic to the Pacific.

Freak wireless is caused principally by a layer of gas called the Heaviside layer which, according to many scientists, is situated about 60 miles above the earth's surface. The waves from a sending aerial strike against this layer, and are reflected down to earth again. This is because the layer is a good electrical conductor, and therefore a good reflector of wireless waves; for all conductors, though they carry the ordinary current so well, reflect wireless waves.

The most conclusive proof that this layer is responsible for freak wireless has been furnished by Dr. de Groot, a famous Dutch wireless engineer. His proof, shorn of all its mathematical intricacy, is as follows.

Sabang is a wireless station in Sumatra, with a range during the day of 240 kilometres (about 150 miles). On some nights this station can be heard by Osaka, a wireless station in Japan, 6,000 kilometres away from Sabang.

At a point between Sabang and Osaka, 4,000 kilometres from the former and 2,000 kilometres from the latter, Sabang can never be heard. Therefore, Sabang can be heard at a distance of 6,000 kilometres, but not at a distance of only 4,000 kilometres.

This proves that above the point 4,000 kilometres from Sabang the wireless waves (which eventually reach Osaka) are striking the Heaviside layer, and cannot be heard on earth for the simple reason that they are about 60 miles above the earth's surface. At this point the waves are reflected down, and strike the earth at Osaka.

It will be seen, therefore, that if the waves travelled along the surface of the earth—which is the Sommerfeld theory—all places between Sabang and Osaka would hear Sabang's transmitter.

Freak transmissions rarely occur in the daytime, owing to the fact that the ultra-violet ray coming from the sun causes the atmosphere to absorb and weaken the wireless waves which travel through it. Consequently the waves do not travel far in the daytime compared with the night, when the ultra-violet ray is not present. Dr. De Groot has shown in his latest experiments that, owing to the effect of the ultra-violet ray on the atmosphere, the wireless waves do not reach the Heaviside layer at all, but travel in a large semi-circle through the lower atmosphere and back to earth.

The reader may wonder why freaks do not happen every night, but certain conditions must be fulfilled before the freaks will occur at all.

The first condition is that the Heaviside layer must be in a highly reflective state. This is not always the case, for on some nights the layer appears to be a better reflector than on others.

Another condition is that the angle at which the waves strike the layer must be well under 90°, *i.e.*, a right-angle; for should they strike the layer at 90°, the complete wave will pass through the layer into outer space. This is because the layer, although a good reflector, is by no means a perfect one.

On the other hand, should the waves strike the layer at or under 45°, they will be reflected to earth.

It should be added that, as the layer is a gas similar to a bank of clouds, that surface of the layer which faces the earth is very irregular. Therefore the wireless waves, on striking this surface, are subject to irregular or freak reflections. For example, on a certain night one wave may be reflected the shortest path down to earth, whereas the following night an exactly similar wave may be reflected at such an angle that it does not strike the earth until it has travelled an enormous distance. This latter wave would be a freak.

It has long been known that extraordinary freak signals occur when the aurora borealis is in the sky. This is because the aurora is an electrical discharge in the upper atmosphere, and, being a very good conductor of electricity, is an excellent reflector. The theory advanced is that the aurora superimposes its reflective properties on the Heaviside layer, and thus makes the layer a much better reflector than it usually is.

Statistics show that the best time of the year for the aurora in this country is in October. Unfortunately, however, auroral displays are not very frequent in England, and in London it is only seen twice each year. Further north, in a town such as Edinburgh, the aurora may be seen four times annually. Sometimes the aurora stretches for thousands of miles, and when this is the case "freak" transmission is exceptionally good.

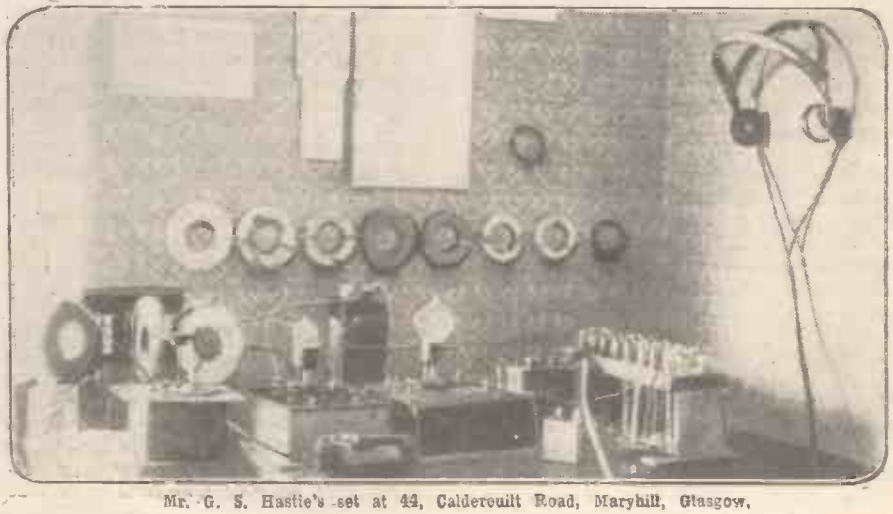
Any experimenter on seeing the aurora should immediately listen in, for interesting results are practically certain. The wave-length is immaterial, for freaks occur on both long and short waves.

Anyone who has experimented with wireless direction-finding has probably noticed that at sunrise or sunset certain wireless stations seem to shift their position for some miles.

This has been shown by Dr. Kennelly to be due to the change in the atmosphere at sunrise and sunset. At sunrise the ultra-violet ray, on coming from the sun, changes the atmosphere from a state of non-conductivity to a state of conductivity. This change does not take place all at once in our part of the world, but is more or less gradual, so that at sunrise part of the atmosphere is conductive and part is not. It follows that wireless waves sent out at sunrise will strike the area where the change is taking place, and pass from a conductive atmosphere to a non-conductive atmosphere, or vice versa. This will cause the waves to be bent or distorted out of their true path.

Therefore, as the direction-finding instruments register the bearing or direction of the transmitting station, the direction of a certain transmitting station will appear to change, owing to the wave being distorted when passing through the area where the atmospheric change is taking place. Very probably what actually happens is that the waves are refracted, just like a ray of light which passes from one medium to another, such as from water into air.

At sunset the atmospheric change is exactly the reverse of the above, for the ultra-violet ray is being withdrawn, and the atmosphere is turned from a conductive state to a non-conductive state.



Mr. G. S. Hastie's set at 44, Caldercuilt Road, Maryhill, Glasgow.

POPULAR WIRELESS BIOGRAPHIES.

No. 1. SIR WILLIAM PREECE.

EVERYONE is familiar with the expressive and captivating phrase, "the Silent Navy," but the Navy is not the only public service which, with a zeal amounting almost to consecration, is doing its duty in the face of great difficulties and discouragements, often needlessly inflicted by an inappreciative British public — the Post Office.

Sir William Preece.

We hear occasionally of a knighthood being conferred on the head, and then the curtain falls again, and the recipient keeps on without intermission at the daily round and the common task of the administration of his department till time brings down the guillotine of enforced retirement, and he has to say adieu to public life while still in the full enjoyment of health and a ripe experience gained in the public service.

So came the closure to the work of one of the brightest ornaments in the comparatively juvenile public service departments, the engineer-in-chief to the Post Office, who, as Mr. Preece, had shortly before earned the mark of his sovereign's appreciation of his abilities and was made Sir William Preece.

No one had a clearer prophetic insight into the uses of wireless communication than had he, and long before the brilliance of Marconi's meteoric star astonished a dazzled British public, Mr. Preece and his modest lieutenants had been investigating with considerable success the practical applications of the science, and the elimination of some of its problems, notably in 1887, 1892, 1893, and 1894.

Early Days.

We now hear breathlessly recounted records of the reception of Moscow signals on a frame aerial, but the writer remembers, in 1897, a couple of frame aerials fastened up in the galleries of the Royal Institution, and signals sent over the space between being received on the loud speaker standing upon the lecturer's table, and the lecturer was Preece.

The guttural signals filling the auditorium from the loud speaker were in the Morse code, with a peculiarly raucous buzz, and a waggish listener asked the lecturer whether the language was Welsh, to which Mr. Preece made a suitably jocular rejoinder.

Preece and Heaviside, in 1885, had done some remarkably clever pioneer work, and, in 1887, A. W. Heaviside succeeded in communicating by telephonic speech between the surface of the earth and the subterranean galleries of the Broomhill collieries, 350 feet deep.

To Sir William Preece came the young Marconi, in 1896, fresh from his college lecture-room, with his little black box containing his secret coherer, and with all the other paraphernalia of a six-inch spark coil and Righi transmitter. He was welcomed with the open hospitality which at all times the chief would extend to anyone with an idea which might be capable of skilful development for the public service communications.

In the lecture above mentioned, Sir William Preece, with that total absence of ungenerous feeling common amongst great scientists, and possessed in a remarkable degree by himself, stated that "in the July of last year Mr. Marconi brought to England a new plan. Columbus did not invent the egg, but he showed how to make it stand on its end; and Marconi has produced, from known means, a new electric eye more delicate than any known electrical instrument, and a new system of telegraphy that will reach places hitherto inaccessible."

Marconi was handed over to the chief electrician, who, still alive, must be nameless, and one or two fundamental electrical disabilities of his apparatus were at once seen and remedied. His set immediately increased greatly in the distance over which it operated, and practically the whole of the Post Office organisation was invoked to further the development of the particular line which Marconi was investigating.

Fortune was knocking at Marconi's door, and he might have become a bright light in the British telegraph service, later on to be promoted to the supervision of the erection of pole lines. But he listened to the voice of the charmer, commercialised his achievements, and made a fortune and a universal name.

But to return to our subject. Sir William Preece put some of his brightest young lieutenants on to the matter of wireless research, and locked away in the archives of a Government department are reports and records which, if published, would establish the position of those early experimenters in the niches of the galleries of fame, whence they have been omitted by the inexorable operation of the law which says that a Government servant has no individuality, but is merely a wheel in the machine.

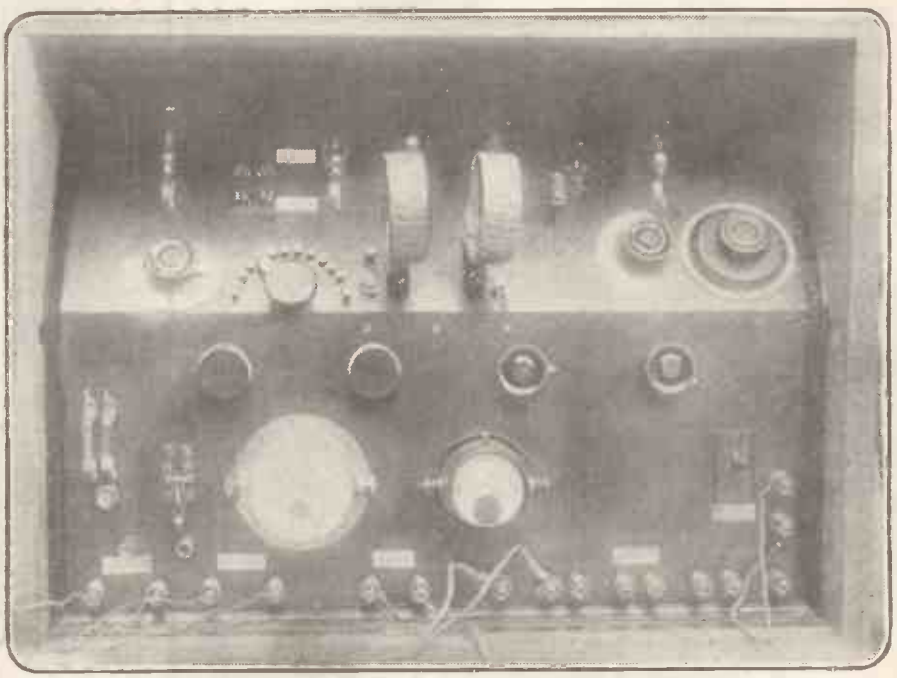
The Helping Hand.

How much was accomplished as the direct outcome of hints given by the far-foreseeing chief will never be known, but whatever new discoveries were made outside his department, they were always foreseen and discounted by those within, and no greater vindication of the sure safety of British red-tape can be produced than that which compares our present immunity from ethereal chaos in England with that which obtains on the other side of the herring-pond. Sir William never shielded himself behind a barrier of unapproachableness. He was always approachable, and, however busy, found time to listen to his youngest assistant if he had anything to say of interest or importance with regard to his work. Woe betide anyone who tried to beguile him, but blessed was he who had anything new to impart!

Those who had the closest associations with him had the greatest admiration for his qualities, and his chief clerk, left behind when Sir William retired from the Post Office, remarked "Ichabod" to the writer when he ventured into the departed chief's room the next morning.

Sir William was always ready to give a helping hand to the young man who was struggling upward along the path of duty and efficiency, and his smile and encouraging word were an inspiration to many beside the writer. If he had to turn anything down, he always did it in a nice way, and an encouraging wish for your better luck next time.

In addition to wireless, he was really the father of the telephone in England, though one doubts if even his Welsh prophetic instincts could foresee the magnitude the undertaking was to achieve.



Close up view of apparatus made by Mr. W. B. Lane, 77, Crescent Road, Woolwich, S.E.18.

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.

Wireless and Experimental Association.*

The meeting of the Wireless and Experimental Association at the Central Hall, Peckham, on Wednesday, 13th ult. was marked by a good attendance and quite an eagerness of the amateurs present to put up and discuss the little difficulties which they had encountered in their experiments since the last meeting. It was to have been a wireless "gadget" night, with a competition for a prize offered by the chairman, but so few gadgets materialised that an extension was made for the event to take place on October 4th.

A member had sent in a communication descriptive of the methods of staining and finishing the woodwork of our home-made apparatus, but when read it was found to be less helpful than had been hoped. The secretary stepped into the breach, and, starting off with the dictum that "the whole art of french polishing lies in the knowledge of when to leave off rubbing," gave the meeting the benefit of his somewhat extensive experience. Questions put, and other experiences detailed, showed that the chat had served the purpose intended.

Quite a lot of business was done in the matter of the rumoured threats to the amateur's liberties by the Broadcasting Company, and the secretary was further instructed.

Hon. sec., George Sutton, A.M.I.E.E., 18, Milford Road, Dulwich.

Ilkley and District Wireless Society.

The fourth general meeting of the society was held at the premises of Mr. Francis Law, Tower Buildings, Ilkley. The chair was taken by the president, Dr. J. B. Whitfield.

Following the reading of the minutes of the previous meeting, a resolution was passed deciding on the construction of a receiving set for the society. A committee was appointed to draw up a scheme and prepare estimates to be brought before the next general meeting.

The chairman then called on Mr. Law to give his lecture on "The Theory, Use and Maintenance of Accumulators."

At the close of the lecture a hearty vote of thanks was accorded to Mr. Law, and an interesting discussion followed. Several offers of lectures, etc., have been received, and a good programme for the winter months is being arranged.

Hon. sec., Mr. E. Stanley Dobson, Lorne House, Richmond Place, Ilkley.

Leamington, Warwick and District Radio Society.

The third general meeting was held on Thursday, September 7th, and in the absence of Mr. Hills, who was to describe the construction of a tuner, Mr. Sleath obliged with a few words on inductances. Several types of inductance were shown, and the method of winding explained. After discussion and questions on various items of interest, the meeting terminated at 9.30 p.m.

Now then, members! Where are you all? Attendance at the last two meetings has been very poor, and not at all satisfying to the committee after the huge amount of trouble taken to get the society running. Let's see you roll up in dozens and show some enthusiasm, because radio has come to stay, and so has our society.

Hon. sec., F. A. Sleath, 31, Archery Road, Leamington Spa.

The Fulham and Putney Radio Society.

The above society started the autumn season with a meeting, at their new headquarters.

As a prologue to the meeting, Mr. Barker (who has kindly lent the building) switched on his set, and the members heard the result of the air race through a Brown loud speaker.

A considerable amount of business was done at the meeting; a new committee was formed to deal with the rules, etc. By a vote of the members it was found that Friday evening was a more suitable night for the meetings, and so the future meetings will be held on that night.

A large number of new members were enrolled, with promises of more to follow.

It was decided that the first Friday in each month should be set apart for lectures, and we hope to start with a well-known lecturer on the October meeting, the between meetings to be devoted to Morse buzzer practice and minor demonstrations and discussions.

At the conclusion of the business, Mr. E. Vernon, who is a member of this and the Willesden Society, explained his apparatus to the members, and with five valves and the Brown loud speaker culled from the ether music and singing that was rendered particularly clear and free from the usual disturbances.

All amateurs in the district are cordially invited to join, and are assured of a continuance of instructive and entertaining meetings. The society has been formed purely as a wireless society devoted to the assistance of the amateur and novice in the science of wireless telegraphy and telephony and does not propose to hold whist drives and dances.

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

Fulham and Chelsea Amateur Radio and Social Society.

A general meeting of the above society was held at their temporary headquarters at the Social Centre, Townmead Road, Fulham, attendance for the evening being 45, and new members enrolled numbered eight.

The crystal set was fully discussed by the members and numerous question papers were handed in, the majority being dealt with by the secretary.

Ladies are specially invited to join the above society. Full particulars obtained from the secretary, Mr. F. S. V. Wood, 48, Hamble Street, Fulham, S.W. 6.

Stoke-on-Trent Wireless and Experimental Society.*

At a meeting of the Stoke-on-Trent Wireless and Experimental Society, it was suggested to form a library of wireless literature. If any members have any books on wireless or electrical subjects, which they no longer require, the secretary will be pleased to add them to the nucleus which the society already possesses.

A demonstration on how to wind coils for wireless receiving sets was given by Mr. F. T. Jones (hon. sec.), and proved very interesting.

A pleasant diversion was then provided by Mr. R. W. Steel (asst. hon. sec.) in the form of a lecture on "Reminiscences of the Wireless Service." In a very interesting and humorous manner the lecturer described some of the actualities which the professional wireless operator has to contend with.

On this ship the conditions were almost incredibly bad; the food was hardly fit to eat a great deal of the time, and there was no comfort on board a ship which was his home for a period of twelve months. This he contrasted with the conditions which the wireless operator expects to find on the ship of his imagination before he actually sees the ship on which he has to sail.

Hon. secretary: F. T. Jones, 360, Cobridge Road, Hanley.

HORRORS OF THE FUTURE: THE "X" STOPPER.

RADIOTORIAL

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

From all over the country letters are pouring in offering congratulations to the organisers of the Radio Association. At the Inaugural Meeting, held at the Hotel Cecil on September 27th, a large attendance of amateurs, manufacturers, and other persons interested in radio work welcomed the formation of this Association with acclamation.

As the Chairman, Professor Low, pointed out, the Radio Association will be analogous to the Automobile Association, in that it will offer means whereby "radio users" may protect themselves, and by co-operation advance their status and generally benefit a promising and new British industry.

I feel sure that all my readers will at once join the Radio Association. The membership fee will be exceedingly low in the case of amateurs—in fact, I understand it will not exceed half-a-crown. For this modest sum, membership in the Radio Association will confer innumerable benefits, and incidentally will help to form a very powerful protective association.

The Association has the sympathies and good wishes of Sir Oliver Lodge, and it has the assured assistance and support of a host of other well-known scientists and radio experimenters. On another page will be found full details concerning the Inaugural Meeting; but I should like to point out here (as it was pointed out very clearly at the Inaugural Meeting) that the Radio Association is in no way antagonistic to any other existing associations.

The Association wishes to co-operate and to remain on essentially friendly terms with every other association or wireless club in the country, and it heartily extends a welcome and friendly hand to all those who have the cause of wireless at heart.

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.

"AMATEUR" (Scarborough).—My aeria runs parallel to some tram wires 50 ft. away. Will it cause trouble using a crystal set ?.

No; little or no interference will be experienced.

* * *

"ENTHUSIAST" (Erith).—What stations should I hear on my crystal set, using a 75 ft. aerial 20 ft. high, a double slide-tuning coil, 3½ in. dia., 300 turns of 24 S.W.G. wire, and 8 ft. earth, and a permanent crystal ?

Your wave-length range is to some 1,300 metres only, so that you will not hear F L, or any of the larger spark stations. You should hear Marconi House and Croydon telephony, and a fair number of amateur stations.

Are reaction coils needed, or do they serve any useful purpose in crystal sets ?

No; these are for re-generation in valve sets only.

* * *

"SPARK" (Bolton).—Would a land line induction coil be of any use for using low-resistance telephones with a crystal set ?

No; the ratio, 25 to 1, would not be at all suitable for the purpose.

"READER" (Cardiff) describes a small variable condenser that he has constructed, and wishes to know where it should be connected in the circuit, and how to take the wiring to the desired points.

Having a very small capacity, only some ·0002 mfd., its only useful position will be across the inductance coil to assist in obtaining fine tuning. You should fix two terminals to the base of the condenser, taking a small length of flex from each plate. It will be necessary to have some sort of insulated handle on the moving plate. If this plate slides fairly easily, a thick piece of sealing wax can be stuck vertically on it for that purpose, but if possible a strip of ebonite should be screwed neatly on to the zinc, so that adjustment is possible without bringing the hand closer than three or four inches to either plate. The benefit of this will be very greatly appreciated if in the future you introduce valves.

* * *

C. S. (Pontypridd).—Is it as efficient to place condensers in parallel with the primary instead of using a larger coil or loading coil in series to increase the wave-length range ?

No; the capacity of the open circuit should not be unduly increased.

When a loading coil is placed in series with the primary, is it necessary to place an extra condenser in parallel, or an extra coil in series with the secondary as well ?

Yes; the values of the closed circuit must also be increased. In this case capacity may be added.

Can a wax-candle successfully be used as a substitute for paraffin wax ?

Yes.

* * *

"REGULAR READER" (Norwood).—What would be the wave-length of an inductance 4 in. in diameter, wound with 350 turns of 22 S.W.G., used with an aerial 80 ft. long ?

1,600 metres.

* * *

W. L. B. (Reading).—How many alternations per minute constitute an audible or comfortable signal from a spark station ?

36,000, but frequency is invariably spoken of as alternations per second, as this latter is the unit of time. Therefore the frequency of a spark signal with a tone conducive to comfortable reception will be 600 or so, although in the case of C.W. signals it may be nearer 900.

If my valve set consumes 1½ amperes of current, will a 40-ampere-hour accumulator last 55 hours without recharging ?

Theoretically only. In practice it will last a considerably less period than that. You should have a voltmeter, and take a reading of the cells while on the set every now and then. They should on no account be allowed to drop below 1·8 volts per cell, otherwise we shall have you writing for advice as to the remedying of sulphation.

Why is it that a dry cell can be shorted, but will rapidly recuperate, while an accumulator cannot ?

Because the latter has practically no internal resistance. Therefore the resistance of the total circuit of an accumulator that is shorted will be negligible, and as current equals pressure divided by resistance, it will be seen that there will be a very considerable flow of current.

* * *

"PLASTERER" (Wolverhampton).—I have wound a frame with 30 turns closely together of No. 20 wire. The frame is 4 ft. square. What is its inductance value and most efficient wave-length ?

About 4,000 microhenries, which, with its self-capacity, will give a natural wave-length of 1,500 metres. An efficient frame aerial should have the winding well spaced to keep down the self-capacity and dielectric losses. We do not know for what wave-length range you desire your frame aerial, so we must refer you back to the table supplied in the article on the subject that appeared in No. 2 of POPULAR WIRELESS.

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

W. H. B. (Lancaster).—What is the capacity of a 15-plate variable condenser, the smaller vanes being 2½ in. in diameter and the larger 3½, spaced $\frac{1}{16}$ in. ?

·000175 mfd.

* * *

S. H. (Ilford).—Why is it that different stations come in better on different detectors ? I have three or four detectors in circuit with a selector switch, and I notice that there seems to be one particular crystal most efficient for certain stations.

That is because the wave train coming in from the different sets employed by the various stations will be different, and in general the strength of signals will vary. The adjustment of the crystals will not vary in the same way with different signals, although it will to the different strengths of signal.

* * *

R. T. (Dursham).—What does D.W.S. mean ?

Double Wound Silk.

Is an electrolytic detector any good ?

We do not recommend it to a beginner, but it is quite good in the hands of a skilled amateur.

* * *

"AMATEUR" (Manchester)—Reference to your reply to N. X. H. (London), in No. 16. Should the equation not read

$$L = \left(\frac{90}{1885}\right)^2 \div \cdot 0002 \text{ mhs.} ?$$

Yes, that is correct.

In taking the length of an aerial in order to calculate natural wave-length, is the total horizontal run included in the case of the "T" type ?

No, only half the horizontal length. The down lead and lead-in is included.

"ELECTRON" (King's Lynn).—Is the Hague station more powerful than Croydon ?

No; the Hague set is 400 watts, whereas Croydon is 500.

* * *

"DOUBTFUL" (Stratford) has taken out a licence for a crystal set, but now wishes to use valves. He wants to know whether it is necessary to take out another licence.

It is necessary to obtain the further sanction of the P.M.G. if it is desired to seriously modify or extend a receiving set, but no further fee will be demanded.

* * *

O. H. (Plymouth).—How does automatic wireless transmission compare with ordinary telegraph automatic systems ?

Very well over long distances. Working to Berlin automatic wireless transmission will average 100 words per minute against the 170 words per minute possible with the Siemens high-speed apparatus. The latter scores more heavily owing to the fact that reception is in printed characters direct, whereas the wireless reception is by means of a "Creed" which perforates a "tape," necessitating a further operation to reproduce printed characters. For land line work there is nothing to touch the 400 words per minute possible with the Wheatstone, although it is seldom that they work above 250, which is found quite sufficient for most lines. That extraordinary speed is possible throughout the whole of Great Britain. For long distances, wireless will score. It is hoped to obtain direct automatic communication between England and Australia at a speed twice that of the cable, which has to employ four or five relay stations.

* * *

A. B. J. (Northampton).—I can erect a temporary aerial, single, 40 ft. long, but later I intend to increase the length to 70 ft., having a pole erected at the free end. In order to prevent the necessity of cutting the wire and at the same time to add efficiency to the temporary aerial I thought it would be a good plan to arrange the 30 ft. in the form of a spiral suspended on a frame made of wood. Will that be all right ?

No; the straight horizontal length of 40 feet would be more efficient. If you can make a good clean soldered or well-twisted join in the wire when you desire to extend the length it will not impair the efficiency of the aerial.

* * *

"MIKE ERR O.B.E." (Walton-on-Naze).—Is it possible on a crystal set to replace the telephones for a relay wound to suitable resistance in order to work a Morse writer ?

Not without several stages of valve amplification.

* * *

J. W. (Colborne).—After winding the reaction coil for the "short wave receiver," is it essential to immerse the same in paraffin wax ?

Not at all. Providing the former is of good insulating material and the wire well covered, that will not be necessary.

* * *

"CRYSTAL" (Newcastle-on-Tyne).—Is it possible to use two single earpieces on a set ? I want to purchase a single 'phone now and another in two or three months' time, and then combine the two.

That is quite O.K. Make sure that they are of similar resistance and that the holder fittings will adapt to a similar strap.

* * *

"AERIAL" (Bayswater).—How are these indoor aerial arrangements, whereby you simply place a plug in the electric light holder, made ?

Simply a lead from each of the main terminals to two small fixed condensers of some ·01 mfd. capacity. The opposite plates of these latter are joined together with fuse wire to a terminal to which the set is attached. Thus the ends of the lighting main each broken by a small condenser are joined together, and we must advise you to be extremely careful in the construction of these small condensers, should you intend to construct such an appliance. Mica dielectric should be used, and particular attention paid to the fuse wire connection.

Is any earth necessary with such an aerial ?

Yes; an earth must be arranged.

* * *

C. S. D. (Thornton Heath).—Am I right in supposing that the softer the metal the better

(*Continued on page* 414.)

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Editor of "Popular Wireless" said (Aug. 12, 1922):

"Mr. Scott-Taggart's 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."

SOME OF THE CONTENTS.

Some General Remarks regarding Wireless—Sources of Electricity—Meaning of Positive and Negative—Electrical Units—Connecting Cells in Series—Electro-Magnetism—The Telephone Receiver—Transformers—Inductances—Condensers—Oscillating Circuits—Frequency and Wave Length—The Aerial Circuit—The Use of a Variable Condenser—The Crystal Detector—The Erection of Aerials—The Earth—Frame Aerials—Loud Speakers—How to Make Broadcast Receivers—How to Work them—Use of Lightning Arresters.

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RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 412.*)

it is for conducting electricity, and the closer-grained or harder the substance the better insulator it makes?

No. See reply to D. K. M. (Enfield) in this issue.

* * *

E. T. O. (Hungerford).—I have read a lot about this wired wireless, but it has occurred to me that they might just as well put the wires on ordinary telegraph poles and use the ordinary telegraph instruments. Where is the advantage? Is it in the fact that greater distances can be covered without relays?

Certainly not the latter, as it has been found that, owing to the fact that the wireless waves do not travel independently, merely being guided by the conductor as it was perhaps hoped that they would, on the contrary, the high-frequency currents transmitted traverse the conductor. Owing to the impedance offered range is very limited. Therefore it would not be a paying proposition to run wires for the purpose, but existing telephone and telegraph wires can be used without impairing in any way their usefulness for ordinary purposes. In the case of the cables to Bristol, for instance. What are known as "loop" wires, *i.e.*, circuits utilising a metallic return, are employed for the "Baudet" automatic transmitters, several of which can work in both directions simultaneously on the same wire, and "plus" wires, in which a circuit is so arranged as to use the "loop" wires and an earth return, and finally the "super" of a wire which is used for both telegraphy and telephony, are all more or less in full service throughout the greater part of the day. On the "loop" already used indirectly for about six instruments in each direction it has been found possible to superimpose high-frequency apparatus, or, as it is generally styled, "wired wireless," thus opening further channels for traffic without the expense of laying extra cables. It has been discovered that it is possible to superimpose several sets of the necessary apparatus operating on different wave-lengths, but the number is limited over a comparatively small band of tuning. In the case of the London to Bristol wired wireless, which has been in operation for nearly four years, a three-valve transmitter and a four-valve receiver are used. Therefore it can be said that "wired wireless" is secretive, directive, and, over the more centred routes, economical. It can be almost called super-superimposing. The telegraph wires become more and more congested, and "quads," "duplexes," "pluses" are all employed, the telephone wires are "bunched," and Wheatstone and other automatic transmissions "looped" in or superimposed. Above all this, "wired wireless" offers an entirely new field for a series of "imposings." It has actually been found possible to work the system for two sets in both directions simultaneously over one short cable that was in use indirectly for thirteen telegraph and telephone sets.

* * *

T. M. L. (Newcastle).—Is the back-lash during C.W. transmission due to harmonics?

No; that is due to the method of transmission, the signalling being accomplished by a small change of wave-length for the dots and dashes.

Is the "Tungar" rectifier better than the "Nodon" valve for charging accumulators from the A.C. main?

A much better piece of apparatus, but more expensive.

Please supply particulars of material for "screening"?

Use copper or zinc for H.F. screening and iron for L.F. The screens should not be perforated, but should be as enclosed as possible, all joints being well soldered. Two thin screens, the one inside the other, will be better than one thick screen, and the metal should not be too close to the windings. The screens should be earthed.

* * *

"LIGHTNING" (Salford).—I read with much interest your article on "Energy from the Air." Can you tell me the difference of potential between the atmosphere at 200, 400, and 600 feet and the earth?

No definite figure can be given. The value will vary from practically zero to some 50 volts per foot at 500 feet, according to climatic conditions. The atmosphere will generally be positive to the earth in fine weather, but there again it is liable to vary.

* * *

W. B. (Balham).—Which will be preferable in a valve set—high-resistance 'phones with a 1–1 ratio transformer, or low-resistance 'phones with a step-down transformer?

L.R. 'phones with step-down transformer.

* * *

D. K. M. (Enfield).—What is the perfect insulator?

No material or substance can claim to be a perfect insulator, while relative efficiencies will be greatly varied in accordance with the condition of the material. Perfectly dry air will head the list, after which will come glass, ebonite, paraffin wax, india-rubber, gutta-percha, silk, wool, porcelain, oils, paper, and marble, but subject to the above condition.

What substance is the best conductor?

The best conductors are metals—silver, copper, gold, zinc, platinum, iron, tin, lead, and mercury, after which come carbon, acids, salt solutions, and water. The order is liable to be varied in the same manner as the list of insulators. *A propos* conductors and insulators, it must be again added that conductivity is purely a matter of degree, for whilst no substance conducts perfectly, it is certain that there is no perfect insulator. Therefore a line is drawn between those substances that offer the smallest and those that offer the greatest opposition to a flow of electricity; so, broadly speaking, all substances are conductors.

* * *

A. O. S. (Newcastle).—Is aluminium attracted by magnetism? If not, can you explain to me the meaning of the following advert., which I have noticed for several weeks in POPULAR WIRELESS: "Brown Headphones, "A" Type. Reed Pattern. Aluminium Diaphragm."

In this case it is not the actual diaphragm that is attracted or repelled by the telephone magnets, but the reed to which it is attached by a small screw in the centre.

* * *

A. D. R. (Exmouth).—Is it possible to hear the Hague, Paris, etc., on a 2-valve set consisting of one detecting and one low-frequency amplifying valve?

Possible, but not probable. As you have no reaction it may require two further stages of amplification to bring in the Hague satisfactorily. Paris will not be so difficult, and it is quite possible that you will hear that station's telephony with just the two valves.

You say that a separate heterodyne can be employed. How much would this cost?

That is merely a simple valve circuit arranged with a tightly coupled reaction to an inductance to loosely couple with the receiving circuit. £5 should easily cover it. We believe that during broadcasting hours even these will be prohibited.

What voltage accumulator is required for the mentioned set?

4 volts for the heterodyne, which may be any fairly hard valve.

* * *

"AMATEUR" (Chesterfield).—What would be the wave-length of an inductance 4 inches diameter and 11 inches long wound with 330 turns of 24 S.W.G. enamelled wire, the aerial being 60 feet long and 35 feet high?

250–1,500 metres approx.

Will No. 14 gauge enamelled copper wire be suitable for the aerial.

Quite

* * *

"NOVICE" (Brighton).—What potentiometer current is required for a permanite and a carborundum crystal?

None at all for permanite; 4 volts or so for carborundum and steel or copper. That is pressure or voltage; the current or amperes will be but a fraction of a milliampere, owing to the resistance of the crystal. (Milliampere is a thousandth of an ampere.)

* * *

"SPARKS" (London, W.C.2).—My aerial is a 50-ft. twin, the lead-in is of flex wire joining together at the terminal of my set. I live

(*Continued on page 416.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page 414.*)

about 500 yards away from Marconi House, and I can get him quite plainly, but not any other stations. My set is crystal working with silicon.

Possibly you cannot tune to above some 500 metres, and in that case there are few stations that you will hear. Again, it may be that you have your set wrongly wired or connected, allowing you to bring in a station so near at hand with comparative ease, but failing on the weaker signals. You should send fuller details along.

"NEMO" (Swansea).—Your aerial, earth, set, etc., appear to be quite O.K., and we can see no apparent reasons for your failure. See the reply to "Disgusted" (London) that appeared in No. 18.

* * *

J. P. (no address).—Should you think that a 30-foot earth lead of bare copper wire, No. 14 gauge wire, is too long to obtain good results?

Yes, it is far too long. Unless you can arrange a shorter earth lead by some means, you should run at least three of these wires in parallel to earth to reduce the resistance.

* * *

F. H. T. (Islip).—Would it be possible to tune to 2,600 metres by adding basket coils to your short-wave receiver?

Quite possible. Place them in series with the A.T.I. and the aerial.

* * *

W. J. H. (Worthing).—Dimensions of a tuning coil to 2,600 metres or more, please?

A former 9 by 5 inches wound with 350 turns of 24-gauge enamelled wire will cover that range with 200 metres to spare on the maximum P.M.G. aerial. 12 ozs. of wire will be required.

What is my nearest broadcasting station?

Marconi House, London.

* * *

"GRATIFIED" (Oldham).—I hear the Hague every time there is a concert on a crystal set that I purchased from the "?" Co.

We could be very cutting, but we prefer to believe that there is some mistake. We know of authentic cases where a crystal set under good conditions has received telephony from a distance of 40 miles, but 400——!

* * *

"VALVE" (Nottingham).—What materials are the three electrodes of valves made of?

The filament is invariably tungsten, while the grid and plate are generally nickel, although sometimes they are of similar metal to the filament. More advanced amateurs have discovered that the nickel casing of the larger rifle bullets can be used for the plate. Some of the earlier types of valves had grids and plates constructed of pure platinum, but nickel was found to replace that costly metal quite efficiently.

Is a receiving valve gas filled?

No; it is as near to being a perfect vacuum as is possible.

J. A. (Bromsgrove).—What would be the wave-length of a coil 8 by 4 wound with 22 S.W.G. and the same wound with 24?

1,100 and 1,800 metres on an average aerial.

Which would be preferable?

For short and broadcasting wave-lengths the coil wound with 22 S.W.G.

* * *

P. T. R. (Sheffield).—Is there any objection to my having have an inductance 12 inches in diameter?

None at all if you have the room to accommodate it and do not require to cut down to the lower wave-lengths on it.

Could a variable condenser be made by suspending one zinc pail inside another?

Of a sort, yes, but we are afraid the resultant capacity would not compare at all well with your large ideas. The same efficiency, and certainly greater adaptability and portability, would be obtained by constructing a simple condenser on the lines laid down in an article that appeared in No. 13 of POPULAR WIRELESS.

* * *

T. S. (London).—Is it essential to have a fixed condenser with a crystal set?

No, but it greatly improves the tone of the received signals, as has been explained before in these columns, and is very advisable if the object of the set is to listen in to the London broadcasting.

* * *

R. P. E. (Birmingham).—For the purpose of receiving broadcast signals only from one particular station, would it be possible to have a receiver consisting of one fixed inductance and crystal and telephones only?

Not satisfactorily, as it is quite within the bounds of possibility that the wave-length of the transmitting station would vary slightly from time to time, apart from the difficulty of winding such a coil to suit the varying values of different aerials. Broadcast tuners, to tune between 300 and 500 metres, are being manufactured. These have a fixed coil with a small variable condenser to give the small variation of tuning.

* * *

W. N. C. (Luton).—If I vary the dimensions of the tuning coil as given by Mr. Coursey in "A Short Wave Receiver" to 2¾ ins. diameter instead of 2½ ins., what will be the effect?

An increase in the minimum and maximum wave-length tuning.

Would it be advisable to increase the diameter of the reaction coil as well?

Yes. We must advise you to adhere to the dimensions given in this and other constructional articles as far as possible.

* * *

"CONDENSERS" (Oxford).—How can one solder lead wires to the plates of a fixed condenser made of tinfoil?

That you would find extremely difficult, almost impossible in fact unless you use copper foil and a very soft solder. Generally speaking a fair margin of foil is allowed, to enable it to be bunched and rolled round the lead, which should be thoroughly scrapped to ensure a good contact.

Does it matter if the foil has pin-holes in it?

No, not at all, but needless to say that is not the case with the material employed as the dielectric.

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

No. 20. HOW TO MAKE A LONG WAVE RECEIVER.

POPULAR WIRELESS Weekly

3d

No. 20. Vol. 1.
Oct. 14, 1922.

Miss Malvina Longfellow and her Radio Receiver.

FEATURES IN THIS ISSUE:

THE THREE-ELECTRODE VALVE. — By J. Scott-Taggart, F.Inst.P.

NOTES ON THE LONDON ETHER.

CONTROLLING MODELS BY WIRELESS.

THE SELECTION OF TELEPHONES.

HINTS TO AMATEURS.

Popular Wireless

TOPICAL NEWS AND NOTES.

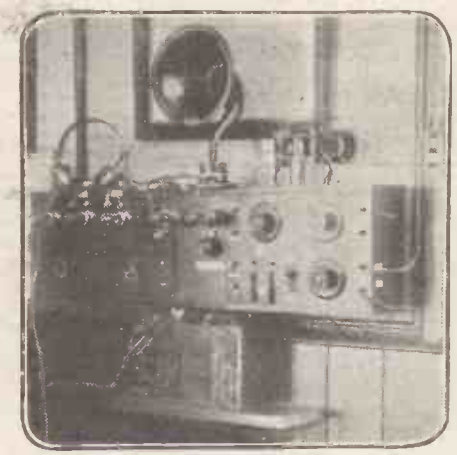
Good Business.

I HAD a long talk with Mr. Bertram Day, the organiser of the exhibition, and he told me that excellent business had been done by the manufacturers exhibiting during the week. Mr. Day himself is to be warmly congratulated on the excellent arrangements and general organisation, for which he was chiefly responsible.

* * *

Historic Relics.

PIECES of historic wireless apparatus used by the Marconi Wireless Telegraph Company during the last 25 years were among the exhibits at the first



Dr. B. K. Teneson Collin's set, 12, Windsor Place, Cardiff.

All-British Wireless Exhibition and Convention.

The exhibits included a Newton coil, used in 1898 at the Needles Station at Alum Bay, Isle of Wight; a coherer, made in 1899, of the type which was used as a wireless detector from 1899 to 1908; an early type of magnetic detector and a Fleming thermionic valve, first used in 1904.

* * *

Telephony to Australia.

TELEPHONE conversation with Australia may become an accomplished fact if the new transmitter and receiver invented by Captain Allan J. Roberts, of Australia, justify the claims made for them. The transmitter consists of an entirely new type of microphone which aims at eliminating all the buzzings that render long-distance telephoning a nerve-racking feat. All metallic contacts are removed. The microphone is a hollow glass container, with a central tube filled with Neon gas, and the sound passes through a tiny cylindrical gap in the gas. Captain Roberts, who is known as the "father of acoustics," was in charge of the acoustics department of the Admiralty during the war. He directed the wireless control of dirigibles, and was the inventor of a mysterious motor craft controlled by light and sound waves.

* * *

Broadcasting.

SIR HENRY NORMAN, M.P., summed up the broadcasting situation as follows, in his opening speech at the All-British Wireless Exhibition:

The differences between the wireless companies have been overcome.

Twenty firms applied for permission to broadcast, and the Postmaster-General has managed to meet their various interests.

Any genuine British company manufacturing wireless apparatus may join the new broadcasting company.

The company has been formed with a capital of £100,000 guaranteed by six important firms.

A simple form of broadcast reception licence will be obtainable at the Post Office.

An indelible mark will be placed on approved types of apparatus.

Really high-class programmes of music, entertainment, and instruction will be broadcast. "Dud" stuff will not be allowed.

The question of disseminating news will be discussed in due course in consultation with the newspapers and news agencies.

According to Sir Henry Norman's belief, broadcasting is due to commence some time this week.

* * *

Various Items.

THE Walsall Electrical Co., Ltd., of 57, Bridge Street, Walsall, have just sent me a copy of their very interesting catalogue of meters, call testers, etc., and amateur experimenters would do well to write for a copy.

* * *

Messrs. P. H. Boys & Co., 187, Goswell Road, E.C. 1, have also produced a new illustrated catalogue which should provide food for thought for the amateur with a limited purse.

The Rawlplug Co., Ltd., of Gloucester House, Cromwell Road, S.W. 7, offer good value at a very reasonable price. Their very useful outfit for fixing screws in plaster, brick, marble, etc., should prove attractive to many readers of this paper.

* * *

Two little booklets by Mr. W. R. H. Tingly, of 92, Queen Street, Hammersmith, on "Fault Finding" and "Earth and Aerial Circuit," will be useful to the amateur. Their modest price is one shilling.

* * *

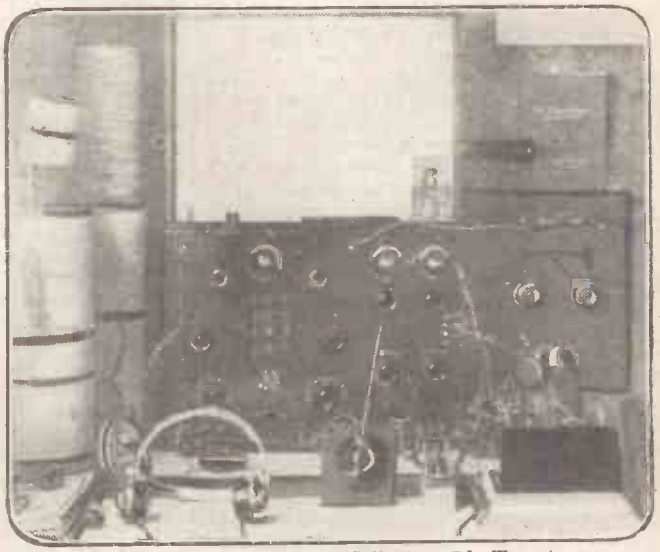
According to the "European Commercial" the French military radio section in Constantinople has now established a regular service with a Bulgarian station at Varna and is accepting commercial messages, but at higher rates than those of the Eastern Telegraph Company for ordinary telegraph messages.

* * *

The Czecho-Slovakian firms of Krizik and Company and Telegraphia, manufacturers of telegraph and telephone apparatus, have formed a mutual enterprise at Prague under the style of Radioslavia, with a capital of 100,000 crowns, which will undertake the manufacture of special apparatus for wireless telegraphy and telephony, the construction of wireless stations, the transmission of Press messages, etc.

* * *

It is announced from New York that the Radio Corporation of America has entered into an agreement with the Postal Telegraph Cable Company whereby every office of the Postal Company in the United States be-



Set built by Mr. A. L. Johnson, 17, Newtown Rd. Worcester

NOTES AND NEWS.

(Continued from previous page.)

comes an agency of the Radio Corporation for the acceptance of radiograms for transmission across the Atlantic Ocean and for the delivery of radiograms received from overseas for points in the United States. This important linking up of radio and wire line services reflects the rapid growth of the Radio Corporation's overseas telegraph traffic since the return of its high-power stations by the Government after the close of the world war. Prior to the arrangement just made practically all the wireless messages transmitted to trans-Atlantic countries originated in New York City or Washington, D.C. It will now be possible for commercial centres and the thousands of small points reached by the postal system to have equal facilities with those enjoyed by the eastern cities, while the same facilities will be available for incoming messages.

* * *

L.C.C. and Radio.

A WIRELESS society formed by the L.C.C. staff at the New County Hall has put up a 150-ft. aerial. The society proposes to conduct research work, many members holding special qualifications in science and engineering.

Mr. L. E. Clarke's set, at 27, Westminster Road, Whitehall, Bristol.

The Latest.

A SLOT machine for the development of broadcasting has been invented in America, and tested officially by the Bureau of Standards. It consists of an automatic apparatus, with an exterior not unlike a post office stamp slot machine. It is claimed that the machine is "fool proof." When the coin is inserted in the slot at the top (at a time when the broadcasting news intimates a programme is being sent out), two lights are automatically switched on, and the music is heard through a large horn at the bottom of the instrument.

* * *

Next Week.

NEXT week's issue of POPULAR WIRELESS will contain a specially written article of the exhibition which should prove of great value to all amateurs and traders. The author of this article is Mr. W. S. Sholl, A.M.I.E.E., who for some years has made a close study of the problems connected with the manufacture of amateur wireless apparatus.

Readers should on no account miss this special article.

ARIEL.

THE RADIO ASSOCIATION.

OWING to the large number of letters of application for membership it has been found impossible to reply to those who have written making various inquiries, but details are given below.

The subscription to the Radio Association is 2s. 6d. per annum, and remittances should be sent to the Hon. Treasurer, Radio Association, 9, Southampton Buildings, London, W.C. 2.

There is no entrance fee payable at the present time.

Members need have no technical qualifications.

Any person who is interested in the practical side of wireless telephony or radio communication in any form is eligible for membership. The acceptance of applications for membership rests with the officers of the Association.

The question many ask, and which is troubling thousands of amateurs, is whether and how broadcasting will interfere with amateurs' work on other wave-lengths. The Radio Association is collecting material on this question and will make representations to the authorities at an early date. An announcement will be made through POPULAR WIRELESS as soon as practicable on this important question for amateurs.

Official representations have been made by the Radio Association to the authorities in regard to the terms upon which small manufacturers may enter the Broadcasting Company and on other questions. For the present all manufacturers are continuing to manufacture as before.

Notice to All Members.

If you desire your interests to be considered and your wishes respected there is only one way—to make the membership of the Radio Association as large as possible. Get all your friends to join the Association. They will get their friends to do likewise.

Local branches of the Association are being organised, and offers of help in this direction should be sent to Mr. S. Landman, M.A., solicitor, the Hon. Sec., Radio Association, 9, Southampton Buildings, London, W.C. 2, without delay.

MEMBERSHIP APPLICATION FORM.

To the Hon. Treasurer,
Radio Association,
9, Southampton Buildings,
W.C. 2.

Dear Sir,—Please enrol me as a member of the Radio Association, for which I enclose annual subscription of 2s. 6d.

Name in full.....
(with titles)

Address .....

.....

Broadcasting Programmes

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

TELEPHONY TRANSMISSIONS

Station.	Call sign.	Wave-length in metres.	Remarks.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Marconi House, London	2 L O ..	360 ..	Not regular.
Writtle	2 M T ..	400 ..	Tuesdays, 7 p.m. (G.M.T.).
Paris*	F L ..	2,600 ..	(See foot-note.)
Königswusterhausen ..	L P ..	2,500 and 4,100 ..	Daily, 7 and 10.30 a.m. (G.M.T.).
The Hague†	P C G G ..	1,085 ..	Sundays, 2.30 and 5.30 p.m., and 8 to 9 p.m. Thursdays, 8 to 9 p.m.
Messrs. Burnham (Blackheath) ..	2 F Q ..	440 ..	About 9 o'clock any evening.
Newcastle	5 B A ..	440 ..	6 and 7.30 p.m. (G.M.T.).

NOTE.—The Bar Lightship, Liverpool, sends telephony at 6 a.m., 8 a.m., 2 p.m., 4 p.m., 6 p.m., 8 p.m. (G.M.T.). Wave-length 440 metres. Calls "Liverpool." When answering Liverpool calls "Bar Light."

* The hours of the telegraphic and telephonic communications transmitted from the Eiffel Tower have been altered on the reversion to "winter time." The official notification of their changes is as follows:

3.20 a.m. to 3.30; 9.20 to 9.30; 15.20 to 15.30; 20.20 to 20.30; meteorological report for France by wireless telegraphy in code. 4.50 and 12.15, telephoned forecasts of weather. 12.30 to 12.45, weather report over Europe generally in code.

10.23 to 10.30; 11.33 to 11.49; 23.36 to 23.49, time-signals, preceded by the usual code and message afterwards.

18.16. Weather forecast in plain language by telephone, followed by a gramophone concert, the latter always with the experimental idea. All reports of the latter throughout Europe and from ships in the Atlantic are valuable. England being in the known radius, English reports are welcomed, but naturally are not sufficiently far-distant to be of any great research value.

† The times of the Thureday transmissions are liable to sudden alteration.

Many amateurs may be heard of an evening on 440 metres, also as low down as 60 metres.

A special concert will be broadcasted on Oct. 18th from 5 to 5.30 and at 6 to 6.30 p.m. Wave-length 360 metres.

HOW TO MAKE A LONG-WAVE RECEIVER.

By Y. W. P. EVANS.

PART I.

IN designing a long-wave receiver it is necessary to combine efficiency with compactness, although for greatest efficiency it would be wise to utilise as much space as possible. This point applies mostly to the actual receiving coils, as in a one-valve receiver the space occupied by the valve rheostat, terminals, etc., is comparatively small.

The thicker the wire in a receiver the less will be the loss from resistance, etc., but considering the length of wire required for a wave-length of, say, 25,000 metres, the coils, wound with 22 S.W.G. D.C.C. (standard wire gauge, double cotton covered) wire would occupy a space of at least three square feet.

The construction of the receiver referred to above will be explained as simply as possible, and all technical details will be avoided with a view to simplicity and cheapness combined with a fair amount of efficiency, so that it can be made by the veriest novice without any knowledge of electricity or wireless.

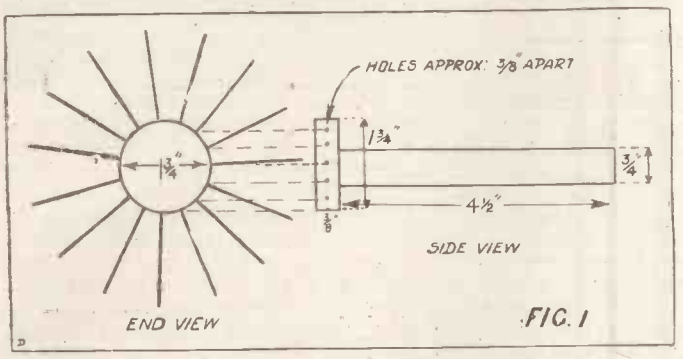


FIG. 1

The construction of the coils will be undertaken first. These will consist of two sets of basket coils, deriving their name from their similarity to basket weaving. The reason why two sets are being designed is in order that the receiver may be divided into a medium-wave range set and a long-wave range, the first to be, say, from 1,000 metres to 8,000 metres, and the second from, say, 5,000 to 25,000 metres, thus avoiding serious losses on the low waves which would otherwise occur owing to the aforesaid resistance and the fact that a large amount of wire would not be in use, and to a certain extent would be draining the other part of the receiver.

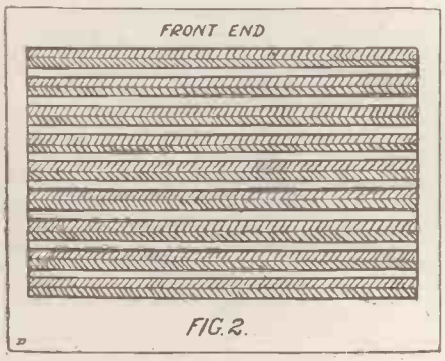


FIG. 2.

The materials required for the first set are: 1 lb. of 22 S.W.G. D.C.C. (6s.); 10 ft. of hard drawn brass wire, $\frac{3}{32}$ in. diameter (2s.); and a home-made former. This latter is constructed from a wooden disc $1\frac{3}{4}$ ins. diameter and $\frac{3}{8}$ in. thick, nailed through the centre to a piece of wooden rod $\frac{3}{4}$ in. diameter and $4\frac{1}{2}$ ins. length. Round the outer edge or periphery of the disc, mark off 15 divisions an equal distance apart; to be precise, each space should be $\frac{3}{8}$ in. plus $\frac{1}{64}$ in. This is best done with a pair of dividers. Having marked these points plainly, drill a hole to a depth of $\frac{1}{4}$ in. in each spot, using a No. 44 morse drill, taking care that the drill points towards the dead centre of the disc.

Having done this, file off the edges so as to give the periphery a rounded appearance like a tyre; this will be of assistance when removing the coils. Cut the brass wire into 4-in. lengths and fix these in the holes already drilled. Having affixed the handle, the former should have the appearance of a wheel with 15 spokes and is now ready for winding the first coil (Fig. 1).

The next item is very simple, that of winding on the wire. Fix the bobbin of 22's on to a spindle where it will revolve easily and take a turn round one of the brass pins with the end, leaving about 3 ins. for connecting. Turning the former slowly to the left with the left hand, wind the wire in and out the pins zig-zag fashion and continue so until the depth of winding is about $3\frac{1}{4}$ ins., or $\frac{1}{4}$ in. from the top of the pins. Dip the inner end of the wire in black ink and the outer end in red ink, cut the wire and prepare to shellac the coil.

The shellac is made up as follows: Obtain 2 ozs. of flake from a paint store (2s.), and 6d. of methylated spirit (commerical). Place the shellac flakes into an old tin and just cover with spirit, allowing the shellac to dissolve, with an occasional stir. Add spirit as required until a nice creamy consistency is obtained, then bottle off and keep tightly corked when not in use. To thin out add a little spirit. Having given the coils about three coats of shellac, allowing each coat to dry (about ten minutes), withdraw the pins and slip the coil off the former.

A small wooden disc, about $\frac{1}{4}$ in. thick, can be fitted to the hole in the centre to form an extra support for the coil. Now insert the pins in the former again and commence the second coil, winding exactly as before, and so on, until four coils have been so constructed. These will form the aerial and loading coils, that is, one will be used with the reactance as an aerial coil, and the others will form extra coils to switch in series with the aerial.

Now wind a similar coil with $\frac{1}{4}$-in. extra winding, about four more turns than the others, this forming the reactance coil. Having marked all the ends black and red as before mentioned, pass the inner end up through one of the holes made by the pins, so as to bring it out at the top or outer edge of the coil, about three holes to the right from where the outer end finished. In the next coil bring the inner end up through the third hole to the left of the outer end, the next coil three to the right, and the last coil three to the left.

Place the four coils side by side, the ends at the top, and make certain that the wire in each coil is travelling in the same direction, say, clockwise from left to right. Leaving the red end of number one coil free, twist the black end around the red end of number two coil, the black of number two to the red of three, and black of three to red of four, leaving the black of number four to hang free. After making sure that the insulation (cotton tape) is clear of the joints, solder the twisted ends so as to make good contact.

You should now have five ends suitable for connecting to a switch, two single and three double. Bind the coils lightly together with tape and place them in a cool, dry atmosphere until required, along with the reactance coil. If desired the four aerial coils can be fitted into a neat little box made of $\frac{3}{16}$-in. ply wood without lid, bringing the ends through the top side without allowing the bare wire to touch the wood.

Now to prepare for the second set, or long-wave coils. The same method is employed as for the low-wave coils, except that finer wire is used and a larger former. The latter should be 3 ins. diameter, fitted as before on to a wooden rod 4 ins. long. Divide the periphery into 19 points, each about $\frac{1}{2}$ in. apart (actual measurement is $\frac{1}{100}$-in. less than the half).

Drill a hole $\frac{1}{2}$ in. deep at each point, using a No. 44 drill, and cut off 2-in. lengths of brass wire, inserting them in each hole, so that you now have a former containing 19 spokes $1\frac{1}{2}$ ins. long. Obtain $\frac{1}{2}$ lb. of 30 D.C.C. wire (about 6s.) and wind this as before, zig-zag fashion, to a depth of 1 in., making the outside diameter of the coil 5 ins. Mark the ends of the coils as before, and give three coats of shellac.

(*Continued on page* 420.)

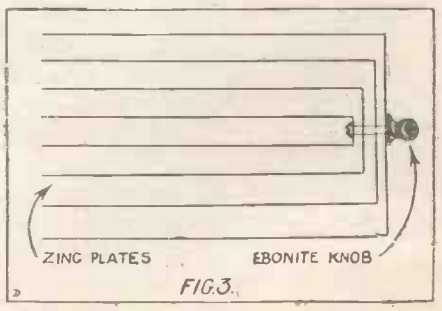
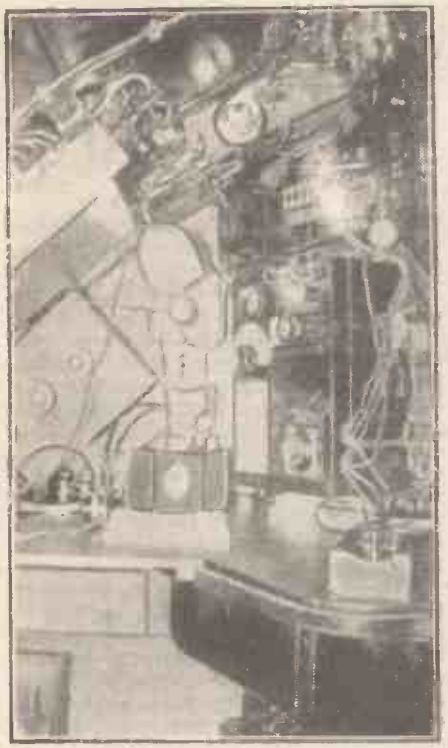


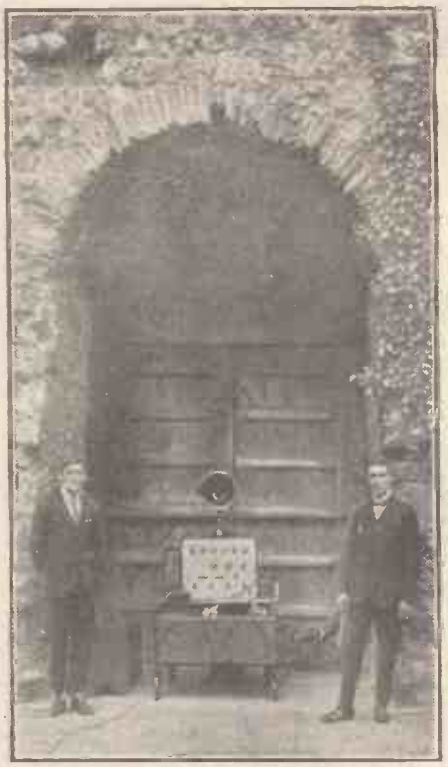
FIG. 3.



The photo on the left, sent in by Mr. H. D. Rumbledon, 88, High Street, Feltham, Middlesex, shows the wireless set fitted up in a submarine.

Above is a photo of Mr. A. P. Skinner (age 14), of 36, Cliffe, Lewes, who made the 35/- receiver described in POPULAR WIRELESS No. 1, and gets excellent results with both telephony and telegraphy.

On the right is a photo of the Quadrangle of the old Norman Castle at Colchester, showing the radio set used at a demonstration in connection with a fête arranged recently by the Mayor of Colchester.



HOW TO MAKE A LONG-WAVE RECEIVER.

(*Continued from previous page.*)

Now remove the pins, slide off the coil, tuck the inner end through to the outside, and the first coil is ready. Wind four of these coils the same size and join them together as with the short-wave coils. If desired place them in a neat little box of 3-ply wood, allowing the five connections to protrude. The reactance coil for this set should be of the same pattern, but wound with 32's (4 ozs. about 4s.).

You have now two sets of coils with reactance coils to match, and these should be kept cool until ready for assembly in the instrument box. The next instruments to be described will be the condensers.

I propose to explain the construction of two kinds of variable condensers, both of which are very simple and inexpensive combined with efficiency. The materials required for the first type are as follows:

Eighteen ¼-plate glass negatives (used); nine sheets of tinfoil, 6 ins. by 3 ins.; sixteen strips of cardboard, 4¼ ins. by ⅛ in. by $\frac{1}{16}$ in.; four sheets of $\frac{1}{32}$ in. zinc, 3 ins. wide, cut to the following lengths: $9\frac{5}{16}$ ins., $8\frac{13}{16}$ ins., $8\frac{5}{16}$ ins., $8\frac{3}{16}$ ins., one $\frac{3}{16}$ in. brass screw (Whitworth or B.A.), one ebonite knob, about ¾ in. diameter; two 4 B.A. terminals; and one baseboard.

First clean the glass thoroughly and get a good surface. Now proceed to build up the various parts. Commence with one glass sheet, then one sheet of tinfoil, one glass plate, two cardboard strips on either side; repeat, one glass plate, etc. (see Fig. 1A), until the last plate is in position, taking care that all parts are in line with the first section. When complete, grip the whole as tightly as you can with safety (a vice is ideal for this) and bind the plates with adhesive tape, keeping the open ends clear.

The front appearance should correspond to Fig. 2, and completes the first half of the condenser. Assuming the ¼-plates to be $\frac{1}{16}$ in. in thickness, the distance apart of the slots should be, from their centre line, $\frac{3}{16}$ in., so that we must now construct the zinc plates to correspond with this distance.

For example, No. 1 zinc plate (Fig. 3) should be bent so as to have three sides of the following dimensions: 4 ins., $1\frac{3}{16}$ ins., 4 ins. When so made, it should slide easily into the top and bottom slots, or gaps, in the first half of the condenser.

Having ascertained this to be correct, take the next smallest sheet of zinc ($8\frac{13}{16}$ ins.) and fold as before so as to fit the position of 2 in Fig. 3, and so on, with the other two sheets. Having got them all to slide easily into their respective slots, drill a hole through the centre of all four plates and bind together with the $\frac{3}{16}$-in. screw and ebonite knob as in Fig. 3.

The halves of the condenser are now ready for mounting. This is best accomplished by fixing the first half at one end of a board, 8½ ins. by 4 ins. by ½ in., a good method being to shellac the board and the bottom of the block of plates and, while "tacky," press them firmly together, the adhesive binding readily adhering to the prepared surface of the wood.

Now press the overlapping sheets of tinfoil together, cut them to an even length, drill a hole through, and bind them together with one of the terminals. Slide the zinc plates into position, and fix a flexible wire on the outer plate to the terminal on the end of the board.

A piece of rubber-covered lighting flexible is suitable about 6 ins. long. Glue a small strip of wood on the centre of the board, just high enough for the sliding portion of the condenser to rest upon, having an extra "lip" at the end to act as a buffer and prevent the plates from being drawn out altogether.

This should be so arranged as just to allow the tips of the zinc plates to rest in the slots when withdrawn to their fullest extent. The condenser should now appear as in Fig. 4, and is ready for use.

(*To be continued.*)

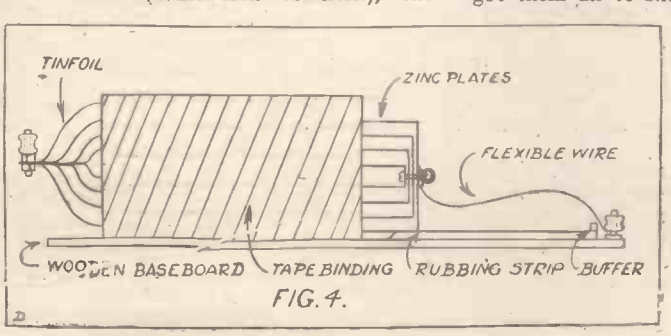
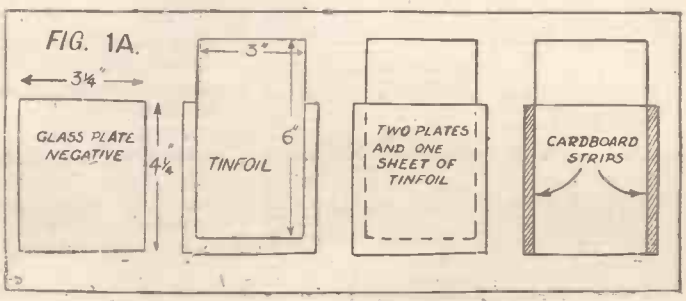


FIG. 4.



NEW SERIES FOR BEGINNERS.

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

PART 13.

HAVING learned that the ether of space is a universally distributed medium in which waves can be set up and propagated at the velocity of 186,000 miles per second, the reader may be interested in a more detailed consideration of waves in general and of ether-waves in particular.

All waves of any kind are the results of some disturbance of the medium in which they appear, and all fufil the same important function, that is, to carry away from the place where the disturbance occurred some of the energy which caused the disturbance.

You speak, and some of your bodily energy is carried off into the air in another form by means of the sound-waves you create; if you speak into a telephone the sound-waves take the energy as far as the instrument, which then passes it on in the form of electrical energy, which, when it reaches the receiver, is transmuted into the energy of sound again.

You throw a stone into a pond. In this instance, the energy you expend passes first to the stone, which, when it strikes the water, causes ripples, and by means of these the energy travels outwards from the centre of disturbance, and is lost in various ways. If you put your finger into the water at the margin of the pool, you can feel by the impacts of the ripples that some of the energy has returned to you.

You light a candle. In producing the light you disturb the ether by setting the particles of the burning wax into violent motion, and the energy of combustion leaves the candle by the extremely rapid means of waves in the ether.

Nature's Illusions.

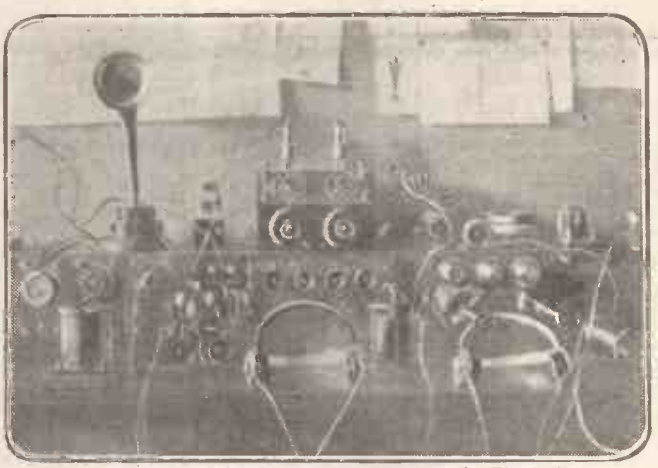
At this point it may be well to insist, with all deference to the popular and convenient form of speech, upon the fact that waves, whether in air, water, or ether, *do not really move;* they seem to do so, but Nature is a clever illusionist. For instance, on rare occasions during the English year the sky appears to be blue, though air has no colour. A block of steel seems to be very compact, yet the particles of which it is composed are in ceaseless motion at high speed.

A flower may appear to be red or blue, but its colour is not in its petals but in our brains; in fact, colour does not exist at all apart from ourselves. The earth moves round the sun at a speed of about 18½ miles per second, but Nature conceals the fact from us fairly successfully. Similarly, although we may feel sure that we can watch a wave out at sea travel towards us and eventually dash upon the beach, we are the victims of an optical illusion.

A wave which we see, for instance, in line with the end of the pier, never leaves there. It is created there and there it dies. But by virtue of the *energy* which created it and which it passes on when it dies, it is *re-created* a little later nearer the shore, and this new wave dies in turn and gives rise to another still nearer the shore, and so on. The first wave resulting from a disturbance of the medium is simply the first of a family of waves, each succeeding member of which appears a little further from the first than the one before it, just as each succeeding generation of mankind is more remote in time from Father Adam than its immediate forbears.

Wireless waves, then, are not air-waves or sound-waves, as they are so often wrongly called, but ether-waves; and they do not travel, but are *propagated* at the speed of light—the greatest speed known to science—from a disturbance of the ether caused by the sending station.

If you pluck a harpstring it vibrates at a certain rate, which is called its *frequency*, and gives out a certain musical note. No matter whether you pluck it strongly or feebly, *the frequency of its vibration and the note it sounds do not vary if the length of the string is not altered.* But if you shorten the string and pluck it again, it vibrates more rapidly and the note it emits has a higher pitch than before. On the contrary, by lengthening the string its frequency is lowered, as is also the pitch of its note. These are facts of common experience, which you can test for yourself with a tightly stretched piece of twine or iron wire.



Mr. C. Noakes' set, at 68, Park Hill, Smethwick, near Birmingham.

Frequency.

Now the ether may be regarded as a harp of innumerable strings, and ether-waves as the vibrations of these strings. There are no actual strings in the ether, of course; it is perfectly continuous throughout space. Yet it acts as though it had strings, because so many "notes" can be played upon it. It is, in fact, in eternal vibration.

The frequency of which an ether-wave (or vibration) is capable is astounding. At the top of the scale, *so far as science has yet discovered*, the ether vibrates with a frequency of millions of billions per second, corresponding to X-rays and the radiations from radio-active materials. Next come vibrations known as ultra-violet light, with a frequency of three thousand billions per second. This light, though not visible to the eye, can be detected by a photographic plate and is called "actinic light" by photographers.

At the bottom of the scale are the huge ether-waves used in wireless telegraphy. The waves sent out by the wireless station at *Bordeaux* have a frequency of about 12,760 per second, but although this is the lowest frequency of any waves produced artificially by electricians, there is no doubt that as the ether becomes more and more crowded with wireless waves, we shall be forced to go still lower.

Wave-length.

Besides the frequency of a wave there is another important measurement which is called the *wave-length*. I have mentioned the fact that if you shorten a stretched string its frequency of vibration increases, and vice versa. In one sense we may compare the length of the string with the length of a wave, because it is true of wireless waves that *the higher their frequency the shorter they are.*

Thus, whereas waves of ultra-violet light, which vibrate at the enormous frequency mentioned above, have a length of one ten-thousandth ($\frac{1}{10000}$) part of a millimetre, the waves used by the *Bordeaux* wireless station, having the much lower frequency of 12,760 per second, are about 14½ miles long.

To sum up: The three fundamental measurements in connection with a wireless wave are:—

1. *The velocity with which it is propagated through space.* This velocity is 186,000 miles per second *always*, no matter what its wave-length or frequency may be. At this velocity a wave-motion in the ether, started by the great Marconi station at Carnarvon, is detected in Australia one-fourteenth of a second afterwards.

2. *Its frequency.* This is the number of times per second a wave is created at a given point in space. This will be clearer to the reader if he will imagine that he is endowed with a special sense which enables him to *feel* wireless waves in the form of, say, a slight electric shock. If, thus equipped, he were to take up his stand within range of a wireless station which is sending out waves with a frequency of five, he would feel five shocks every second. (Five is an impossible frequency for a wireless wave, but the argument is none the less correct.) To revert to common phrase, we may say that the waves are passing across him at the rate of five per second.

3. *Its wave-length.* Wireless waves spread out from a sending station in all directions. We may usefully compare them to the ripples which spread out from a stone thrown into a pond, but the comparison is not complete, because whereas the ripples in the latter case are confined to the surface of the water, the ether-waves not only spread

(*Continued on page 422.*)

NOTES ON THE LONDON ETHER.

By 2 A N.

THE nightly congestion on and near the amateur transmission wave-length in the London area is becoming so self-evident and self-assertive that of the two we prefer to talk about it rather than listen to it.

On certain evenings during recent weeks, spark jamming—broadly tuned and very penetrating—has seriously interfered with many experiments; but, in spite of this, we are conscious, "through the medium of our instruments," of the rapid progress being made by private stations in the volume and clarity of their radio-telephonic communications.

Experimental musical transmissions by amateurs have also shown wonderful development.

The gramophone of the cheap and tinny variety, which was perhaps good enough as a convenient source of noise for preliminary work, is no longer "suffered gladly" by the discriminating amateur.

The technical details of transmitters have now reached such a degree of perfection that we are beginning to aim our criticism at the original music rather than at the type of the radio apparatus employed. Whether this is always justifiable remains to be seen.

It seems to be generally recognised now that, if you want really enjoyable music at the receiving station, it is essential that the original music at the transmitting point must be of unimpeachable quality. This point is so obvious that we feel almost compelled to apologise for pointing it out, but our justification is furnished by certain stations who strive most industriously after perfection and have actually attained it—*i.e.*, perfect reproduction of all the original defects of the records used.

In this connection it is interesting to draw attention to the excellent music transmitted by 2 W Q, who, we understand, is experimenting with the "Algraphone" (a super-gramophone manufactured by Alfred Graham & Co.). This reproduces the record music with extraordinary fidelity, freedom from "blast" and resonance being most marked.

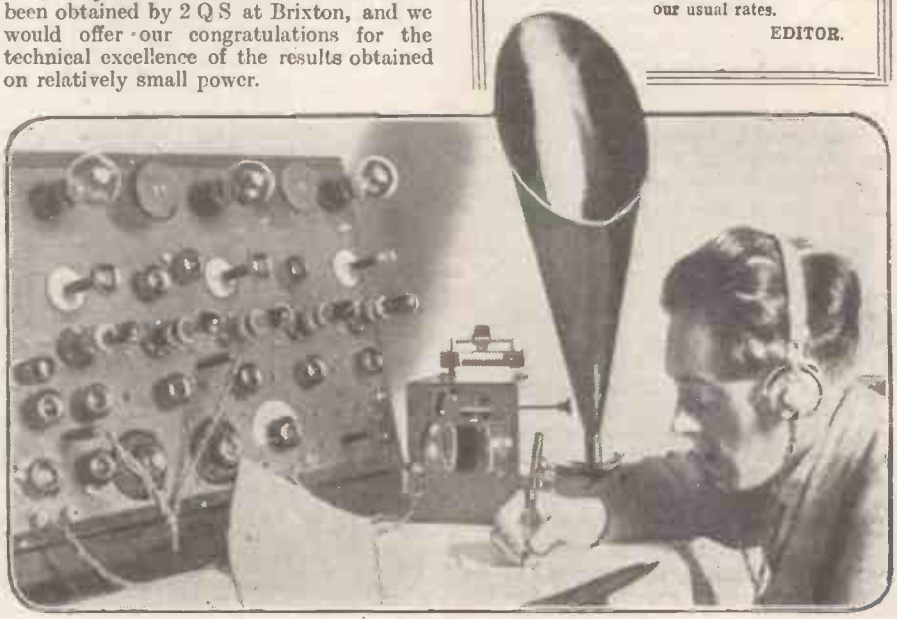
The general recognition of the need of original music of good quality has turned the attention of many of the London experimenters to the use of the piano for musical experiments.

We have been much interested in the experiments recently carried out by 2 Q M, and have noted with pleasure the round and mellow tone and the great volume and wide scale range attained in these experiments. Similar results have been obtained by 2 Q S at Brixton, and we would offer our congratulations for the technical excellence of the results obtained on relatively small power.

Might we conclude these notes with an appeal to those using transmitters to wind up each speaking period, or separate experiment, with their own call sign and that of the station they are working with thus—"2 Z Z changing over for 8 A B," instead of letting this very reasonable regulation degenerate into the single word "over," or even the equally vague "over for you."

Amateurs engaged in experimental transmission work are invited to send in concise reports and criticisms for publication in "Popular Wireless." Copy accepted will be paid for at our usual rates.

EDITOR.



NEW SERIES FOR BEGINNERS.

(*Continued from previous page.*)

upwards, but also penetrate the earth slightly. For our purposes it is simplest to imagine the waves spreading out in huge circles with the sending station at their centre.

It is obvious that all receiving stations, equally distant from a sending station, will be affected by the waves at one and the same time. Thus, although a message may be intended for one particular station, this property of wireless waves, whereby they distribute themselves to every point of the compass, causes every other receiving station within range of the transmitter to share in the distribution.

Only an infinitesimal portion of the total energy thrown into the ether is really needed by the station for whom the message is intended; all the rest, almost 100 per cent. of the total, is wasted. There is, however, a great advantage to be gained from what may strike the reader as a clumsy and wasteful method of telegraphing, namely, that when it is desired to send the same message to more than one station it can be done without expending any more energy or time than is needed to communicate with one station only.

Within the huge circle which represents the effective range of the transmitter, thousands of receiving stations may be set up, and all of them can receive the message at the same moment. This is, nowadays, called "broadcasting," and many a life and many a good ship has been saved because it was possible to send a wireless distress call simultaneously over a large area of the sea, and thus ensure its reception by other vessels.

Similarly, were it not for our ability to spread wireless transmission we should be unable to enjoy the novelty of receiving in our homes music and speeches by wireless sent out by the promoters of wireless concerts. The value of broadcasting in the cases of time signals and weather reports is inestimable.

The reader must not imagine for a moment that because in theory it is possible for all stations to receive from a transmitter if they are within its working range that this actually occurs in everyday work. Very little business would be possible if there were no means for a receiving station to "pick up," undisturbed by the others, the messages it wants. Every second, day and night, the ether is pulsing with myriads of wireless waves, yet in the receiving rooms of the wireless stations are wonderful instruments which enable the operators to select from the etheric tangle the messages intended for them, just as a single strand of cotton may be drawn from a woven fabric.

Whilst it is true that modern methods of tuning prevent the undue interference of unwanted waves with any given station, it would clearly be very useful if we could telegraph wirelessly in a straight line, and although the art has not yet reached such perfection, the Marconi Company has already succeeded in concentrating the outward flow of energy from the transmitter into the form of a beam, so that the waves emerge from the station something like a beam of light from a searchlight.

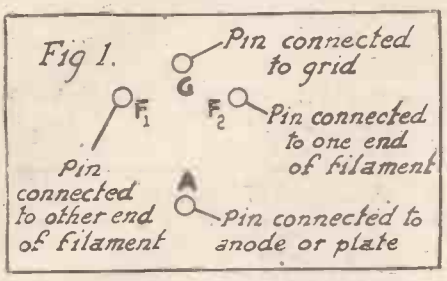
THE THREE-ELECTRODE VALVE.

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

(Chief Technical Adviser to *Popular Wireless*).

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

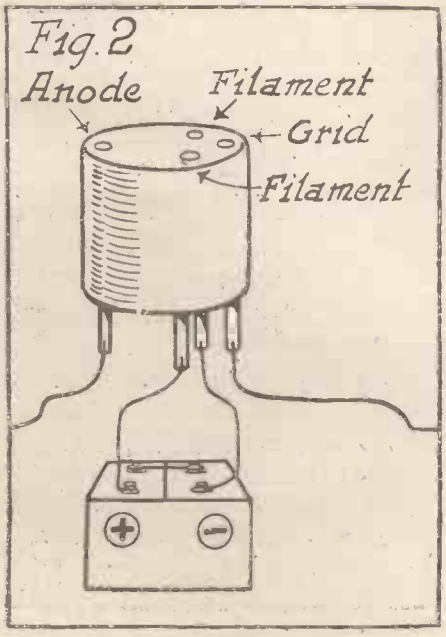
THE kind of valve shown in Fig. 4 (POPULAR WIRELESS No. 16) is called a two-electrode valve because it only has a filament and a plate, each of which is called an "electrode." Such an arrangement was at one time used for receiving wireless signals, but it was displaced by what is known as "the three-electrode valve," which contains not only a filament and an anode, but an additional electrode



called a grid. This grid is a metal structure arranged between the filament and the anode, and is of open-work nature so that electrons can pass through the holes in the grid on their way to the anode.

The Valve Holder.

The different parts of the valve are the filament grid and plate. There are four pins passing through what is known as the "cap" of the valve. Each pin is connected to an electrode inside the valve. If you examined a valve you would find that the pins, instead of being arranged in a square, form the points of a kite, as shown in Fig. 1. The pin marked G is connected by a wire passing through the bulb to the grid; that marked A passes to the anode or



plate; the two pins marked F_1 and F_2 are connected to the two ends of the filament wire. Sometimes the valve will have the cap lettered showing which pin goes to which electrode; sometimes the pin going to the anode is indicated by the letter A or P. The pin immediately opposite is the grid, while the other two are the filament pins.

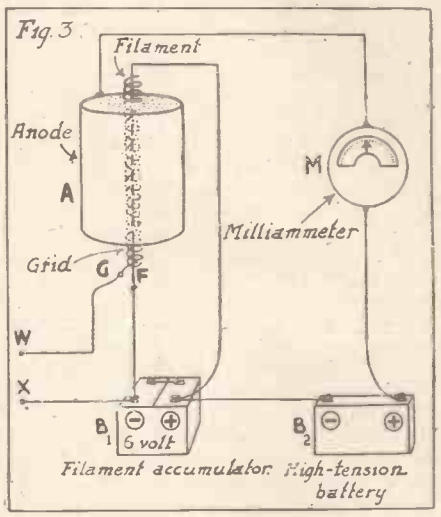
Connections to the electrodes might simply be made by fixing wires to the pins, but this would be very inconvenient, especially as it is often desired to remove a valve or replace it. A special valve holder is therefore employed, and serves a similar purpose as a lamp holder for an ordinary electric lamp. The holder, Fig. 2, which varies in design, has four sockets arranged in the shape of a kite, and the pins on the valve cap fit into corresponding sockets to which external connections are made. The reason for arranging the pins and sockets in an unsymmetrical manner will now be understood; the valve cannot be fitted into the holder incorrectly. For example, the grid pin could never slip into the socket intended for the anode connection. We will now investigate the action of the three-electrode valve.

Fig. 3 shows diagrammatically a three-electrode valve consisting of a filament wire F heated by current from a six-volt accumulator B_1. Round this filament is an anode A. This anode is sometimes arranged as a metal plate, but it more usually takes the form of a cylinder round the filament. Round the filament, and closer to it than the anode, is a spiral, or, more accurately, a helix, of wire which is labelled G. This helix must not touch either the anode A or the filament F. The three electrodes of the valve, therefore, are the anode A, the grid G, and the filament F. The grid G was originally so termed because in the earlier forms of the three-electrode valve the plates and grids were flat and did not surround the filament, as in the case of most modern valves.

Operation of the Valve.

In such cases, the grid often consisted of an arrangement something like a sieve through which the electrons passed on their way to the anode. In Fig. 3, the electrons shoot off from the filament F, pass through the open spaces in between the turns of the grid G, and travel to the cylindrical anode A. Between the anode A and the filament F is a milliammeter M and an "anode battery" or "high-tension battery" B_2, the positive side of this high-tension battery being connected to the anode and the negative side to one side of the filament. It does not matter to which side of the filament the battery B_2 is connected, but it is preferable to connect it to the positive terminal of the filament accumulator B_1.

If we connect up the arrangement shown in Fig. 3, under normal conditions a steady electron current will flow from the filament through the spaces in the grid to the anode A and round the anode circuit. This steady current will produce a deflection of the milliammeter M. It was found that the arrangement could be used as a strengthener or detector of wireless signals. It is not



possible to explain here all the reasons why the three-electrode valve may be used as a detector or amplifier; it is only proposed to give a very brief theoretical description. It is found that if a positive potential is applied to the grid of a three-electrode valve, the electron current from the filament to the anode and round the anode circuit is increased, whereas if a negative potential is given to the grid the normal steady current round the anode circuit is decreased.

Effect of Varying Grid Potential.

In the Fig. 3 arrangement the current through M will be increased or decreased according to the way we connect the terminals W X to a source of potential such as a battery. It is to be noted that the potentials of the grid are potentials relative to the filament.

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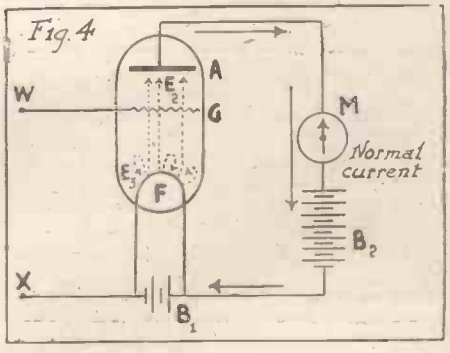
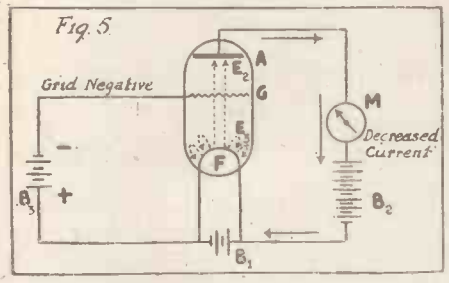


THE THREE-ELECTRODE VALVE.

(Continued from previous page.)

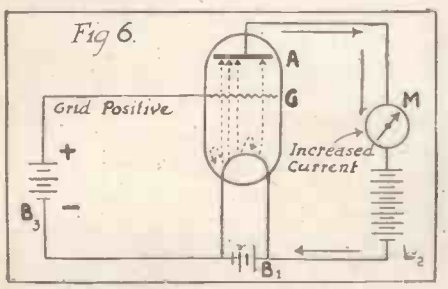
Fig. 4 shows how we represent diagrammatically the arrangement of apparatus shown in Fig. 3. The grid G is shown as a dotted or zig-zag line G placed in between the filament F and the anode A. This method of showing the valve is varied sometimes, but the reader will always recognise the different electrodes. The arrangement of Fig. 4 shows a picture of what is happening to the electrons. Many of the electrons (such as those marked E_2) pass from the filament F through the holes or spaces in the grid G to the anode A and so round the anode circuit in the direction of the arrow-head.



Some of the electrons emitted from the filament (such as those marked E_3) return again to the filament. We see, therefore, that the anode is not drawing up all the electrons emitted by the filament. If now we connect a battery B_3 across the terminals W X, as shown in Fig. 5, the number of electrons passing to the anode and round the anode circuit will vary according to which way round we connect the battery B_3. In Fig. 5 the battery B_3 has its negative side connected to the grid G and its positive side to the filament F. The grid is therefore given a negative potential of several volts.

Effect of a Negative Potential.

The result of this negative potential will be to repel the negative electrons leaving the filament, and many of them will therefore be sent back and will return again to the filament. Many others, however, will slip through the holes in the grid and pass on to the anode A. The effect, however, of the negative potential on the grid will be to cut down the number of electrons reaching the anode, and therefore to reduce the anode current flowing through M. If we increase the negative potential on the grid sufficiently we would repel all the electrons which would have gone to the anode, and the current round the anode circuit will thus be reduced to zero.



If, however, we connect (as in Fig. 6) the battery B_3 so that the positive terminal is connected to the grid G and the negative terminal to the filament F, the grid will help to attract electrons from the filament to the anode. Very few of these electrons will actually strike the grid itself. Most of them will pass through the holes in the grid and be attracted on towards the anode A. If we keep on increasing the positive voltage of the grid by increasing the battery B_3, a time will come when all the electrons emitted from the filament will be passing to the anode A.

Meaning of "Saturation."

This is because a filament will only emit a certain number of electrons per second at a given temperature, and when these are being sucked up by the anode it is impossible to produce a bigger anode current without altering the temperature of the filament.

When the grid is helping the anode A to draw up all the electrons emitted from the filament, the valve is said to be *saturated*, and the point beyond which it is impossible to increase the anode current is called *saturation point*.

The action of the three-electrode valve may be explained by considering our water analogy. Fig. 7 shows the same arrangement as that explained in connection with the two-electrode valve, but has the addition of a propeller P_2 placed in between the rose R and the inverted funnel U. The handle T may be used to rotate the propeller P_2, the actual mechanical arrangements, of course, being of no importance in connection with this explanation. By rotating the handle T in a clockwise direction we can cause the propeller P_2 to revolve also in the same direction.

Let us assume that the propeller P_2 is normally still and that the revolving propeller P_3 causes the funnel U to suck up about half the water which is sprayed out from the rose R. If we rotate the propeller P_2 in an anti-clockwise direction, we may counteract the suction of the funnel U and blow back a good deal of the water which would have been sucked up to the funnel U. If we turn the handle T fast enough the back draught of P_2 will more than counteract the suction of the funnel U, and no water, as a result, will be sucked round the circuit UP_3V. The revolving of the propeller P_2 in an anti-clockwise direction corresponds to the application of a negative potential or voltage to the grid of a three-electrode valve.

In the case of the three-electrode valve, there is normally a flow of electrons from filament to anode, and this flow is reduced by repelling electrons by a negative potential on the grid. In the same way, by revolving the propeller P_2 in an anti-clockwise direction, we can repel the streams of water which would otherwise be sucked up by the funnel U.

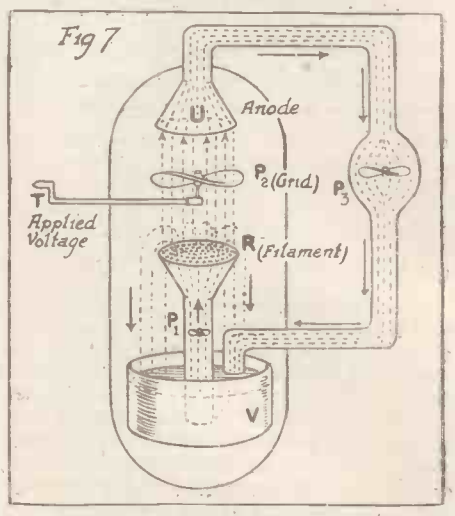
It is to be noticed that the water which is repelled will fall back into the vessel V just as electrons repelled by the grid return to the filament.

If now we revolve the propeller P_2 in a clockwise direction it will suck up water from the rose R and will, therefore, be assisting the suction of the inverted funnel U. The propellers P_3 and P_2 will be assisting one another to produce a very strong draught which will suck up more water than before; the propeller will, in fact, suck up a lot of the spray which, although being projected from the rose R, is merely falling back into the vessel V.

A Water Analogy.

By drawing up these fine streams of water, the water entering U and passing round the circuit UP_3V is increased. However fast we revolve the propeller P_2, it will be obvious that no more water will pass round the circuit UP_3V than that which passes when all the water sprayed out from the rose R passes up to U. This effect, therefore, is very similar to the saturation effect produced in a three-electrode valve. The revolving of the propeller P_2 in a clockwise direction is equivalent to applying a positive potential to the grid of a three-electrode valve.

The Fig. 7 arrangement will help to explain why small variations in grid voltage produce large variations of anode current. In Fig. 7, since the propeller P_2 is much closer to the water emerging from the rose R, a much stronger suction effect will be obtained than that produced by the



main propeller H revolving at the same speed. The distance between U and R weakens the suction effect on water emerging from the rose R; but the propeller P_2, being quite close to R, has a very big effect on the quantity of water sucked up into the funnel U.

In the same way, the grid of a three-electrode valve, being closer to the filament than is the anode, is able to control the anode current very effectively, the slightest voltages applied to the grid causing large variations of anode current.

The three-electrode valve, therefore, will act as a strong amplifier. Further explanations of the action of the valve as an amplifier will be found in the present author's new book, entitled "Wireless Valves Simply Explained."

The Editor will be pleased to consider articles from amateur experimenters for publication in POPULAR WIRELESS.

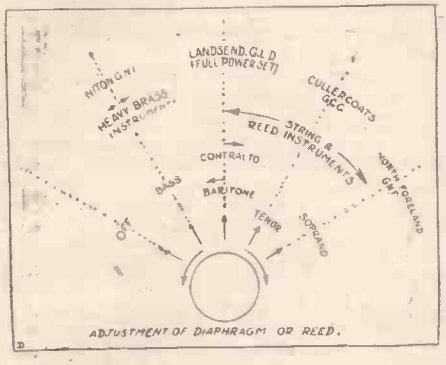
Articles accepted will be paid for at our usual rates.

THE SELECTION OF TELEPHONES.

By BERNARD LAX.

DUE to the considerable controversy at the present time between various manufacturers of telephone receivers, the writer is prompted to give an outline of the functions of the telephone and show methods whereby the reader can test and select the best telephones for his purpose.

The function of the telephone is to convert pulses of current passing through the magnet windings into audible sounds. For a given current, the amount of sound the telephone diaphragm will produce depends upon a resonance effect between the frequency of the pulses of current and the natural mechanical frequency of the diaphragm.



If the two be equal, then maximum sound will be produced; the diaphragm will vibrate in unison with the fluctuating magnetic pull upon it. The greater the difference between these two periods, the weaker the sound-waves become.

Diaphragm Adjustment.

It is usual in the reception of continuous waves to vary the frequency of the beat note until maximum sound is produced, which means that in this condition the beat currents equal in frequency the mechanical period of the diaphragm. In the reception of spark signals, however, this is not possible, as the note received is of fixed frequency. Thus, with a given amount of power, the station with a note near or having the frequency of the receiver telephones will give the best results on comparing distances. Modern spark transmitters are designed with a high spark frequency near the natural period of the telephone diaphragm.

Telephones with non-adjustable diaphragms generally have a natural period of about 1,000 per second. From this it is seen that they will be most sensitive on or around this frequency.

The reception of speech and music calls for a good design of telephone receiver, in order that minimum distortion shall occur. With fixed diaphragms, distortion occurs to a degree more or less dependent upon the character of the speech and the thickness of diaphragm or reed. Much less distortion occurs with a soprano than with a bass voice, and this is noticeable every day on telephone trunk lines. A female voice can generally be heard with far more clarity than a male voice, and this is due to the fact that the female tones are higher pitched, and therefore nearer the natural period of the telephone diaphragm.

For speech frequencies, a medium thickness of diaphragm is most suitable, this having a natural mechanical period of 700 to 800 per second. Thin diaphragms, although giving good results with reception of wireless telegraphy, produce badly distorted speech which is termed "tinny."

The design of telephones has had great attention paid to it, but, although this is the case, no doubt many types of telephones give poor results with reception of music, and more especially speech. If fixed diaphragm telephones be used, comparison with various makes should be made on speech reception. The receiving circuits should be detuned sufficiently for the speech to be just intelligible.

By inserting various makes of telephone in the circuit, comparison can be effected and a good pair for vocal frequencies easily found. It will be noticed that the telephones which produce the loudest sounds may not give the best reproduction of speech. Discernible, clear results, however, are more desirable than louder but distorted speech.

Adjustable diaphragm or reed telephones can be purchased with more certainty of good results. It is necessary to adjust the diaphragm or reed when receiving speech, and it will be found that slightly different adjustments are required for the character of the various voices. The diaphragm or reed adjustment varies the natural period of the telephone, and by this means an average frequency can be selected to suit the incoming speech or music.

The method of diaphragm adjustment for various voices and instruments is shown in Fig. 1. The notes of various well-known spark stations are indicated to show the average frequency for speech or music reception.

By use of this chart the reader will be able to overcome to a great extent the chief disappointment in connection with the reception of radio telephony.

HINTS TO AMATEURS.

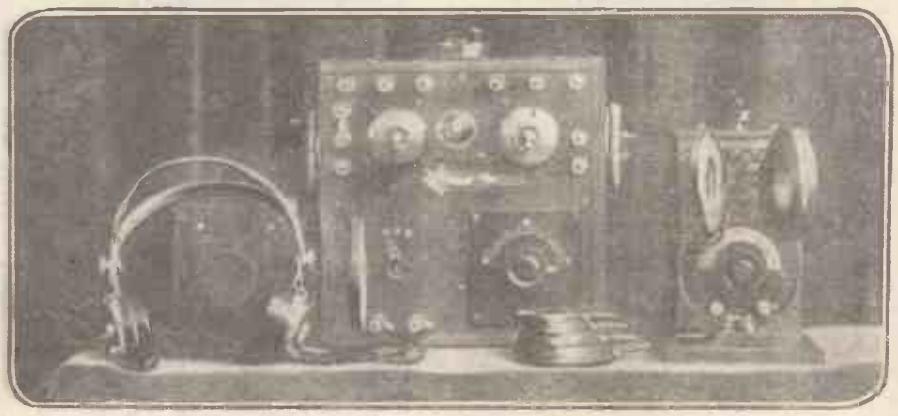
WHEN drilling holes into the edges of ebonite plate it will be found a very tiresome task, as the ebonite will often break away from the edges. To overcome this difficulty clamp the ebonite between two pieces of wood in the vice. This will keep the edges from breaking away. Where it is not possible to clamp it up, always drill a small "pilot" hole first, and then use the desired drill.

* * *

A very neat form of connecting plugs instead of terminals may be made from some short pieces of copper or brass tube. Two sizes will be required, one for the hole to be plugged and the other to act as the "jack." The larger tube should be cut off into short lengths, slightly longer than the thickness of the panel. Stand the tube on end and on something solid (metal preferred), and flange out the end with a centre punch. Drill holes in the panel (a good tight fit for the tube), put the prepared tube into the hole, and then flange out the other side. This will make a kind of rivet in the panel. Then gently tap one side with a hammer whilst the other side is resting on a piece of metal. This will close the tube down quite tight. A good plan is to make a small brass tab with a hole in it that will just slide on the tube before it is riveted in, so as to allow the lead to be soldered on and leave the hole quite clear. The jack portion is a very simple matter; just make a saw-cut down the tube lengthwise for a little way and open it out a little so that it will have a springy fit in the tube. Instead of the tube jack a brass split pin will do very well, and if a small piece of ebonite tube is slipped on after the wire has been soldered in it will add to its appearance.

* * *

To cut threads on small rods or wire make a pair of hard wooden jaws to fit the vice and cut V-shaped slots vertically to take the rods, making these different sizes. This will keep the rods from turning round just as you begin to get a decent depth of thread.



Receiving Set constructed by Mr. R. C. Reynolds, of 65, York Place, Edinburgh.

A GLOSSARY OF RADIO & ELECTRICAL TERMS.

RECTIFIER.—A device for converting an alternating current into a unidirectional current. This is usually brought about by means of apparatus (*e.g.*, a crystal detector) which allows current to flow through it in one direction only, and so wipes out one half of each alternating current cycle.

REGENERATIVE COUPLING.—A system of coupling in which the varying anode current is sent through a reactance coil which is inductively coupled with the grid circuit Thus, variations of anode current produce further impulses on the grid, these in turn producing still greater variations of anode current, and so on. Regenerative coupling, therefore, enables one valve both to detect and amplify.

RELUCTANCE.—The opposition offered by a magnetic path to the passage of magnetic flux. The reluctance of any path depends upon the length and sectional area of the path, and the permeability of the material of which it is composed. In any magnetic circuit, the reluctance is given by Magnetomotive Force ÷ Magnetic Flux. *Cf.* Ohm's Law.

RESISTANCE.—The opposition offered by an electric path to the passage of current, when no reactance is present. Except in the case of high-frequency currents, resistance depends purely upon the conducting path and is independent of changes in the value of the current. The resistance of any path depends upon the length and sectional area of the path, and upon the material of which it is composed.

RHEOSTAT.—A variable resistance placed in a circuit to control the value of the current flowing. The resistance is placed in series with the rest of the circuit, and not in parallel as in the case of a potentiometer.

R.M.S.—An abbreviation for Root Mean Square. The R.M.S. value of an alternating current is the square root of the average value of the square of the current, and is the value of the direct current which would produce a heating effect equal to that of the alternating current. In most cases the R.M.S. value of an alternating current is about 0·7 of the maximum value. For example, a current whose maximum was 10 amperes would heat a conductor to the same extent as a direct current of 7 amperes.

SELF-INDUCTION.—See Inductance.

SERIES.—Two or more conductors or pieces of apparatus are in series when the whole of the current in the circuit has to pass through them one after the other. In a simple receiving circuit, for instance, the telephones and crystal detector are connected in series. Cells are connected in series when the required voltage is equal to the sum of the voltages of the individual cells.

SHUNT.—When two portions of a circuit or pieces of apparatus are connected in parallel, one is said to shunt the other. In a grid circuit, for instance, the grid condenser is shunted by the grid leak, the two being connected in parallel.

SKIN EFFECT.—Unequal distribution of current in a conductor—the current tending to flow near the surface of the conductor and not in the centre. The effect is only noticeable in the case of high-frequency currents. For this reason, conductors for large high-frequency currents are often made of copper tubing—sometimes silver-plated.

SOFT VALVE.—A valve in which a little gas remains. The anode current is carried partly by this gas as well as by the electron stream from the filament.

SOLENOID.—A coil of wire wound in a long spiral, for the purpose of producing a magnetomotive force along its axis.

SPARK.—An electric discharge which occurs between two electrodes when the applied voltage is sufficient to break down the air in the gap. A spark usually consists of damped oscillations, the frequency of which depends upon the inductance and capacity of the circuit, and the number of which depends upon the resistance of the circuit, including the gap.

SPARK TRANSMISSION.—The transmission of wireless waves by means of oscillating condenser spark discharges across an air gap. Each discharge sends out one train of damped oscillations.

SPECIFIC INDUCTIVE CAPACITY.—The specific inductive capacity of a material is the ratio of the capacity of a condenser having that material as dielectric, to the capacity of an exactly similar condenser using air as dielectric. The specific inductive capacity of air is 1; of mica, 5; of waxed paper, 2; and of glass, 6 to 10.

SPECIFIC RESISTANCE.—The resistance of a sample of material 1 cm. in length and 1 sq. cm. in cross-section. The specific resistance of copper is 1·7 microhms (1 microhm = $\frac{1}{1000000}$ ohm), and that of iron is 12·2.

STATIC ELECTRICITY.—Electricity which remains stationary on the surface of a body in the form of an electrostatic charge. Disturbances caused by static electricity collecting on an aerial from the atmosphere are often called "static."

THERMIONIC VALVE.—A bulb, partially or entirely exhausted of air, and containing a glowing filament, a metal cylinder (plate or anode), and a wire or perforated metal mesh, or grid. The discharge of electrons from the heated filament enables the valve to rectify, amplify, or generate electric oscillations.

TRAIN OF WAVES.—The group of waves radiated by one spark discharge from a spark transmitting station.

TRANSFORMER.—An apparatus for producing alternating voltage and current in one circuit by magnetic induction from another circuit carrying alternating current. The induced or secondary voltage may be greater than, equal to, or less than the applied or primary voltage. Not to be confused with the *converter*.

TUNING.—The operation of adjusting the natural frequency of one circuit to be equal to that of another, by varying the values of the inductance and capacity in the circuit.

TUNING COIL.—A variable inductance by means of which tuning is effected.

VALVE.—See Thermionic Valve.

VOLT.—The unit of electromotive force or electrical pressure, being that pressure which will drive a current of 1 ampere through a resistance of 1 ohm. The electromotive force of a single accumulator cell is about 2 volts.

WATT.—The unit of electrical power, being the power exerted by a current of 1 ampere flowing under a pressure of 1 volt. 746 watts are equivalent to 1 horse-power.

WAVE-LENGTH.—The distance travelled by a wireless wave while it increases from zero to its maximum value in one direction, reverses, attains its maximum value in the other direction, and falls to zero again.

WAVEMETER.—An instrument for measuring the length of wireless waves. It generally consists of a simple receiving circuit, the variable condenser scale of which is marked with divisions corresponding to the wavelengths which give a maximum signal strength at the particular setting.

WIRELESS WAVES.—Oscillating disturbances of the electrical and magnetic conditions of the ether, which are set up by an oscillating electric discharge, and are capable of producing oscillating currents in a receiving aerial.

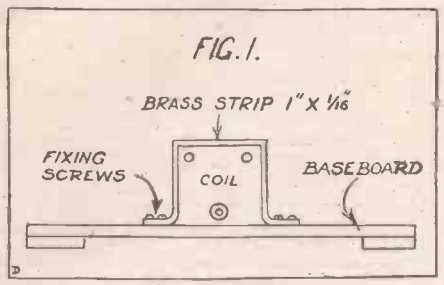
Mr. B. H. Beukes, Somerset West, Cape Colony, South Africa, and his home-made set.

CONTROLLING MODELS BY WIRELESS.

By MAJOR RAYMOND PHILLIPS, I.O.M., Late Member of the Inter-Allied Commission of Control.

PART 4 (NEW SERIES).

HAVING described in my previous article a simple method of constructing a modified form of "Hertz" oscillator suitable for transmitting purposes, I want to advise amateurs to be careful, when securing an ignition coil to the base-board as described, that screws are not used in such a manner that damage may be done to the condenser, or the secondary winding of the coil. It is better to make a suitable clamp of brass strip 1 in. wide by $\frac{1}{16}$ in. thick, and secure the coil to the base-board as shown in Fig. 1.



The receiving apparatus for use in connection with the wireless control of a model electric train will consist of a coherer, relay, simple selector (*i.e.*, selection by sequence), and switch, the latter for opening and closing the circuit connected with a coherer. Current for the coherer circuit will be supplied from an ordinary 3½-volt pocket-lamp battery.

The antenna, or aerial, will consist of two aluminium, brass, or copper tubes, 2 ft. 6 in. long by $\frac{3}{16}$ in. outside diameter, the same as those fitted to the transmitting apparatus described in my previous article.

Mounting the Relay.

The relay is a simple and inexpensive type, and I am now going to furnish diagrams, together with such elementary instructions that practically any amateur should be able to undertake the construction of same. Fig. 2 shows the relay complete.

It consists of a base-board A, electro-magnet B, armature C with contacts D and D1 (the latter being adjustable, as shown at E), vulcanised fibre block F, soft iron shoe G, armature balance spring H with adjusting rod I, supporting pillar J with adjustable rod K, four terminals L, M (*i.e.*, two at each end of the base-board A).

The base-board A should be made of white pine 5 in. long by 3 in. wide by $\frac{5}{8}$ in. thick. It should be either shellac varnished or french polished, and four terminals fitted as shown in Fig. 3.

The electro-magnet B (as shown in Figs. 2 and 4) consists of a wound boxwood bobbin, a Swedish charcoal soft iron core 2 in. long by $\frac{3}{4}$ in. diameter, riveted to a soft iron base (or it can be secured to the base by means of an iron screw) and fitted with a soft iron shoe, also vulcanised fibre block and contact rod.

An old silver watch-case bow will, if straightened out, make a good contact, and a small piece should be forced into a hole drilled in the contact rod D1; or, if sufficient is available, the silver rod itself may be used for a contact.

The armature C (as shown in Figs. 2 and 5) consists of a piece of Swedish charcoal soft iron 2½ in. long by $\frac{3}{8}$ in. wide by $\frac{1}{16}$ in. thick, tapered, and fitted with a piece of spring brass No. 28 gauge, and a silver contact riveted at one end as shown.

A small piece of silver rod cut from an old silver watch-case bow will also do for this contact, which latter should be filed smooth after riveting in order to present a good contact surface.

The boxwood bobbin of the electro-magnet should be fully wound with No. 34 gauge single silk covered copper wire. It will be necessary to purchase about a quarter of a pound of the wire in question.

Winding should be commenced by passing the wire through a hole in one flange of the bobbin (as shown in Fig. 4). The latter can be mounted upon a mandrel in a lathe, whilst the bobbin or reel (upon which the wire is wound when delivered from the makers) can be mounted upon any suitable spindle, and arranged in such a manner that the reel can revolve freely. The wire can then be guided by hand.

After winding the first layers of wire, a piece of silk should be placed over the leading-in wire to obviate any possibility of its short-circuiting with subsequent layers.

Great care must be exercised in winding, more especially with the silk covering of the wire, which is easily damaged if carelessly handled.

Those amateurs who do not possess a lathe can easily rig up a mandrel fitted with a crank handle, so that winding the bobbin should not present any difficulties. I have often rigged up a cinematograph film rewinder for the purpose.

When the bobbin is fitted with wire the end of the latter should be secured by passing it twice under the last single coil.

Fully six inches of spare wire should be left at each end of the winding, so that it can be coiled up and connected to terminals as required.

Other Parts.

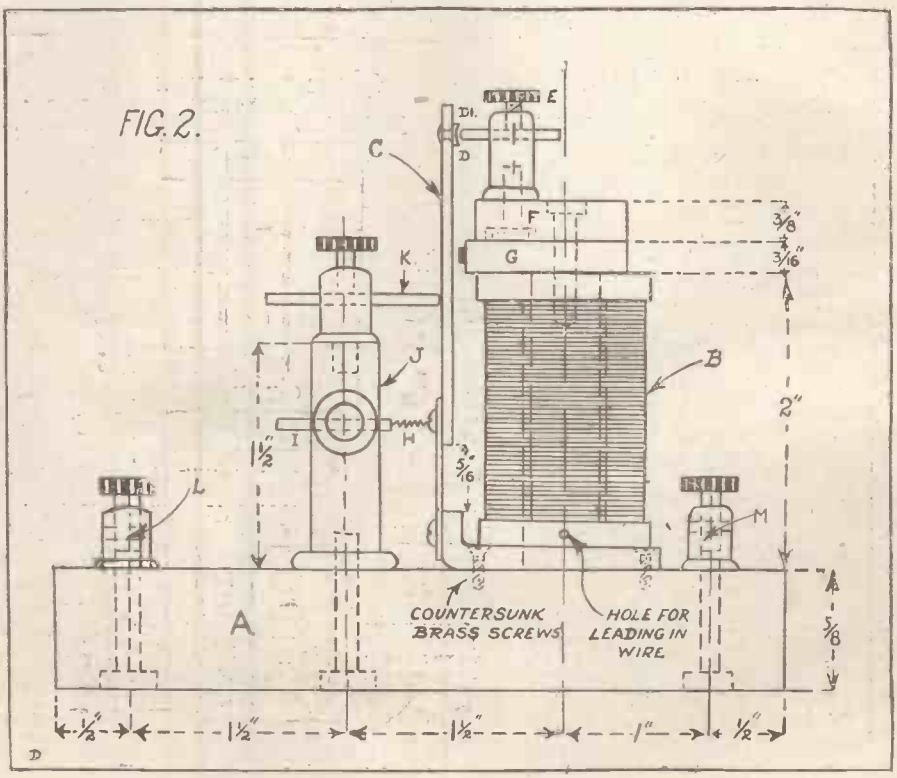
Those amateurs who do not mind the extra trouble involved could make a neater job of the winding, and also render the terminal wires of the latter less liable to breakage during handling, by soldering to such terminal wires (and afterwards insulating the joints) a short length of No. 22 gauge double-silk-covered copper wire.

The lead-in with the larger gauge of wire would then be passed through the small hole in one of the flanges of the bobbin, and sufficient space being left, the last layers of the fine wire could first be wrapped with a layer of paper coated with paraffin wax, and then the larger gauge of wire used for winding the finishing coils.

The other component parts of the relay are shown in Figs. 2 and 6.

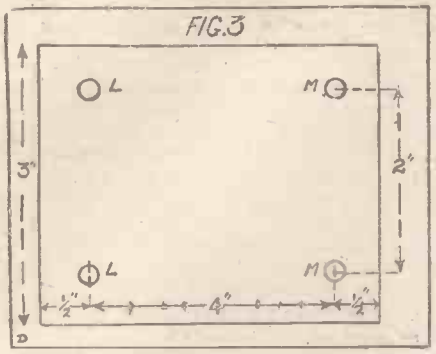
These simply consist of a standard terminal screwed into a threaded hole bored in a pillar of brass 1½ ins. long by $\frac{3}{8}$ in. diameter, with two adjusting rods as shown. One of

(*Continued on next page.*)



CONTROLLING MODELS BY WIRELESS.

(Continued from previous page.)



the latter is fitted with a spiral spring made with No. 30 gauge hard drawn brass wire.

This provides the necessary balance for the armature C shown in Figs. 2 and 5. When all the component parts are made as described the relay will be ready for assembling. This should be effected as shown in Fig. 2.

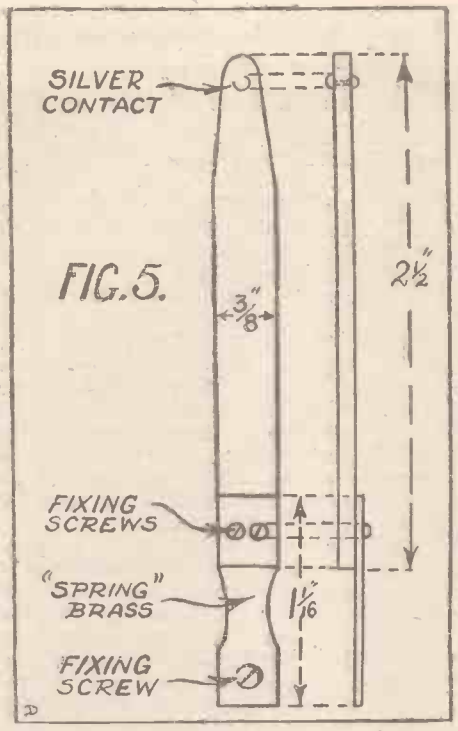
The two terminal wires from the electro-magnet B should be connected with the two terminals M fitted at one end of the baseboard A.

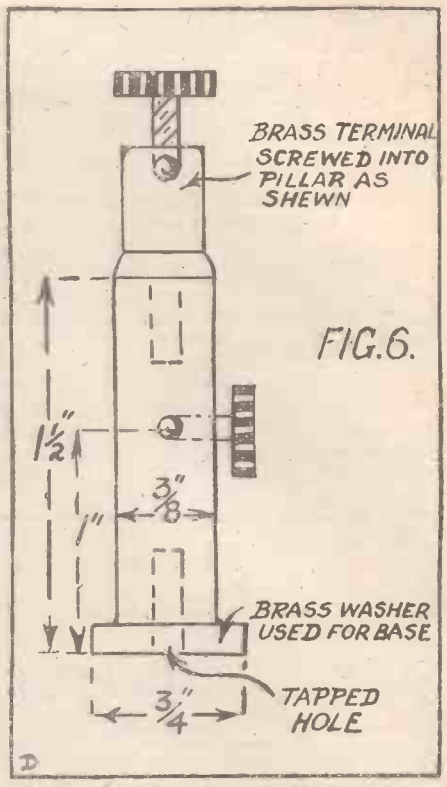
A short length of No. 20 gauge double silk or double cotton covered copper wire should connect the terminal securing contact D1 with one of the terminals shown at L on the baseboard A. The other terminal should also be connected with similar wire to the soft iron base of the electro-magnet B.

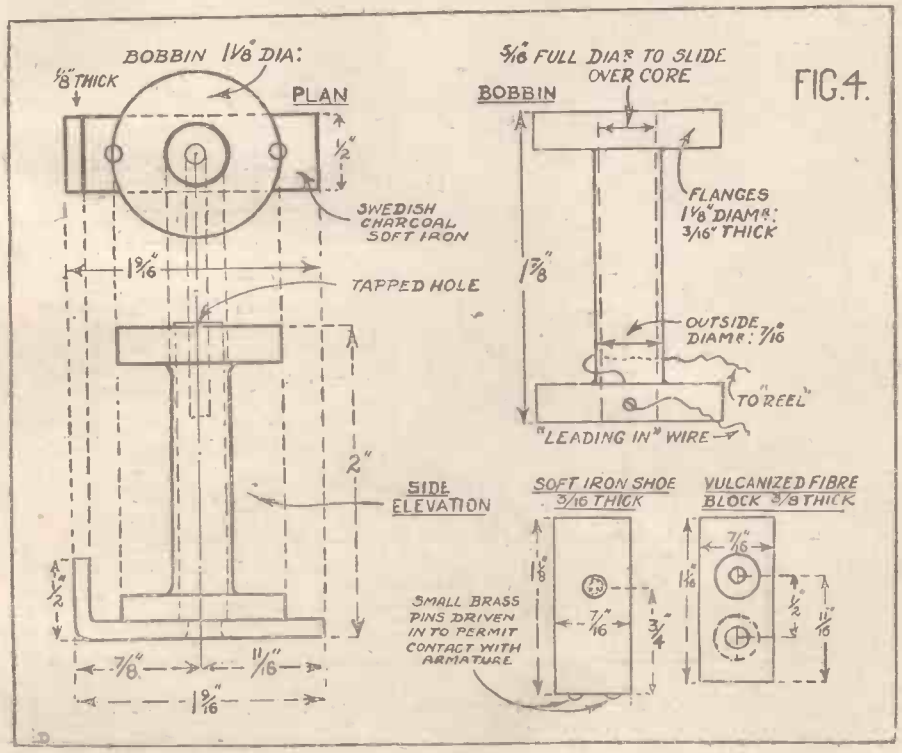
The armature C (shown in Fig. 2) should be so adjusted that the clearance between it and the soft iron shoe G is not more than $\frac{1}{16}$ in. The contacts D and D1 can also be adjusted accordingly.

In operation it will be apparent that when the two terminals M are connected with a battery, current from the latter will flow through the windings of the electro-magnet B, causing same to attract its armature C, and closing contacts D and D1, so that current from another circuit connected to the two terminals L could flow through such contacts.

In subsequent articles I shall furnish diagrams, and simple instructions for constructing other apparatus required to complete the wireless receiver in question. I shall also in due course furnish a diagram showing the complete wireless receiver together with the circuits involved.







CORRESPONDENCE.

The Editor, POPULAR WIRELESS.

Dear Sir,—In your issue of the 16th inst. your contributor, Mr. George Sutton, A.M.I.E.E., is responsible for a technical misconception in his paragraph headed "Improvised Aerials."

As patentees and manufacturers of the "Esi-Fix" Aerial (which has been sold through your advertising pages to a great many readers of POPULAR WIRELESS), we take the strongest exception to statements of this character.

We have many testimonials showing the complete success that attends a rubber-covered aerial when it is simply "slung up anyhow." We have never had a single complaint from the hundreds of users of our one-piece "Esi-Fix" Aerial, with the tough rubber compound continuous insulation.

We should be very glad if you will on our behalf correct this misleading statement of the case for insulated aerials, with similar prominence to that which it has been given.

We are, Dear Sir,

Yours faithfully,

CHAMBERS & ELLIS.

To the Editor, POPULAR WIRELESS.

Dear Sir,—It has occurred to me that there are thousands of people who daily listen to the voice of the Frenchman at the Eiffel Tower. We know every tone of his voice. Could not POPULAR WIRELESS give us his name, perhaps a small note about him, and *his photograph?* It would interest hundreds to know what he is like. Is he a Beaver?

Yours faithfully,

B. K. TENISON COLLINS, M.D.

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 first public lecture and demonstration organised by the above club took place on Friday, September 22nd. The hall was packed to the limit. To suit the requirements of the majority there, Capt. H. de A. Donisthorpe did not make his address of too technical a nature.

The lantern slides were shown admirably by Mr. Bertram, who is a member of the club. At the conclusion of the lecture, Lieut-Col. Cluff, on behalf of the meeting, thanked Capt. Donisthorpe, and asked for appreciation to be shown in the usual way.

A large percentage of those present remained behind to inspect the apparatus, amongst which was a loud speaker, a 7-valve Marconi receiver, seismograph, and a fine compact 3-valve audio-frequency amplifier belonging to Mr. W. Bramwell.

Hon. sec., Geo. Barnard, 3, Sowerby Street, Sacriston, Durham.

Falkirk and District Radio Society.

A meeting of the society was held at 23, Vicar Street, on Thursday, September 21st, Mr. G. Walker, vice-president, taking the chair at 8 p.m.

A half-hour's Morse instruction was given by Mr. Milne, after which some home-made apparatus was exhibited and explained—one of these pieces of apparatus being a three-valve receiver.

The chairman intimated that several new members had enrolled, and the total membership was 60.

Hon. sec. and treas., Mr. M. B. Blackadder, Glenmorag, Falkirk.

Fulham* and Chelsea Amateur Radio and Social Society.

The above society have much pleasure in announcing that they have obtained permission to have their headquarters at the Chelsea Polytechnic, Manresa Road, Chelsea, where all meetings will now be held every Tuesday evening from 8-10 p.m.

Sec., Mr. R. S. V. Wood, 48, Hamble Street, Fulham, S.W. 6.

Wolverhampton and District Wireless Society.*

A meeting of the above society was held at headquarters on Wednesday, Sept. 13th, when a very interesting and instructive lecture was given by Mr. H. Taylor (2 K Q) on "Hints and Tips on Receiving."

The lecture was chiefly for beginners, and commencing with the correct method of using a single-valve set, the lecturer (by means of diagrams) illustrated the importance of correct circuits.

Mr. Taylor laid great stress on the fact of having a good and permanent grid leak of correct value, and also the advantages of grid batteries and their effect upon the circuit.

Many questions were addressed to the lecturer, whose extensive experience proved exceedingly beneficial and opportune to all present. One of the chief items of discussion was the question of grid batteries, and various opinions were expressed as to their importance, permanency, and correct method of coupling.

Hon. secretary, J. A. H. Devey, 232, Gt. Brickkiln Street, Wolverhampton.

Borough of Tynemouth Y.M.C.A. Radio and Scientific Society.

The third annual general meeting of the above society was held on Monday, September 18th, in the Y.M.C.A. Buildings, Bedford Street, North Shields. Councillor A. E. Hill presided, and there was a good attendance of both old and prospective members. There were also present Mr. R. Lishman, J.P., and Mr. J. C. Burnett, B.Sc., vice-presidents of the society.

Mr. Littlefield read the secretary's report of the last year's work, which showed considerable progress, the outstanding features being the exhibition and the dinner, both of which were highly successful. During the summer months two field days were held, one at Holywell Dene and the other at Newbiggin. At the latter place transmission tests were carried out under the guidance of Mr. Forsyth and Mr. Boutland, of Ashington. A transmitting licence for the society is now being applied for.

The treasurer, in his report, stated that although there had been a considerable expenditure this past year, particularly on the club installation, the financial position of the society was extremely good.

Several new members were enrolled. Full particulars of the society will be gladly sent to anyone interested on application to the hon. sec., Geo. J. S. Littlefield, 37, Borough Road, North Shields.

Wireless and Experimental Association.*

The Wireless and Experimental Association, meeting at the Central Hall, at Peckham, on Wednesday, September 20th, were a very cheerful crowd.

They had been despondent over the persistent rumours of the threats to their liberties, as amateur wireless men had seen the big teeth of their fairy godmother, the Broadcasting Company, and were overjoyed to think that they had hot yet to fear being made a meal of.

They paid a special meed of appreciation to their secretary for the prompt and able way in which he had called public attention to their danger, and now that it was passed they appreciated somewhat of the magnitude of what had threatened them.

They were also rejoiced to hear that Sir Frederick Hall, M.P., K.B.E., had acceded to their request, and had honoured them by becoming the vice-president of the association.

Hon. sec., George Sutton, A.M.I.E.E., 18, Melford Road, Dulwich, S.E.

Stoke-on-Trent Wireless and Experimental Society.*

At a meeting of the Stoke-on-Trent Wireless and Experimental Society at the Y.M.C.A., Hanley, on Thursday, September 21st, there was a much larger attendance than there has been during the last few weeks.

The outside aerial has now been erected, and requires a little tuning up before the best results can be achieved. The society has not yet received a reception licence from the Post Office, but there is every indication of this being granted in the near future. When this comes along, the practical work of the society will be able to progress unimpeded.

Through the kindness of one of the members, a blackboard and easel will be provided to facilitate the giving of lectures.

Hon. sec., F. T. Jones, 360, Cobridge Road, Hanley.

Beckenham and District Radio Society.

On Thursday, September 21st, the study of component parts of wireless apparatus was continued, the condenser being chosen for the subject at this meeting, the vice-president being in the chair.

The hon. sec. continued his lecture, and ably explained the construction, approximate cost, and use of the condenser. A number of questions were asked and answered.

It was decided to have a question box, to enable members to put in written inquiries, which would be replied to on the following Thursday immediately preceding the chief item of the agenda.

The society headquarters are still at the Dorothy Tea Rooms, Beckenham High Street.

Hon. sec., Mr. J. Butterfield, 10, The Close, Elmers End, Beckenham, Kent.

Huddersfield Radio Society.

A club has been formed, and the secretary would be glad to hear from any persons over 18 years of age who are desirous of becoming members.

Hon. sec., C. Dyson, Y.M.C.A. Buildings, 14, John William Street, Huddersfield.

(Continued on next page.)

WIRELESS CLUB REPORTS.

(Continued from previous page.)

Barnes, Mortlake and Richmond Wireless Society.

An inaugural meeting of the above society was held at East Sheen, and over 40 people turned up.

Mr. F. Hope-Jones, M.I.E.E. (chairman of the Wireless Society of London), kindly consented to take the chair, and in his opening speech gave us some very good reasons why we should form such a society.

The subscription was fixed by the meeting at 10s. 6d. per annum, payable in advance.

Over 30 visitors signed the membership form before leaving, and many promised to send theirs along.

Full particulars of the society will be gladly sent by the hon. sec.

Barnsley Amateur Wireless Association.

The headquarters of the above association have been finally established at the local Y.M.C.A. buildings.

The members of the recently formed wireless section of the Y.M.C.A. have been embraced—an amalgamation which now makes the Barnsley Amateur Wireless Association a strong and enthusiastic body of between 40 and 60 members to date.

The Fulham and Putney Radio Society.

The above society held a meeting on Friday, Sept. 22nd. The meeting was well attended and several new members were made.

After the buzzer class a large variety of apparatus and components were shown by the members, and a variety of interesting discussions took place regarding the various parts.

Mr. Calver presented the society with a large number of basket coils, a large tuner coil, and also a basket coil winding former. Mr. Hart Smith presented a book for the library and also a number of Morse code instruction leaflets.

Mr. S. W. Martin presented a piece of apparatus which after alteration will make an efficient practice key.

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

Stockton and District Amateur Wireless Society.

The monthly meeting of the society was held on Thursday, September 14th, in the Concert Hall of the Malleable Workmen's Institute, Norton-on-Tees.

The chair was taken by the vice-president, Mr. S. G. Marston.

At the conclusion of the usual business a lecture, entitled "The Romance of Wireless," was given by Mr. Norman Whiteley, of the Bradford Wireless Society, and profusely illustrated with slides specially prepared by the lecturer.

The progress of this particular branch of electrical science was aptly illustrated and explained, and a large and appreciative audience spent a most interesting and enjoyable evening.

At the conclusion of the meeting hearty votes of thanks were accorded to the lecturer and lanternist.

The members meet each weekday at 7 p.m., and arrangements are in hand for the holding of classes for the winter season, commencing in October.

Hon. sec. . William F. Wood, 4, Birkley Square, Norton, Stockton-on-Tees.

The Liverpool Wireless Society.*

A meeting of the above society took place at the Royal Institution, Colquitt Street, Liverpool, on Thursday, September 14th. A demonstration was made of the society's instruments, Mr. C. G. Williams explaining the C. Mark III three-valve amplifier.

Mr. F. P. Owen next demonstrated to the society a very compact portable receiver, consisting of both crystal and single-valve detector. This instrument was entirely home-made, including the outer case, switches, tuning coils, etc., and every item, including the L.T. and H.T. batteries, were housed in the one outer case. Although operated in conjunction with the society's indoor aerial, signals were received on the valve detector. A vote of thanks was passed in favour of Mr. Owen, and the members were invited to bring along for demonstration at any subsequent meeting home-made apparatus of the same nature.

Mr. J. Coulton, who has been prominently associated with the society for many years, gave a short address. All regretted to learn that Mr. Coulton has found it necessary to leave Liverpool for London for a considerable period, possibly for good. Mr. Coulton was elected the society's accredited representative whilst there.

Hon. sec., Mr. C. L. Lyons, 76, Old Hall Street, Liverpool.

Swadlincote and District Radio Society.

Inaugurated at a meeting held on August 25th, the above society is making rapid progress, and already the membership numbers over 30 enthusiasts. A further meeting was held in the Hastings Road Schools on Wednesday, Sept. 13th, when a discussion took place on the rules framed at the last meeting. The question arose as to a suitable room to be used as the society's headquarters, and the hope was expressed that one would be found shortly. As to the apparatus, the decision of the sub-committee that the members construct their own was endorsed. Six new members were enrolled, and a hearty invitation is extended to all interested in wireless.

Hon. sec., Mr. H. Shakespeare, 46, High Street, Newhall, Nr. Burton-on-Trent.

Glasgow and District Radio Club.

This club, which is usually in a state of "suspended animation" during the summer months, has now resumed its activities with the annual general meeting, which will be held at the club's new premises, 290, Buchanan Street.

In view of the interest in wireless, the club has arranged for a public exhibition and demonstration of wireless reception at the McLellan Galleries Hall, Sauchiehall Street, on Saturday, November 4th. The exhibition will commence at 12 noon and will continue till 9 o'clock p.m. The committee hope to have a collection of both ancient and modern wireless apparatus, and trade firms who wish to be represented should send full particulars of offers to the hon. secretary as soon as possible. Two aerials will be available.

Professor G. W. O. Howe, D.Sc., M.I.E.E., has kindly consented to deliver an address at 3 o'clock p.m., and special messages from Continental stations have been arranged for.

Tickets for admission are 1s. each (including tax), and can be had from all club members and the principal wireless dealers in Glasgow.

A syllabus for the ensuing session is in the course of preparation, and the secretary will be glad to have the name of any gentleman who can give a lecture or otherwise contribute to the winter's programme.

Hon. secretary, Robert Carlisle, 40, Walton Street, Shawlands, Glasgow.

Plymouth Wireless and Scientific Society.

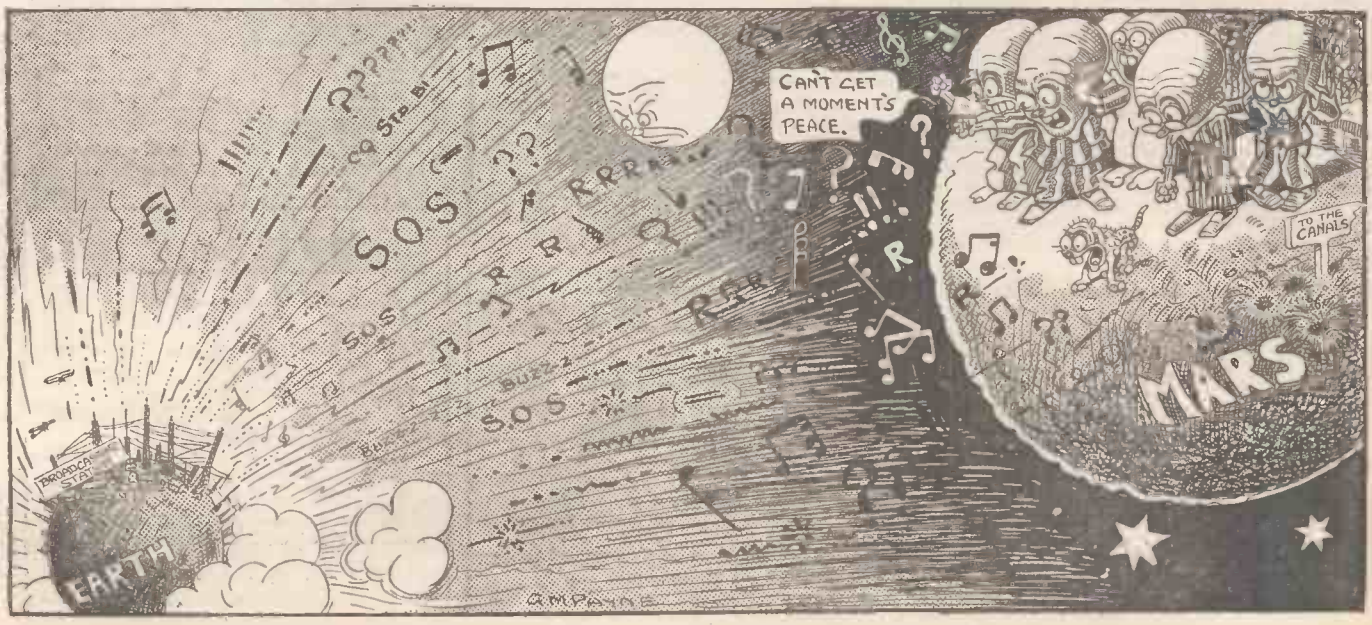
The second annual general meeting of the above society was held on Friday, Sept. 15th, The reports of the secretary and treasurer on the year's work were read and approved. The society is at present in a very satisfactory and flourishing condition.

Full particulars of the society will be furnished on application to the hon. sec., G. H. Lock, 9, Ryder Road, Devonport.

Knightsbridge Radio Club.

A wireless club has been formed at Knightsbridge. We have obtained ideal headquarters at St. Paul's Men's Club, Wilton Crescent Mews, S.W. The secretary, Mr. R. Davis, 1, Kinnerton Place South, Knightsbridge, S.W., will be pleased to hear from intending members.

HORRORS OF WIRELESS: A PLANET'S PLAINT.



RADIOTORIAL

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

According to Sir Henry Norman, broadcasting is about due this week.

Many will say overdue—but, in his speech at the opening of the All-British Wireless Exhibition, Sir Henry Norman declared his belief that the delay in broadcasting had been unavoidable, and that, all things considered, the delay had been a brief one!

The less said on this point the better.

* * *

Readers will learn with interest that the newly formed Radio Association has been given enthusiastic support by the manufacturers, the trade, and amateurs.

There is little doubt in my mind that the Association will prove of great help to all concerned.

At any rate, for a young association it has had a remarkably successful send-off. I strongly advise all readers to become members at once.

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.

H. D. (Southend-on-Sea).—Are all quick-drying varnishes insulators?

Most of them are.

Can a walnut stain be used instead of shellac?

We would not like to say that. Any hard white varnish could be used, but we do not trust the pigment.

For the sake of compactness will I obtain the same results by having more plates of smaller size than fewer of a larger size?

Yes.

"TELERADIO" (Reading).—Reference your remarks as to working on "plain aerial." Why is it that more current does not pass through the telephones and produce stronger signals when the crystal and telephones are placed directly in series with the aerial than when they are merely tapped across the coil? It would seem to me that the majority of the current oscillates backwards and forwards through the coil and very little goes through the crystal and telephones.

In the first case, why should any more current flow through the detector circuit in those circumstances? Elementary rules of voltaic electricity that can be applied to high-frequency currents in this instance, say that the current flowing through a circuit will vary directly as to the pressure and inversely as to the resistance. But apart from that point it is advantageous to arrange that the aerial and earth form an open oscillatory circuit offering as little impedance to the high-frequency currents induced as possible. Refer to the reply given to "Elvav" (Middlesbrough) in No. 17. That would, of course, be absolutely prevented were the crystal to be placed in series with the aerial, and weak impulses would be induced by all kinds and lengths of waves.

* * *

W. S. A. (Oakfield).—For my short wave tuner, I am told that a ·001 mfd. variable condenser is too large. If I place a fixed condenser of ·001 mfd. in series with it, will it have the same effect as placing a smaller condenser across the coil?

Yes.

What will be the maximum capacity of the combination?

·0005 mfds.

What is the formula for finding the capacity of several condensers placed in series?

The sum of the reciprocals of the individual capacities is equal to the reciprocal of the total capacity. The reciprocal of a value is the value divided into 1. Thus the reciprocal of 2 is ½.

* * *

"BASKET" (London).—Can a number of basket coils be connected together in series for the long wave-lengths, and if so can I lay them one on top of the other on the table and slide the reactance basket coil off or on?

Certainly they can be placed in series, and that is the only practicable way to work on the higher wave-lengths with that type of coil; but they should not be allowed to touch each other, as capacity effects are liable to be undesirably great. A holder consisting merely of an ebonite or well-shellacked wooden roller or tube should be mounted horizontally, and the basket coils placed in position with at least half an inch of intervening space between each.

What is the formula for basket coils placed in series?

There is no formula applicable, as the total inductance will depend upon such involved factors as spacing, thickness of pegs upon which baskets were wound, etc.

Can the basket coils be taken to a switch in the same way as tappings are taken on the other coils?

For ranges of wave-length within reason—say, 300–3,000 metres—yes; above that it would be as well to provide plugs, so that the coils not in use could be cut out.

What variable condenser should be used?

About ·0005 mfd. is a useful value for placing across any such fixed coils as baskets, honeycomb, etc.

* * *

W. J. (Harlow).—What is presspahn?

A manufactured insulating material made from wood fibre with an oily glaze.

When the first, second, third, etc., valve is spoken of, does it mean first, second, and third circuits for amplifying, or is the detector the first valve, and then the H.F. number two, and then the L.F. number three?

Valves in multi-valve circuits are generally numbered according to their position in relation

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from previous page.*)

to the aerial or open circuit. In other words, they are sequently enumerated according to the path of the received current. Thus, if a set employs one H.F., a detecting, and one L.F. valve, the received signal is first amplified by the H.F. circuit; therefore, that will contain valve number one. Next it is rectified by the detecting valve, which is obviously number two; and finally the rectified or audio-frequency current passes to the L.F. circuit, which will contain valve number three.

"AMATEUR" (Darlington).—Since a condenser is variable from zero to maximum, why should it be said that a certain variable condenser has too great a capacity for a certain circuit?

A moment's reflection will suffice to convince you that, unless the plates are actually shorted, no variable condenser can have zero capacity. When the vanes are totally apart there will be still the end-to-end capacity effect of the vanes.

* * *

"CRYSTALS" (Norwich).—Can you give me a description of the various crystals used as wireless detectors?

Practically all metal crystals can be employed, but the following are the better known. Bornite, which has a peculiar bronze colour, used in combination with zincite. Carborundum possesses various tints, from deep grey to violet purple. Silver grey is the most sensitive. It is used with steel or copper, and is practically the only crystal that requires an applied potential. Copper pyrites, which is copper ore containing iron existing in several forms, one of which is chalcopyrites. It has a brilliant brass yellow colour, and is used in conjunction with zincite and tellurium. Galena has a colour similar to scraped lead, being a bluish grey. It is one of the most sensitive of crystals, and frequently employed in fusion with silicon to produce various proprietary crystals. Iron sulphide, generally called iron pyrites, used with a gold or phosphor bronze point, is very similar to gold in colour. Only the brightest of the crystals are of any use for wireless purposes. Specimens can often be found with ordinary house coal, and are generally mistaken for gold quartz. Silicon, greyish metallic colour, used in contact with copper, steel, or gold. Tellurium is silver white in colour, and is used in combination with copper, galena, or zincite. Zincite is red in colour, and is used in combination with bornite, or more suitably copper pyrites. Whereas the majority of the crystals mentioned above are more or less brittle, carborundum is extremely hard.

* * *

W. B. (Preston).—What should be the resistance of a grid potentiometer?

Not less than 100 ohms.

* * *

"TRANSFORMER" (Belfast).—Does each layer of wire on a telephone transformer commence at the one side, or do you have to cross a turn?

Your alternatives would appear to amount to the same thing, as if every layer was required to commence at the one side it would certainly be necessary to cross a turn. Winding should, however, be from left to right, and then the next layer back again right to left, and so on.

* * *

T. S. A. (Burnham) has a four-valve set that employs three stages of low-frequency amplification. He states that frequently it emits a high-pitched howl, and inquires as to the cause and remedy.

That is due to inter-magnetic or electro-static action between the L.F. transformers, causing audible frequency oscillations to be generated. Reversing the transformer connections will cut it out.

* * *

"SPARKS" (Bedford).—Is the resultant capacity of two condensers in parallel the sum of the individual capacities?

Yes.

If such is the case, can the formula $1885\sqrt{LC}$ be employed in your calculations given to N. X. H. (London) (P.W. No. 16) when a condenser is placed in parallel with the coil by merely adding its capacity to the coefficient "C," which I understand to be the capacity of the aerial and taken as approximately ·0002 mfd.?

Yes.

When a condenser is placed in series, what then is the effect?

That will reduce the capacity of the circuit, and "C" will equal the resultant effect of the condensers in series, *i.e.*, the reciprocal of "C" will equal the sum of the reciprocals of the two capacities, the aerial and the condenser, in series.

Will either effect cause any alteration in the coefficient "L"?

No. It must be added that these calculations will be approximate only, and must not be expected to give a less error than 5 or 10 per cent.

(*Continued on page* 440.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 436.)

"GRID" (Neath).—Can you give me dimensions for constructing a grid condenser employing mica ·002" as a dielectric ?

A rectangular sheet of the mica, 1" by 1¼", will be required, upon each side of which should be fixed with shellac a foil 1" by ¾", with ¼" lugs projecting at opposite ends for purpose of making the connections.

* * *

"PUZZLED" (Winchester).—How can a north pole be a north pole in a magnet if it points to the north pole of the earth ? I thought unlike poles attracted.

More correctly, the north pole of a magnet is the north-seeking pole, and the south pole south-seeking. The subject has been fully dealt with in the "New Series."

* * *

"AERIAL" (London, N.).—Could I use a lead roof as an aerial, following the lines of the super-antenna ? If not, could the gas-pipes or front iron railings be used ?

We have experimented with varying success with such an instrument used in conjunction with a gas-pipe and a lead roof, and also wire fencing nailed to wooden supports; but the difficulty with railings is to find a run that is fairly continuous and does not earth at various points. In the case of the lead roof, which was about 20 ft. by 10 ft., connections were made merely through a ·001 mfd. variable condenser placed in series, using an earth consisting of copper plates buried 2 ft. deep in the ground. Signals from the higher power stations came in as loudly as on the 50-ft. twin orthodox type of aerial, but no short wave telephony was heard. That may have been due to the absence of suitable transmission for the test. On the other hand, it was found that this latter came in very well on a gas-pipe aerial to which was attached a fixed condenser of ·001 mfd., with a further variable condenser of ·001 mfd. placed in series. Results were found to be many times more satisfactory when the gas-pipes of an upper room were employed, the reason for which it is not very hard to seek. The foregoing results were, however, eclipsed when the electric light main with two ·0015 fixed condensers in series with each lead was tried. Although the switch was on, as appears necessary for efficient reception by this method, there was a remarkable absence of noise even when employing L.F. amplification. As a matter of fact, when we attached our set to the fireplace, and even then received fair telephony from 2 L O, we began to wonder what could not be used as an aerial.

* * *

H. T. C. (Purfleet) wishes to have details as to capacity reaction.

As yours is a single-valve set, this will be impossible, the only method for such a set being the orthodox inductive reaction coupling. It must also be pointed out that a single slide inductance will not give sufficiently sharp tuning for the reception of C.W., and therefore a variable condenser will be necessary.

* * *

"AMATEUR" (Colchester). — Why are "hard" valves preferable to "soft" valves ? What is the difference, and are they more sensitive ?

A "soft" valve is more sensitive than a "hard" valve; but is not so stable in action. Used for detecting, a "soft" valve will give as strong signals as one of the "hard" variety, with an additional stage of amplification if well handled. The difference is merely degree of vacuum, as has been explained before in these columns. A "hard" valve is one that has been very highly exhausted.

* * *

R. O. (Crewe).—Can wood be used for insulating equally as well as ebonite for crystal bases, inductance coils, etc. ?

A well-seasoned, good old oak, well dried to exclude moisture and then well shellacked, is nearly equal in insulating qualities to ebonite, and there is no reason why it should not be used for the purposes you mention. As a matter of fact, any fairly close-grained wood, such as teak or mahogany, can be used if the above precautions are taken. Even aerial insulators can be made of wood if well baked in paraffin wax. During the Great War portable field sets were equipped with these. We have seen a seven-valve resistance coupled set, the panel and all fittings of which are made of oak treated as above. The apparatus has been in use for some considerable time, and no ill effects have been noticed from having diverted from the usual practice of employing the more expensive material ebonite.

* * *

H. L. K. (Newton Abbot).—What is it to place anything "in shunt," and what is a shunt-wound dynamo ?

Placing in "shunt" is to provide an alternative path for the current. Broadly speaking, it means the same as placed in parallel, except that "in shunt" is more correct when the paths are of widely different resistances. A shunt-wound dynamo is one in which only a portion of the generated current is used to excite the field magnets. This type is invariably employed for charging accumulators, as it gives a very constant E.M.F.

* * *

H. G. (Bristol).—Can insulated wire be used for the aerial ?

Electrically, there is no reason why it should not be used, but the insulation is liable to rot quickly and become unsightly. On the other hand, it is advisable to employ enamelled wire, more especially in town areas. It has been proved by test that corrosion due to exposure will cause the efficiency of a bare wire aerial to be reduced 20 per cent. after a period of but a few weeks. Strangely, its point of efficiency does not seem to fall below that, but over similar periods the efficiency of enamelled wire is found to remain unimpaired. This is due to the fact that corrosion of the surfaces of wire causes a considerable increase of resistance to high-frequency currents, as these travel on the surface of conductors; hence the term "skin" resistance. It is significant to note, in connection with the above test and others carried out at the same time, that one enamelled strand of 22 gauge copper wire, after six months of exposure during the winter season, not only did not drop one point in efficiency, but gave equal points to a 7/22 stranded bare copper cable that had been exposed to the elements for a similar period. Therefore, while the 20 per cent. drop in efficiency which was gauged from the drop in signal strength from standard transmission has been found to apply to wire of all gauges, it is evident from the above that a considerable increase in conductor area must be allowed to compensate deteriorated surfaces. The conclusion to be drawn is obvious.

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

No. 21. A SPECIAL REVIEW OF THE EXHIBITION

POPULAR WIRELESS

3d.

Weekly

No. 21. Vol. 1.
Oct. 21st, 1922.

Miss Ellis Jeffreys and Miss Margaret Bannerman "listening-in" on a Gecophone set at Drury Lane Theatre.

THE HAPPINESS OF RESEARCH

By Professor Low, D.Sc.

How to Make a Long-Wave Receiver.

Controlling Models by Wireless.

Radio Notes and News.

New Series for Beginners.

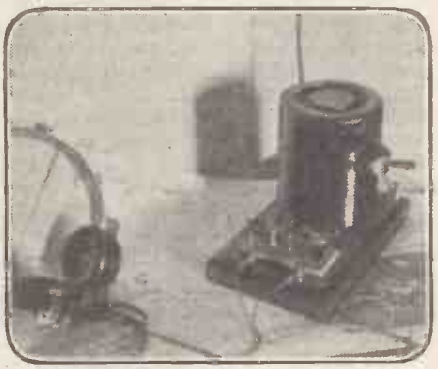
Popular Wireless

TOPICAL NEWS AND NOTES.

A Royal Amateur.

I HEAR that his Royal Highness the Prince of Wales intends having a radio set fitted up at St. James's Palace.

I listened in to the Prince's broadcasted speech the other day, and every word—without any exaggeration—was heard perfectly. The Prince has a really excellent 'radio voice." I also heard him rehearsing the day before he delivered his official speech. He read an extract from "The Field" once or twice. The second reading was far better than the first, and it seemed obvious that the Prince had quickly adapted his voice to the needs of the microphone.



The 35/- Crystal Set made by Mr. B. Kerney, 16, Prentis Road, Streatham, S.W.16.

* * *

Powerful Swiss Station.

THE new wireless telegraph and telephone station just opened at Lausanne is said to be the most powerful on the Continent. By means of this station communication can be kept up with aeroplanes of the Paris-Lausanne Air Service.

* * *

Wireless on Tanks.

THE successful adaptation of the wireless telephone for use in tanks is announced by the U.S. Army Ordnance Department, which is about to give a demonstration of the new engines of war it has produced since the war.

As part of the programme a fleet of tanks will manœuvre under the wireless orders of its commander in a flagship tank, and a tank machine-gun, firing armour-piercing bullets of ½-in. calibre, and an amphibious tank able to travel over land or through water will also be demonstrated.

Another new weapon is an anti-aircraft shell fitted with a fuse so sensitive that it will detonate its charge when the shell passes through the fabric of an aeroplane wing. (Extract from "The Daily Mail.")

Mme. Tetrazzini—Radio Amateur.

MME. TETRAZZINI was so interested by the exhibits at the Wireless Exhibition that she purchased a four-valve receiver. I happen to know the name of the makers of the set—and Mme. Tetrazzini has certainly picked on a first-class instrument.

* * *

Radio in South Africa.

CONSIDERABLE progress is being made with the wireless station at Tete, Lourenço Marques, most of the plant having arrived. The station will put Lourenço Marques into direct communication with Lisbon. Small installations have been erected on the coast at Inambane and Chai-Chai, and ultimately a chain of stations will be connected through the province between Lourenço Marques and Lisbon.

* * *

Broadcasting in the Fatherland.

COMMENTING on the broadcasting service in Germany, whose inauguration I recently mentioned, the "European Commercial" says that the cost to subscribers is at present prohibitive, so that only the large banks and principal business houses can afford the luxury. There is an initial charge of 6,000 marks for the installation of the receiver, and a further charge of 4,000 marks a year for the use of the instrument, this fee being subject to increase in accordance with the rate of exchange. For the messages themselves there is a charge of from 4,000 to 30,000 marks per month according to the nature of the service required. By April next it is intended to organise a series of lectures for simultaneous transmission throughout Germany, and to provide facilities for "listening-in" in factories where the labour is particularly monotonous.

Wireless Telephony in Mexico.

THE installation of a wireless telephone service to operate between various important centres in Mexico is being contemplated.

* * *

A Fair Field and No Favour.

THE "Daily Herald" seems rather concerned about the news to be broadcasted. The following appeared in a recent issue of that paper:

"Will the 'listeners-in' be supplied with more partisan 'dope' about strikes and wars?

"When the broadcasters meet the P.M.G. both sides must realise that Labour wants to know all about this news-service. For, if the listening-in habit catches on, the men who select the news and speeches for circulation will have a powerful lever on public opinion.

"Who are those men to be? They must represent all parties, not one alone."

That sounds reasonable enough, but why get the wind up—yet?

* * *

G.B.S. and Wireless.

"I SEE no objection to the wireless broadcasting of news that does not equally apply to the broadcasting of news through the Press," said George Bernard Shaw to a "Daily Herald" representative recently.

Mr. Shaw asked whether "listeners-in" would pick up all the bad language in the neighbourhood.

He further thought that if broadcast news was only available for those who could afford expensive receiving sets at 75 or 100 guineas, it won't matter much what news they get. When told that a man can "listen-in" for an initial outlay of £5 15s., he admitted that the matter is more serious.

A Motor Car Frame Aerial Set. The frame is in sections and can be quickly dismantled.

NOTES AND NEWS.

(*Continued from previous page.*)

Growing.

THERE are now something like 500 transmitters in this country, and the number of amateur receiving sets between fifteen and twenty thousand.

* * *

World Wireless.

I HEAR that the Radio Corporation of America has announced that a world wireless combine, with New York as the centre, will include British (at Carnarvon), French, German, and Argentine stations. The whole represents a total invested capitalisation of £34,000,000. Tests will soon be made, and regular operations will begin on May 1st.

* * *

Honour for Marconi Official.

FOLLOWING the broadcasting by His Royal Highness The Prince of Wales of an address to the Boy Scouts of Great Britain, on Saturday evening, October 7th, Mr. Arthur R. Burrows, Chief

Mr. J. N. Court's set, at 44, Wanderers Avenue, Beakenhall, nr. Wolverhampton.

of the Demonstration Department of Marconi's Wireless Telegraph Company, who was responsible for the wireless arrangements in connection with this event, has been the honoured recipient of an autographed copy of the preamble in which he announced His Royal Highness.

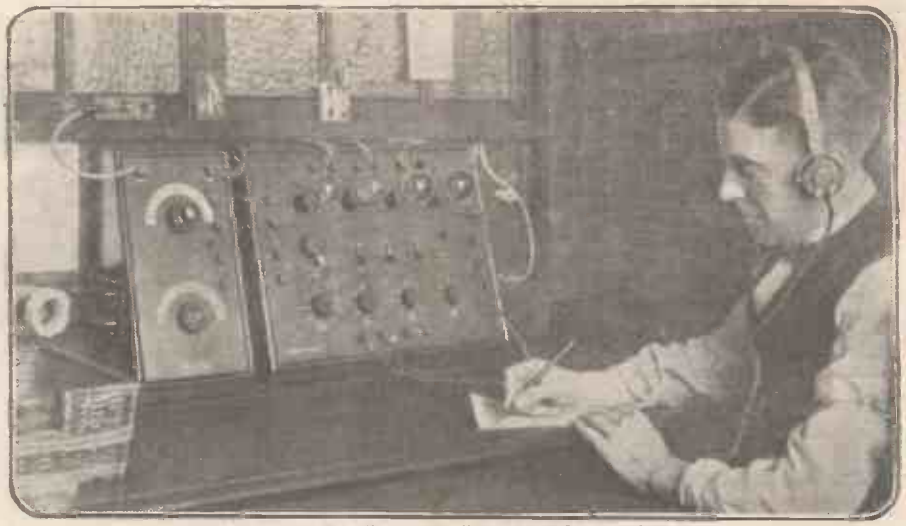
* * *

Wireless Telephony for Blinded Soldiers.

AMONG the many thousands of people who listened-in to the Prince of Wales' broadcast speech to the Boy Scouts of the nation were the blind soldiers of St. Dunstan's.

Capt. Ian Fraser, the blind chairman of St. Dunstan's, has been an ardent wireless experimenter for two years past, and in the course of a short address following the transmission, he stated that wireless telephony was opening a new world for the blind. A blind man's hobbies were limited, but wireless was one of those which he could pursue just as well as anyone else. In listening-in he was at no disadvantage to those who could see.

Mr. Oswald Carpenter, of The Marconi Scientific Instrument Company, Ltd., in the course of a subsequent chat to the men, mentioned that Capt. Fraser was one of the most capable amateurs he had met.



The radio set at the offices of the "Evening Telegraph," Northants.

Insuring "Wireless."

THE first "wireless" insurance policies are being issued by the Liverpool Marine and General Insurance Company.

For an annual premium of 7s. 6d. it is possible for the radio enthusiast to insure against the loss of, or damage to, his wireless apparatus, including the aerial, and also third party damage up to £500 (any one accident), including damage to property belonging to, or under the control of, the insured.

The risks covered include damage by lightning, as well as theft and malicious damage.

* * *

Another Giant Tube.

"WHAT is said to be the largest radio vacuum tube in the world has just been developed at the telephone laboratories of the Western Electric Company in New York. It is rated at 100,000 watts, or 200 times the power required for the usual broadcasting station of 100 miles range. The essential feature of the new tube is that the "plate" is a copper cylinder forming the outer wall of the tube, which makes it possible to cool the tube by water. Difficulty was found in making the instrument air-tight and in getting the wires for the filament and grid into the tube while keeping them insulated against 20,000 volts. Mr. W. G. Housekeeper, a Western Electric engineer, discovered a way to seal copper to glass, making an air-tight joint that will not crack at any ordinary working temperature. One of these tubes stands 3 ft. high, and is 3½ in. in diameter at the bottom."—*The Electrician.*

* * *

London Radio Club.

THE Radio Association have secured an option of premises in the West End for the purpose of establishing a Radio Club.

The latest forms of apparatus for "listening-in" will be provided at the club. There will also be a library and information bureau. Provincial members, it is pointed out, will be able to make this their headquarters when in town.

ARIEL.

Broadcasting Programmes

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

TELEPHONY TRANSMISSIONS.

Station.	Call sign.	Wave-length in metres.	Remarks.
Croydon	G E D	900	Throughout day to aeroplanes.
Marconi House, London	2 L O	360	Not regular.
Writtle	2 M T	400	Tuesdays, 8 p.m.
Paris	F L	2,600	5.16 p.m.
Königswusterhausen	L P	2,500 and 4,100	Daily, 7 and 10.30 a.m.
The Hague	P C G G	1,085	Sundays, 3 to 5 p.m.
Messrs. Burnham* (Blackheath)	2 F Q	440	About 9 o'clock any evening.
Newcastle*	5 B A	440	6 and 7.30 p.m.

NOTE.—The Bar Lightship, Liverpool, sends telephony at 6 a.m., 8 a.m., 2 p.m., 4 p.m., 6 p.m., 8 p.m. Wave-length 440 metres. Calls "Liverpool." When answering Liverpool calls "Bar Light."

Many amateurs may be heard of an evening on 440 metres, also as low down as 60 metres. Amateurs who transmit music regularly please communicate with the Editor.

All times G.M.T.

* These transmissions are made purely for experimental purposes.

A RAPID REVIEW OF THE ALL-BRITISH EXHIBITION.

By WARING S. SHOLL, A.M.I.E.E.

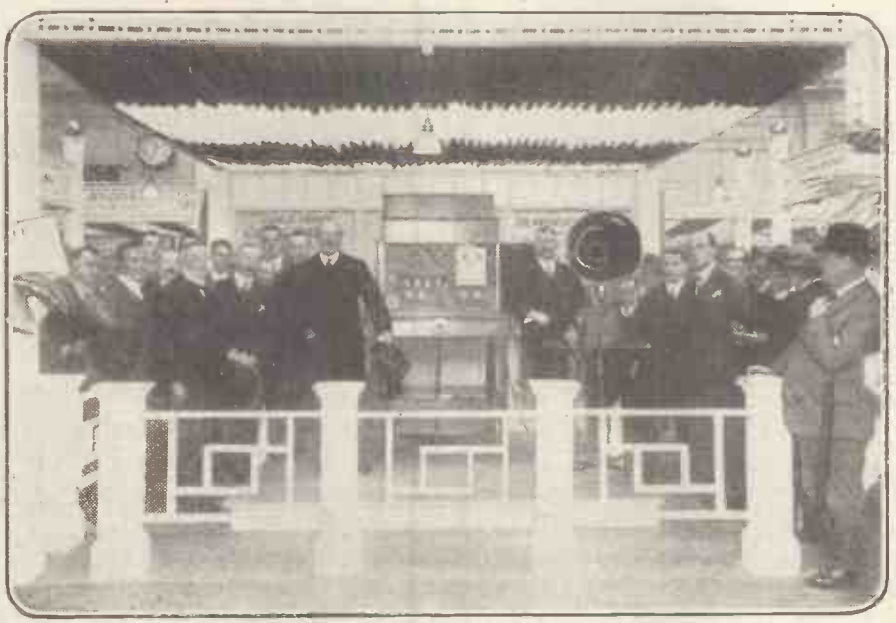
For the benefit of readers of "Popular Wireless" who were unable to visit the All-British Wireless Exhibition, Mr. Sholl has written the following article at my request. It is a rapid, but comprehensive review of all the exhibits, and amateurs in particular will find it of considerable interest.—EDITOR.

TO those who have not been able to visit the show it is hoped that a review written from the point of the amateur may be "the next best thing." The writer has endeavoured to break away from the catalogue type of "report," and to place a picture before the eye of the distant enthusiast that shall convey to him something of the atmosphere of the exhibition as well as a description of the many and interesting exhibits.

With this idea in view the writer set out for the Horticultural Hall, arriving not long after the doors were opened, to find himself among quite a "respectable" crowd—that is in numbers, of course—even at so early an hour.

Admission having been obtained for the modest sum of one and threepence, the "book of words" was acquired for another tixpence, and very excellent value it was. A handy book which I doubt not will find a place upon the wireless enthusiast's shelf for frequent references in time to come.

A turn round to get the lie of the land revealed a hall packed with stands of simple and uniform appearance, but, withal, neat and devoid of unnecessary adornment. In the centre of the building a broadcasting station adjoining a lounge of rather limited accommodation entertained the visitor with a programme transmitted from 2 L.O. four times during each day the exhibition was open.



Sir Henry Norman, Bt. (left), speaking at the opening of the Exhibition. Note the Trade Demonstration Set.

Chief Impressions

The set installed comprised a frame aerial, Armstrong circuit and twelve valves, which operated through two loud speakers with sufficient volume to fill a building not renowned for its accoustic properties. Now, as the writer visited the show in order to tell his country friends "all about it," one of the first questions would naturally be, "What were your chief impressions of the show?"

The first impression was that wireless is in danger of becoming too expensive and elaborate, a sort of precocious and spoilt kid with too many toys and too much attention from admiring parents keen on "showing him off." In the writer's opinion the present measure of success attained in the transmission of musical items, particularly vocal numbers, hardly justifies the costly and elaborate externals with which some of the sets were arrayed in the shape of expensive cabinets and other fitments.

Outstanding Features.

From an artistic point of view the clashing of medieval art with hard twentieth-century science seems rather on a par with Noah stepping out of the Ark into a Rolls-Royce and proceeding to light up a Corona Corona. To those not fully conversant with the difficulties of receiving within a steel building upon an indoor aerial, it may seem a rather costly feat to employ eight to twelve valves in picking up transmission of considerable power generated about a mile away.

Those who are out to tempt the nouveau riche probably know their own business best, but the man who will eventually keep the business going is not the well-to-do faddist, but the consistent experimenter whose hand is ever in his pocket, and whose hobby is his very existence. If the writer were out to sell loud speakers, he would be inclined to keep female vocalism more or less at a distance, and to reduce the number of valves to the minimum.

The finest singers in the world have had at one time to perform exercises of a not very attractive nature, but these rather trying ordeals are generally performed in private, until a measure of proficiency has been gained sufficient to justify the test of public opinion. Probably what the visitor would appreciate most is the ability to compare under one roof the products of the many firms whose acquaintance he has made through the columns and advertisements of POPULAR WIRELESS. There is a subtle fascination in being able to "wallow" in wireless, to drink to one's fill, to handle the apparatus, and to get first-hand information.

To the keen seeker after information, to the man of limited means, there is a pleasure of anticipation of eventual possession untainted by the merest suggestion of "sour grapes."

Next to this there is the pleasure of hearing some of the notable men of the day delivering lectures which will be looked back to in years to come as milestones on a new road of science and progress. To the pure scientist the outstanding feature of the show was the collection of historical exhibits displayed by Messrs. Marconi's Wireless Telegraph Co., Ltd.

Here we have the original detector in the shape of the coherer, not an invention of Marconi's by any means, but a crude device which his genius coaxed and cajoled into some form of reliability, and which, in spite of many difficulties, showed that there was something in wireless worth striving for, despite the limitations of the times and the comparative perfection of "wired" telegraphy.

What terrors coherers were to the early experimenter! They must have been bad enough when made under the most favourable conditions, let alone the atrocities rigged up by the experimenter out of bits of glass tube, corks, and filings surreptitiously removed from the edge of threepenny bits.

Ringing bells at a few hundred yards was not too difficult, but getting a sounder to work consistently for a few letters even was enough to turn one's hair grey, while the desperate efforts to decipher the records of a Morse inker were calculated to qualify one for Bedlam.

The magnetic detector in its experimental form is a most interesting example of setting out to get results from the sheer necessity which is proverbially the mother of invention. In this case there was no half-completed task to finish and reap a share of

(*Continued on next page*)

A RAPID REVIEW OF THE ALL-BRITISH EXHIBITION.

(*Continued from previous page*)

another's work, as in the coherer, something new, and, above all, something reliable had to be evolved, as the new science was by this time becoming a factor of safety in the seafaring man's life, and no longer a pretty and spectacular experiment for the lecture table.

The Fleming two-electrode valve appeared next, about the year 1904; but while it constituted a reliable detector it remained for De Forest to introduce the grid in 1907 which, to parody Euclid, amounted to making the part greater than the whole.

"The little more and how much it is" was never written more truly than of this great and epoch-marking addition to an invention that was *nearly* complete.

As a comparison look at the huge induction coil capable of giving an 18-inch spark, the then only known means of generating oscillations, and capable of transmitting over a few miles only, and think of the mere handful of gear used nowadays for sure and certain transmission even by amateurs over ten times the distance.

To the keen investigator these exhibits are worth the rest of the whole show put together; money won't buy them; they are locked away in strong rooms every night; and the only pity is that they cannot be put permanently on exhibition at South Kensington for the education and enlightenment of posterity.

The Modern Show.

It was well that the "Father of Wireless" was not plain John Smith, of Balham or Brixton; had an unfortunate accident of birth made him so it is pretty certain that he would have been kicked out of the G.P.O., and his apparatus thrown after him.

The crude apparatus of the great Clarke Maxwell was found in an old curiosity shop, and picked up for a mere song; whilst Graham Bell tramped through the soles of his boots whilst hawking his invention—the telephone—among the obtuse-minded citizens who finally *had* to recognise his efforts.

So much for the historical associations of the show: let us put the clock forward and seek the inspiration of the present hour. Mingling with the crowd, we find the various types of visitor well represented; here is our old friend the catalogue collector, as keen, as usual, on getting "something for nothing," there is the man from the country, catalogue in hand, ticking off each item, that nothing be missed; here again is the secretary from the provincial wireless society, with his notebook well filled against the night when he shall have to answer innumerable questions as to what he "saw at the show."

We like the "Crystor" cowl insulators on the stand of Messrs. Wireless Supplies Co.; that tough, unbreakable ebonite is just the thing to withstand the elements and bring in our signals good and strong. The "Lattikone" coil is likely to be heard a good deal of in the near future: it promises much that is good in the way of tuning, and, like most sound ideas, it is simple to the point of being obvious but not ordinary.

Complete Crystal Receiver (Stanley Prince & Co.).

Next door, stand 2, occupied by Messrs. Anode Wireless and Scientific Instruments, Ltd.; also of London, we find a new type of variable condenser, not very much bigger than a blocking condenser, which takes our fancy very much. It is a pretty little instrument admirably adapted for panel mounting, and the price is "right."

Advanced workers and the trade will find much that is interesting at stand 3, Messrs. Zenith Mfg. Co., the firm specialising in resistances and potentiometers of the highest class, also rectifiers for charging accumulators from A.C. mains. Everyone knows the famous Duo Lateral coils, but possibly everybody is not aware that the Igranic Electric Co. hold the sole rights for manufacturing from the De Forest Co. On stand 4 the coils may be seen in the making by electrical machines of the greatest precision. The new "Gimbal" motion coil holder is the last word in fine tuning.

Messrs. Harwell, Ltd., stand 5, have a nice little variometer which is just the thing for the broadcasting band—the wave-length, of course, and not the musicians—also numerous specialities in "Solidite" for the trade.

Familiar Names.

Radio Service is available at the stand of like name, No. 6 on the list, and the amateur will find his needs well catered for by the firm of 62, Oxford Street.

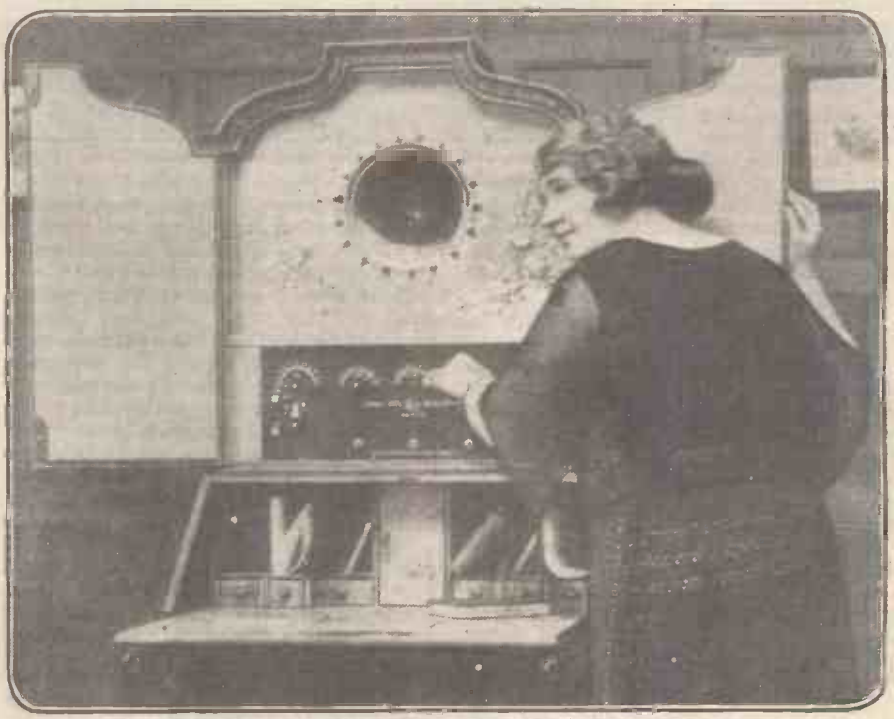
The B.T.H. Co. needs no introduction, its name being a household word even to the man in the street.

This firm is making a big effort to produce a loud speaker, and promise great things as the outcome of the most exhaustive experiments. Their new insulating material is pleasing in appearance, and much nicer in finish than the rather funereal matt ebonite so much in vogue at present; the portable set with frame aerial is a little beauty.

"K.B., of Kilburn," is another familiar name, and we find here the units which have always been associated with their house, also ample supplies of the innumerable "gadgets" so indispensable to the serious worker. A call at stand 8 is well worth while. Mr. T. H. Isted is showing a good range at stand 9, his wares revealing not only good workmanship, but sound and substantial design, being constructed for real hard everyday use; the 3-valve station is a good example of British thoroughness.

Fellows are the people for "jolly good" things and at the right price; we found their famous 'phones going strong, as well as a number of crystal and valve sets.

(*Continued on next page*)



One of the Antique Cabinet Sets by Messrs. Elwell & Radio Communication Co., Ltd.

A RAPID REVIEW OF THE ALL-BRITISH EXHIBITION.

(*Continued from previous page*).

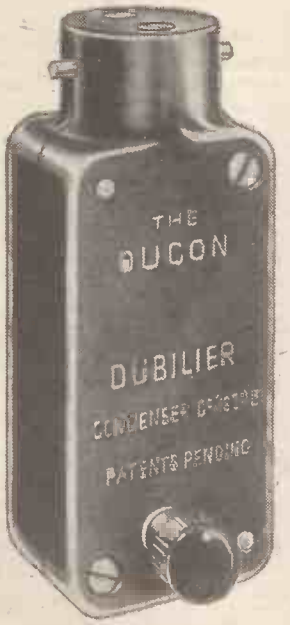
Keen as our appetite may be for the intellectual, we find the calls of the inner man directing our steps to the luncheon-room, and we are not sorry to put down our rapidly-increasing pile of catalogues, etc., and refresh the material side, albeit filling in the time between the courses with sundry efforts to decipher *some* of what we have written under somewhat hasty conditions.

We listen to the claims of the "crystal merchant" and note the indulgent tolerance of the multi valve fiend who, if he lived at the Waldorf, would bang on "two stages of each" to get 2 L.O. The funny man is here, too, who refers to his pal as an "oyster" because his one stage of L.F. makes him a "bivalve"!

A New Line in Coil Holders.

After that we get downstairs, missing the cheese in our hurry, and hoping our funny friend will never obtain a transmitting licence.

Having a fancy for "gadgets," we make our way to Messrs. Gamage's, at Stand 31, and find condensers are the leading line, real precision instruments which stand out amongst a fine display of all the other accessories for which this house has so long been noted.



An Electric Light Aerial Adaptor.

Messrs. Mitchell's, of Peckham, are as keen as ever on advancing with the times, and, if we are not mistaken, they have one or two little surprises up their sleeves in the way of new things.

Wireless Equipment are well up to their title, and next door, at Stand 15, Messrs. Wates Bros. are staging a cabinet set in dark oak with four valves and all etceteras at £80.

Nearby Messrs. J. B. Bower & Co. have a good show of the usual lines, and also specialise in high frequency apparatus for medical purposes. Over the way Aucklands have a fine display, a new line that is worth noting being their coil holder to take three coils, and priced at the moderate figure of 12s. 6d. Makers of these instruments are apt to forget that not everyone is able to pay 25s. to 30s. for this item, and we expect Messrs. Auckland will have a good run with this line.

Most people have heard of Peto-Scott's Units, but probably few have had the opportunity of examining the sets of parts put up complete for home assembling. For the amateur of limited experience—and pocket—these sets can be thoroughly recommended, being well designed, complete to the last screw, and finished with proper working drawings.

All units are available, whether for tuning, H.F., detecting, L.F., or condenser panels, the whole installation being gradually built up without any need for scrapping original work. The prices are remarkably reasonable, and represent sound value for plain, straightforward work, and without any unnecessary trimmings.

Hart accumulators are shown in a new high insulation glass cell particularly for H.T. work, where leakage is far more serious, both on account of the higher voltage and also the comparatively small capacity of anode cells.

The Ionophone set by Messrs. Coomes & Co. is quite in a class by itself, the tuning by condensers in a battery of small elements instead of the more usual variable or "vane" type is of considerable interest. The loud-speaking telephone adaptor at 42s. should interest many who require reasonable magnification without undue distortion.

The R.F.H. stand will interest readers of POPULAR WIRELESS, particularly as the illustration of a wireless equipped car in the September 30th issue is exhibited by Messrs. Rogers, Foster & Howell as an installation of their apparatus which they claim to have fitted to the car.

Messrs. Elwell's, Ltd., have an elaborate display of fitted cabinets in Sheraton and Adam styles, also a lacquer-work cupboard of authentic period containing a complete Aristophone installation.

In the thick of it.

The self-contained note magnifier, for which the firm is well known, is also shown.

Having digested these exhibits, our thoughts turned towards the lecture-hall, where we were fortunate in hearing Mr. John Scott-Taggart deliver an address on his great subject, the thermionic valve. A well-spent half-hour was the unanimous verdict, and then, the tea-room being invitingly near, we partook of rest and refreshment and a further dip into our now enormous pile of pamphlets.

Returning to the hall, we examine a new type of crystal detector in the shape of a small cartridge containing an "ever-set" crystal and multi point brush contact, on the stand of the Telephone Manufacturing Co. Crystal enthusiasts will regret to learn that the detector is not for sale apart from the complete sets.

Mr. W. H. Tingey's five-valve set is a taking proposition—the compactness of the whole outfit makes for ease of control and efficiency in working; there is not much going in the ether that this set will not bring in to excellent satisfaction.

Hard by we find General Radio Co, surrounded by a crowd of inquirers, which was not surprising, considering the excellent display made by a firm that has specialised in electrical instruments for years.

Lovers of radio literature had every opportunity to gratify their tastes at the stall of Radio Press, Ltd.

Here was a tempting display indeed of much that is best in current literature, the names of the various authors ranking high in the annals of radio science; the Radio Directory is unique.

The Magnavox Loud Speaker.

M.O. valves arrest our attention next. We were particularly interested in the new low temperature filament valve type L.T.1, which will come as a boon to the country operator, rendering him independent of accumulators.

We note that these valves are the "most suitable" for broadcasting sets, a claim that seems to be quite popular among the generality of valve makers.

Messrs. Cossor, Ltd., seem to be making as many valves as ever, notwithstanding—shall we say—somewhat fierce "competition"! The form of their anode, somewhat akin to an umbrella, ought to catch all those electrons and turn them to good use. The makers claim exceptional amplification for the new valve, which we hope to test shortly.

Chloride batteries have been on the market for longer than some of us care to remember. What this old-established firm doesn't know about batteries can hardly be worth knowing; they had a nice display of these excellent lines.

Well to the Fore.

Messrs. Marconi Scientific Instrument Co., Ltd., had a display at Stand No. 32 of a more highly technical nature than their other exhibit under the ægis of the parent firm. Here we had a fine range of the stuff used by the expert and the professional operator.

Metropolitan-Vickers were well in the limelight with a scale model of their research laboratory at Trafford Park, which we understand may be used for broadcasting if we go on waiting long enough. The powers that be are in no hurry to forgo the war habit of saying "You mustn't" where anything pleasant is concerned, and we wish Manchester the best of luck, and may they get their broadcasting early and often.

The Magnavox is now well on the market as a British production, despite the large number bearing the American transfer. We understand that for some time now the home production has entirely superseded the imported supplies that originally were sold by the company in the capacity of

(*Continued on next page*).

A RAPID REVIEW OF THE ALL-BRITISH EXHIBITION.

(*Continued from previous page.*)

agents. The Sterling Company are also doing well with their celebrated head 'phones, which are so deservedly popular everywhere.

H. P. R. Wireless have an unique proposition in their wave-length indicator which enables any transmission to be picked up at once by means of their admirable chart and coloured indicators.

Their stand is very prettily set out with flowers, which, together with the taking appearance of the exhibits, makes up one of the most attractive stands of the show.

Another adaptation of "Wired Wireless" is seen on the stand of the Dubilier Condenser Company, in the shape of an adapter for plugging into the ordinary standard lamp-holder and getting in the oscillatory currents via the house wiring, instead of an aerial. We hope to test this idea shortly and report on the results in an early issue.

One of the Old Brigade.

Radio instruments in great variety are to be found on the stand of like name. Very high standards have been set up by the proprietors, and, while the highest class of goods naturally cannot be done at cut prices, one feels assured that the value is there, and that the quality will be remembered long after the price is forgotten.

Messrs. Leslie McMichael, Ltd., have a very comprehensive display of high-class apparatus appealing more to the advanced worker than the beginner of moderate means. In his capacity of secretary to the Wireless Society of London, Mr. McMichael has had an unique opportunity of studying the requirements of the wireless amateur.

No newcomers to the electrical world are the Western Electric Company. One of the oldest concerns in the industry, it is fitting that they should move with the times and give their great experience to the development of radio science.

They are making a real effort to tackle the loud-speaker job, and they will find plenty of room for their activities, and not a great deal of competition. The best of success to their efforts.

Messrs. Mullard.

Mullard Radio Valves are to be seen on their stand, No. 41, in every possible form. Amateurs will look with mild surprise on the huge 4 K.W. tube made of silica to stand the great heat involved in transmitting comparatively high powers. The "Ora" tube is highly popular among amateurs, by reason of its high efficiency and moderate price. We use them ourselves, and like them immensely. The history of the Mullard Company has been a record of continual victory over difficulties of all kinds, and we welcome the announcement that their business has entirely outgrown their present premises; may their shadow never grow less.

Britwire coils are well known to many workers, and these useful items were found at stand No. 42, together with many other equally good lines.

Everyone knows Brown's 'phones and loud speakers. They are admittedly a standard of their own, and have probably caused more contention among advertisers than any other line in the industry.

They are not "cheap," but they are good, and, in any case, one does not purchase 'phones every day, so a trifle extra is well spent where the buyer can run to it. Telephones are about the last thing one can economise on, where good signals are concerned.

'Phones for Ladies.

Messrs. Alfred Graham are indeed deserving of the support of the wireless public in their production of the "Amplion" loud speaker for home use at 45s. The question of entertaining an audience is a difficult one to the amateur of moderate means, as the majority of loud speakers are beyond his pocket, and even the expensive ones are apt to be disappointing in use. We trust the makers will issue detailed instructions with every instrument warning the user against over-amplification, which at the moment threatens to make loud speakers a byword, if not a nuisance.

We look to testing out one of these promising instruments under the ordinary limitations of average amateur use, and hope to report on the result exactly as we find it. The head 'phones for ladies' use are a commendable feature, as mere man is quite apt to overlook the fact that handfuls of hair torn out by the roots is not at all a pleasant feature to "listening in."

Gambrell Brothers' coils are renowned for efficiency, and, like all their apparatus, are quality propositions rather for the advanced worker of comfortable means than for the novice of limited resources.

Next we had a look at Siemens' excellent display, another case of a pioneer firm moving with the times and backing their products with many years of experience. Here we have receiving sets of various types, and, above all, batteries for every purpose, a line in which this firm have specialised for many years.

Mr. Sullivan's stand was undoubtedly the rendezvous of the wireless highbrow; the show of advanced and ultra-advanced apparatus almost made the ordinary man feel queer. He must almost have felt in need of a pass-word to admit him to such a veritable temple of applied science. A grand show of beautiful apparatus is the impression it gave us.

The "Extraudion" Valve.

Another firm is paying due regard to my lady's coiffure by offering a lorgnette type of 'phone which may be held to the ear without scalping the listener, as is so often the case with head 'phones.

The patent aerial insulator which has been so well received was going strong, and we were informed that the makers, Messrs. Econ Manufacturing Company, Limited, were going "all out" on this excellent line.

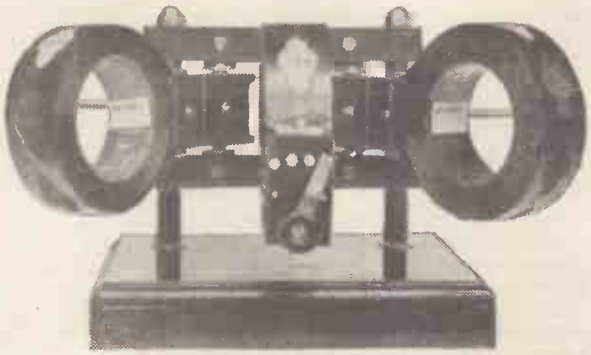
Messrs. Economic Electric, Limited, are showing their new valve, the "Extraudion," which is causing quite a stir both among the valve-makers and the users. We hope to try one or two of these ourselves, and for our own part the more valves there are on the market the better we shall be pleased, and the greater the good to interests of wireless in general.

Messrs. Automatic Telephone Manufacturing Company, Limited, embrace many activities, being the offspring of a sturdy old parent firm long renowned for British thoroughness.

Their display is a pleasure to behold, and they have experience to offer, covering more years than some of us would care to count.

Plenty of choice of apparatus was found on the stand of Messrs. Pettigrew & Merriman, No. 53 on the list; crystal sets, one-valve sets, four-valve sets, and a host of sundries made up an exhibit of general interest to the typical amateur worker.

Messrs. Stanley Prince & Company were well in the running with a good all-round selection of apparatus embracing practically every need for modern reception.



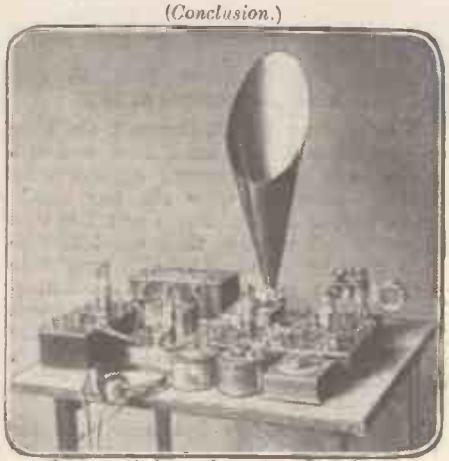
A neat inductance by the Igranic Electric Co.

The "King Radio" struck us as being a good type of two-valve set, the one stage of L.F. amplification being well suited to the average amateur by reason of its comparative simplicity and certainty of efficient action on short wave-lengths.

Thus ended our "go as you please" trip to the show, in which we tried to view it through the eyes of the country visitor and give a rough impression of what was to be seen and heard at a most interesting and comprehensive exhibition of the many things concerned with wireless.

More than 25,000 visited the show and on every side I heard satisfactory reports with regard to business done. Indeed, I could name some firms who made a very substantial sum during the exhibition week. There is every likelihood of another exibition being held soon: if so, it will have to be *very good* to even equal the All-British Exhibition.

(*Conclusion.*)



A compact four-valve set, Sent in by Mr. J. Williamson Dunedin, London Lane, Bromley.

NEW SERIES FOR BEGINNERS.

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

PART 14 (Conclusion).

THE "range" of a wireless station is a very vague expression, and often misleads people unversed in the subject. For practical purposes, the range of a transmitter is the greatest distance at which its signals can reliably be received by a modern form of receiving instrument. Obviously, then, the range of any sending station depends chiefly upon its electrical power, because the total energy flung into space is spread over a circular area, and the greater this area the less is the energy at any point in it.

Therefore, the range of a station is the length of the radius of the largest circular area over which its waves can spread before their energy becomes too weak to work a receiver properly. An ether wave is weaker the further it is from the transmitter, and, if it be represented quantitatively by a wavy line, its height, measured from the normal level to the crest, is a measure of the energy of the wave.

Hard to Define.

This height is called the amplitude of the wave, and although it gradually decreases as the energy moves outwards, and eventually becomes so small that no man-made instrument can detect the wave, it never quite vanishes. Once the wave is created only its strength alters; its velocity, frequency, and length never change.

The invention of a more delicate receiver would automatically increase the range of existing transmitters. This has occurred several times in the history of wireless. It is a mistake to suppose, as many people do, that a receiver has a "range." Any receiver of a particular kind needs a certain amount of energy to work it, and how far that energy has travelled does not matter at all.

The receiver might be unable to receive signals from a station 500 miles distant, but quite well able to do so from another 5,000 miles away, simply because the station 500 miles distant cannot deliver waves of the required strength (amplitude), whereas the more remote station can. Substitute a more sensitive receiver and it will come within the range of the weaker transmitter.

From this it will be seen that if we say that the "range" of the first receiver is 5,000 miles we shall find it difficult to explain why it cannot receive from a station only 500 miles away.

A given receiver will receive signals from any wireless station strong enough to send it the minimum of electrical energy needed to operate it, regardless of distance. But the receiver must be "in tune" with the transmitter.

Weather and Wireless.

A very interesting fact about "range," is that the range of a transmitting station during darkness is at least twice as great as it is by day. This is partially explained by the fact that daylight robs the ether-waves of some of their energy.

The scientific explanation of this has to do with a property of wireless waves to which I have not yet referred, that is, their power to pass through material objects. They flash through trees and houses. They are passing through your body as you read this.

It is impossible to form a mental picture of this other world of vibrations; one can but cling to the conception of a universal ocean of *something* which is of such fine grain that it belongs to a different order of creation than ordinary matter.

Although material objects do not stop the passage of wireless waves they can, if they are conductors of electricity, take toll of the energy of the waves. Thus after a wave has passed through a building it is weaker than before. For this reason you should not set up an aerial wire in a space enclosed by high buildings, if you can put it on top of them or in an open space. Wireless signalling is, for the same reason, always easiest over the sea and flat country.

If you are compelled to use an indoor aerial be sure you do not set it in a galvanised iron hut or in any building containing a large quantity of steel girders in its construction; if you do the results will probably disappoint you.

Now during the day the atmosphere is very much more conductive of electricity than during darkness, and therefore robs the wireless waves of their energy much more by day than by night. Hence by night the range of a transmitter is greater than by day, because, starting out with the same amount of energy, the waves do not grow weak so rapidly.

People often ask whether fog, rain, wind or snow have any effect on wireless signals. The answer is "Not sufficient for one to be able to say that the effect is either harmful or beneficial. The wind sometimes sways the aerial wires so that there is a slight effect upon the signals in telegraphy and a greater effect in telephony on short waves; and in northern latitudes "silver thaw" forms upon the aerial wires so thickly that its weight would bring them down were they not heated at intervals by special apparatus.

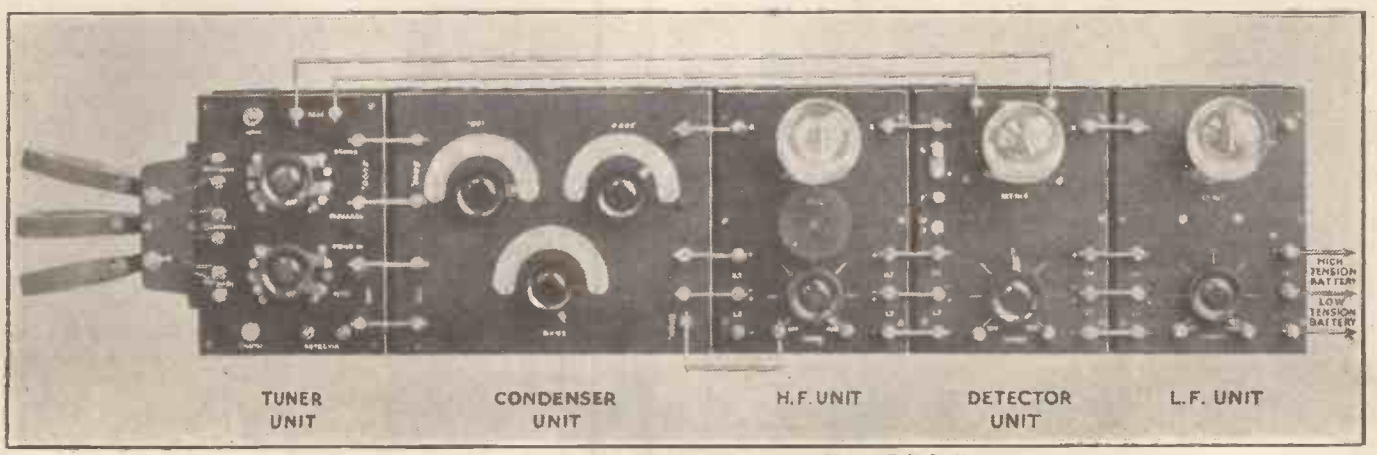
Apart from these indirect effects, wireless does not "feel the weather," but it has a rival, a natural rival, which is still mostly mystery. So mysterious is this rival that he is called "X," signifying the unknown. These X's (also called "atmospherics" and, in America, "static") are *natural* ether-waves, some of which, it is certain, are caused by lightning, and atmospheric electricity which discharges to earth through the aerial.

Messages from Mars.

They mix with the artificial waves sent out by wireless stations and have a tendency to interfere with messages. Most commercial wireless receivers are fitted with one or more traps for these stray vibrations and discharges. The systematic observation and study of X's is one of the many ways in which amateurs can help the science along, though it is to be hoped that the reader, if he does actually undertake such work, will not be drawn aside into speculating about whether a certain "X" came from Mars or not.

A great deal of print has been allowed to spoil paper by reason of the much writing which has been done on the subject of messages from Mars. Reputable scientists have been represented as having discussed that subject in all solemnity, though the facts probably are that they received their interviewers with courtesy, and answered questions with well-concealed

(*Continued on next page.*)



The Panel Unit System Receiver, manufactured by Messrs. Peto Scott.

HINTS TO AMATEURS.

AFTER long use telephone receivers often become quite moist, and should be carefully wiped before putting away. Otherwise, the diaphragms will become rusty at the edges. If they should be found to be rusty, gentle wiping with a little sewing-machine oil will remove the rust. Great care should be taken that the diaphragms are not bent.

* * *

Valves should never be moved while alight. Sometimes the slightest knock will break the thin wire that forms the filament, and if hot this wire is very easily damaged.

* * *

Those amateurs who are lucky enough to have plenty of space in which to erect their aerials should take full advantage of it. Though they may not seriously interfere with reception, all obstacles such as trees, telegraph wires, house or high metal work tend to take up energy from the ether, which might otherwise help to increase the efficiency of their receiving set.

* * *

Don't always blame your crystal if you find your signals are weak. The crystal may be a poor one, but the fault often lies in the contact wire, which should be springy and press firmly on the crystal. If the tension can be adjusted, the pressure may be varied to suit different crystals. The buzzer is useful in finding the spot on the crystal which gives best results.

* * *

If you wish to use more than one pair of telephones on the same receiver, it is advisable to employ 'phones of the same resistance, and, if possible, of identical type. Be careful never to drop or knock your 'phones; the magnetism in them will be weakened, and the sensitivity therefore reduced.

For supplying voltage to the valve plate circuit, ordinary flash-lamp batteries may be used. A large number should be connected in series; but it is very uneconomical, and the cells soon run down.

* * *

Amateurs are often puzzled to know how to find the negative pole of a low-voltage direct current. If both wires are placed in

A "Chloride" H.T. Battery, with glass test tube containers.

vinegar and water—taking care not to let them touch—the end where the bubbles are more numerous is the negative pole. When charging accumulators, this pole should be connected to the negative terminal on the battery.

* * *

Australia now sets its clocks right by time signals from the United States naval observatory.

"Howling" in valve sets may be greatly reduced by earthing the valve sockets and tsansformer cores. In circuits which employ amplification valves, the transformers to the valve grids should be as short as possible.

* * *

If a loud speaker is desired it can be placed in the last amplifying circuit. It should be connected in a circuit containing a large capacity condenser in series and shunted across a choke coil—which has been placed in the plate circuit—and the plate battery.

* * *

When a several stage amplifier is employed, and a resistance coupling is used, the voltage of the plate battery should be increased from two to four times owing to the absorption of voltage in the coupling.

* * *

Very illusive failures can be caused by loose or bad connections. It is a good plan to run over the entire wiring of the set at intervals, tightening screws and terminals (and it is astonishing the number that at times will be found to have worked loose), and cleaning contacts. This latter should include such details as valve legs and plugs, accumulator straps, etc.

* * *

Fuse wire should figure in every amateur's set, and costly trouble can be avoided by its inclusion. For instance, the external wiring of the H T battery should always be broken by an inch of so of ¼ amp. fuse wire.

* * *

The L.T. accumulator should have a small cartridge fuse of sufficient strength to carry the valve current connected between its cells. The cartridge fuse is advisable, as there is the danger that bare fuse wire would ignite the celluloid of the cells if it melted.

* * *

Crystals should be cleaned with carbon disulphide in preference to methylated spirit.

A Radio Instrument Condenser.

NEW SERIES FOR BEGINNERS.

(*Continued from page 447.*)

impatience. Then the interviewers went away and added deep purple patches to the dull truths the sceintists had uttered. I venture the remark that no engineer whose opinion is worth having has ever seriously stated his belief that any signals he had heard came from Mars.

Problems to Solve.

What he will say is that it is unscientific to assert that it is impossible to receive signals from Mars, or that certain unaccountable sounds heard in the telephones did *not* have their origin in that planet. Senatore Marconi, who naturally has suffered more than any other scientist by the misrepresentation of his remarks on this subject during interviews, published a letter in the "Electrician" of Jan. 30th, 1920 in which he wrote:

"At times signals are received which are apparently due to electromagnetic waves of great length (up to hundreds of miles), and these signals are not of the same character as those commonly called X's or "strays." Occasionally such signals can be imagined to correspond to the Morse signals for certain letters, and these signals occur at all seasons with irregularity.

The sources of such signals are unknown. They may be in the atmosphere or outside it, and due to electrical disturbances. If outside the atmosphere, they may arise in any point of interplanetary space, possibly in the sun, where it is well-known that electrical disturbances occur.

Obviously since the planet Mars is situated somewhere near in interplanetary space, the source of such signals might be on it or on any other planet. There is *nothing* however, to show that this is the case, nor must any purely fanciful speculations of mine be interpreted to mean that I have asserted having received any intelligible messages from Mars or from any other point in space outside the earth."

The science of radio-communication bristles with problems yet to be solved, and has before it a very large field of application. Radio-vision, radio-photography, radio-control of mechanism, and the distribution of power by radio means are but a few of the applications which need the attention of wireless engineers. Maybe some of those beginners who have read these articles will be the wireless wizards of the future.

(*Conclusion.*)

ORA

The Valve for perfect reception

For receiving vocal and instrumental items you must have

MULLARD "ORA" Valves

to get the best results.

Oscillates—Rectifies—Amplifies

Specially recommended where good amplification is required.

The "ORA" valve requires about 3·8 volts on the filament and 30 volts, or over, between the anode and filament for efficient results.

15/- each

IMPORTANT NOTICE.

The great demand for Mullard "ORA" Valves and other accessories has compelled us to open much larger works. A greatly increased output is now available.

The MULLARD "R" Valve is now reduced in price from 22/6 to **17/6**.

Mullard Radio Valve Co. Ltd.

45, Nightingale Lane, Balham, S.W.12.

Contractors to H.M. Admiralty: Signal School, Portsmouth,

War Office, Royal Air Force & Post Office.

Telephone: Battersea 1068 Codes: ABC (5 Ed) Bentley's Telegrams: Radiovalve Hammer Lond.

THE RADIO MULLARD VALVE Mark

Please send me post free

Quantity.	Description.	Price.
.....	Telephone Head Sets	30/- Per set
.....	"ORA" Valves ...	15/- each
.....	Grid A Resistances...	5/- each
.....	Anode A or B Resistances...	5/- each
.....	B.A. Condensers, '0005 mfd...	2/6 each
.....	Combined Resistance and Condenser...	7/6 each
.....	Valve Bases with Terminals...	6/- each
.....	Valve Sockets ...	1/3 each
.....	Terminal Clips ...	9d. per pair

I enclose (Cheque, Money Order, P.O.) ..... value ..... to cover the cost.

Name and Address .....

Name of usual Wireless Dealer .....

To the MULLARD RADIO VALVE CO., LTD., 45, Nightingale Lane, Balham, S.W.12.

SEND THIS TO-DAY.

THE HAPPINESS OF RESEARCH.

By PROFESSOR A. M. LOW, A.C.G.I., M.I.E.A., D.Sc., F.C.S., F.R.G.S.

TO write of research is difficult; it is never easy to lay bare one's feelings where an old love is concerned.

The very word "research" sounds mysterious; there is the glamour that hangs always round the unknown. Someone has defined genius as an infinite capacity for taking pains, and, like all definitions, it can be shown to be both right and wrong.

Certainly it is not the slow, careful, plodding mind that pores over the infinitesimal errors in the work of others that often alights upon the new fact. More often is it the man who will begin each problem without tying up his mind with empirical results, and who will consider each step and admit fully to himself how contemptibly small is his foremost effort at knowledge.

A Great Law.

It is impossible to always tell where work will lead. We may, one moment, be standing watching a two-inch steel bar battered into shape and be hoping we may make the mechanical tongs holding it more effective and more sensitive; the next day we may be bending over a microscope, afraid that the least tremble of our clumsy hands will fracture a celluloid bubble scarcely thicker than some of the wavelengths of light.

Change is very necessary, and we have to accustom ourselves not only to rapid mental transition, but to the realisation that, although our thinking capacity is as yet little better than a dog's, we must make ourselves see that the practical difficulties of space, food, and bodily discomforts can be overcome in one way.

First realise this great law. In a few years, just as we now only have record of moments' scientific time, we shall be looked upon much as we now regard the worst-educated cave man and the most amateur product of darkest Africa. And remember that the difference, such as it is, between each step of mankind's improvement is chiefly due to concentration and retentivity.

It is true that few of us are capable of more than one minute's accurately consecutive thought—that it is useless to flit from one subject to another, forgetting what went before and omitting to apply it.

Such method as this prevents constructive research; it leads only to dreams. We must be retentive and avoid losing by lack of retention or memory the foundation of each sound thought and idea.

The Mother of Research.

Some of the best thinkers in the world will forget the most beautiful idea if they pass a fried-fish shop and feel hungry. This may not present a pretty picture, but it is the end of invention and research.

Do not let us get the idea that poetry form can represent invention; they are but physical gifts. Music is rhythmic; it is based on the tides that, in protoplasmic form, supplied us with regular food; the whole body is regular, as are most facts of life cyclic in some manner.

This should be a lesson to us and should teach us that consecutive thought based upon understood, solid foundations is the Mother of Research.

Appreciation of knowledge limitations proves how wrong is subjective concentration for the man whose mind is merely a storehouse of so-called facts. Surely basic fact is not known to anyone, but it can be valued at the price of a subscription to a public library? It is novel application that makes work helpful to mankind.

Similarity is a matter of relative eyesight. Even twin-children likeness is due to faulty perspective upon such details as shape of nose, etc. The skin itself may be totally different in thickness. It is exactly the same with research: we must learn to use our imaginations and to realise that things are not always what they seem.

Slow-motion Pictures.

The mind must carry more than one idea at a time, and in consequence it is often the man who has not the best read knowledge on the subject who has the power of foresight and imagination.

In every invention, in every step of science, each problem is all-embracing. Thought must never be stunted by sudden changes of subject or consecutive ideas lost, otherwise research becomes drudgery—a mere boosting up of the mental storehouse with more memory photographs.

It is the real originator who counts. We hear often of the romantic accidents which have given to us some of the greatest improvements of life, but these accidents apply usually to a variation of existing knowledge.

One of the most interesting branches of science is the development of scientific instruments, for new methods of observation nearly always show how wrong were some of our most favoured hopes.

Very many years ago I was experimenting upon the valve gears of internal combustion engines, and I built a little apparatus consisting of seven cinematograph cameras running in synchronism. Seven films used to be taken by each alternate machine in turn, and by piecing the films into one I could obtain the modern slow-motion picture.

Old as the Hills.

I was told it was a toy; but my reply was quite simple. I used to ask my friends some such question as this: "What happens when I hit a glass tumbler with a hammer?"

"Why, it breaks," said they.

"Really, at once?"

"Yes, of course."

Then I would take them gently by the hand and lead them into my laboratory, and would there show them that the glass *bulges* as the hammer hits it—bulges like a rubber ball pushed by the finger.

I would go on to explain that *nothing* is rigid; I would point out that probably atomic speed accounts for the difference between solids, liquids, and gases, and that all such differences are relative—mere phenomena of oscillation. What a help is this simple thought to a student of wireless vibratory theories!

The time factor is at the root of many problems, for relativity is as old as the hills and far, far older. It is no more a German idea than is the reflection of light from the moon, or the taking of photographs by invisible light.

What is the time factor to do with it? I am asked.

Everything!

Cause and Effect.

Supposing I hit an electric light bulb with a hammer. It bends, bulges, and bursts. Yes, but so quickly—notice my time factors—does the gas transmit the blow that it often bursts *first opposite to the point where the blow is struck*. The pressure cannot spread all over it in the time available.

Now, does not that make you think about knocking engines? Does it not make you think of the time when only a few of the many oscillatory circuits of wireless receivers were appreciated?

It is but a short time ago that we were worrying how to prevent a magneto affecting a coherer locally, and asking if catalytic sparking plugs afforded a solution.

I can remember our delight on finding that coated filings held a charge and enabled mechanical circuit protectors to operate. It may seem that modern wireless is totally unprotected, and that for real commercial purposes our wireless knowledge compares somewhat with that of a naked savage and the calculus. Instrumental research is valuable for this very reason; it forces upon us the realisation that we know so very little. It teaches us that science is so very human; it tells us how to learn consecutively in everything—from the reason why a sparrow dives sideways from a roof, to the need for directional wireless, or the originality shown by a woman in the choice of a new hat.

The Televista.

Supposing we have a loud speaker and discover the horn attachment is bad. We can photograph our sound waves, not by listening and trusting to one of our many partially atrophied senses, but by utilising our eyesight and seeing what is happening, and by using our power of vision which is so relatively sensitive to rapid change.

If an instrument board is vibrating and causing trouble, can we tell what is wrong any better than by feeling a leaking alternator switch and saying, "This vibrates"?

But if the vibration speed can be taken and compared with material frequencies, a cure is so easy by raising the pitch.

A vibrometer is only a machine for using a sense which we can use comparatively and consecutively in thought. It is easier to compare a written wave than several forgotten notes which the ear or brain has felt.

Personal feelings must be conquered in research. I spent many years on my Telivista for seeing and writing by wireless and for the reproduction of photos.

I was asked why I did not "make it useful and use it to kill people in the war?" Clear proof that it is other people's temporarily improved requirements that matter!

(Continued on next page.)

THE HAPPINESS OF RESEARCH.

(Continued from previous page.)

Natural love for science is good, for science can love us back, and like all human beings a tendency towards good will prevail.

I remember an old Scotch engineer telling me that the integral calculus was natural language to a scientist. It is my opinion that his natural language is still more expressive.

If inventors are badly treated it is often their own fault for trusting too much. It has been said that over the Patent Office should be a carefully detailed notice, bearing the words: "Abandon hope all ye who enter here." Should these words not be: "There is no such thing as a basic fact"? Real love of the work is as essential as adoption of scientific and instrumental observation.

Think Why!

Do not think air is clean because our poor eyes without a microscope see no dirt; do not believe that Nature is placid because our cinematographic life appears to turn slowly.

Develop the sense of relativity, and when a dispatch-case trembles in your hand at a passing car do not say, "How strange," but think *why*, and realise that everything moves, and that interdependent oscillation is worthy of wonder.

When you step on a train, realise that the train *sinks down* by however little, and follow with care and consecutive ideas each phase until you reach just one step further than the last man. It adds so much to life to know *why* a sunset seems beautiful, and how light can affect the clarity of our wireless concert to which poor, unscientific friends listened without weariness.

In modern wireless research it is dangerous to be over-optimistic; true theory has a habit of showing us our faults very quickly, and it is as well to bear some definitions in mind.

Theory is perfected practice, and theory always agrees if the latter is complete. There is no such thing as a basic fact. Comfort is a part of efficiency, and is the absence of the unintentional. Work is doing something that we do not want to do in someone else's time! A careful absorption of these sayings has helped what is one of the most complicated and irritating of modern problems to a successful conclusion.

Remote Control

Control by wireless or the wireless reproduction of any mechanical motion must appeal to everyone.

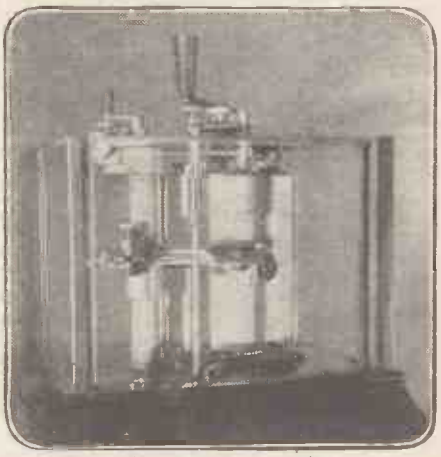
To direct a boat by wireless is easy when it only means an amplifying relay and a signal which puts a series of contacts into operation, but the problem is not to select but so select quickly, and in such a manner that jamming by outside stations is unlikely.

From the purely wireless aspect, combined waves, ultra-red carriers, and every possible idea has been tested almost *ad nauseam*, but the fact remains that jamming may entirely alter a sequence of operations.

The solution is not yet a matter of publication, but it may be stated that even to receive the impulse is not easy. Motor gears spark locally and need protection; relays are often delicate; induced currents have not yet reached any magnitude with air gaps of 50 miles.

When this is overcome, it has to be considered where the protection shall come. Most successful selector gears depend not only on tuning, but upon speed of sending, and the speed selector can be on either side of the amplification relay.

The old rocking pendulum device is far too slow, even when a gyroscope is used to maintain direction, and many forms of instantaneous differential ratchets have been used.



The Vibrometer, for measuring vibration frequencies.

With this argument, and with synchronised sending gear, selective reception can now be attained somewhat on the letter block principle, with a lag of not more than $\frac{1}{5}$ second. The total time taken for the completion of this work was roughly four years, and its objects still vary, as does its method, almost day by day.

That these problems will be understood and easily solved in years to come by a proper understanding of wave motion can hardly be doubted, but as yet we can only theorise doubtfully when we are told the simple fact that sunlight affects wireless reflection.

Selectivity has enabled us to write by wireless, but only inasmuch as direction can be indicated to a pencil by a preliminary sending of key signals.

The telegraph and wire is the only perfect selector, and this is little better than the mechanical jerking of a stretched string. We do not yet understand how wave selection can be obtained. Real selectivity—such as would be obtainable by the mechanical unravelling of speech—is as yet unknown.

I am sure of one thing: the man of to-day has as much opportunity as ever. Can it be seriously suggested that in years to come we shall be content to see an event hours afterwards on the films? We used to see it after many weeks on a drawing, and now we see it one hour after at the cinema. Many years cannot pass before we shall visualise it instantaneously.

Can anyone doubt that in the future we will prohibit smoke, noises, and horses in our streets?

We will not spend hours each day eating, and we certainly will not allow ourselves to be turned out of warmed houses into such wet and fog as a city may wish to show us. Cities will be covered in; rubber or resilient roads will be in use.

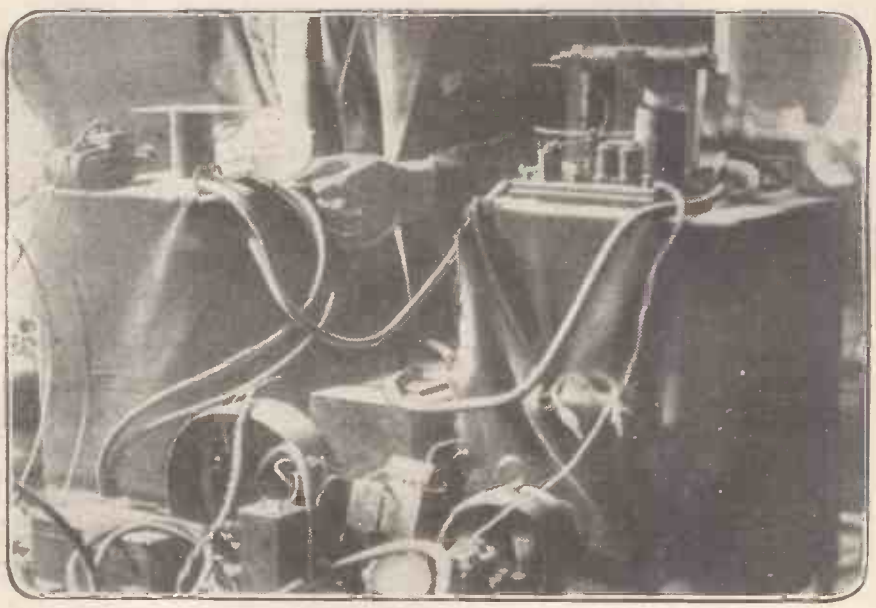
Such things are not laughed at now, but when indicated four years ago it was thought quite amusing.

Looking Ahead

All this is good ground for research, and wireless research in particular is now altering the whole time factor of life. It is increasing the speed of communication, and strengthening international friendships. It helps us to meet our friends for fifths of a second in the spirit, and when our senses are less needed to convey thought we shall doubtless see each other by wave motion and conduct our business in seconds at our own chosen times.

A railway journey will not keep us from our work, and, sad as it is, we shall fight and kill each other with still greater facility.

The inventor of to-day commands his bread far more easily when he is planning to destroy than when his aim is to build; but he may not always be such a plaything of necessity.



Portion of the Televista by which the possibility of seeing by wireless has been demonstrated.

HOW TO MAKE A LONG-WAVE RECEIVER.

By Y. W. P. EVANS.

PART 2.

ANOTHER very simple type of condenser is made as follows: Materials required: Ebonite sheet (one), 8 by 3 by $\frac{3}{8}$ in.; one ebonite sheet, 6 by 3 by $\frac{1}{4}$ in.; sheet aluminium or zinc, 11 pieces, 3 by 2 by $\frac{1}{24}$ in. thick; 18 spacing washers (brass), $\frac{3}{32}$ in thick, or lesser sizes to make up this thickness, and capable of slipping over $\frac{1}{8}$ in. brass rod; 4 pieces of screwed $\frac{1}{8}$ in. brass rod, $1\frac{1}{2}$ in. long, with 2 nuts and washers;

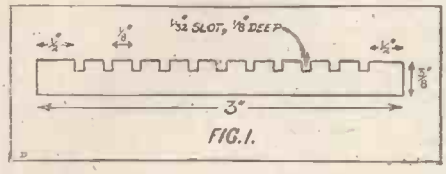


FIG. 1.

4 similar rods, $4\frac{1}{2}$ in. long, with nuts and washers; one brass screw $\frac{3}{16}$ in. about $1\frac{1}{2}$ in. long, fitted with ebonite knob and two nuts.

Having obtained the above supplies, it is recommended that the instrument be built up as follows: Take the ebonite sheet, 8 by 3 by $\frac{3}{8}$ in., and mark off 22 lines with a very fine pointed pencil, or, better still, a steel scribe or darning needle. These lines must be absolutely true, and it is better to use a T-square.

Construction of Parts.

They should be drawn parallel to the 8-in. edge, and the first one should commence $\frac{1}{2}$ in. from that edge, the remainder being spaced $\frac{1}{32}$ and $\frac{1}{4}$ in. alternately, until you have completed 22 lines, the last one being $\frac{1}{2}$ in. from the opposite edge of the sheet.

The $\frac{1}{32}$-in. space has now to be grooved out, and this is best done with a hacksaw, which should be tested on a spare piece of ebonite or wood, and should leave a clearance of exactly $\frac{1}{32}$-in. Having selected the saw, obtain a piece of brass strip or iron, $\frac{1}{8}$ in. thick and $8\frac{3}{4}$ in. long, and having a perfectly straight edge.

Bend over the ends at right angles, so that the inside measurement is 8 inches and will allow the strip to clip over the ebonite with a tight fit (if you can clamp the two in a vice, it is much better). Adjust the strip in position along the second line, and use this as a guide for the saw, which should just take out the first line during the cutting process. Saw to a depth of $\frac{1}{8}$ in., and then move along to the fourth line, and repeat until you have completed the eleven slots (Fig. 1).

Now divide the sheet into two halves each four by three, and saw through so that you have two slotted sections exactly the same size. Place the slotted sides face to face squarely, and stand them upon the other sheet of ebonite (6 by 3 by $\frac{1}{4}$ in.) which forms the baseboard. If they are placed in the centre there should be an inch clearance at each end of the latter, and the whole should appear as in Fig. 2.

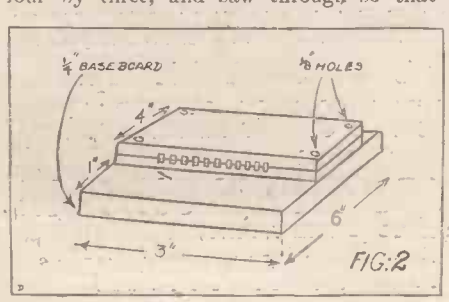
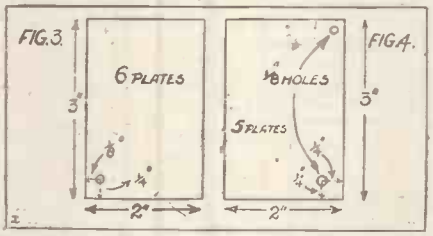


FIG. 2.

If you can clamp these three pieces together absolutely rigid, the next operation should be very simple, and consists of drilling four holes right through at each corner, the size of the hole to be such as to allow the $\frac{1}{8}$-in. brass rod to pass through with ease. The centre for these holes should be punched about $\frac{1}{4}$ in. from the edge of the 4 by 3 block. Drill other two holes, one at each end of the 6-in. sheet on one side only, and $\frac{1}{2}$ in. from the sides, these to be of a size to accommodate the two terminals as shown in Fig. 6. That completes the construction of the ebonite part. The next step is to prepare the condenser plates or vanes.

These are marked out on the sheet of metal, unless obtained already to size (3 in. by 2 in.), and care must be taken that they are all exactly the same or they will not work smoothly in the grooves. Clamp six of these pieces together, and, if possible, hold them in a vice. Drill a $\frac{1}{8}$-in. hole



through one corner, the centre of which should be $\frac{1}{8}$ in. from one edge and $\frac{1}{4}$ in. from the other (Fig. 3). Now clamp the remaining five plates, and drill a $\frac{1}{8}$-in. hole through each corner on the 3-in. side, the centre to be $\frac{1}{4}$ in. from each edge.

The next step is to build up the plates on to the brass rods or bolts. Commence with the six plates, and build up as shown in Fig. 4A, by sliding one plate on the bolt, on the end of which you have fixed a nut; then slide on a $\frac{3}{32}$-in. washer, another plate, washer, and so on, finally tightening the whole bunch with another nut. A piece of small flexible wire should be fastened under the nut at one end. Next take the three pieces of ebonite, and place the 6 by 3 at the bottom, the 4 by 3 slotted piece directly over this, insert the plates in the grooves with the brass rod at the bottom, and on the top of this place the second piece of 4 by 3 ebonite.

Pass the $4\frac{1}{2}$-in. brass rods through the whole, and secure moderately together with nuts, so that the plates are held firmly in the grooves at one end. Now build up the other five plates as shown in Fig. 5, the rods being passed through top and bottom, and spaced by the $\frac{3}{32}$-in. washers, the piece of brass strip 2 by $\frac{1}{2}$ in. being bent to shape and drilled as shown, so that the bottom brass rod will pass through comfortably, and also

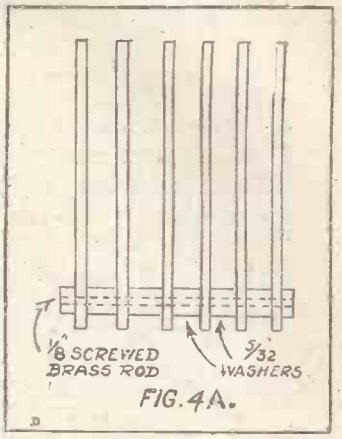


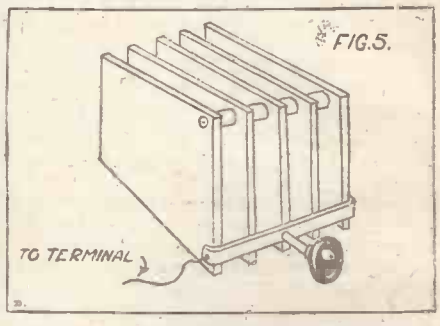
FIG. 4A.

accommodate the $\frac{3}{16}$-in. screw with the ebonite knob.

When finally adjusted, the whole bank of plates should slide easily into the spare grooves between the ebonite sheets, and should be so adjusted as to allow of a slow, smooth movement being maintained throughout the whole range of the 2-in. slide. After affixing another small piece of flexible wire on to one of the screws, put the terminals into position as in Fig. 6 and connect the wires, and the condenser is now ready for working, the complete instrument appearing as in Fig. 6.

Telephone Condenser.

This condenser is required to place across the telephone's terminals when the receiver is complete, and is very simple to construct. Materials required: 5 pieces of tinfoil, 1 in.



square; 6 pieces of paraffin-waxed paper, $1\frac{1}{2}$ in. square; and two pieces of $\frac{1}{8}$-in. ebonite, 2 by $1\frac{1}{2}$ in. Four $\frac{1}{2}$-in. brass screws will do for securing the parts together.

(To be Continued.)

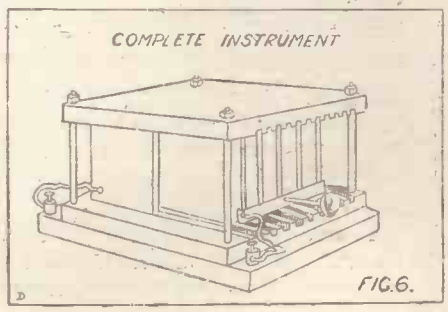


FIG. 6.

CONTROLLING MODELS BY WIRELESS.

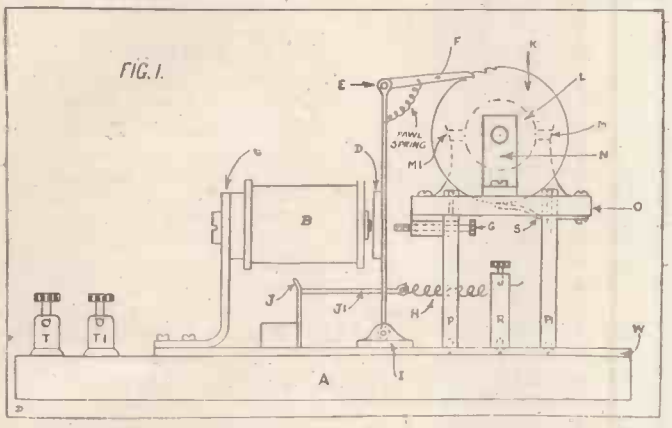
By MAJOR RAYMOND PHILLIPS, I.O.M., Late Member of the Inter-Allied Commission of Control

PART 5 (NEW SERIES).

THE relay described in my previous article is designed in such a manner that its construction should not present any difficulties to an amateur mechanic possessing a few tools such as a vice, hacksaw, files, drill brace, taps, etc.

All terminals can be purchased ready made, so that a lathe will not be required.

Practically any wood turner will undertake to make the bobbin for a small sum, and those enthusiasts who desire to only assemble the relay will find that most small engineering shops will readily undertake to cut to length and screw-thread (where required) the various component parts, and at the same time improve the appearance of such parts by machining and lacquering where necessary.



The relay shown in Fig. 1, in my first article (new series), No. 17 of POPULAR WIRELESS, is a more sensitive type than that described in my last article, but as its construction would involve the use of a lathe, I do not propose at present to furnish constructional details of same.

I explained in my previous article that the receiving apparatus for use in connection with the wireless control of a model electric train will comprise a coherer, relay, and a simple selector. The latter is a form of relay, but arranged to open or close a series of circuits.

The Selector.

I shall now commence to furnish details and diagrams of a simple selector (*i.e.*, selection by sequence) suitable for use with the receiving apparatus in question, which will be so arranged that a motor fitted to a model electric train can be started, stopped or reversed. It will thus be apparent that the model train can be caused to run backwards or forwards, and stopped as desired.

The selector will also be arranged to open or close a circuit connected with a miniature electric lamp. The latter will act as a signal which will indicate to an operator at the transmitter that the receiving apparatus is responding to the transmitted wireless waves.

In the event of the model train being controlled from a point which renders the electric lamp in question invisible to the operator, the signal will no doubt interest any spectators who may be watching the model, more especially if the transmitter is not installed in the same room as the receiving apparatus. The presence of a brick wall separating the two instruments appears to make no difference to the transmission and reception of wireless waves.

Fig. 1 shows the complete selector. It consists of a baseboard A (with metal base W), electro-magnet B with support C, armature D with support E and base I, pawl F, adjusting screw G, balance spring H with clamping pillar R, contacts J and J1, for opening or closing a circuit connected with a decohering device, ratchet K, drum L, contacts M and M1, support (for spindle of drum and ratchet) N, vulcanised fibre base O with supports P and P1, check spring S for ratchet K, eight terminals (two only shown) T and T1.

In operation it will be observed that when electric current traverses the windings of electro-magnet B, the latter will attract its armature D with support E and pawl F, and close contacts J and J1. The latter will close a circuit connected with a decohering device. On electric current being cut off from electro-magnet B, the armature D is released, and the balance spring H drawing the latter forward, the pawl F engages with the ratchet K, and causes the drum L to revolve a stage forward. The check spring S is provided to prevent any possibility of the ratchet K with drum L revolving in an opposite direction.

Closing of the Circuits.

It will thus be apparent that by causing the drum L with ratchet K to revolve in desired stages, the contacts M and M1 can be caused to open or close other local circuits as required.

The contacts M and M1 will (for the receiving apparatus in question) be arranged to open or close circuits conveying electric current to the model electric train and signal lamps previously referred to in this article.

In my second article (first series), No. 13 of POPULAR WIRELESS, a simple circuit is shown in a diagram marked Fig. 3. A similar circuit will be used for connecting up the electro-magnet B of the selector in question.

Fig. 2 shows respectively plan and side elevation of the electro-magnet B, which consists of a yoke A, cores B and B1, and bobbins C and C1.

The yoke A should be made of Swedish charcoal soft iron $1\frac{3}{8}$ in. long by $\frac{5}{8}$ in. wide by $\frac{1}{8}$ in. thick, as shown.

The cores B and B1 should also be made of Swedish charcoal soft iron, each core being $1\frac{1}{4}$ in. long by $\frac{3}{8}$ in. diameter, and secured to the yoke as shown by means of two cheese-head brass screws $\frac{5}{8}$ in. long by $\frac{5}{32}$ in. diameter.

The bobbins C and C1 should be made of boxwood $1\frac{3}{16}$ in. long, with flanges $\frac{3}{4}$ in. diameter by $\frac{1}{16}$ in. thick, and should be fully wound with No. 25 gauge single silk-covered copper wire.

Winding the Bobbins.

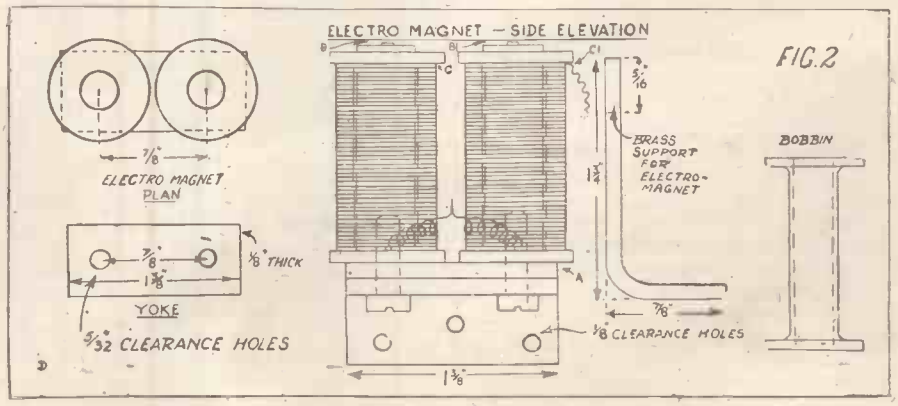
To wind the bobbins, each should be mounted upon a mandrel, and winding should be commenced by passing the leading-in wire through a hole in one of the flanges of the bobbin, and a piece of silk should be placed over the leading-in wire when commencing to wind the second series of layers, to prevent any possibility of short-circuiting subsequent layers.

Each bobbin should be wound in the same direction, otherwise complications will be involved when connecting the two windings together.

The finishing coils should terminate at the end opposite to the leading-in wire. The end of the last layer of wire should be secured by passing it twice under the last single coil.

Fully 6 in. of spare wire should be left at each end of the windings, so that it can be neatly coiled up and connected to various terminals as required. There will be no advantage gained by leading in and finishing the windings with a larger gauge of wire, as specified for the relay

(*Continued on next page.*)



CONTROLLING MODELS BY WIRELESS.

(Continued from previous page.)

described in my previous article, as the gauge of wire used for winding the electro-magnet for the selector in question is sufficiently strong to obviate risk of breakage. At the same time every care should be taken when handling the wire to watch that the silk covering is not damaged.

When the winding of the two bobbins is completed as described, each bobbin should be gently forced over the cores B and B1 of the electro-magnet, and the leading-in wires from each winding connected together as shown in Fig. 2.

It will be well to test the windings by connecting each of the two remaining terminal wires with the terminals of an ordinary 3½-volt pocket lamp dry battery. Current from the latter should then cause the electro-magnet to strongly attract a piece of bar iron held near the cores.

The same test can be applied to the windings of the relay described in my previous article.

It will be observed that a small piece of brass wire (No. 18 gauge) is forced into a hole bored in the end of each core. The object of this is to prevent the armature D (Fig. 1) actually touching the cores. Such a precaution precludes the possibility of an armature sticking, the latter defect being due to residual magnetism in the cores after electric current has been cut off from the windings of an electro-magnet.

In my next and subsequent articles I shall furnish further details and diagrams of other component parts of the selector, also other apparatus required to complete the receiver in question.

BOOK REVIEWS

Radio for Everybody, by A. C. Lascarboura (Managing Editor, "Scientific American") published by Methuen & Co., Ltd. Pp. 308, illustrated. Price 7s. 6d.

This book is all the more welcome because it has been completely revised to suit British readers. In this way, much information of real utility, but free from American allusions, is presented to the British amateur in an understandable manner. There is some excellent constructional matter in the book, and the general style is at once pleasing and uniformly suited to the needs of the radio enthusiast who wishes to study the subject in a broad, and comprehensive, yet not too detailed manner.

* * *

A Wireless Directory. (Radio Press, Ltd. Price, 2s. 6d. Nett.)

This comprehensive directory of commercial, naval, and amateur call signs will supply a long-felt want wherever a radio set is installed.

The call signs are arranged in alphabetical order, and any particular station can be found at a moment's notice.

It is a cheap book for 2s. 6d., and is bound to enjoy a large sale.

TELEPHONES IN 1878.

By SIR J. KENNETH D. MACKENZIE, BT.

A TELEPHONE as a curiosity! That is what it was when, in 1878, as an undergraduate at Pembroke College, Cambridge, I fixed up between my diggings in St. Andrew's Street, two or three doors away from the "Spinning House" (long since abolished, I believe), a couple of telephones, one in the house and another in a little summer-house some fifty yards away, at the bottom of the garden backing on to the grounds of Downing.

Why? Chiefly because it was secluded and handy to play forbidden games of cards in, and consequently convenient to know if anyone should call to see me or my friend who "kept" with me, and who might be likely to "say things" if he found gambling going on!

New Playthings.

Just as well to be on the safe side in case of accidents when one was doing what one didn't ought to, and, having had quite enough of proctors and their "bulldogs," had no wish for further interviews, fines, or "gating." I knew our landlord would let me know by these 'phones who it was who called if he thought they might not be wanted.

Only a couple of plain telephone receivers and an electric call bell with a switch on the same line; no *transmitters*, mark you, for they had not been brought out then as part of a telephone circuit, though Professor Hughes's "microphone" had been invented and given to the world by him a year or two previously.

I had bought them as a curiosity from Mr. Edward Patterson, of Little Britain, E.C., who started making a few for experimenters and amateurs, just as other makers are doing now for "wireless" amateurs who want something new to play with and amuse themselves and friends.

I think they cost a couple of pounds for the pair! Just plain wooden cases shaped and constructed much like the present telephone receivers in use with table instruments, only that the mouthpiece holding the diaphragm in place was fastened with screws, and not screwed on to the case.

Receiver and Transmitter Combined.

Mr. Patterson later on took into partnership an old friend of mine, and the firm of Patterson and Cooper were one of the earliest pioneers of electrical engineering, with works at Dalston, N.E., making the once well-known "Phœnix" dynamo, arc lamps, and all kinds of electrical accessories and gadgets.

Having no transmitters, one had alternately to speak into and listen at the "receiver" or telephone—not a very comfortable or handy method of communication even if a "receiver" made a good "transmitter." So I tried to make a microphone transmitter of the Hughes' type, out of two small carbon blocks with a little stick of the same material sharpened at both ends connecting the two blocks loosely, the whole arrangement standing on a wooden base with a wooden side to support the upper carbon.

Just Professor Hughes's original idea as described in the "English Mechanic," wonderful as a discovery, as a kind of coherer, but not of much use for *speech* transmission, since merely breathing on it made a horrible row in the receiver if only one Leclanché cell were used.

"Weird and Comic."

How telephonists would laugh nowadays at such a gadget. But, nevertheless, it was a great curiosity in 1878, and of sufficient scientific interest to induce the dear old Master of Pembroke—"Old Charlie Searle," as we irreverently used to call him, to come and see it with one or two other dons—needless to say, when there was no card-playing going on.

I think, and, in fact, I am sure, that that pair of telephone receivers were the first ever seen in Cambridge, and many of my friends used to "chip" me about them, and speak of "'Mac' and his telephone" as being something weird and comic for an undergrad to mess about with!

During the "Long Vac." that summer I took my two telephones to Canterbury, where my people were staying, and rigged them up between our house and that of a friend some 200 yards away, using two of the wires of a fence which ran along the bottom of the gardens as lead and return wires, and managed to talk with my pal after a manner of sorts, though the lines were uninsulated except for what the wooden posts afforded.

Then and Now.

Quite a novelty there also, and a wonderful thing only forty-four years ago! And now, who would dream of taking the trouble even to cross the street to see or speak into a common telephone? Yet even five years later, in 1883, neither I nor my old friend Mr. George Preston, when with me then in the long-defunct Metropolitan Brush Electric Company, Limited, ever dreamed what the telephone industry would grow into or that he would one day become Controller of a G.P.O. Telephone Service.

And now the youths and maidens of post-war period "listen in" through their wireless sets by the thousands, little thinking of how short a time ago it is since their fathers were astonished by the wonderful discovery of Dr. Graham Bell, the inventor of the *telephone*, and who spent many long and fruitless months trying to find someone who would take his invention seriously and not look upon it as a mere toy.

How many of those who see that notice hanging up outside shops, "You may telephone from here" over the picture of a bell, realise that to that "Bell" they owe one of the most wonderful and useful inventions in the world?

I might say—very few. Though, not unlikely, there are many who think it should be spelt with an "H" instead of a "B" when worried by "wrong numbers," "cut-offs," "out of orders," etc., to say nothing of heavy fees and charges when using that wonderful invention—the telepho-

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.

Bethnal Green Wireless and Scientific Society.

The first meeting of the above society for the winter session was held at the Men's Institute, Wolverley Street, Bethnal Green Road, on Tuesday, September 26th.

The meeting was an open one, and many visitors were present. The chair was taken by the Rev. Stewart D. Headlam, L.C.C., who introduced the lecturer in a characteristically happy speech.

The lecture was given by W. Hawker, Esq., B.Sc., who outlined the growth of wireless from 1908 up to the present day, and discussed the merits of both the valve and crystal sets. He urged the members not to regard wireless as simply "threepennyworth on the 'phone," but as a fascinating hobby, which gripped one more as one learned more about it.

Demonstrations on the apparatus were given by the instructor, Mr. H. V. Mitchell, F.I.C.

In welcoming the visitors to the institute, the principal said that their object in forming the society was to bring together working men who wanted to know something of modern scientific development. The annual subscription was one shilling. He thought he ought to mention that, in case it might be thought that membership of a wireless and scientific society was an expensive luxury. The meetings would be held weekly, and would include instruction in making and fitting up amateur sets.

The secretary is Mr. S. H. Dennison, and he will be pleased to welcome all men interested.

* * *

Report of a Meeting of the Liverpool Wireless Society.

An interesting and instructive meeting of the above society was held on Thursday, September 28th, at the Royal Institution, Colquit Street, Liverpool.

The question-box was passed round, and resulted in a very interesting batch of questions, which were very ably dealt with by Mr. S. Lowey, who illustrated his replies by very clear blackboard diagrams. (It will be remembered that Mr. Lowey's very efficient station was described and illustrated in "The Wireless World and Radio Review" some few issues back.)

The next step was then made with the series of short lectures which is proceeding in conjunction with the society's apparatus. At the last meeting the C. Mark 3, three-valve amplifier, was fully described. On this occasion the Mark 3 Tuner was described in detail by Mr. N. D. B. Hyde, in his usual extremely lucid and more or less non-technical manner, the lecturer illustrating his remarks by very clear blackboard diagrams; and, the receiving panel proper having been taken from the containing case, same was passed round for close inspection by each member in turn. Questions were again invited, but on this occasion dealing specifically with this particular form of tuner, and Mr. Hyde again dealt with same.

The winter session of the society opened on Thursday, October 12th, when the president of the society, Professor E. W. Marchant, D.Sc., of the University of Liverpool, delivered an interesting address. All local amateurs already in possession of wireless apparatus, and also enthusiasts who have not as yet secured licences and installed their stations, are earnestly recommended to join the society.

During the month of September over twelve new members were enrolled, which is very satisfactory.

Hon. sec., Mr. C. L. Lyons, 76, Old Hall Street, Liverpool. (Telephone, 4641 Central.)

* * *

The Fulham and Putney Radio Society.

At a meeting held at headquarters on Friday, September 29th, Mr. Calver opened a discussion on aerials by describing a very compact set he had made. Using a small frame aerial, he went into all details very carefully and gave a wiring diagram. Judging by the number of notes made by the members, this was much appreciated. During the discussion which took place after regarding indoor aerials, Mr. Winnett expressed his views very clearly on the advantages of vertical over horizontal loops.

A very interesting exhibit, in the shape of an ancient coherer set, was shown by Mr. S. W. Martin, and the working of this was explained to the young members by Mr. Winnett.

Mr. Houstoun had on show a complete set of panels for unit system. After the usual votes of thanks, the meeting closed at 10.30 p.m. The membership is increasing, by recommendations principally.

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

* * *

The Wallasey Wireless and Experimental Society.*

The society met on Wednesday, September 6th, on the occasion of a lecture and demonstration by Messrs. Cowan and Hamilton.

A four-valve receiver was used, a detector panel and low-frequency unit constructed by Mr. Hamilton, and a two-valve L.F. unit made by Mr. Cowan. The society's indoor aerial not being as efficient as could be wished, the results were, perhaps, open to criticism; but signals were received from several Continental stations, and telephony from the Dock Board and Bar Ship was made audible to the members through a "Brown" loud speaker.

A field meeting was held on the following Saturday, excellent results being obtained on two valves; telephony was received from several local stations.

Hon. sec., C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

* * *

The Burnham, Highbridge and District Wireless Society.

A meeting was held on October 3rd in the adult schoolroom, Adam Street, Dr. N. Burns of The Lodge, Highbridge, in the chair, to consider the formation of a local Wireless Society. There was a good number of local amateurs present, and it was decided unanimously to form such a society, all present enrolling as members, and Dr. N. Burns as chairman for the year. A committee was appointed, and meetings to be held every fortnight, with a buzzer class each week. Annual subscription. 5s.; associates, 2s. 6d.; and it is hoped, from the enthusiasm shown at the meeting, to further extend the membership, and anyone in the district can obtain full information of L. Lott, hon. sec., 52, High Street, Burnham-on-Sea.

Papers and discussions will be arranged for; also a question box, and other means of helping members new to wireless. Twenty-one members enrolled.

* * *

Newbury and District Wireless Club.

The first annual meeting of this club was held on September 28th, and the following officers were elected for the ensuing year: President, Mr. H. Kent-Norris, A.M.I.M.E.; vice-president, Capt. F. M. J. White, B.Sc.; chairman, Mr. H. Brown; hon. sec and treasurer, Mr. W. L. Taylor; committee, Messrs. A. Corden, H. W. Porter, P. H. Sellwood, F. Ford, J. Brown, J. B. Webb, and A. M. Povey. The club is in a sound financial condition, mainly due to the fact that the club-room is provided by the chairman, Mr. H. Brown, free of cost. The business of the meeting was followed by a demonstration on a very fine set loaned by Mr. H. W. Porter.

A general meeting was held on October 5th, and a demonstration of a home-constructed set was given by the hon. sec. This proved to be one of the most successful demonstrations held at the club. The transmission of a prominent local amateur 2 G G. was thoroughly enjoyed by all present.

An interesting programme has been arranged for this session. All interested in wireless matters in the Newbury district are invited to communicate with the hon. sec.

Hon. sec., Mr. W. L. Taylor, The Lillies, Arthur Road, Newbury.

RADIOTORIAL

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

The British Broadcasting Company has issued the following list which broadcast receivers should fulfil to obtain Post Office approval. The conditions are :—

1. That all types of broadcast receivers may be constructed for the reception of signals of any wavelengths.

2. That the apparatus shall be so constructed that it is difficult to change the arrangement of the circuits embodied in the design by means of external connections.

3. The following units, each of which must consist of apparatus assembled, connected, and mounted in a single container, shall be approved :—

(a) combined tuner and rectifier,
(b) combined tuner, high-frequency amplifier and rectifier.
(c) audio-frequency amplifier (of valve or other type).

Any combination of two or three of the above separate units (a), (b), and (c) will be allowed.

4. No receiving apparatus for general broadcast purposes shall contain a valve or valves so connected as to be capable of causing the aerial to oscillate.

5. Where reaction is used on to the first receiving circuit it must not be adjustable, but must be fixed and incapable of causing oscillation.

6. Where reaction is used between a second or subsequent valve on to the anode circuit of a valve connected to the aerial and there is no specific coupling provided between the first receiving circuit and the first anode circuit, the reaction may be adjustable.

7. Tests of sets will be made on two aerials, one 30 ft. long and the other 100 ft. long.

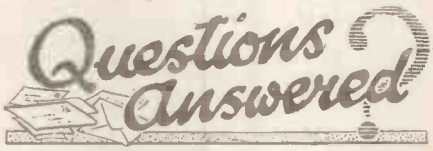
8. The sets will be tested for the production of oscillations in the aerial and for interference properties with a factor of safety, i.e., increasing the high-tension battery by about 30 per cent., changing valves, etc. but not by altering any soldered connections.

9. The Postmaster-General must be satisfied that sets containing reaction can be reasonably repeated with consistent conditions.

10. After approval the type will be given a Post Office registered number, and makers must see that the sets fulfil the non-interfering conditions before they are sold. All sets sold under the broadcast licence shall bear the registered trade mark of the broadcasting company and the Post Office registered number.

11. The unit or set approved as the pattern instrument of a type shall be retained without alteration by the maker. The Postmaster-General shall have the right at any time to select any set of an approved type for test to see that the set is reasonably similar to the approved pattern. In the case of sets of an approved type employing reaction being found to oscillate the aerial, the Post Office may cancel the authorisation of the future sale of that type. No change in the design of any set or unit may be made after approval without the previous sanction of the Postmaster-General.

THE EDITOR.



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.

P. N. M. (Stockport).—Can the metal used for cocoa tins be used for making variable condensers ?

It is not advisable to employ such metal, which is thin steel plate, on account of the losses that will arise due to the magnetic properties of this or any other ferrous metal. Use thin zinc, aluminium, or even brass or copper sheet.

Is aluminium much better than copper for the aerial wire ?

There is little to choose, if both are enamelled; but aluminium oxidises rapidly when exposed to the atmosphere. See reply to H. G. (Bristol) in this issue.

* * *

T. L. (Harwich).—As I am apparently not allowed to employ a reaction, does it mean that all the time I have spent in constructing your "short wave receiver" (not to mention the money) is wasted ?

Not at all. The reaction coil can be dispensed with and the two connections soldered together, and the set will still be as efficient a receiver, using one valve, as is possible under the new regulations.

* * *

"MORSE" (Doncaster).—Why is it that certain stations never send a call either before or after sending messages ?

When two trans-continental or even smaller stations are working together continuously, perhaps even both ways on the "duplex" system, it would be both unnecessary and a waste of time to exchange calls for each message.

What does LN, VCR, and MTL mean ?

Abbreviations for London, Vancouver, and Montreal.

* * *

"CARBORUNDUM" (Purley).—What is the maximum wave-length of a loose coupler, the primary of which is 4½ by 4 inches, secondary 4½ by 2½ inches, wound with either 24 or 28 S.W.G. ?

Unless you can be more accurate with regard to the sizes of the wire employed, or can supply the

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from previous page.*)

number of turns on each coil, it is impossible to give even a rough approximation. Turn back to the reply given to N. X. L. (London) in No. 16 of POPULAR WIRELESS for a method to derive an approximation of wave-length range.

Would I hear Paris, Writtle, and Marconi House telephony ?

You should be able to hear Marconi House on a crystal with careful tuning and adjustments, but Writtle and Paris will require at least one valve.

* * *

T. Y. (Godalming).—What is the use of transmitting time signals to ships, more especially when the time at different places on the earth varies at any point ?

Although, as you point out, the time at any given place varies according to the longitude, yet there must be some "standard" time in the same way as there must be a standard for almost anything. The standard time recognised nearly everywhere is Greenwich time. Where the need for wireless signals comes in is for navigation. It is imperative that ships always have correct Greenwich time, for it is by means of this that they calculate their position at sea. Of course, they carry chronometers, but, accurate as they are, they have to be checked, and the more frequently the better. This is where wireless time-signals come in; ships are now able, by this means, to check their chronometers at sea, and at all points of the globe. For the purposes of ordinary routine, the ships' clocks are altered every day in accordance with the position of the ship.

* * *

"STAKIFORD" (Stakeford).—How many valves will I require to listen-in to Nauen, Germany ? I am fifteen miles north of Newcastle.

You should hear Nauen on spark, using a crystal set with a fairly good outdoor aerial.

* * *

R. E. (Acton).—I have built a variable condenser with 21 moving vanes and 22 fixed, using ¼-inch spacing washers. What capacity should this be ?

·00075 mfd. if the moving vanes are 2½ inches in diameter. We cannot recommend any particular apparatus in these columns, as that would constitute free advertisement for the firms mentioned. Study the advertising columns for the reply to your second question.

* * *

"CURIOUS" (Fleetwood). — What range would I obtain with a crystal set on a 45-ft. twin aerial ?

The exact range could not be computed, as has been explained before in these columns, as there are so many more or less indeterminate factors to consider, but 20 miles is reckoned a good average for the reception of telephony on a crystal set. In the case of spark signals, it will be some hundreds of miles in the case of the more powerful stations.

What number of volts and amps. would be required for a valve of the hard, open grid type ?

Four volts for the filament, and 60 for the plate.

* * *

"NOVICE" (Newcastle-on-Tyne).—What are the maximum and minimum wave lengths I can tune to on a coil wound with 210 turns of 24 enamelled wire on a former 5¾ inches in diameter, using a standard 100-ft. aerial ?

1,800 metres approx.

How many extra turns will be required to tune to 3,000 metres on the same aerial and using the same size former ?

About 100.

* * *

A. H. D. (Mere).—On a one-valve set I hear extraordinary noises like pigeons cooing. Who do you think these could be ?

That may be due to intermittent induction from an A.C. main that may be in close proximity to your set. It will be more probable that that is the cause of the interruptions if you are located near to a large works or power station.

* * *

"TEXEPU" (Dalston).—Does a loud speaker merely take the place of telephones in the circuit ?

Yes; and it should be ascertained before purchase that the resistance of the loud speaker is suitable for the circuit in exactly the same way as in the case of telephone receivers. Thus a 120 loud speaker would be useless on a set that had no telephone transformer. Also it must be added that it is advantageous to employ a loud speaker of low resistance with a transformer, as also it is in the case of telephone receivers on a valve set.

* * *

"WORRIED" (Aldershot).—It is said that a condenser on the primary of a loose coupler is not necessary if there is a sliding contact and not tappings. It is also said that even if there are tappings a variable condenser is still not essential, owing to the fact that tuning between the studs can be obtained by varying the coupling of the two coils and thus varying the mutual inductance. If this is really the case why does it not apply to the secondary making it so that no variable condensers at all are necessary ?

For the simple reason that if it was necessary to rely upon the degree of coupling between the two coils for the tuning, all the advantages of loosely coupled circuits would be lost. It is by the loosening of the coupling and the fine tuning of the open and closed circuits that unwanted stations, atmospherics, etc., are tuned out. It can almost be said that the looser the coupling the greater will be the selectivity. Therefore, unless you can work to that rule you might just as well dispense with a loose coupler and have just a single slide A.T.I.

* * *

W. T. (Salford).—What is the ratio of transformation required for a loose coupler ?

The term is not correct in the case of such circuits, as the volts induced are not proportional to the number of turns. The value of the secondary coil should be such that it will, with the addition of suitable capacity in the form of a variable condenser, approximate the frequency value or wave-length of the open circuit.

Can you give me formulas to work out high-frequency transformer windings to suit various wave-lengths ?

There are no satisfactory formulas for discovering the wave-length values of high-frequency tuned transformers, as their values depend upon more or less indeterminate factors.

* * *

"COUPLINGS" (Plymouth).—Is it correct that transformer-coupled circuits are better than resistance-coupled valve circuits for short waves ?

Yes. Although the latter give very good results on the higher wave-length adjustments, they give poor results on short waves; while the transformer type is good for any wave-length, providing the transformer is suitable, as different windings are required for different ranges of wave-length.

* * *

A. B. (Leigh).—Does the use of a reaction coil increase the wave-length range of an A T I ?

Yes, by virtue of the mutual inductance that will exist between the two coils to a certain extent it does do so. However, as the coupling between the coils will be, or at least should be, fairly loose, the increase will not be very great.

* * *

What exactly is an umbrella aerial ?

An aerial the wires of which resemble the frame of a half-opened umbrella. From the top of a mast or any other elevated point, several wires are run down radially to points a few feet from the ground, where they are highly insulated. A down lead joins all the wires together at the apex and forms the lead in to the set.

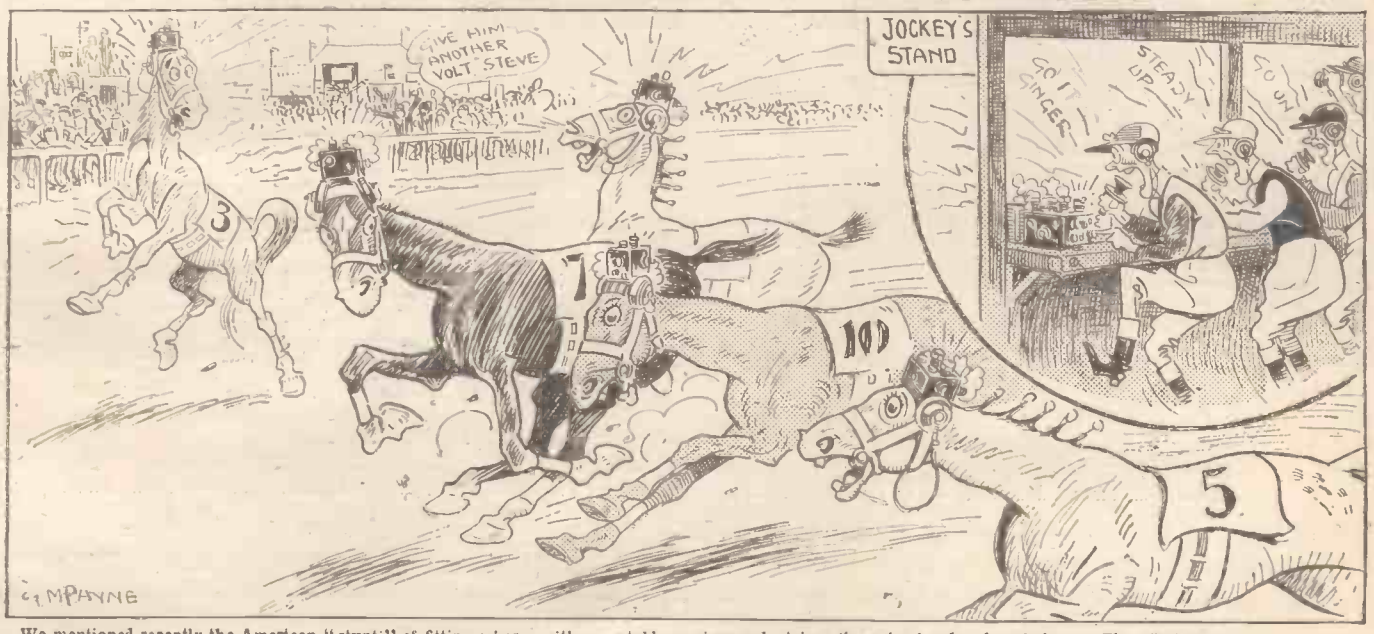
* * *

S. A. F. (Wendover).—It would seem to me after reading answers to various readers on the subject of condensers that there is no reason why such a variety of variable condensers should be made when it is evidently possible to arrive at any value by juggling two or three variables about with two or three fixed. One last point: Is it possible to obtain small value variable condensers by placing small fixed condensers in series with large variables ?

The point mentioned in the first part of your question certainly could apply to the experimenter,

(*Continued on page* 462)

HORRORS OF WIRELESS: THE RADIO DERBY.



We mentioned recently the American "stunt" of fitting a horse with a portable receiver and giving the animal orders by wireless. The effect of this story on our artist is obvious.—EDITOR.

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 460.*)

but would hardly be a convenient method to apply to complete sets. The second part of your question brings to our mind a useful arrangement embodying the principle in question. If two condensers are placed in series the resultant capacity will be something less than the capacity of the smaller. Therefore if a variable condenser was to be placed in series with a small fixed condenser of .0003 mfds., with a switch so that the smaller fixed condenser could be shorted when not required, the result would be that in the latter case there will be a variable capacity of something up to .001 mfds., but if the switch was opened, and the small fixed condenser brought into series, the greatest capacity value possible would be something smaller than .0003 mfds., .00023 to be precise, and the adjustment of the variable condenser will then be something up to .00023 mfds. That is an extremely useful method of obtaining very fine tuning. In the first case the inductance is varied, and the capacity by means of the variable condenser with the small fixed condenser shorted. The latter value is brought down very low and the inductance increased, and then the small fixed condenser is brought into series so that a wide range of fine capacity tuning is available to obtain the sharpest possible tuning.

What is a Vernier condenser ?

A variable condenser with a fine cog and screw adjustment for micrometer capacity tuning. The term is frequently applied in error to variable condensers of small value owing to the fact that the function of these is similar, but the method as detailed in answer to your first question, and placing them in parallel for the same purpose is different.

* * *

J. M. (St. Albans).—Why is it that I get better results with my set at sunrise and sunset ?

This is a very common occurrence, and is attributed to the fact that the rays from the sun are capable of making the atmosphere more conductive, and hence your signals will be clearer and you will be able to receive from a greater distance. There is an article touching on the subject in No. 19 of this paper.

* * *

"PUZZLED" (London).—Why is it necessary to use an applied potential in the case of some crystals, such as carborundum ?

This is because carborundum differs from most conductors of electricity in a very peculiar way. If a graph is drawn plotting the voltage against the current, in an ordinary conductor it will be approximately a straight line. This means that the current increases an equal amount for each equal rise in voltage. In the case of carborundum, however, the graph rises slowly in a straight line until it reaches a point called the "critical voltage," when it turns upwards and continues in a steep straight line. At this critical voltage the resistance of the crystal becomes less, and for the same increase in voltage we have a much larger increase in current. When a carborundum crystal is used for rectifying, it is placed so that the aerial voltage will be added to that of a battery which is always applying the critical voltage across the crystal. As soon as this voltage is increased by the slightest aerial voltage—that caused by incoming waves—it causes a sudden increase in current through the crystal. This sudden increase produces a sound in the phones, and thus the signals are produced. If the crystal has not this critical voltage applied, the small extra voltage from the aerial would only produce a very slight increase in current, which would not be enough to actuate the phones satisfactorily.

* * *

M. P. (Bishops Stortford).—I have a crystal set and have so far experienced no trouble. Recently, however, there is a frequent clicking in the 'phones, when I am tuning in. If I sit still for a moment it ceases, but comes on again when I commence to tune ?

You do not state whether you receive signals, but it would appear that you have a loose connection somewhere. Go all over the set carefully and test for continuity. If it is not a loose connection, you should test the phone leads across a battery. If there is a break you will hear a click on bending the leads carefully, inch by inch.

* * *

Q. R. T. (Birmingham).—What is the cause of atmospherics ?

Atmospherics are electric disturbances in the atmosphere which affect the receiving apparatus of a wireless set. The harsh crackle they make in the telephones is well-known by all who have receivers. The difficulty is to eliminate them, and as they have no particular "tune," they cause the aerial to oscillate at its own natural frequency, so that it does not matter upon what wave-length the aerial is tuned, the atmospherics will still cause trouble. There is one type of atmospheric which is capable of doing a certain amount of damage should you be using a condenser in series with the aerial. It is known as "static," and continually charges up the condenser until either the charge sparks across the two sides of the condenser, or else the condenser is broken down. The best safeguard against this is to connect a highly inductive coil of wire across your condenser, *i.e.* from the aerial side to the earth. This coil is usually known as an "inductive shunt."

* * *

F. L. R. (Southsea).—What is "permeability ?" Why is it that soft iron soon loses its magnetism, while steel does not ?

1. "Permeability" is the magnetic equivalent of "conductivity." That is, the ease with which a substance allows the lines of force of a magnet to pass through it.

2. This depends upon the "theory of magnetism," which states that when a magnetic field passes through a bar of iron, or of any magnetisable substance, the molecules—tiny particles—of the bar arrange themselves, from their ordinarily confused order, into lines of tiny magnets with their unlike poles adjacent to one another. Now steel molecules are stated to be more closely packed than those of iron, and consequently offer more resistance to this "re-arrangement" than do those of iron. But conversely, when they have been "arranged" they are more difficult to displace again or, in other words, steel retains its magnetism far better than iron.

* * *

"CURIOUS" (York).—If, as is stated, wireless waves follow the curvature of the earth, why is it that signals from an aerial 400 ft. high can be received by one 4,000 ft. high ?

You have overlooked an important fact, namely, that an aerial does not transmit waves only parallel to the earth's surface, but radiate in practically all directions. They do not radiate in a series of perfectly concentric circles, but in various shapes depending upon the type, etc., of aerial. But for general purposes of explanation they can be said to radiate in all directions. There is a "blind spot," known to all connected with aeroplane wireless, somewhere above the aerial ; but that does not really come into the question. Another factor comes into operation with regard to the waves which are radiated upwards. This is the theory that some miles above

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from page 462.)

the earth's surface is a layer known as the "heaviside layer," which is said to reflect all such waves down again. So that it is true to say that "wireless waves follow the curvature of the earth."

* * *

"DOUBTFUL" (Salisbury).—Can you tell me which legs of a plug in high frequency transformer are primary, and which are secondary ?

Generally the projecting leg and the opposite are wired as the primary in the set, although it is of no great consequence, as both the windings are similar. The only point to watch is that opposite and not adjacent legs are taken.

* * *

T. M. N. (London, W.).—Why is it that when calculating the capacity of variable condensers the total number of plates minus one is taken ?

Because that will give the total working sides of the plates connected to each terminal. In a 29 valve variable condenser the number of moving vanes will be 14, and the two sides of every one of the vanes will be opposed by one side of one of the fixed vanes when the whole are interleaved. Similarly one side of both the top and bottom fixed vanes will be inactive, but as there are 15 fixed vanes representing 30 surfaces, the total working sides will be exactly the same as in the case of the moving vanes.

In order to make the calculation of variable condenser more easy, could you give the area in cms. of a few of the more common sizes of vanes, and how to arrive at the co-efficient "d" ?

2 inches—0.8 sq. cms., 2¼ inches—12.4, 2 inches—15.3, 2¾ inches—18.5, 3 inches—22. In order to calculate the distance apart of the unlike vanes, reduce the thickness of the fixed vane spacing washers to cms., by multiplying the faction in inches by 2.5. That, however, will not give the required co-efficient "d," as that must represent the distance between unlike plates, so that it will be necessary to subtract from the above the thickness of the moving vanes. For instance, the spacing washers may be ⅛ inch thick, that in cms. is .3125, the thickness of the metal may be .1626 cms., as that is the measurement of 16 gauge metal which is generally used. Therefore, subtracting .1626 from .3125, leaves .1499, and that in this particular example will be the co-efficient "d" in $K = \frac{Ak}{11310000 \times d}$ mfds., where ⅛ inch spacing washers and 16 gauge metal is used. As the specific inductive capacity of air equals 1, "k" can be disregarded in the case of air dialectric condensers. It should be noted that 11310000 is given in the above formula instead of 11.31 × 10 ohms, for the sake of simplicity.

* * *

"AMATEUR" (Burnley).—What purpose does the reservoir condenser on a valve panel serve ?

Several. The first and perhaps the most important is to offer an alternative path to the high frequency impulses, so that they do not have to overcome the impedance offered by the high-tension battery and telephone receivers. For that reason it is frequently called a "by-pass" condenser. Its further uses are to smooth over the irregularities of the discharge from the high tension battery, and to collect stray impulses that would tend to oppose the free action of the telephones.

* * *

Q. E. D. (Hazel Grove).—What arrangement for a three-valve set would you advise me to have, and will resistance couplings be less difficult to handle than transformers ?

Resistance couplings would certainly be simple to manipulate, but would not be suitable for the lower wave-lengths. For simplicity of manipulation two stages of L.F. amplification preceded by one of detection would be the best arrangement, as then, apart from filament control, the only adjustments necessary will be the tuner. Moreover, such a set would be suitable for all wave-lengths.

* * *

R. O. (Langford).—What resistance will be necessary to bring down the voltage of my 220 D.C. supply so that I can charge accumulators ?

It is not necessary to reduce the voltage; all that is required is a resistance or lamps in series that will take just the current required to charge the accumulators. Thus if the charging rate of a cell is about 2 amps, a resistance must be placed in series with the main, and the cell of not less than 100 ohms, with a current carrying capacity of at least three amps. It is hardly necessary to add that 3 or so amp fuse wire should be inserted in the charging circuit.

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

How are they connected?

Positive of cell to positive of main, and negative of cell to ditto main as marked. Another point to remember is to carefully check the polarity of the mains from time to time by means of a polarised galvonometer or voltmeter, as it does happen at times that the poles become reversed.

What are the causes, and how am I to steer clear of "buckling" and sulphating? What are the signs and remedy of both troubles?

Buckling will occur through too rapid action of the cell, *i.e.*, a too great charging rate or too heavy discharge. The plates short and the cell is rendered more or less useless. Sulphating will occur if the cell is allowed to run down or remain in a more or less undischarged condition for any length of time. Signs—whitish deposits on the plates. Remedy—a prolonged charging at a very reduced rate.

* * *

E. V. D. (Girvan).—Wireless waves do not, or at least I believe they do not, carry heat, therefore is it not possible to have light without heat?

Quite possible, but it is a problem that has so far only been successfully solved by the firefly.

* * *

"SPARKGAP" (Liverpool).—I am in a difficult position regarding aerial and earths. I can obtain a very short earth, only 3 feet to a waterpipe, but if I use that room my lead in will be 30 feet long, going through another room. Again, I can obtain a direct earth to something buried in the ground, but the lead will be 15 feet long, and although I can reduce the lead in to a few feet just from the window to the set, using this room I must lower the height of the aerial 6 feet to escape an overhanging projection on the roof. What shall I do?

It is indeed a rather difficult position, and there is little to choose between the two. The sacrifice of height would be serious, but the more direct lead in, and the direct earth, even though it necessitates a rather long lead, is very desirable, and if there is absolutely no other alternative, that will be the better scheme of the two. You should remember that it is not essential to adopt the more common inverted "L" type aerial, and that as a matter of fact the "T" type is very useful for all-round reception, and is not so directional as the "L" type. In the "T" type the down leads are taken from the exact centre instead of from one end.

* * *

T. L. (Hayes).—Is it possible to use anything else besides telephones to receive wireless signals apart from loud speakers and automatic stuff?

If that last phrase includes all types of relays, there is nothing that we can call to mind except a sheet of paper and a friend. This is, however, a scientific "freak" arrangement that requires almost as much amplification as would be necessary to actuate a relay. Briefly, however, we refer to the fact that if two electrodes or metal handles are fixed to the output terminals of an amplifier, and two people, each holding one, place their heads together with a sheet of stiffish paper between, it is possible for both to hear signals by that means alone. This is due to a static action that will take place between the persons with the paper acting as both a dialectric and a diaphragm.

* * *

"RADIOBOY" (Hull) has a five-valve set, and complains that signals are not at all good. He wishes to know whether he should add another stage of amplification.

There must be something radically wrong with the set. We have had many similar letters lately from amateurs, who are not obtaining the results with five or even more valves, that others obtain with one or two. General advice we have given before (see reply to "Disgusted," London, in No. 18, and others of a similar nature), so that there is little to be added except that another stage of amplification should hardly be necessary.

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

No. 22. THE SUPER-REGENERATIVE SET : HOW TO MAKE IT

POPULAR WIRELESS

3d

Weekly

No. 22. Vol. 1.
Oct. 28, 1922.

Major Armstrong and His Super-Regenerative Set.
(See Article Inside.)

FEATURES IN THIS ISSUE :

NEXT WEEK.

HOW TO MAKE A LOOSE COUPLER.

In view of the many questions received on the construction of loose couplers, an article on the subject has been specially written for POPULAR WIRELESS.

Popular Wireless

TOPICAL NEWS AND NOTES.

COMMENCING SHORTLY.

HOW TO MAKE A D. F. STATION.

A new series of articles by an ex-Air Force Wireless Instructor, giving full details for the construction of a Direction Finding Station suitable for amateur experimental work.

A Fateful Day.

THE big broadcasting meeting held at the Institute of Electrical Engineers on October 18th was quite breezy.

Several "posers" were put to the representatives of the "big six," and, to say the least of it, they showed a remarkable gift for "turning the barbed shaft."

Mr. Isaacs was hard pressed about the exact date when broadcasting would begin. In the end he declared that Marconi House would "probably begin on Monday" (October 23rd).

There was another little breeze about "something from the Danube" over which I propose to skip, because "somebody" at the meeting delivered good advice about people minding their own business.

* * *

That £50.

MANY manufacturers present were vastly indignant at the news that, besides paying for a £1 share, they would have to shell out £50 as a deposit.

It appears that the Broadcasting Co. are going to hold each member's £50 just as long as the member remains a member. Meanwhile, people are asking why the Broadcasting Co. should enjoy the interest on the aforementioned £50.

* * *

Crystal Sets.

AND will the crystal set buyer find he has to pay an extra 7s. 6d. ? For details, see the Editor's letter.

By the way, the company only guaranteed a service for two years, because, at the end of that time the "protection" clause would be dead, and foreign goods might play havoc.

However, I hear that the P.M.G. is open to consider this protection question at the end of two years.

* * *

Probable New Station.

CANADA has been asked by the Post Office Department to build a giant new wireless station to communicate with the English station and form a link in the proposed Empire wireless chain.

Proposals have been made to the Hon. E. M. Lapointe, Canadian Minister of Marine, for the construction of a station at a cost of about £250,000.

It is estimated that it will require £50,000 annually for upkeep. If it is constructed, there will be all-British wireless communication between England, Egypt, India, Australia, and New Zealand and Canada.

Mr. Lapointe has cabled for Canada's Governmental wireless experts to come to England to discuss the cost of the scheme.

2 M T Drama.

WRITTLE broadcasted a real drama on October 17th, and the result was surprisingly good.

This was a selection of three simple scenes, in English, from the play "Cyrano de Bergerac," recited during the Marconi concert by Miss Agnes Travers, of the Royal Academy of Dramatic Art, with some amateur assistance.

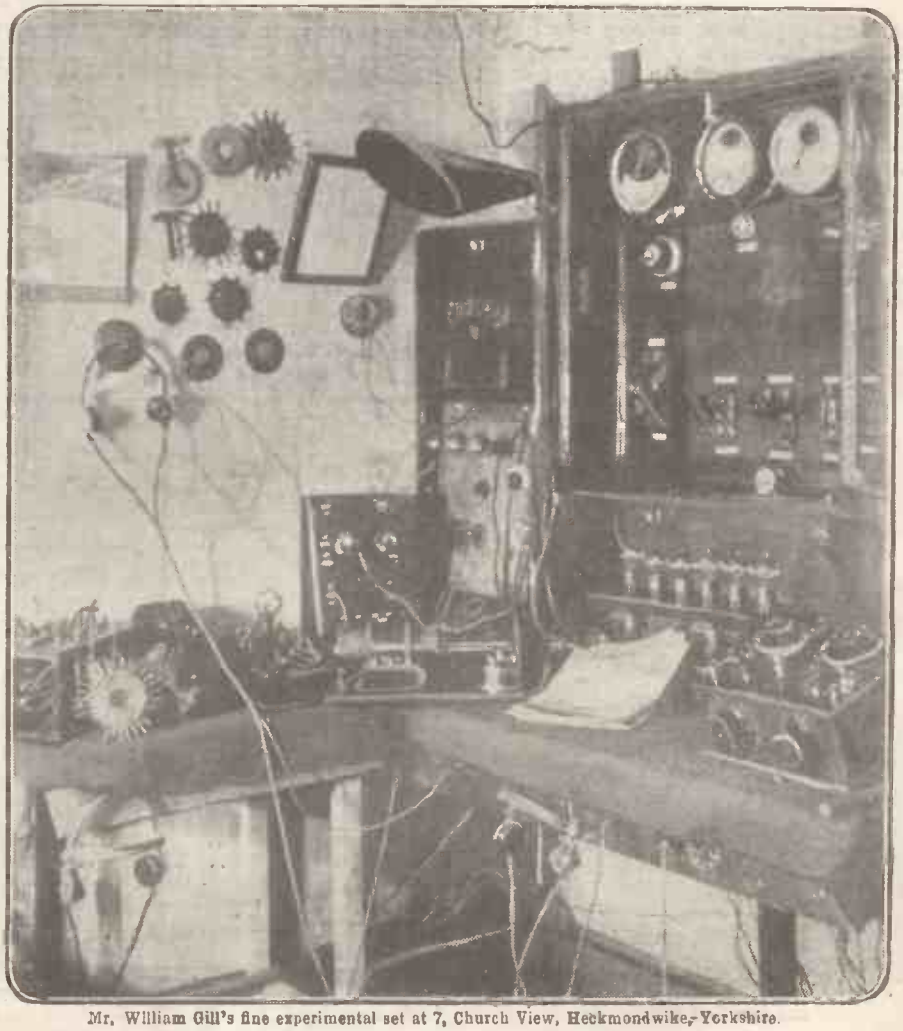
As appeal in broadcasting has to be made solely through the sense of hearing, the balcony scene from "Cyrano" was chosen, as in it the stage is in darkness and action is reduced to a minimum.

This is a new departure in the Writtle programme, and I hope a few more innovations will be made in future.

The Army and Private Sets.

IT is officially stated that officers and other ranks of the Regular Army, Militia, Territorial Army, or Officers Training Corps who wish to instal private wireless sets for sending or receiving messages, are subject in all respects to the Postmaster-General's regulations governing the installation and working of such sets.

They should apply in their private capacities for transmitting or receiving licences to the Secretary, General Post Office, London, E.C., who will treat their applications on the same lines as those received from members of the public generally. The War Office accepts no responsibility for wireless sets other than those held on the authorised establishment of units.



Mr. William Gill's fine experimental set at 7, Church View, Heckmondwike, Yorkshire.

NOTES AND NEWS.

(Continued from previous page.)

Mr. Rex Fowell (no address given) and his home-made set. Will he please communicate with the Editor.

Good Advice.

"TO be a success in this country broadcasting must be absorbed into the main stream of life; it must become an institution, like the telephone in America.

"Owing to the peculiar fascination surrounding the radio art, because of the remarkable physics involved in its practice, and the fact that its stamping-ground is the mysterious ether of space, there can be no doubt but that many holders of "broadcasting" licences will hanker to possess and use experimental apparatus and to become real wireless amateurs. Now, without committing myself to a prophecy about Post Office regulations, I think I may safely assert that the granting of experimental wireless licences will always be conditional upon the would-be licensee being to a certain degree expert in both knowledge and practice of wireless.

"In order to attain the standard of proficiency in and knowledge of wireless matters, the aspirant to an experimental licence can do no better than join a wireless club, of which there are many.

"Most clubs require no qualification save enthusiasm for wireless, and are only too willing to assist the beginner. In the ranks of a club you may practise Morse, receive practical and theoretical instruction, and talk "wireless" to your heart's content. The address of the club nearest to your home may be obtained from the editor of any of the publications concerned with amateur wireless affairs."

(M. E. BLAKE, A.M.I.E.E., in the *Daily Mail.*)

Mr. Farman, of 10, Abbeygate Street, Bury St. Edmunds, busy making a coil.

Canada and Radio.

CANADIAN wireless experts will shortly visit England in order to discuss with the General Post Office authorities a proposal to build a great wireless station in the Dominion.

* * *

The Mullard "ORA."

WHAT'S in a name? Quite a lot—as a representative of Mullard's pointed out to me the other day.

Take the famous "Ora" valve, for instance. The name is derived from the unique properties of this valve as an oscillator, rectifier, and amplifier. This triple function enables the one type of valve to be used for the three different purposes on any valve set.

One specially interesting feature of the Mullard valve series is the range of valves with low temperature filaments. These constitute a new development which should arouse considerable interest in view of their great advantages for all valve purposes.

* * *

A Protest.

THE following notice was sent to the Press after the big broadcasting meeting:

"The Radio Association deplores the fact that thousands of licence-holders were entirely ignored in settling the form which broadcasting is to take, and that the general public is receiving no adequate protection against the growth of a monopoly.

"Those present at the meeting were afforded no opportunity of seeing the articles of association of the company, although they gave practically unlimited powers to a small group.

"A deposit of £50 is to be demanded from small manufacturers who subscribe for a £1 share. What is the purpose of this deposit and to whom does it go?

"The royalties are altogether too excessive, and bid fair to cripple an important British industry.

"The Radio Association looks to the Postmaster-General to give an early explanation of these measures."

* * *

The Mullard Case.

MR. JUSTICE P. O. LAWRENCE has dismissed the action which was brought by the Marconi Wireless Telegraph Company, Limited, against the Mullard Radio Valve Company, Limited, for an injunction for alleged infringement of patents. The defendant company pleaded that the Marconi patents in issue were invalid, but his Lordship decided that the attack on the validity of those patents failed. He came to the conclusion, however, that the valves made by the defendant company did not infringe the plaintiff company's patents.

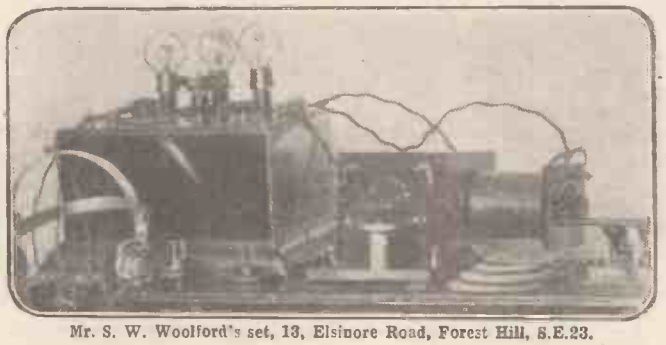
* * *

Valve Merchants.

A BERLIN engineer, two physicists, and a mechanic have been arrested on the charge of having obtained patented wireless transmission valves belonging to the Telefunken Company, and sold them abroad.

The company is stated to have found its valves in use in stations situated in the United States, Holland, and the Russian border states. The persons arrested are said to have confessed, and have been released on bail pending prosecution.—*The Times.*

ARIEL.



Mr. S. W. Woolford's set, 13, Elsinore Road, Forest Hill, S.E.23.

Broadcasting Programmes

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

TELEPHONY TRANSMISSIONS.

Station.	Call sign.	Wave-length in metres.	Remarks.
Croydon	GED ..	900 ..	Throughout day to aeroplanes.
Marconi House, London	2LO ..	360 ..	Not regular.
Writtle	2MT ..	400 ..	Tuesdays, 8 p.m.
Paris	FL ..	2,600 ..	5.16 p.m.
Königswusterhausen ..	LP ..	2,500 and 4,100 ..	Daily, 7 and 10.30 a.m.
The Hague	PCGG ..	1,085 ..	Sundays, 3 to 5 p.m.
Messrs. Burnham* (Blackheath) ..	2FQ ..	440 ..	About 9 o'clock any evening.
Newcastle*	5BA ..	440 ..	6 and 7.30 p.m.

NOTE.—The Bar Lightship, Liverpool, sends telephony at 7 a.m, 9 a.m., 12 noon, 3 p.m., 5 p.m., 7 p.m., and 9 p.m. Wave-length 440 metres. Calls "Liverpool." When answering Liverpool calls "Bar Light."

Many amateurs may be heard of an evening on 440 metres, also as low down as 60 metres. Amateurs who transmit music regularly please communicate with the Editor.

All times G.M.T.

* These transmissions are made purely for experimental purposes.

HOW TO BUILD A SUPER-REGENERATIVE SET.

LAURENCE M. COCKADAY, R.E.

ANOTHER great step has been taken in the radio art—a step that is destined vastly to extend the use of radio by improving the receiving apparatus in important particulars.

Announcement of this important development has only recently been made by Edwin H. Armstrong, the inventor, who gave two impressive demonstrations in New York of what he calls the "super-regenerative circuit." The first demonstration was made before the Institute of Radio Engineers, and the second was made a few days later at Columbia University; both meetings were open to the public, and both were attended by great numbers of radio enthusiasts. So important is this discovery regarded in scientific circles, and so far-reaching is it in its effect upon the development of radio, that detailed information concerning it is of value to radio amateurs and professionals alike.

The remarkable feature of the new Armstrong circuit lies in the fact that it permits almost unlimited amplification—but at the same time requires only a small number of tubes. In Armstrong's demonstration he used one, two, or three.

Users of Armstrong's ordinary regenerative circuit will remember how, by turning the knob of the dial marked "regeneration," the signal strength of incoming messages could be increased slowly at first and then with a rush as the dial approached the point on the scale where the circuit began to oscillate. If the dial were turned beyond this point the voice signals would become distorted.

A Wonderful Discovery.

Many investigators have wondered if it would be possible to prevent the circuit from self-oscillation by some means, even if the dial should be turned past this point, thus obtaining an unlimited amount of amplification without experiencing trouble from the distortion which would certainly take place were the circuit to produce oscillations.

The general opinion among the experts was that this was not possible; Armstrong himself, up to a year ago, would have replied in the negative.

Nevertheless, he continued his researches with the vacuum tube, studying the reactions that took place in the tube circuits and learning just what sudden changes in the positive and negative resistances of the circuits would accomplish. Finally he conceived the idea of his new invention.

It is a well-known fact that a tuned circuit will oscillate if the resistance of the circuit is not too great to dampen out the oscillations. Now suppose that we should introduce a certain critical amount of resistance in the vacuum tube input circuit of an ordinary regenerative receiving set while it is in a state of oscillation. Under these new conditions the oscillations would suddenly be dampened out and cease.

If this adding of resistance to the circuit could be done periodically (say at a frequency just above the frequency that the human ear could detect), the vacuum tube circuit would become, alternatingly, extremely sensitive and then dead and sluggish.

In other words, the circuit would be "damped" at intervals that occurred at a high rate of speed. During these intervals the circuit would be of increased resistance, and the self-oscillation would cease. But between these intervals the circuit would be at an extremely critical stage, as the resistance would be withdrawn and the circuit, while trying to start oscillating, would amplify incoming signals enormously. This would give a series of periods of almost unbelievable amplification which would follow each other so rapidly that they would seem to run into each other; so far as working the telephones and affecting our sense of hearing are concerned, they really do just that.

Remarkably Sensitive.

These results are brought about by the use of the circuit shown in Fig. 4. The damping device consists of another vacuum tube which is attached to the regenerative circuit so that the oscillations generated by the second tube effectively vary the damping of the first tube circuit with respect to the regeneration.

Another method for accomplishing the same results would be to vary the amount of regeneration with respect to the damping of the vacuum tube input circuit. If the handle of the regenerative dial could be rotated back and forth at a terrific rate (above audibility), what would happen? The circuit would become enormously sensitive for an instant; then when the knob was brought back in the opposite swing it would be effectively prevented from self-oscillation. This method would give the same series of periods of increased amplification as the first method, and is accomplished by the use of the circuit shown in Fig. 5, in which the second tube is attached to the plate circuit of the first tube by means of the coupling transformer T and the condensers C2 and C3, so that the oscillations generated by the second tube are used to vary the amount of regeneration in the first tube circuit.

Still a third method may be used for super-regeneration. This is accomplished by varying both the damping of the first circuit, and the amount of regeneration, at the same time, with respect to each other, keeping the proper phase relations. Fig. 6 shows such a circuit, where the same tube is used for both regeneration and for generating the oscillations by which the characteristics of both circuits are varied, the second tube being used merely as a detector.

Since Armstrong made his announcement many experimenters have tried to get a receiving set that embodies one of these different methods to work. Some have had great success with it, while others have had little or none.

Materials Required.

The writer has tried the various circuits as described, with variations and adaptations, and has had such great success with one particular circuit that it is recommended for use by the amateur because of its simplicity of operation and flexibility. It can be used for receiving continuous waves, telephone, music, and (by making slight adjustments) for spark reception.

For building this set, the following materials will be required:

1 duo-lateral or honeycomb coil, L-1,250 (A).
1 duo-lateral or honeycomb coil, L-1,500 (B).
2 variable condensers, ·001 mfds. capacity, (C).
2 fixed mica condensers, ·002 mfds. capacity (D).
2 fixed mica condensers, ·0005 mfds. capacity (E).
1 insulating tube, 4 inches long, 3 inches in diameter, wound with 60 turns of No. 19 S.W.G. copper wire (F).
1 moulded variometer (G).
1 amplifying transformer (H).
3 tube sockets (I).
3 filament rheostats (J).
10 terminals (K).
1 insulating panel, 8 inches by 20 inches by ¼ inch (L).

(Continued on next page.)

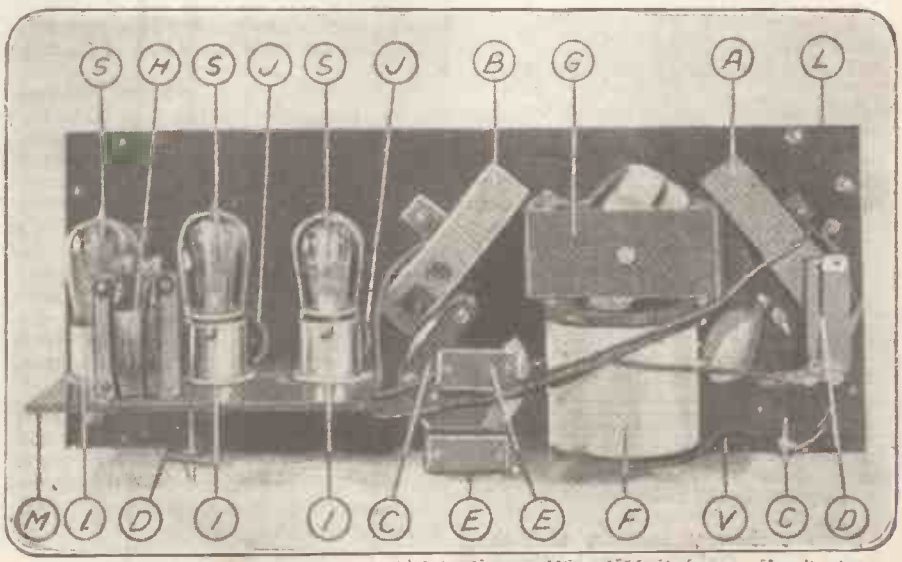


Fig. 1.—The various items that are required in the assembling of this Armstrong-circuit set are illustrated in this diagram. Note that the coil F and the variometer G are placed in inductive relation to each other. The regeneration in the first valve is controlled by the variometer.

HOW TO BUILD A SUPER-REGENERATIVE SET.

(*Continued from previous page*).

1 insulating panel of suitable size for mounting sockets and the amplifying transformer (M).
3 large knobs and dials (N).
1 cabinet, outside dimensions 8 inches by 20 inches by 6½ inches, with a door at right top, 4 inches by 8 inches, for inserting tubes (O).
2 automatic lighting jacks, one double circuit and one single circuit (P).
1 duo-lateral or honeycomb choke coil, L-200 (Q).

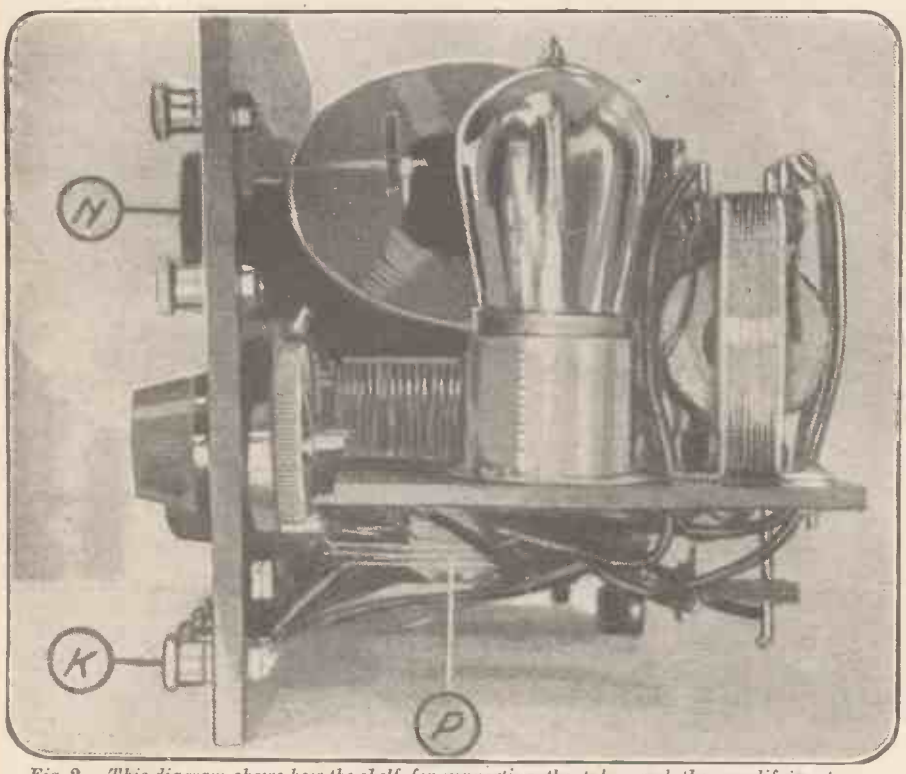


Fig. 2.—This diagram shows how the shelf for supporting the tubes and the amplifying transformer is mounted on the jacks P. The jacks are fastened to the panel L, as shown in Fig. 1

1 1-megohm grid leak (R).
3 "hard" valves. R Type (S).
Miscellaneous screws and bolts (brass) (T).
Some connecting wire, bare copper (U).
Varnished cambric tubing for insulating the connecting wire (V).

The panel is laid out as shown in the illustration above, in which the three small knobs and pointers at the left are

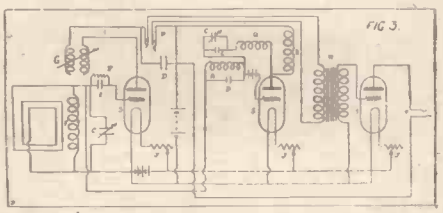


Fig. 3.—Circuit for set described in this article. Letters correspond exactly in the diagram, the text, and illustrations.

the filament rheostat controls, with the two telephone jacks mounted directly beneath. The two large knobs at the left bottom are connected to the two variable condensers, and the large upper knob is fastened to the variometer.

The method of mounting the various instruments on the back of the panel is shown clearly in Fig. 1.

The method used for mounting the tube shelf on the telephone jacks is indicated in Fig. 2.

After the instruments have been mounted, they should be connected up according to the diagram shown in Fig. 3. All joints should be soldered. Connecting wires should not run parallel for any great distances.

The parts on the diagrams and the photographs bear the same letters as the list of parts in the text, so the amateur should have no trouble in assembling this set.

The duo-lateral choke coil cannot be seen in the illustration, but it is mounted flat against the panel in the rear of the coil, F.

The two terminals at the left of the panel are for connection to the loop antenna. Starting at the left, the row of terminals shown in the illustration should be connected as follows: first, negative "L.T." battery; second, positive "L.T." battery and negative "H.T." battery; third, "H.T." battery positive of the first two tubes; fourth, "H.T." battery positive of the third tube; fifth, positive "C" battery for second tube grid; sixth, negative "C" battery for second tube grid. The two terminals arranged vertically at the right can be used for connecting to a loud speaker.

When the set is completed and hooked up to a suitable loop antenna, which can easily be made by winding on 12 turns of No19.SWg copper wire on a three-foot-square wooden frame, extremely good results may be obtained.

The writer used an 8-volt L.T. battery and a H.T. battery potential of 100 volts on the plates of the first two tubes, and

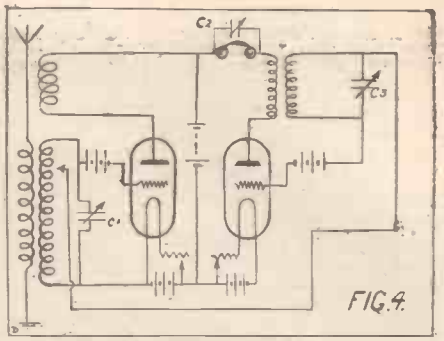


Fig. 4.—This diagram illustrates the method of obtaining super-regeneration by varying the damping of the first tube circuit with respect to regeneration. The set described in this article uses an adaptation of this method.

150 volts on the third tube. The "C" battery on the second tube, used to keep the grid at the correct negative potential, was 3 volts. An ordinary grid condenser and grid leak was used here with fair results, although the "C" battery was better.

The condenser connected across the primary of the amplifying transformer was found sufficient to bypass the high-frequency current generated by the second tube and prevent it from inducing a strong current in the grid circuit of the amplifier tube, thus "knocking" the amplifier tube. No other

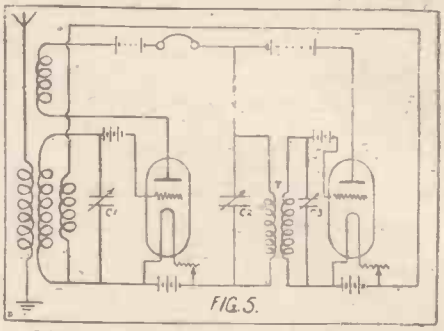


Fig. 5.—This circuit diagram shows how super-regeneration may be obtained in still another way—by varying the amount of regeneration with respect to the damping of the input circuit of the first tube.

form of filter was found necessary, although a good filter probably would help here.

The object of this description of the set is not so much to show the amateur all the structural details of a set that employs this circuit, but to give a general idea of a simple way to build it so that it will work, if the main points are carried out to completion.

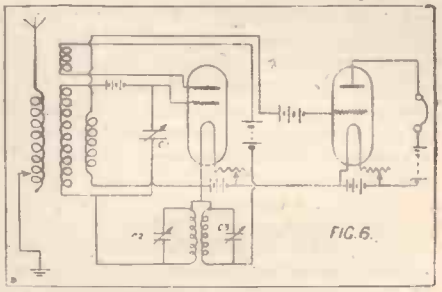


Fig. 6.—How super-regeneration may be obtained by varying both the damping and the regeneration with respect to each other, keeping the proper phase relations.

(*Continued on next page*)

THE RADIO ASSOCIATION AND HOW IT WILL HELP YOU.

By C. L'ESTRANGE MALONE, F.R.Ae.S., M.P.

IT is only in the last few months that radio telephony has made its début before the general public as a coming factor in our national life.

It is rapidly becoming clear that the benefits of radio telephony will not be confined to persons with certain scientific attainments.

Radio telephony appeals to a wide public, it is within the means of a wide public, which is good for all concerned.

One doubts whether some of the large organs of the Press yet realise how this child, which is just growing up, may one day affect them. The day is probably not far distant when radio-telephotography will have passed beyond the experimental stage, and then the ether will be able to provide all the benefits (or are they evils ?) of the daily picture paper.

Whoever controls the radio world will control an enormous force for good or evil.

When a new development starts there are always difficulties and misunderstandings —obstructive regulations, the control of prices, the "bubble" manufacturer, etc.

It is to deal with these conditions that the Radio Association, whose aims have already been fully published in POPULAR WIRELESS, was formed.

Hundreds of people are beginning to ask themselves the question, "What is all this about broadcasting ?"

The Radio Association have already arranged a tour of lectures in the provinces to explain the elementary principles of radio-telephony, the apparatus required and how difficulties may be overcome.

The Postmaster-General has to make regulations as to licences, the fees to be paid, the qualifications necessary, the times between which amateurs who hold transmitting licences may transmit, and other points which will occur to your readers.

The Radio Association is in communication with the Postmaster-General on many of these points, and will endeavour to secure the best conditions for the licencees.

There is a danger, too, that broadcasting may become the monopoly of a few privileged firms. The secrecy with which the negotiations have been conducted do not lend confidence either to the prospective listener or to the manufacturer who happens to be outside the favoured circle.

Monopolists who keep the prices unnecessarily high, or patentees who make unscrupulous use of their patents to check progress or to threaten rival manufacturers with perhaps more limited financial resources, will soon find themselves up against the Radio Association.

It is hoped that ultimately the Radio Association, the Wireless Manufacturers and Traders Association and other kindred bodies will be represented on the directorate of the British Broadcasting Company, and so to protect the interests of the thousands of license-holders and of the small manufacturers and traders.

These notes indicate just a few of the directions in which the Radio Association is taking active steps.

"Efficient broadcasting at a reasonable cost" might sum up these activities.

All are eligible for membership. Applications for membership are coming in from all over the country. A few nights ago a message came by radio-telephony from somewhere in Devon asking for the address of the secretary.

Special activities of the Radio Association will be reported in the official organ—POPULAR WIRELESS.

The address of the secretary is, S. Landman, M.A., 9, Southampton Buildings, W.C.2.

HOW TO BUILD A SUPER-REGENERATIVE SET.

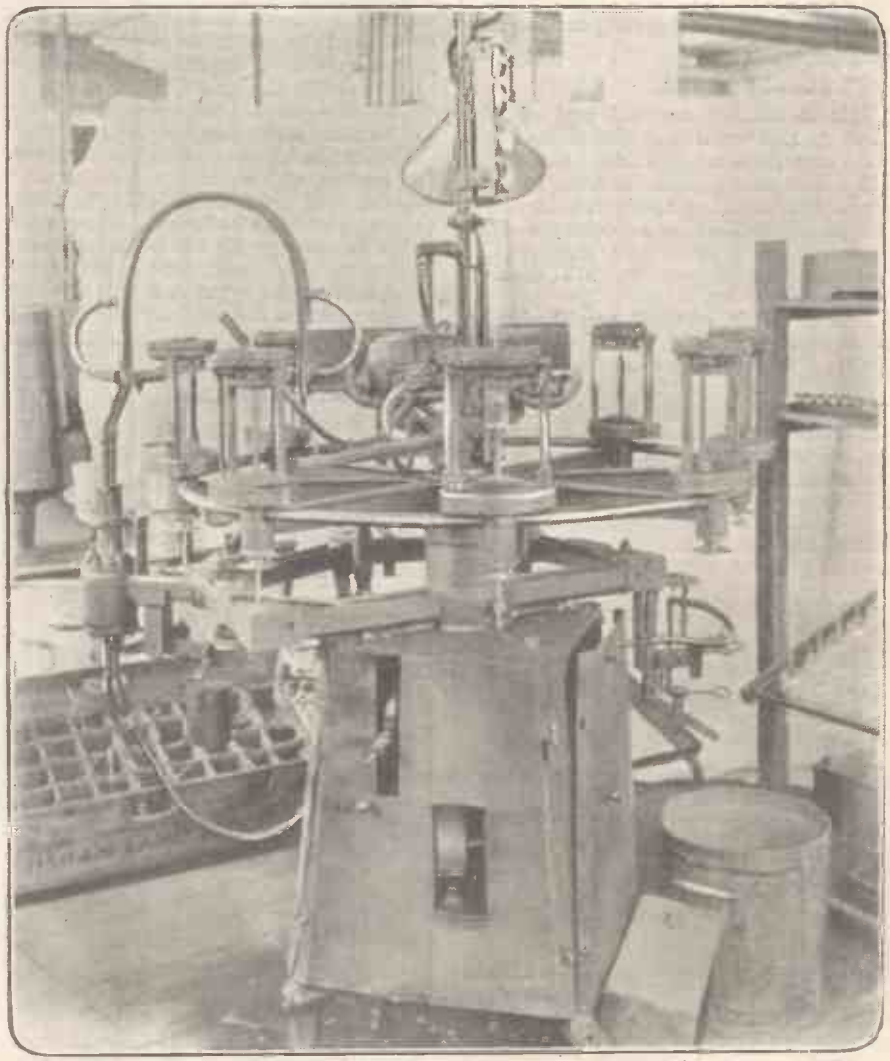
(*Continued from previous page.*)

The easiest way to find out how to tune the set is to turn up the filaments of the tubes rather high, and then set the tuning condenser located at the lower left-hand corner of the panel at zero. The next move is to turn the other lower condenser to a near-maximum setting. Then the upper dial which is affixed to the variometer should be turned in the same manner as the ordinary tickler adjustment until a loud squawk is heard. Then turn down the filament of the second tube slightly until the squawk increases in intensity. The squawk is then tuned out by adjusting with the variometer, and for each given setting of the wave-length tuning condenser there is a setting on the variometer at which static and signals will come in loudly. When a signal is finally tuned in it may be slightly distorted or mushy at first, but it can be cleared up by careful adjustment of the two lower knobs and by slightly varying the filament adjustments of the three tubes.

In a few hours of practice the amateur can master the method of tuning this new set by learning what each particular sound heard in the receivers means in regard to adjustment.

"THE ELIMINATOR."

Full details of a new and most ingenious invention will shortly be published in POPULAR WIRELESS. The inventor of the Eliminator is an ex-Naval officer, who spent two years and over £2,000 on his invention. Its claims and method of working will interest all experimenters.



The sealing-in machine, in which the "pinch" is sealed in a valve. (See special article on page 475.)

HOW TO MAKE A LONG-WAVE RECEIVER.

By Y. W. P. EVANS.

PART 3.

THE tinfoil should be cut so as to have a small tail, and then built up one tail to the left and one to the right alternately, a layer of waxed paper being placed between each piece of tinfoil, and one layer top and bottom. When this has been done, grip the whole with the finger and thumb of the left hand and bind them together with gummed paper or adhesive tape, taking great care

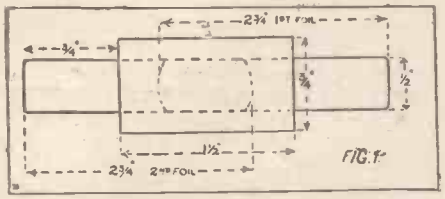


FIG. 1.

not to disturb the position of the foil, each of which should be directly over the next below, the same rule applying to the tabs, or tails. (There should be 2 tabs one way, and 3 the other.) Drill four holes at the corners of the ebonite sheets, and countersink one set sufficiently deep to take the bevel of the wood screws. These parts should now be placed on one side until they are required for mounting on the panel of the receiver.

Grid Leak and Condenser.

This is another essential part of the receiver, and great care should be taken in its construction. The final value of the leak cannot be determined until the receiver is ready for working, unless you are fortunate enough to have its resistance tested at some post-office or electric works. The resistance should not be less than 2 megohms.

The materials required are: 2 ebonite strips, 2½ by ¾ by ¼ in.; five pieces of tinfoil, 2¾ by ½ in.; 6 pieces of mica sheet or paraffin-waxed paper, as near ·001 in. in thickness as possible, and 1¾ by ¾ in. in size; 2 BA terminals. The first step is to make up the condenser element, following the procedure used in the construction of the telephone condenser.

First a layer of mica or waxed paper, then a sheet of tinfoil, the latter to overlap 1¼ in., another piece of paper, then one more foil in the opposite direction (Fig. 1), and so on until the material is used up, when you should have three pieces of tinfoil overlapping at one end and two at the other. Keep these carefully in position, and bind together with thin gummed paper or fine adhesive tape. Now prepare the ebonite strips by placing them together and drilling a hole through each end as shown in Fig. 2.

These holes should be such as to accommodate the two terminals. Having done this, select one strip, and file a V-shaped groove along its centre line about $\frac{1}{16}$ in. deep. This should be done with a fine ward file, so as to obtain a very smooth surface in the groove. With a good quality H.B. pencil draw about six lines along the bottom of the groove so as to form a continuous film of graphite along the whole length.

At each end continue the film up the sides and around each hole, so that when the terminals are in position they will actually be in electrical contact with the graphite.

The instrument can now be assembled in the order named: Bottom strip of ebonite, condenser element, top strip of ebonite, the V uppermost. Holding these three sections together, bend over the tinfoil ends so as to cover the holes and make contact with the graphite, and with the point of a penknife, or other suitable implement, make a hole in the foil of a size that will ensure it gripping the terminal screw fairly tightly.

Flatten the foil out so as to present a perfect surface, and secure the three sections together with the terminals (Fig. 3). Small packing pieces can be inserted between the strips to make up for the thickness of the condenser. The instrument is now ready for mounting on the panel, details of which will be given in the next article.

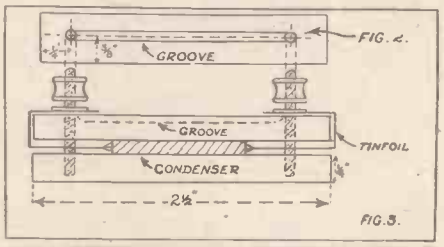
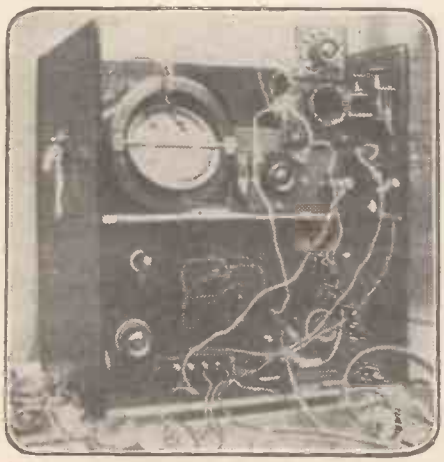


FIG. 3.


A 2-Valve Set made by Mr. H. Wilson, 18, Richmond Road, Aylestone Park, Leicester


Condenser and container shown at the Exhibition by Messrs. Peto Scott

THE ANTICIPATOR.

DR. J. A. Harker, F.R.S., who made an interesting speech at the British Association meeting the other day, is an authority on internal combustion engines, nitrogen from the air, and any number of other abstruse subjects.

Some time ago he delivered a lecture during the science week at the Browning Settlement and told an interesting story of how Sir Oliver Lodge anticipated Marconi in the invention of "wireless."

"I remember," said Dr. Harker, "the British Association meeting in Liverpool in 1896. At the end of the meeting on the last morning Sir William Preece, who was then chief electrician to the Post Office, had been describing in the course of a debate on transmission of wireless signals, the fact that a young Italian had come a few months previously to his laboratory at the Post Office, and had succeeded in showing what then was an extremely novel thing, that wireless signals could be transmitted over a distance of about a mile.

"That young man was Marconi. After the morning's work was done, I was clearing away my apparatus in the preparation room attached to the Physical Lecture Theatre, where the meeting was held, and was having a word with Sir Oliver Lodge.


Tuner shown at Exhibition by Messrs. Gambrell & Co.

"As we were talking, Lord Kelvin came in—came up to Sir Oliver just like a school boy let out of school. For the programme was over and he felt, like the rest of us, that we had done our work.

"He said: 'Let's see, Lodge, weren't you on with something of this sort, with Hertzian waves?' 'Yes,' said Sir Oliver, 'and under the circumstances I'm sorry that I didn't show this experiment myself. I have been so busy as general secretary of the association that I haven't had time to do what I had planned to do during this meeting.

"'I have been telegraphing by wireless signals between my house and this laboratory, and I intended to have the installation fixed up to demonstrate to the members of this section.'

"Kelvin asked with enthusiasm: 'How far is it to your house? How far have you succeeded in getting good signals?' 'Oh, about two miles,' said Sir Oliver. I shall never forget the reply of Lord Kelvin.

"He said: 'That's right, Lodge. If Mr. Marconi can go a mile, surely you can go two miles!"

EINSTEIN, MARS, AND WIRELESS.

By JOHN HILL,

NOTE.—THIS ARTICLE IS INTENDED FOR THE MORE ADVANCED EXPERIMENTER AND STUDENT.

THE experiments in physics recorded in Einstein's work "Relativity" are quite extraordinary in character, and the conclusion arrived at by that thinker—when modified in the light of the principle of correlativity—should be of interest to every student of wireless.

Two measuring rods are placed on a disc—the one tangentially to the edge of the disc, the other in the direction of the radius. The disc is then rotated. If any change takes place in the rods, it will be impossible to discover it by ordinary means because an additional rod, in application, would come under the same conditions. Instead, a mathematical equation is used. While the rod laid radially is proved (mathematically) to remain stable in length, the tangential rod is proved (mathematically) to suffer a shortening or contraction. The non-contraction of the radial rod is accounted for by the effect of centrifugal force. The conclusion is that moving bodies are shortened in the direction of their motion. As a consequence, "the propositions of Euclidean geometry cannot hold exactly" in physics, and "the idea of a straight line also loses its meaning."

Now, the special theory of relativity enunciated by Einstein leads, according to a correlative standard, to one-sided conclusions because its interpretations of scientific events are solely from a motional standpoint. Thus, while the tangential rod is rightfully supposed to undergo a change of some sort, a shortening or contraction remains in doubt when we consider the possible behaviour of both rods in their cross-sections. The radial rod, cross-sectionally, is in the same direction of motion as the tangential rod taken as a whole.

Another Aspect.

On Einstein's basis, therefore, it should suffer a shortening in its breadth. The tangential rod, cross-sectionally, is in the same direction as the radial rod. These cross-sections, then, should remain stable as to length. In that case, how is it possible for the tangential rod to suffer a shortening as a whole? Not by compression lengthwise, because then the cross-sections, although radially laid, could not remain stable. Not by an absolute loss of material in its length, because such a thing would have been discoverable with the rod at rest after the experiment. Yet Prof. J. A. Thomson says that if a foot-rule be projected at the speed of 161,000 miles per second it would "shrink into nothingness." It is thus doubtful if the relativists can furnish a precise definition of the shortening.

But look at the problem in this way. The tangential rod is moving faster in every succeeding cross-section from the middle towards both ends. There is a tendency to uniform motion diminishing in every cross-section from the ends of the rod towards the middle. The tangential rod, therefore, in obedience to both forces—centrifugal and centripetal—is likely to suffer a distortion in the nature of a curvature.

And when we take into account the tendency to distortion in the cylinders of a rotary engine, and when we know also that those cylinders are similarly placed as the tangential rod, we can conclude we are safe in saying that that rod undergoes distortion also. Why, then, could Einstein assert that the rod is shortened? Because the curvature, so minute as not to be evident, was, moreover, not discoverable by means of his equation.

The mathematical process, in reality, resulted in the discovery that the ends of the rod had approached each other. Hence the apparent proof of shortening. Plainly, the straight line does lose its meaning in physics; but, because of this very happening, the validity of mathematics as a proof of shortening can be questioned, since the science of mathematics was built up on the same considerations that established the validity of the Euclidean straight line.

Contrary to Nature.

Let us now examine the statement that a foot-rule would diminish into nothingness if projected at the rate of 161,000 miles per second. I trust I shall be readily understood when I say we can conceive the spacial side of things in terms of a co-existence of positions that offer resistance, and that we can conceive the motional aspect of things in terms of a co-existence of successions that offer no resistance. We do so conceive of existence through the process of mental analysis by which we split up unity into two aspects.

View of a radio cabinet set, 6 valves and loud speaker. Sent in by H. M. WOOLLEY, 90, Russel Road, Selton Park, Liverpool.

But if we take either of the two to be wholly true or wholly efficient *in itself*, we shall obtain a one-sided or narrow interpretation of what is happening in our world. Knowledge is just as one-sided or inconclusive when we think similarly of either centrifugal or centripetal force, instead of viewing them as analytic terms of what must be, after all, one process.

For, if we eliminate centrifugal force, we have movement without reference to extension or position; if we eliminate centripetal force, we have extension taking place without movement. Both are impossible.

What I want you particularly to note is that movement without reference to extension or position would be quite possible if a body can diminish into nothingness by reason of its motion or movement. Do you not see that if the foot-rule vanished—not into its original element or elements—but into nothingness, it would leave us with motion unaccounted for?

On the foregoing we can safely hold to another conclusion—a novel one, I believe. Motion is always associated with a curve, whether we see the curve or not; and nothing exists without motion. Every problem, then, is a space-motion one. Most certainly, therefore, a body would diminish into nothingness if projected along a mathematical straight line, *whatever its velocity*. It would be an event contrary to nature. Yet that is what is implied in Einstein's statement of the shortening of the tangential rod.

A Message Carrier.

What has all this to do with Mars and wireless? This. In the typescript of my first work on "Correlativity," written some years ago, I state that at a definite point between the sun and the earth such conditions obtain that space, motion, and force as we ordinarily apprehend them would be inappreciable to us if we were placed at that point. Also, that the point is nearer to the solid earth than to the sun. That is, it would be approximately where Prof. Fleming places the "screen of dust" he believes to be projected from the sun.

Now, the surface of the world, correlatively speaking, is not what we ordinarily call its surface, because the solid earth is not the limit of our sphere. We must assume that our atmosphere fines away until it reaches the point of inappreciability. There is our actual boundary, and for an electro-magnetic current to be able to penetrate past that point it would have to cease following the curve of the earth. Its path, in that case, would flatten so much towards a mathematical straight line that extreme dissipation would take place.

As a message-carrier the current would become useless; it would cease to be worthy the name of "current." Thus we can follow an electro-magnetic current, as a current and therefore as a message-carrier, only within the world-limits.

(*Continued on next page.*)

TWO USEFUL IDEAS FOR THE AMATEUR.

By H. W. KENDALL.

THE two following ideas will doubtless be very useful to the experimenter, since they are inexpensive, and can be made from stock materials.

The rotary switch arm with the knob situated centrally can be seen on practically any wireless set, sometimes in large and sometimes in small numbers. Yet, on questioning the owner, it will be found in nine cases out of ten that these articles have been purchased simply because it was thought that they were too difficult to make. But really they are simplicity and cheapness itself.

Procure an ordinary 1½-in.-diameter ebonite knob, and, starting from the under side, drill a ⅜-in. hole, either with an ordinary carpenter's centre-bit or a twist drill. The appearance is improved if the drilling is stopped just before coming through to the other side, but if this does occur it will not matter much. The under side of the knob will be found to be ¾ in. diameter, just leaving room for two holes at opposite ends of a diameter to be drilled and tapped for 6 B.A. screws.

Next, cut off a piece of ⅜ in. by $\frac{1}{16}$ in. strip brass 1½ in. long, and drill it as shown in the diagram (Fig. 1). The two smallest holes are for riveting on with short pieces of brass wire, a piece of phosphor bronze or springy brass of the dimensions shown; this should be bent so as to be slightly concave on the under side, so that it will negotiate smoothly any irregularities in the height of the studs. A piece of brass rod 1½ in. long threaded 2 B.A. should be cut. This will be found long enough to go through any panels up to ⅛ in. thick. This threaded rod can be obtained from most metal merchants for a few pence per foot.

A spring washer is essential to the smooth working of this or any other switch. When buying spring washers, ask for the two-coil type, as there is more "give" in them.

The rest is practically self-explanatory from the drawings. Some hexagon 2 B.A. nuts are slightly larger than others, and in that case it may be found necessary to file off the corners of the two which go inside the ⅜-in. hole in the knob. Instead of using two nuts inside the knob, an alternative is to fasten one only on the rod with solder.

Small fixed condensers are indispensable on any set, for grid condensers, coupling condensers, by-pass condensers, etc. The following is a simple method of constructing robust condensers from stock materials.

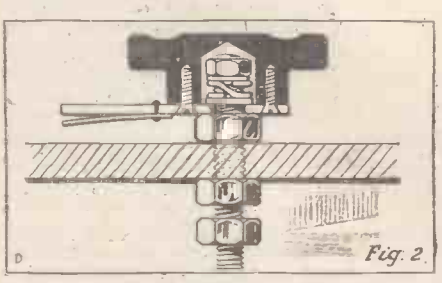


Fig. 2.

All that is required are some large size solder connecting tags, mica washers, brass washers, and a length of 4 B.A. threaded brass rod and nuts to fit. When it is intended to mount these condensers straight on to a panel, use a 4 B.A. cheese-headed screw ⅜ in. long. Before assembling, slip a short length of cycle valve rubber tubing over the middle portion of the rod or screw; this will fit more snugly and with much less trouble than small ebonite tubing. The tags should have the circular part ½ in. in diameter with ¼ in. hole; the mica washers can be ¾-in. in diameter with $\frac{3}{16}$-in. hole.

For each piece of mica dielectric, the capacity can be reckoned as ·00005 mfd., assuming the mica to be of average quality and ·0025 in. thick. The best way of making connection to the tags is to tin them all first on both sides, taking care not to put on so much solder that the small hole gets filled up. The flux used should be resin dissolved in methylated spirit; this is not the difficult flux to work with that some people imagine, provided that everything is well cleaned and kept free from grease.

Then put all the tags belonging to one side of the condenser into line and pass a short length of braided copper wire, or, failing this, 18 gauge solid wire (tinned), through all the holes, and then dip bodily up to the level of the wire in some melted solder contained in a small tin lid (*e.g.*, the lid of the tin containing French chalk usually supplied with bicycle tyre repair outfits); treat the tags belonging to the other side of the condenser similarly. This method will ensure a first-class connection to all the tags. Alternatively, the tags may be connected by passing a 6 B.A. brass screw through the small holes and securing it with a nut. It will usually be found that the valves of condensers required for efficient working in various positions in a circuit are not very critical. A condenser will generally function reasonably well even if it is as much as ten times too large or too small, as it should be. But generally speaking, grid condensers and coupling condensers should be on the small side, and by-pass or blocking condensers somewhat larger. For the former, use six pieces of mica dielectric (and consequently 7 tags), and for the latter, 20 pieces of mica (21 tags).

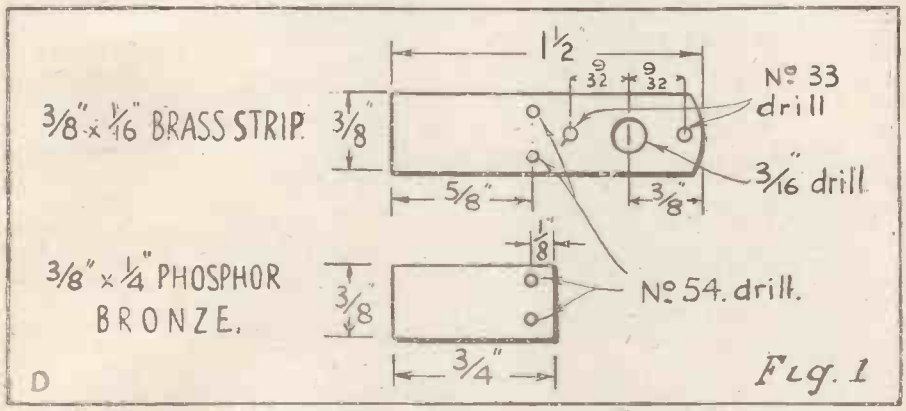


Fig. 1

EINSTEIN, MARS, AND WIRELESS.

(*Continued from previous page.*)

In other words, wireless to Mars is impossible.

It is quite likely there is such a screen of dust held in suspension at our actual world-limits, as Prof. Fleming suggests. It would be tenuous in the extreme and probably highly electro-magnetic. But, of itself, it would not prevent the exit from our world of a message-carrying current.

The point of inappreciability is the crux of the whole matter. From that point there begins that part of the sun-earth process whereby are set up the light, heat, and energy we are supposed, in orthodox thinking, to receive direct from the sun by means of the ether. Thus, on correlative considerations, the earth is of equal importance with the sun in the generating of our familiar phenomena. In other words, the point of inappreciability presents an impassable barrier to human operations.

With all the power possible—now and to be—at our command, we can never control the centrifugal-centripetal process sufficiently to be able to project an electro-magnetic message-carrier outside the earth. To think we can do so is to imply motion along a mathematical straight line. My argument, of course, applies to Mars also. The natural processes on that planet differ from ours in degree only.

Thus I agree with Mr. Risdon's opinion of interplanetary communication, expressed in No. 14 of POPULAR WIRELESS.

Finally, we must not take "following the curve of the earth" literally. Our familiar earth phenomena are shaped within the sphere, where we are ourselves. In a centrifugal-centripetal process we cannot expect a relatively free-moving body to follow a perfectly circular course, either within the solid globe or about any part within its real limits. Even a body "at rest" on the solid surface does not do so, since we must take into account the earth's path round the sun. Here again we do not find a perfectly circular path, our earth being only a relatively free-moving body.

Since, then, the mathematical circle, as well as the mathematical straight line, loses meaning in physics, we may well ask how far the science of mathematics is valid in solving problems of motion.

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THE CONSTRUCTION OF THE VALVE.

By P. J. RISDON, F.R.S.A.

NOTE: This article is the outcome of a visit to the M. O. Valve Works which Mr. Risdon undertook on behalf of "Popular Wireless" in order that readers might know exactly how the new Aladdin's lamp is made.—EDITOR.

WHERE the construction of a valve really begins it would be difficult to say. One might suggest at the works where the glass is made from which the tube is blown, or where the nickel is produced from which the anode or plate, and other parts are made. We might say in America, where the copper for the external leads is chiefly produced, or where it is electrolytically purified; or in Australia, whence is derived the heavy, white ore known as scheelite, rich in tungsten, from which the delicate filament is evolved.

But without going so far afield we may begin at the works where these materials in the rough state are gathered together from the ends of the earth, there to be converted into those delicate and exquisite instruments by means of which messages are flung on ether waves to the countries of their origin, and by which other messages, borne on dying waves from all over the world, are magnified a thousand times and rendered intelligible.

At the works of the M. O. Valve Company, at Hammersmith, probably the greatest in the world for wireless valve manufacture, this wonderful transformation of crude materials into the finished valve is effected, and it is the object of the present article to describe the various processes involved.

There, in the stores, are stacks of thousands of plain, straight glass tubes of various sizes; scores of crates and bins containing glass bulbs as they arrived with unfinished, open ends; coils of copper wire of all gauges; tons of molybdenite ore and scheelite ore; large quantities of platinum wire, and roll upon roll of nickel sheet.

Let us take the scheelite first, and see how the tungsten filaments are produced. About 70 per cent. of the ore is tungsten oxide, the remainder consisting largely of calcium oxide. First the ore is ground to a fine powder and heated in a solution of hydrochloric acid. From this solution is precipitated a yellow sludge—impure tungsten oxide—which is treated with a cold solution of ammonia that absorbs the oxide.

The Tungsten Process.

The solution is then stored in tanks until required, when it is poured into a boiling solution of hydrochloric acid, kept in constant agitation. The powder resulting from this operation is washed in boiling distilled water, and partially dried to the consistency of yellow butter—which it resembles in appearance. At this stage certain tests are made, and certain materials are added that improve the physical properties of the finished product. Next it is calcined, and ground to a fine powder again of a pale canary-yellow colour. This in turn is heated whilst subjected to a current of hydrogen gas which extracts oxygen by chemical combination. From this last process it emerges as practically pure tungsten of a grey colour.

The tungsten powder is then measured out in papers, placed in steel moulds, put under an hydraulic press, and compressed into brittle sticks (somewhat resembling graphite in appearance), about 8 inches long and ¼ inch square in section. These sticks are first heated whilst subjected to a current of hydrogen gas; this hardens them somewhat, although they still consist of more or less incoherent particles of compressed powder.

The sticks are next placed between electrodes within a protecting cylinder, and through each is passed an electric current of no less than 1,500 amperes, which heats them almost to melting point and converts them into homogeneous bars of the solid metal tungsten.

"Drawing" the Wire.

The next process, known as swaging, consists of passing the tungsten bars through a series of ingenious hammering machines which impose extremely rapid local blows from end to end, thereby lengthening them so that the original bar 8 inches long emerges from the last hammering machine as a rough wire 10 yards long and about 1-32nd of an inch in diameter.

Then commences a long series of "drawing" operations in which the wire is passed through dozens of wire-drawing machines, one after another, each of which reduces the diameter and increases the length of the wire. As it enters each machine, the wire is heated, and is then drawn through a tiny hole in a diamond, and wound on a spool, from which it passes through the next machine, the hole in the diamond of each successive machine being smaller than that in the diamond of the preceding one, until the required gauge of fineness of wire is reached, when the drawing stops.

In this way it may be drawn down from 1-32nd inch to 1-2,000th of an inch in diameter, to serve as the finest filament required, the length being increased from 10 to 25,000 yards during the process.

In this article we shall describe more particularly the construction of the R type of receiving valve, such as is commonly used by amateurs.

The nickel anodes or plates are first cut out of sheets into rectangular strips, each with a small projecting lug (Fig. 1), the object of which will presently be seen. These strips are placed on a little mandrel and rolled into the form of cylinders (Fig. 2), the edges of which are electrically welded, thus forming the anode or plate which is now ready for fixing.

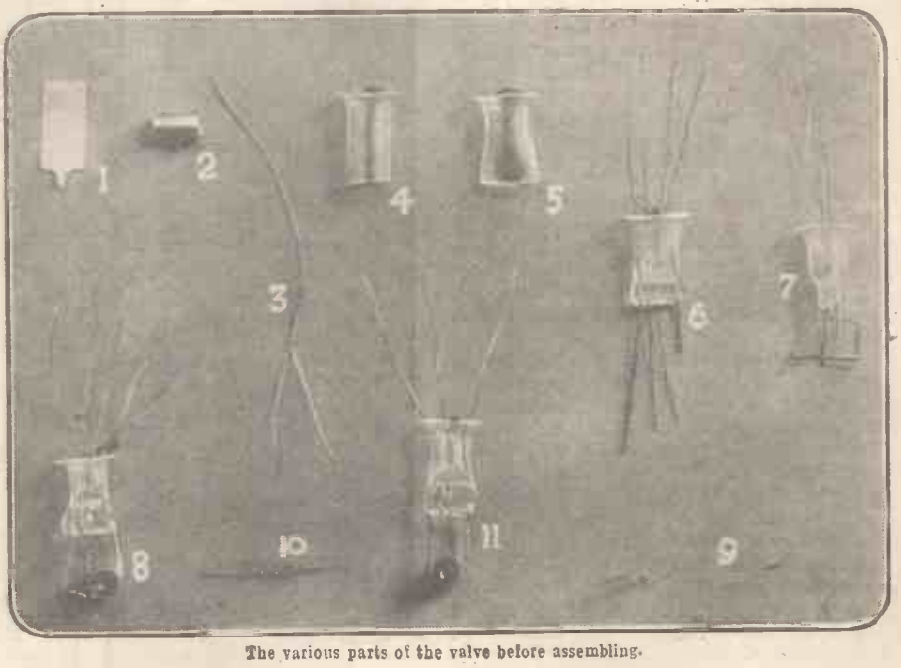
Owing to expansion and contraction of the glass bulb, due to heating and cooling of a valve, where the leads pass through the glass seal, it is necessary to employ wires of a metal that has exactly the same coefficient of expansion and contraction as glass. Up to the present, the expensive metal platinum has been found to be the only suitable one for use in glass seals.

The outside leads are of copper, whilst the internal wire frames or holders for carrying the filament, the grid, and the plate are of nickel.

Placing the Electrodes.

Seated side by side are girls, each with a blow-pipe in front of her. Holding a bundle of short, fine copper wires in one hand, the first girl picks up a tiny thread of platinum wire with a pair of fine pliers, and holds one end of it against one end of the copper wire in the flame. In an instant the ends are fused together. Other operators then fuse the other ends of the platinum wires to the various nickel wires and strips

(Continued on next page)



The various parts of the valve before assembling.

THE CONSTRUCTION OF THE VALVE.

(*Continued from previous page.*)

that form the wire frames or holders already referred to (Fig. 3).

The next operation to consider is the formation of a "foot tube." A short length of glass tube is placed on a head-stock, rotated, and heated by a flame from a blow-pipe, an operator opening out one end of it to a bell-mouth shape (Fig. 4), the other end being subsequently shaped as a flat oval opening (Fig. 5). The "foot tube" is then placed in a machine and the four leads are placed within it. Passing on automatically, it is heated in a series of flames so that the glass is fused round the platinum wire and the ends of the other wires, forming an airtight seal. Finally, a pair of jaws compresses the end of the fused glass and nips it off, leaving the "pinch," as it is called, shown in Fig. 6.

The pinch is passed on to another operator, who, with a pair of small pliers, twists and bends the nickel wires, and forms the ends for carrying the grid, plate, and filament (Fig. 7). The "plate" is now fixed securely to its holder (Fig. 8).

The grid consists of a spiral coil of fine molybdenum wire. A length of the wire is first close wound round a gauge rod from end to end and heated. It is then drawn off and pulled apart in sections (Fig. 9), each section constituting a grid of definite length, and with a definite number of turns in the coil, which is laced to a straight wire so that the turns of the coil are accurately spaced (Fig. 10). The grid is then inserted inside the "plate," and the ends of the straight wire are clipped to the nickel grid supports (Fig. 11).

Finally, the tungsten filament is passed through the grid and clipped at each end to its holder. Our pinch, with the plate, grid, and filament, is now ready for inserting in and sealing to the bulb. Care, of course, is taken that the filament is central in the grid, and the grid central in the plate.

Exhausting the Air.

Fig. 12 is a photograph of the bulb in its first stage, but without the piece of straight tube shown. A hole is "blown" in the end of the bulb, and the piece of straight tube is melted on, the object of which will presently be explained. (Unfortunately, the piece of tube was broken off when taking the photograph.)

The bulb is now placed in a machine, and, the rough, open end having been cut off by heat, the pinch is placed in position, with the grid, etc., inside the bulb, and fused on to it, forming an airtight seal (Fig. 13). The construction of the valve is now almost complete.

The next process is that of exhausting air from the bulb. Several bulbs are placed in a cabinet or cage, with the glass tubes downwards. These tubes are temporarily sealed on to others connected to the exhausting apparatus and pumps. The operation, although a fairly simple one in principle, involves the use of apparatus too complicated to attempt a description of in the present article. Suffice it, therefore, to say that, during the process, which involves the use of mercury and liquid air, the valves have to be kept under constant observation for periods varying from 2 or 3 hours for small receiving valves, up to 2 days in the case of very large transmitting valves measuring 24 inches long by 8 inches diameter.

An electric current at a potential of 1,500 volts is passed all the time from the plate to the filament, and the plate is thereby maintained in an almost red-hot condition. The result of this exhaustion is probably a more nearly perfect vacuum than is obtained in any other commercial process, for the remaining gas pressure is only equivalent to from 1-10,000th to 1-1,000,000th of a millimetre of mercury!

A brass ring or "shell" (Fig. 14) is then placed round the neck of the valve and cemented on, and the base—an insulating disc (Fig. 15) or four-way plug—is wired up to the copper leads, pressed into the shell, and clipped in position (Fig. 16).

Ready for Use.

The valve is then subjected to an electron emission test and a filament current test, from the readings of which its amplification value can be calculated. It is also subjected to an "ageing" process for two hours, whilst high and low tension current are passed through it, and during which it is believed that practically all the minute quantity of residual gas is absorbed. There are also vacuum, insulation, and final general tests.

It is finally taken to the cleaning and marking department, where it is cleaned up and marked with the maker's name, etc., by means of rubber stamps and hydrofluoric acid (an acid that attacks glass), and the valve is now ready for our wireless receiver.

Other valves are constructed on practically similar lines. In the case of big transmitting valves, however, to ensure proper insulation, the leads are not all taken in through a cap, but through different parts of the bulb.

In conclusion, the writer desires to record appreciation of the courtesy of the M. O. Valve Company on the occasion of his visit, when every facility was afforded him for the purpose of preparing this article. The works of M. O. Valve Company (which exists as the result of an agreement between the Osram Lamp Company, the General Electric Company, and the Marconi Company) are very fully equipped, and comprise, among other things, complete plant for the production of hydrogen gas and liquid air.

CATALOGUES.

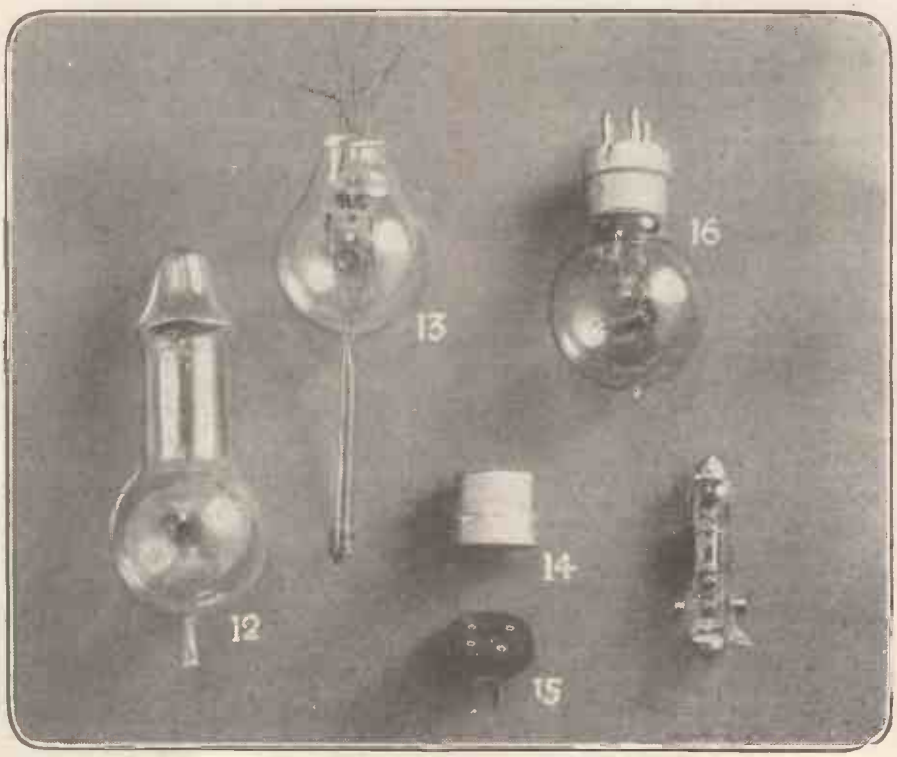
We have received from the General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C.2, copies of booklet No. BC. 2815 listing "Gecophone" Receiving Sets and Aerial Equipment for Wireless Broadcasting, and also Leaflet BE. 2813, giving further particulars of "Gecophone" Double Headgear Telephone Receivers.

The General Electric Co., Ltd., has fully realised the wisdom of making haste slowly in the production of its wireless equipment as it is very evident from perusal of the literature supplied and by detailed examination of the various sets.

Simplicity is the keynote of all the "Gecophone" sets and equipment, which is noticeably devoid of technical complications, and can be easily worked.

Three standard complete receiving sets are at present listed, two of these being crystal sets, and the third a valve set.

We understand that it is the intention of the G.E.C. to widely advertise these sets to the public in order to create and maintain demand, but that they will rigidly abide by the established policy of distributing through trade only.



The valve nearing completion: The last phases in its construction.

A NOVEL CRYSTAL DETECTOR.

By CHARLES FORSTER.

NOW that the crystal receiver is becoming popular once again, the following description of an efficient detector may not come amiss. It is very easily made, and when mounted on a panel has a very neat and pleasing appearance. The diagram will explain the method of construction, and the necessary parts are easily obtained, as will be seen in the specification given below.

Construction.

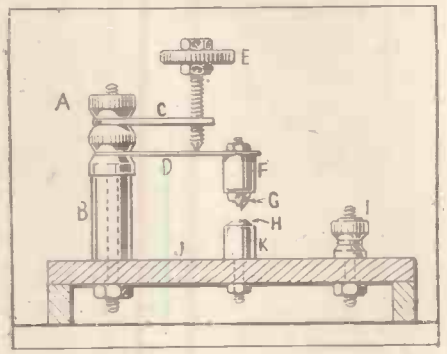
The standard or pillar marked A in the diagram is a double 4 BA terminal with back nuts and washer, and is about 2½ inches long. These terminals can be obtained from advertisers in the journal at 3d. each.

The part B is made from brass tube of any diameter from ¼ in. up to ½ in., and is ⅞ in. long. This goes on the lower part of terminal A, as shown in diagram.

Clamped between the top nuts of the terminal is the part marked C, which is made from strip brass about $\frac{1}{16}$ of an inch in thickness and ¼ in. in width. The length required is 1½ in., and a hole should be drilled in one end so as to fit on terminal, the other end being drilled and tapped with a 4 BA tap to provide a thread for adjusting-screw E. If tapping is beyond the reader's ability, a larger hole should be made, and one of the hexagon back nuts of terminal A should be soldered directly over this hole.

The part D is made from a piece of springy brass strip 2 in. long and ¼ in. wide. A hole should be drilled in either end, one to fit on terminal A, and the other to take the small bolt of crystal cup F.

The adjusting screw E is made from a piece of 4 BA screwed brass rod, 1 in. in length. If desired this can be obtained from a 4 BA terminal. A round piece of ebonite should be clamped between two hexagon nuts at one end of this rod, and the other end should be filed to a point as shown.



The parts F and K are two crystal cups. These can be bought of any wireless dealer, or can easily be made from old brass cartridge cases.

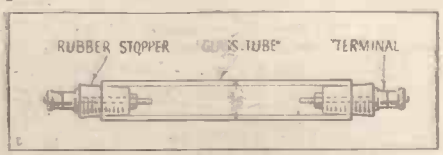
The letters G and H represent the crystals, the top one being zincite and the other one bornite. Other crystals can be used, but the zincite-bornite is recommended owing to their stability and sensitivity.

Two terminals are required for connecting purposes (only one shown (I)), and a wire should be brought from crystal cup K to one terminal, and another wire is brought from terminal A to the other connecting terminal. The baseboard J can be made of ebonite or hard wood if desired, or the detector may be mounted direct on the receiver panel.

A SIMPLE POLARITY INDICATOR.

By W. MILLAR.

TO all wireless amateurs a pole-finder is an invaluable aid. It may save pounds to those who try charging their own accumulators, for how many utterly ruin their batteries by charging them reversed? You need never have any doubt about the polarity of your H.T. or L.T. batteries if you carry out the instructions below at a cost of only a few pence.



Firstly, procure from any chemist's two pennyworth of sodium sulphate and three-pennyworth of phenolphthalein. Into an old tumbler or cup, half-full of warm water, put as much of the former as will cover a five-shilling piece and as much phenolphthalein as will cover a threepenny-bit, and stir until dissolved.

To try this mixture, place your charging leads into it (about 1½ in. apart), and you will notice that the negative lead turns the surrounding liquid a reddish colour. Shaking the liquid will make the colour disappear at once.

Then try two leads from your filament accumulator, and add a little of each chemical until the mixture is sensitive enough to make the negative wire colour the surrounding liquid as before.

Having done this, you can now make the container described.

The glass tube and rubber stoppers can be obtained at nearly any chemist's, and the length should be kept as near as possible to about 3 in. Screws should be fixed tightly through the stoppers as shown, protruding about ¼ in. on the inside, and a nut at each end of stopper with an extra terminal nut on outside ends.

When this has been done, all that is required is to fill up the tube with the liquid you have made, leaving a small air space so that the liquid can be shaken to disperse the colour.

Pole-finding paper can be made by immersing some absorbent paper in the liquid. To use, wet the paper with finger, and place wires about ½ in. apart on the wet portion, when the *negative* wire will make a *red* mark.

WIRELESS AND TELEPATHY.

ARE we all walking wireless stations? That is the question that is puzzling many of the scientists of to-day.

A theory has been put forward that there is a complete transmitting and receiving set in every human being. This hypothesis has been advanced to try and explain the well-known phenomenon of "telepathy."

A Big Step Forward.

A man walking along the street suddenly thinks of a friend of his, whom, perhaps, he has not seen for years, and he looks up to see him coming round the next corner. "Telepathy," we say, and there it ends.

Theories have recently been advanced that nervous energy is electrical energy, and being such, why should it not act as other electrical impulses and set up wireless waves? Still further, it is quite within the range of physical possibility that certain chemical reactions in the brain, of which we know nothing at present, should make it possible to detect these wireless waves, and render them intelligible.

With very strong amplification it should be practicable to detect the wireless waves set up by the nerve "transmitters," using an ordinary wireless receiving set. This would then be a very great step towards determining what really occurs in telepathic phenomena.

There is, however, one very serious and apparently unsurmountable obstacle to the success of this theory. All waves of wireless obey a law known as the "law of inverse squares"—that is, they diminish in intensity or power proportionally to the square of the distance from the transmitter. Therefore, telepathic communication should become weaker as the distance increases between the two "stations."

In experiments, however, this does not hold true, very good "results" being recorded at long distances—hundreds of miles in some cases being recorded—and at short distances—a few feet—there has been absolute failure.

Time Will Show.

Belief in telepathy is by no means general among scientists, and it yet remains to be decided which side will win the day.

Sir Oliver Lodge among others is a firm believer in some "sympathetic communication of intelligence," which in ways of which we may be ignorant, carries messages from one being to another. Thus, he says: "The danger or death of a relative may be signalled, without wire or telegraph, to the heart of a human being fitted to be the recipient of such a message."

Other scientists doubt that telepathy really exists at all, while some agree that it has been proved conclusively.

Meanwhile, with the gradual growth of the acceptance of telepathy as a fact, albeit unexplained, we may expect the problem to be further investigated by scientists. Time will show whether the wireless hypothesis is tenable, and if the human brain does contain such a wonderful and delicate "receiver."

FROM OUR NEW YORK CORRESPONDENT.

RADIO to aid the sick and suffering! Here is another, and a truly great use for the art. A few weeks ago we were told of a doctor who performed a difficult operation on a young girl with a weak heart with an almost total absence of shock, due to the fact that only a local anæsthetic was used, the patient's attention being attracted, and her nerves soothed, by listening to radio music through a pair of head-phones.

But radio can do, and is doing, very much more than that in several American hospitals. The therapeutic value of music has of course long been recognised; but the means of relaxation and diversion furnished by a radio set go far beyond the powers of music by itself. The value of cheerfulness and diversion, particularly in nervous complaints and long, tedious illnesses, is a matter of commonplace knowledge, but not until the advent of wireless telephony has it been possible to bring such things to the bedside of any sufferer at will.

Sick people can now have not only music, but lectures, speeches, and all the news of the busy world, brought to their bedsides. Radio is much better for the patient than any visitor, because, as every nurse knows, nine visitors out of ten do patients definite harm by remaining too long, the patient being unwilling although he feels his strength being taxed, to risk offending his kindly visitor by asking him to depart. The radio visitor has no feelings, and can be cut off at any moment. Moreover, should he be offering entertainment of the wrong kind, he can be stopped, and a change made to another.

That these remarks have a solid backing of fact is amply evidenced by the reports of hospital authorities who have brought radio into their institutions. Dr. W. F. Jacobs, medical superintendent of the Cumberland Hospital, Brooklyn, a great New York hospital, expresses the emphatic opinion that "Radio deserves to be ranked with the best mental therapeutic agencies. In fact, for hundreds of cases, the radio telephone can be prescribed as the one best treatment."

"Think what it means," Dr. Jacobs points out, "for some poor devil with a broken back or leg, laid up day after day, and often receiving no visitors, with nothing to do but look at the wall and brood over his misfortunes. I have put headsets over such men, and have seen them transformed in a few minutes from creatures that just existed, to the intelligent, interested men that they once were, and who will soon be well again and much quicker, because of the interest, the life, and the health that radiates from radio."

And in this connection it is worth noting that for hospitals, where patients in widely differing stages of illness or convalescence are together in one ward, lectures or music by ordinary means, while good for some of the patients, must be forgone because others are too ill. But the sounds from a radio headset are heard only by those who can derive benefit from them, and disturb no one else.

Radio Royalties.

A few weeks ago I wrote of the fear of music composers and publishers concerning the probable loss of revenue through the broadcasting of their copyrights by radio. The American Society of Composers, Authors and Publishers has now taken action to compel all broadcasting agencies to announce before the wireless performance of any work of which the copyright is owned by a member of the society, the fact that "This copyright composition is broadcasted by permission of the American Society of Composers, Authors, and Publishers." And the permission has first to be applied for in writing. It is hoped that an arrangement satisfactory to all parties will eventually be arrived at on the larger question of collecting royalties, but in the meantime the society has taken this step to protect its members' rights. It emphasises the view that an artist singing a song to a radio audience is making a public performance in just the same sense as if he were singing in a concert or music-hall, that is, for profit. If the singer is not paid, then the society argues the performance is still for the benefit of the radio firm, which gives the concerts in order to induce people to buy its receiving sets.

Variable Grid Leak.

One of the most recent patents granted for a piece of radio apparatus is that for a variable grid resistance, invented by Mr. Aubrey Goodwin, of Melrose, Massachusetts. It is, in other words, a variable grid leak. The grid leak, of course, is used to allow the escape of the excess negative charge which accumulates on the grid, hampering the flow of the electron stream.

The amount of this negative accumulation varies with the operating characteristics of different tubes, none of which exactly resemble each other. It varies with the incandescence of the filament, the strength of the positive charge on the plate, the gas content of the tubes, their degrees of evacuation, and so on. Mr. Goodwin's invention, then, allows the introduction of the correct grid resistance at will, and renders possible the use of all tubes at their proper operating pitch.

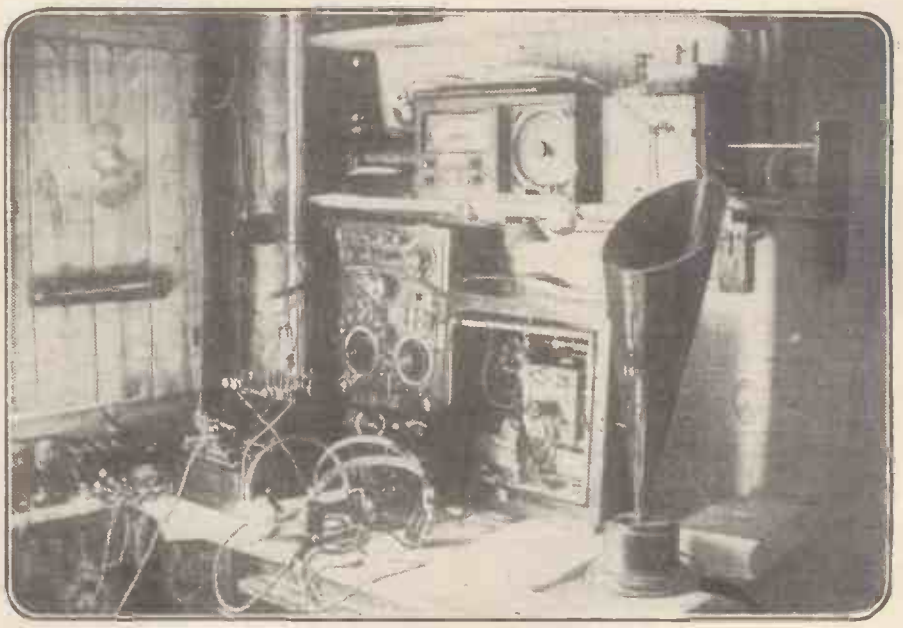
Broadcasting Speeches.

The New York Municipality has struck a brilliant idea in arranging for the installation on the Municipal Building of a powerful broadcasting set. Not only will police reports and other public announcements be sent out from it, but it will be connected by private wires to the City Hall, corresponding to the Guildhall in London, so that all civic functions, including the receptions of distinguished visitors, can be broadcast. Why not a similar arrangement by the City Fathers of London, so that the many epoch-making speeches delivered at Guildhall banquets, for instance, can be broadcast all over the country?

The New York City Council, by the way, is installing receiving sets with loud speakers in the public parks of New York, so that band concerts may be broadcast on Saturday and Sunday afternoons and evenings.

Tapping the Operas.

The ultimate hope of those of us who are music enthusiasts is, of course, that the Metropolitan Opera will allow its performances to be broadcasted. So far permission has been withheld, but now that the Philharmonic Orchestra is having its summer open-air concerts broadcasted, perhaps the Metropolitan will recognise the signs of the times, and fall into line. It is being urged to do so by Dr. Lee Forest, the famous inventor, and by many others.



Experimental set erected by Mr. J. S. Roberts, "Gorphioyofa," Cobham, Kent.

CONTROLLING MODELS BY WIRELESS.

By MAJOR RAYMOND PHILLIPS, I.O.M., Late Member of the Inter-Allied Commission of Control

PART 6 (NEW SERIES).

IN my previous article I furnished diagrams and constructional details of certain component parts of a selector for use with receiving apparatus suitable for the wireless control of a model electric train. I also stated that I should furnish further details in this and subsequent articles.

It will be understood that a selector can be made in various forms, according to the number of mechanisms it is desired to control.

The selector in question is designed in such a manner that an amateur mechanic should not experience any difficulty in constructing same. On referring to the diagrams marked Figs. 1 and 2 in my article (Page 455, No. 21 of POPULAR WIRELESS), it will be observed that so far I have furnished constructional details of the electro-magnet B, and brass support for same. The latter can be made of strip brass, No. 10 or 12 gauge, which can be bent to the specified shape, and afterwards cut off to the length required and cleaned up as desired.

Baseboard.

The cores of the electro-magnet B can then be secured (by means of two brass cheese-head screws) to the soft iron yoke, and support, as shown. The baseboard A should be made of white pine, 10 in. long by 5 in. wide by $\frac{5}{8}$ in. thick, and should either be French polished or shellac varnished.

The metal plate forming the base W should be either brass or aluminium, 6 in. long by 4 in. diameter by $\frac{1}{8}$ in. thick.

The terminals, T and T1, are standard pattern. Eight will be required for the selector, and they can be fitted to the baseboard A in any convenient manner, and in any suitable position, so long as none make contact with the metal base W, except where necessary in connection with the contacts, J and J1, for the de-cohering device to be described in due course.

The four pillars, P and P1 (two only shown), should be made of brass, $2\frac{1}{4}$ in. long overall by $\frac{5}{16}$ in. diameter.

Those amateurs not possessing a lathe can purchase $\frac{5}{16}$ in. screw-threaded brass rod, and cut such rod to the lengths required. Brass nuts can then be used for securing the pillars to a vulcanised fibre base O, and metal base W, so that the distance between the former and the latter does not exceed $1\frac{1}{2}$ in.

The Armature.

The clamping pillar R should be made of brass, $1\frac{1}{8}$ in. long by $\frac{5}{16}$ in. diameter, fitted with clamping screw, and drilled to admit one end of the balance-spring H, being passed through as shown. The latter spring should be a closed coil type, 1 in. long by $\frac{1}{4}$ in. diameter, and made of No. 22 gauge hard-drawn brass wire.

A loop should be formed at one end of the spring, and about 1 in. of straight wire left at the other end for passing through the hole drilled in the clamping pillar R.

The vulcanised fibre base O should be 3 in. square by $\frac{5}{16}$ in. thick.

The brass ratchet K should be either $1\frac{1}{2}$ in. or $1\frac{5}{8}$ in. diameter, and should contain not less than 100 teeth. Ratchets can be purchased from most dealers in clock material.

The armature D should be made of Swedish charcoal soft iron, $1\frac{1}{2}$ in. long by $\frac{5}{8}$ in. wide by $\frac{1}{8}$ in. thick, and should be secured to the support E as shown, by means of two brass screws, the latter engaging with two screw-threaded holes in the armature.

Pawl and Ratchet.

The armature support E should be made of strip brass, 3 in. long by $\frac{5}{8}$ in. wide by $\frac{1}{16}$ in. thick, with contact J1 attached to same. Both ends of the support should be rounded off, or bent round, as shown in Fig. 1 (last week), and arranged to accommodate a steel pin, $\frac{5}{8}$ in. long $\frac{1}{16}$ diameter. The pin lengths required can be cut off from an ordinary steel knitting pin.

A slot should be cut (a file can be used for the purpose) in one end of the support E to accommodate a pawl F, as shown in Figs. 1 (last week). A steel knitting pin will be found useful in connection with bending round the ends of the support E; the operation being easily effected with the aid of a hammer, vice, pair of pliers, or preferably pincers, and the steel knitting pin used as a mandrel, and gauge for the holes at each end of the support E.

The pawl F can be made of brass, 1 in. long by $\frac{1}{4}$ in. wide, No. 20 gauge, and bent round at one end as shown in Fig. 1 (last week), and arranged to be attached to the support E by means of a steel pin. A light spiral spring (made of No. 30 gauge hard-drawn brass wire) should be attached to the pawl, and support in order that the pawl may be kept in contact with the rachet K.

The base I can be made of strip brass, $\frac{1}{2}$ in. wide by $\frac{1}{16}$ in. thick, as shown in Fig. 1. The contact J should be made of spring brass, No. 26 gauge, and attached to a vulcanised fibre block ($\frac{5}{8}$ in. square by $\frac{1}{2}$ in. thick), as shown in Fig. 1 (last week).

Bracket and Supports.

The adjusting screw G can be made to engage a screw-threaded hole in a block of brass ($\frac{1}{4}$ in. square by $\frac{3}{8}$ in. long). The latter can be secured to the vulcanised fibre base O by means of two screws.

The brackets or supports N (two in number), should be made of strip brass, 1 in. long by $\frac{1}{2}$ in. wide by $\frac{1}{8}$ in. thick, bent and secured to the vulcanised fibre base O, as shown in Fig. 1 (last week). It will be observed that the total length of each bracket, including its base, is approximately $1\frac{3}{8}$ in.

The drum L should be made of a vulcanised fibre tube, $1\frac{1}{2}$ in. long by $1\frac{1}{4}$ in. outside diameter, cut into two equally divided parts, and such sections should be mounted upon two brass or aluminium flanges, with two brass spindles ($\frac{5}{16}$ in. diameter), and ratchet, as shown in Fig. 1 (last week).

The vulcanised fibre drum should have four equal divisions marked upon same, and three $\frac{1}{8}$ in. tapping holes should be drilled on each division line to accommodate three $\frac{5}{16}$ in. by $\frac{1}{8}$ in. brass cheese-head screws.

Contact Screws.

The length of the spindles outside the flanges of the drum should be $\frac{1}{2}$ in., so that at one end the free length will be $\frac{3}{8}$ in., assuming the brass rachet is $\frac{1}{8}$ in. thick.

Six of the contact screws fitted in the vulcanised fibre drum should be connected together (*i.e.*, three *opposite* each other) by soldering (inside the drum) a short length of insulated flexible instrument wire.

The soldering of the flexible wires can be effected by disconnecting the two halves of the vulcanised fibre drum from its flanges, and when the soldering is completed, care must be exercised to see that all wires are insulated from each other before again assembling the drum, and its component parts.

Selective Action.

Four of the remaining contact screws in the drum should be connected in the form of a cross thus ×.

The object of reversing the connections is to cause a reversal of polarity of the electric current in a circuit connected with such contact screws, when the drum is caused to revolve step by step by impulses from the electro-magnet B as shown in Fig. 1 (last week).

The two remaining contact screws should be connected together (*i.e.* opposite each other) with a short length of instrument wire as previously described.

The contacts M and M1 (six in number), should be made of No. 28 gauge spring brass ($\frac{5}{16}$ in. wide), mounted, and secured by screws on the vulcanised fibre base O.

The contacts should be shaped in such a manner that no contact is made with the contact screws fitted to the drum, when the latter is in mid-way position.

The check spring S, Fig. 1 (last week), should be made of No. 26 gauge spring brass, and secured to the vulcanised fibre base O by screws, as shown in Fig. 1 (last week).

In my last article I shall furnish diagrams showing how the complete selector should be connected to its various terminals.

(To be continued.)

COMMERCIAL WIRELESS DEVELOPMENTS.

By Major BASIL BINYON, O.B.E., A.M.I.E.E., Managing Director, The Radio Communication Co., Ltd.

WHENEVER we tune our receivers to about 600 metres wave-length we hear, almost invariably, a perfect concert of signals. It does not matter at what hour of the day or night, the signals are always there—high notes, low notes, grunts, scrapes, wheezes, and shrill piercing noises. No doubt every reader is aware that these emanate from ship and coast stations, chiefly in the vicinity of the English and French coasts, and more particularly from the Channel. This, of course, represents a very limited area, and when we consider the relative size of foreign waters, and the number of ships of all descriptions equipped with wireless installations, we can estimate the vast amount of traffic which is handled from hour to hour.

While engineers have been engaged chiefly in the development of the wireless telephone, and the high power continuous wave transmitter, the ship installation has not been forgotten. Most liners still employ the spark method of transmission, but modern apparatus is very different from that of even a few years ago. In fact, the low grating tone of the old fixed spark gap is now more or less obsolete.

The 1½ KW. Set.

The first improvements were with quenched and rotatory gaps, and it is the development of the latter which is used universally by the Radio Communication Company to produce the distinctive tone of their transmitters. The particular apparatus is known as a motor alternator, which consists of a D.C. motor and an A.C. generator mounted on the same shaft. On one end of the shaft is fixed what is known as a "synchronous spark gap," consisting of a wheel of an aluminium alloy having a number of teeth which revolve in close proximity to two fixed electrodes. The alternating current produced by the generator is stepped-up through a transformer which is suitably connected to the fixed electrodes. When the generator is running it is so arranged that the revolution of the toothed wheel causes a large number of sparks to be produced per second. As a matter of fact, when the generator is running at normal speed, exactly a thousand sparks occur every second, and thus the note heard in the telephones, when receiving signals from such a transmitter, is extremely clear and penetrating.

Probably every amateur is familiar with the Post Office station at North Foreland. For many years the grating note of its spark has been one of the best known English signals. However, modern apparatus has replaced old, and for the past 12 months the North Foreland station has been the proud possessor of a modern 1½-kw. spark transmitter manufactured by the Radio Communication Company. The spark note of a thousand per second is extremely piercing, and whenever our receivers are tuned to 600 metres we are sure to hear the well-known call "G N F" ringing clear above the other feebler voices of the "600 metre concert." The installation has been so successful that another is in course of erection at the Seaforth Post Office station.

The actual transmitter is very compact and has an extremely pleasing appearance. The front is a slate panel containing an aerial ammeter, power and wave switches, and the motor starter. Behind the panel the various elements of the high and low frequency circuits are mounted, together with the emergency transmitter. Below this is the motor generator which is placed in a sound-proof compartment. The control wheels on the face of the plane regulate the wave-length, and the power used for transmission. The wave switch gives wave-lengths of 300, 480, 600, and 800 metres, but any wave-length up to 900 metres can be obtained without any complicated adjustments. The other wheel actuates the power switch, which provides full, half, and quarter power. All other working adjustments are made from the operator's table by means of remote control switches, thereby enabling the operator to remain at his post.

Efficient Working.

The photograph shows a number of transmitters in various stages of completion in a corner of one of the assembly shops at the company's factory at Barnes.

During the war a vast amount of research was devoted to improvements in wireless telegraphy, and very rapid progress made. Many steamship companies were unfortunately unable to derive the full benefits of new developments due to having entered into long term agreements for the equipments aboard their ships, but those who were free to do so were not long in taking advantage of the apparatus offered by the Radio Communication Company, which embodied all the latest improvements of the past few years.

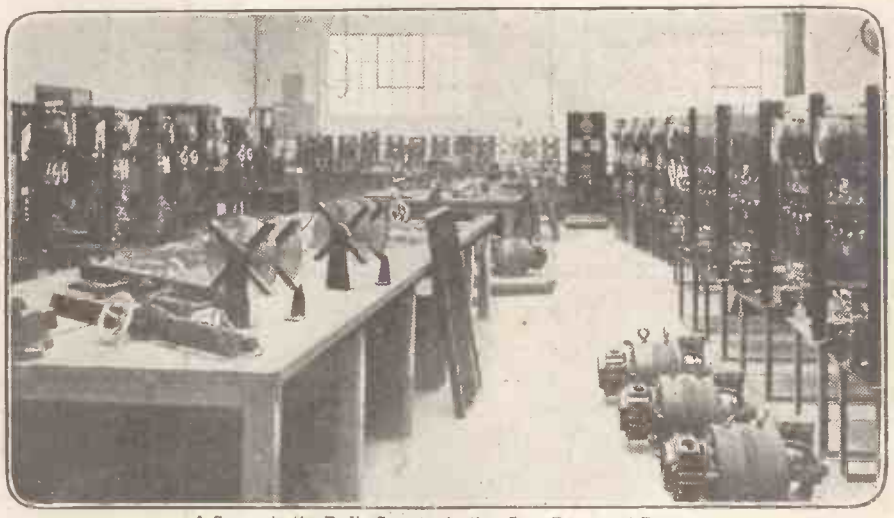
A number of the largest liners belonging to the Union-Castle, Cunard, Bibby, Orient, and many other companies are fitted with "Polar" Radio Equipment. One of the Union-Castle Line boats (the "Arundel Castle"), a photograph of which recently appeared in POPULAR WIRELESS, has subsequently replaced the gear illustrated, by the Radio Communication Company's standard equipment, and an idea of the efficiency of this apparatus can be obtained from the fact that this ship reported traffic with Capetown as being highly satisfactory, over a working distance of 2,932 miles, with severe atmospheric jamming prevailing at the time. A highly efficient valve receiver forms part of the company's standard equipment by means of which the same boat reads Annapolis at a distance of 8,000 miles, while other ships having "Polar" receivers are able to read Leafield (England) while in Australian waters

Progress.

In less than two years more than 40 of the most important liners and about 90 other boats have been fitted with the Radio Communication Company's wireless equipment, including the s.s. "Berengaria," the second largest ship in the world. Vessels of this type usually carry a dual equipment comprising the standard spark set, and in addition either a 5 kw. or 10 kw. continuous wave transmitter, by means of which they are able to maintain continuous communication with America and England throughout the entire trans-Atlantic run.

It has been the aim of the Radio Communication Company to supply only the very highest standard of radio gear, and a large range of types are manufactured to suit the requirements of every class of vessel. In addition, several ships have been fitted with direction finder apparatus which is operated from the chart-room of the vessel, and is a valuable addition to the ship's navigating equipment. A photograph is shown, which illustrates a complete direction finder equipment installed in the chart-room of the s.s. "Cairnross."

However, the activities of the Radio Communication Company are not merely confined to ship installations. Their system of telephony has been brought to a high standard of perfection, and it is perhaps the best heard to-day. In the very near future, when broadcasting commences, it is safe to predict that programmes from stations controlled by the Radio Communication Company will be eagerly awaited by all interested in this new development. For the broadcast enthusiast a number of "Polar Radiophones" have been prepared, and as these are similar to standard commercial equipment it is assumed that they will be very popular amongst wireless amateurs.



A Corner in the Radio Communication Co.'s Factory at Barnes.

NOTE.

In order that readers of this paper may become acquainted with the progress of commercial wireless, the Editor is prepared to consider articles on experiments, research and general wireless developments undertaken by bona fide manufacturers of wireless apparatus and amateurs engaged in serious experimental work.

Articles should not exceed 1,200 words in length, and must be illustrated with photographs.

Articles accepted for publication will be paid for at our usual rates.

A COIL WINDING WRINKLE.

LITTLE workshop wrinkles, the outcome of meeting a special case of construction, could often be much more usefully applied if they were more widely known. Necessity, the mother of invention, has a very large and varied family.

In a works laboratory recently, it was found necessary to wind a new secondary on to an intervalve transformer, and without the special appliances for handling No. 48 S.W.G. enamelled copper wire, the job of winding seemed as if it were going to be a very long and tedious one. Certainly in this case it was not a race against time, but the deadly tedium of such a "never ending" job would militate against the best being made of it.

The little ebonite bobbin of the transformer, A Fig. 1, was intact, and a light wooden core was fitted and centred so that it ran easily on its axis. Upon the end of the overhanging spindle was fixed a little circular fan, B Fig. 1. Another motor fan was driven off the Electric Light mains, and the wind from this was made to blow round the fan carrying the bobbin on which it was desired to wind the fine wire from the bobbin C Fig. 1.

Any degree of elasticity of coupling could be provided by merely varying the distance between the driving and the driven fans, and the delicate wire was wound on without a mishap.

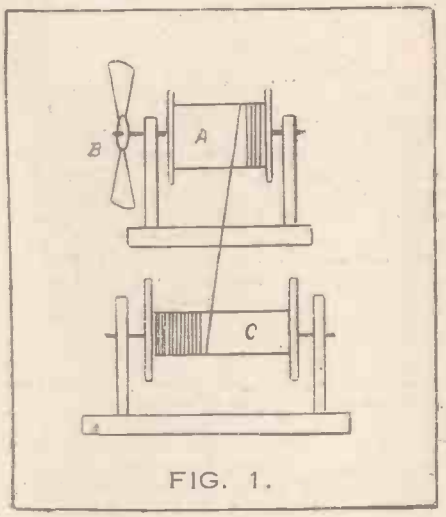


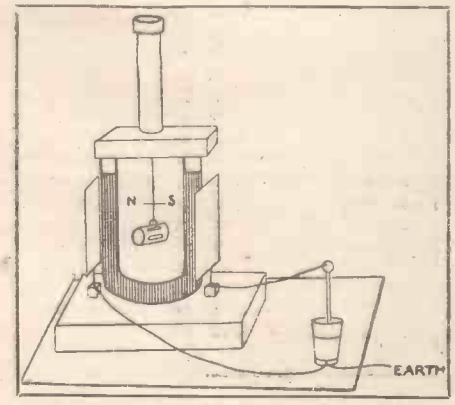
FIG. 1.

DOES THE EYE WIRELESS?

To the Editor, POPULAR WIRELESS WEEKLY.

DEAR SIR,—Owing to the holidays, I saw your article somewhat late—I mean the one commenting on the mysterious force which so many realise to be associated with the eye. In view of the qualifications and special capacity of so many of your readers in the realm of physics, I venture to indicate a point of interest. I refer to a condenser of a simple type, which was screened from heat by its envelopment in a collar of liquid paraffin. The sketch shows the arrangement.

A small cylinder of mica or celluloid was fitted with strips of aluminium on corresponding points of its inner and outer surfaces. The cylinder was suspended by means of a fibre of unspun silk within a glass or metal tube closed above. The tube was mounted in an ebonite disc, which rested on a glass beaker within which the cylinder (condenser) hung. The cylinder also carried a small bar magnet in a stirrup, which made an easy attachment to the silk fibre. The beaker was surrounded by a larger beaker and paraffin filled the space between the beakers.



Outside the outer beaker there were two aluminium plates, mounted in sulphur near, but not touching, the outer beaker. One plate was connected to the inner, and the other to the outer coat of a Leyden jar. The outer coat was also earthed, and the jar was charged from a Wimshurst machine.

The condenser, free to rotate on its fibre, took up the position with its long axis in the magnetic meridian—owing to the small magnet. The aluminium plates were arranged at right angles to the axis of the magnet.

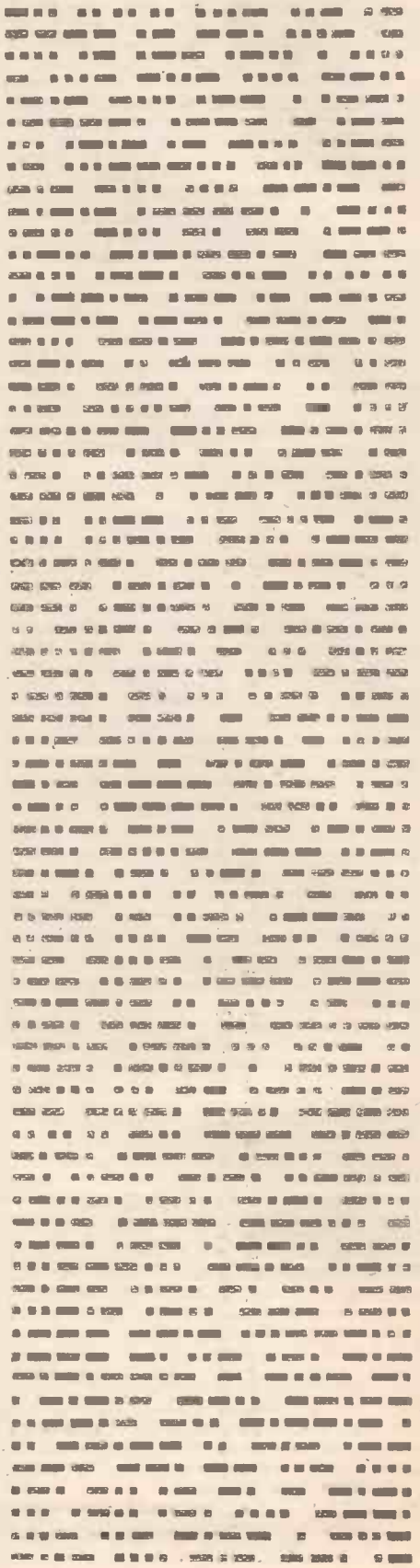
In dry weather, on charging the plates, the cylinder makes a sharp swing through 90 degrees, and is held under the stress from the charged plates for perhaps an hour. As the charges leak away, it slowly turns into the magnetic meridian. If while there is still a charge on the plates (giving a spark when discharging the jar by the tongs) one discharges the jar there is a further swing induced in the suspended condenser at the moment of such discharge. Apart from the charged plates one can set the condenser in a similar rotary motion by bringing a charged glass rod near it.

The interest is the extreme sensitiveness of this system to any change in the static in its vicinity. Moisture from the human breath is able to cause a deviation of the condenser by altering the conductivity of the zones of stress in the charged plate arrangement. The experiments illustrate the penetration of the various layers of insulators by a charge arranged outside them. I am credibly informed that the sensitiveness resembles that of the valves used in wireless. It may perhaps be of some service to some of your readers in their pursuit of the wireless wonder-field.

Yours faithfully,

CHARLES RUSS.
M.B., M.R.C.S., L.R.C.P.
(Late physician London Lock Hospital).

MORSE CODE PRACTICE FOR THE BEGINNER.



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R.F.H.

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.

Sutton Wireless Society.

The Rev. F. C. Lees, F.R.G.S., F.R.A.S., has very kindly accepted the presidency of the society, and his expert knowledge of radio and kindred subjects is of considerable benefit to the members. The roll now stands at 26, and is steadily increasing. A two-valve set on the unit system is to be installed, and the society has already been presented with an L.F. transformer and a ·0003 variable condenser.

On Saturday, August 26th, by the courtesy of the Controller of Communications, Air Ministry, a party of 16 spent an extremely interesting and instructive afternoon at the Croydon Aerodrome. The wireless transmitting and receiving gear was seen, and the working explained to the visitors by the engineers in charge.

Secretary, E. A. Pywell, "Stanley Lodge," Rosebery Rd., Cheam, Surrey.

The East London Radio Society.*

On Tuesday, September 12th, the usual meeting of the above society was held at the Lecture Hall, Woodstock Road, E. 14.

The attendance was quite as good as usual, and after 2 M T (Writtle) had finished his excellent transmission, the members settled down to the first of Mr. J. Keens' series of lectures on "How the Valve Works." Mr. J. Keens is a lecturer of very considerable ability, and his extensive knowledge of all matters wireless enables him to deal with his subjects in a manner which is not too simple for the old hand and not too intricate for the beginner.

Votes of thanks to both chairman and lecturer were carried, and the meeting closed at 10.15 p.m.

On Friday, September 18th, the society's enthusiastic "buzzerites" turned up in full force, and got so interested in their own doings that they rather overstepped the time allotted to them. So much so that listening-in did not commence until 9.15 p.m., and after various interesting experiments the meeting closed at 10.20 p.m.

Hon secretary, H. E. Lubbock, to whom all communications should be addressed.

Bradford Wireless Society.

The opening meeting of the session was held in the club-room, at 7.45 p.m., on Friday, October 6th, a number of new members being present. After the business of the meeting, the chairman, Mr. W. C. Ramshaw, called upon Mr. Whiteley to give his lecture on Popular Wireless. The lecture took the form of a historical survey, with special reference to wireless in the mercantile marine. Special reference was made to the excellent performances of the Radio Communication Company's commercial apparatus, and the whole lecture was illustrated by lantern slides, specially prepared by the lecturer. At the conclusion a hearty vote of thanks was passed.

Meetings will continue to be held throughout the session at the society's rooms, at 5, Rendall-well Street, Bradford, a few of the dates being below:—

Nov. 3rd—Debate, "The Prevention of Self-Oscillation."
Nov. 17th—Cinema Display (details later).
Dec. 1st—Mr. A. Liardet (title later).
Dec. 15th—Mr. S. Davies, Dewsbury (particulars later).
Dec. 29th—Annual General Meeting.

Hon. sec., Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising sec., Mr. H. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

The Finchley and District Wireless Society.

The fourth meeting of the above society was held at the Wright-Kingsford Home, Granville Road, when it was decided to hold future meetings on Monday evenings, at 8 o'clock.

A buzzer class is held at the close of each meeting, and is conducted by Mr. Nicholls. The membership of the society is now over forty, but this number should be increased still further.

The hon. sec., Mr. A. E. Field, 28, Holmwood Gardens, N.3, invites inquiries from all interested amateurs in the district.

Bromley Radio and Experimental Society.

The above society held its inaugural meeting on Monday, September 25th, at 8 p.m., at 14, College Road, Bromley, when a good number of amateurs attended.

All interested in wireless in the Bromley district are earnestly invited to communicate with the hon. sec., Mr. J. Fergusson-Croome, "Gowrie," Wendover Road, Bromley, Kent.

Leeds and District Amateur Wireless Society.*

The second annual general meeting was held on September 22nd, at 8 p.m., at the Leeds University. Mr. A. M. Bage (vice-president) was elected chairman. The chairman called upon the hon. secretary to read the minutes of the first annual meeting, which were accepted as correct. The hon. secretary then presented the report of the committee, who had pleasure in recording a year of steady progress and success. An exhibition of apparatus and demonstration of wireless telephony inaugurated the first complete session of the society.

Two informal meetings were also held. Most of the meetings have been held at the Leeds University. The thanks of the committee are due to Mr. H. F. Yardley, A.M.I.E.E., of the British Wireless Supply Co., for having kindly placed rooms at the society's disposal on several occasions.

It was resolved that the annual subscription and entrance fees be altered to 7s. 6d. and 4s. respectively for members over eighteen years of age, and 5s. and 2s. 6d. respectively under eighteen years of age. Meetings will be held weekly; formal or general meetings and informal or instructional meetings to be held alternately on Fridays. It was resolved to take steps to acquire transmitting and receiving apparatus, and a sub-committee was appointed to work with the ordinary committee in dealing with the question. Accommodation for the 1922-23 session has not been completely arranged, but it is hoped to make a definite announcement almost immediately. Certain rules were then altered, following other business. After a hearty vote of thanks had been accorded to the chairman for his excellent management of the meeting, the meeting adjourned.

Hon. sec., Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

The Wireless Society of Hull and District.*

This society continues to make steady progress and the membership is now over seventy. Meetings are held twice monthly; on the second Monday and fourth Friday at the Signal Corps Headquarters, in Park Street at 7.30 p.m. Recognising that there are a large number of beginners amongst the members who have joined recently, an interesting list of lectures and papers, which should greatly benefit these persons, has been drawn up for the approaching winter season.

Persons wishing to become members of the society should drop a line to the hon. sec., Mr. H. Nightscales, 16, Portobello Street, Hull, who will furnish full particulars.

A Wireless Club for Nottingham.

A wireless club for boys between the age of fourteen and eighteen has been formed in Nottingham, at the Y.M.C.A. Boys' Club, King Edward Street, where a two-valve receiving set has been installed.

New members are being enrolled and, judging by the interest taken in this innovation, a successful winter season is anticipated. Mr.

(Continued on next page.)

WIRELESS CLUB REPORTS.

(Continued from previous page.)

Carpenter is giving a series of lectures on Wireless Telegraphy and Elementary Electricity, and a demonstration will take place every Thursday evening.

Hon. sec., R. Weston, 3, Harcourt Road, Nottingham.

Tottenham Wireless Society.

The second meeting was held on September 28th, when Mr. Fred Bourne was elected chairman; Mr. R. A. Barker, secretary, and Mr. Baker, treasurer. The first half-hour was spent in buzzer practice, after which the chairman opened a discussion on wireless in general. Business was then discussed and several new members were enrolled.

The chairman is drawing up a syllabus of lectures, demonstrations, etc., so that the coming session of meetings should prove very interesting.

Meetings will be held every week on Thursdays, 8 p.m. sharp, at No. 10, Bruce Grove (temporary headquarters), and the secretary will be pleased to welcome prospective members of either sex.

Hon. sec., R. A. Barker, 22, Broadwater Road, Bruce Grove, N. 17.

The Portsmouth and District Amateur Wireless Society.

A meeting of the above society took place at the John Pile Memorial Rooms, Portsmouth, on the 4th inst. at 7 p.m., and a fair number of members were in attendance. At 8 p.m. the fortnightly business meeting took place, at which various matters were discussed. After the meeting, the president called upon Mr. Donkin to give his lecture as arranged. Mr. Donkin's subject was "My Portable Crystal Receiving Set," and consisted of his exploits when he first took an interest in wireless. Mr. Donkin explained that he made a cycling tour—taking his set with him—and his adventures with regard to aerials and other such important items were both instructive and amusing. A hearty vote of thanks was given Mr. Donkin at the close of his talk. After this lecture a short address was given by Mr. Harrold on his impressions of the London Wireless Exhibition, which he visited earlier in the week. His remarks were of very great interest to all the members. The president and council of the society are anxious to extend the membership, and any amateurs in the locality who are interested are invited to write to the secretary, Mr. R. G. H. Cole, of 34, Bradford Road, Southsea, for further particulars.

Sec., Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

The Fulham and Putney Radio Society.

At a well-attended meeting held at headquarters on Friday, October 6th, after the buzzer class, Messrs. Houstoun and Calver described and explained some interesting and unique circuits which were much appreciated, judging by the number of notes which were taken.

The membership is still on the up grade, and every effort is being made to provide interesting and instructive meetings.

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

The Thames Valley Radio and Physical Association.

At a general meeting held at East Sheen on October 4th, it was decided to alter the name of the Barnes, Mortlake, and Richmond Wireless Society to the above title, as many members had joined from the further districts of Teddington, Kew, Wimbledon, etc.

Mr. C. Appleton-Smith was elected chairman to the meeting, and the minutes of the last meeting were read and confirmed. The rules were duly presented, discussed, and passed.

A letter from Mr. Blake, M.I.E.E., our president, was read to the meeting, in which he apologised for his absence, owing to the prior claim on his services by the Wireless Society of London.

He expressed his desire to meet all members on November 7th at a special meeting, notice of which will be given in due course, when he will give his presidential address and lecture (with lantern slides).

It is hoped that everyone in the district interested in Wireless will be present. Hearty welcome will be extended to all visitors. Tickets for visitors can be obtained from the hon. sec. These tickets are free, but the number is limited.

An entrance fee to the association was fixed at 5s. by the meeting, and the subscription is 10s. 6d. per annum.

The next meeting of the association was held at the Girl Guides Hut, Wigan Institute, Mortlake (close to Mortlake Station, L. & S.W.R. on Thursday, October 19th, at 8.0 p.m., at which our series of lectures for the season commenced.

Hon. sec., Eric A. Rogers, 17, Leinstor Avenue, East Sheen, S.W.14.

Bromley Radio and Experimental Society.

A meeting of the above society was arranged to have taken place at 14, College Road on Oct. 2nd, at 8 p.m., but owing to the sudden growth of the society, the meeting was held at the White Hart Hotel.

The meeting commenced at 8.30 p.m. when the chairman, Mr. L. Stopes put before the 29 gentlemen present the objects of the society. He mentioned that several wireless lectures and demonstrations had been fixed, and visits to Croydon Aerodrome and other places of wireless interest would be arranged, also that application for affiliation to the Radio Society of Great Britain had been made. The chairman then called upon the secretary to read the rules. The treasurer made a strong appeal for new members and pointed out that for the society to be a success everyone interested in wireless must join.

The society has now approximately 40 members.

All applications for membership should be made to the hon. sec., Mr. J. Fergusson-Croome, Gowrie, Wendover Road, Bromley, Kent.

RADIOTORIAL

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

A meeting of manufacturers was held at the Institution of Electrical Engineers on Wednesday the 17th inst., when the Memorandum and Articles of Association of the British Broadcasting Company were ratified. Sir William Noble presided, and the attendance exceeded 200 representatives of interested firms.

It was decided that Marconi House should be used temporarily for broadcasting. Also, in order to expedite the commencement of actual broadcasting, a temporary station should be provided for Manchester. Stations for Birmingham, Newcastle, Plymouth, Glasgow, Aberdeen, and Cardiff to be erected as soon as possible.

Broadcasting licences covering the employment of apparatus bearing the stamp "P.M.G.-B.B.C." will be issued as soon as possible. These will cost 10s. per annum; this sum being equally divided between the Treasury and the broadcasting company. In addition, the latter will receive the following royalties on all apparatus sold by members in order to meet the expenses of broadcasting. Crystal sets, 7s. 6d.; microphonic amplifiers, without using valves, 7s. 6d.; crystal set and one valve, £1 7s. 6d; with two valves, £2 2s. 6d; one-valve set, £1; two-valves, £1 15s.; three valves, £2 5s.; Four valves, £2 15s.

Any firm will be eligible for membership on taking up one £1 share and depositing £50.

Endeavours are to be made to obtain permission to increase the power of the broadcasting stations from 1½ to 3 K.W.

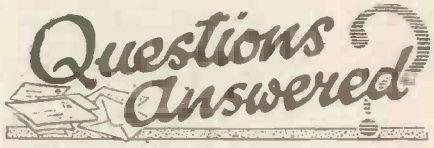
No foreign apparatus imported subsequently to July 18th last is to be allowed to be sold for broadcasting purposes.

One of the articles of association of the Broadcasting Company describes the Company as "A public utility service for the broadcasting of news, information, concerts, lectures, educational matter, speeches, weather reports, and theatrical entertainments."

Manufacturers will probably have something to say concerning the £50 deposit. Many of them will rightly object to the Broadcasting Company drawing interest on money they could well do with in their business.

I understand the Radio Association are giving their attention to this point, and also to the reason why a representative of the thousands of potential broadcaster users was not invited to the meeting.

THE EDITOR.



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.

"QUERY" (Tunbridge Wells).—I have a one-valve set. Can I use the electric light main—100 volts—for my high-tension voltage, using a suitable resistance?

No. The electric light main, even if it is direct current, is not suitable for the purpose you mention. You should use a high tension battery of about 40 to 50 volts.

* * *

D. T. (Mill Hill).—I cannot connect my set to earth, as there is no chance of connection with a water-pipe, and there is concrete all round the house, so that I cannot use an earth plate. Shall I be able to work a wireless set?

Yes. You will be able to use your set by employing a balancing capacity instead of the usual earth. The aerial and earth of every wireless set constitute a huge condenser, so if you can arrange an alternative "plate" instead of the earth, you will be able to receive in the usual way. To do this, erect a length of well insulated wire directly under the aerial and of the same length. It can be longer, but not shorter. This wire should be at a height of about 2 ft., and very great care must be taken that it is well insulated. Connect this wire to the "earth" of your receiver and you will be able to receive in the usual way.

* *

"WORRIED" (Southend).—I have no space in which to erect an aerial. I want to hear telephony from Marconi House. What is the best arrangement for me to use?

The best set for your purpose would be a three-valve set. You would be able to use a frame aerial quite satisfactorily. Another advantage you derive from using a frame aerial is that you do not need an earth connection. This eliminates many of the "parasitic" noises which are caused by odd currents coming into the receiver by means of the earth lead, and allows greater selectivity by virtue of its directional properties.

* * *

A. T. Q. (South London).—I have a one-valve set, but although I am nearer Marconi House than Croydon, I hear the latter far more clearly than the former, which is quite faint. Can you throw any light on the problem?

In all probability the reason is that you cannot tune down to a low enough wave-length to get Marconi House. If this is the case, as you are so near the London station, signals from 2LO would be so strong that they would be heard in spite of the set not being tuned to their wave-length. You are probably hearing a harmonic in the place of the actual signal. This would account for the weakness of reception.

* * *

A. R. F. (Rhyl).—Do you think it is possible for me to hear American stations working? My set is a three-valve one with an 85-ft. aerial 35 ft. high.

There is no reason why you should not hear American stations, provided your set is in good order. Of course, the signals would be confined to C.W. or spark stations. Telephony could not be heard that distance on your set. It is probable that the best results will be obtained at night, as it is possible to hear much farther then than during the day.

* * *

"READER" (Bedford).—I am contemplating buying a wireless receiving set, and I want to be able to hear the concerts from London. Will a two-valve set be sufficient, or should I get three valves?

You should be able to hear London quite well using two valves, but if you wish to employ a loud speaker three valves at least will be necessary.

* * *

"WAVE-LENGTH" (Plymouth).—I have a crystal set, and have wound a coil with 300 turns of 24 S.W.G. wire. The diameter of the coil is 4 ins. What is my wave-length?

If you are using a normal aerial, 2,300 metres. No, it is not any use considering the coil with only 10 turns, as it would not materially add to the fundamental wave-length of your aerial.

* * *

R. F. (Clapham).—My aerial is fairly high, but I can only have it 60 ft. long. Is it all right for me to have a double aerial, or am I only allowed to use a single one? My down lead is 15 ft.

Yes, you can put up a double aerial. If the combined height and length does not exceed 100 ft. Having two wires does not affect this regulation.

* * *

T. P. H. (Hendon).—I have been using a crystal set with a galena crystal, and until recently it has given very good results. Now, however, I cannot find any sensitive spot on the crystal. Is it worn out?

This trouble is sometimes found with crystals, but it does not mean that you will have to discard it altogether. Try scraping the surface with a knife; it is quite likely that you will find several sensitive spots. If this fails, break the crystal into several pieces, and use any of these as your detector. This method very often gives you several good detectors in the place of the old crystal. Of course, if you cannot find any sensitive spots even then, the crystal will have to be changed and a new one obtained.

(*Continued on page* 490.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 488.*)

R. A. V. W. (London).—To what part of the variable condenser are the wires connected ?

One to one of the pillars supporting the fixed vanes and the other to the moving vane spindle.

Which is the better, 100-ft. single aerial or a 50-ft. double at the same height ?

The longer single will be preferable.

What is the maximum size for a tuning inductance to use for a valve set ?

Hardly any limit can be placed on the size, which, within reason, is of no great importance apart from the fact that upon its dimensions will rely its wave-length range. Thus, if it is desired to bring in the very short wave-lengths the diameter should not be excessively large and the maximum value not more than three or four times the desired minimum.

* * *

"WIREFUL" (Dagenham).—What thickness of soft iron is used for high resistance telephone receivers ?

.01 to .005 inches.

* * *

"READER" (Bexley).—Would it be possible to hear The Hague on an indoor aerial wound 15 times round a frame with 3-foot arms using 2 valves ?

From the sketch we take it that the frame is 6 feet square. You would not hear the Hague with less than four valves.

What condenser do I require for tuning ?

.0005 mfds.

* * *

"LICEC RELLAW" (London, N.16).—In the article in number 18 on "Controlling Models" would the cost for making a wireless controlled train, not including the train and the accumulator, be only the prices mentioned, i.e. 5s., 5s. 6d., 7s. or 17s. 6d. in all ?

That would cover the more expensive transmitting apparatus, but does not include that required for the receiving and relaying instruments, which will be dealt with in subsequent articles.

A. G. D. (Thames Ditton).—What is the "Debeg" code sent out by Nauen at 9.40 a.m. G.M.T. ?

"Debeg" is an abbreviation for the Lindenberg meteorological code, which reports wind in the upper atmosphere by means of captive balloon observations.

* * *

"WONDERING" (Chelsea).—I am erecting a wireless set at home, but the Underground Railway runs alongside of the house. Is that going to affect the reception of signals ?

There will doubtless be considerable interference due to the inevitable leakage causing earth currents, but with a crystal set it will not be as noticeable as it would be using valves. The former should be quite O.K. for 2LO on 'phones, and, in any case, we do not think that you would be able to employ valve amplification in order to introduce a loud speaker owing to the probable interruptions.

* * *

"COLONIAL" (S. Africa).—I have a crystal set, but wish to be able to hear such stations as Carnarvon. My aerial is 80 feet long and 40 feet high, and I live 800 feet up. Does this mean my aerial is 840 feet high ? What set should I use for long-distance reception ?

You would need at least a five-valve set to give anything like satisfactory results. It would even then be doubtful as to whether you would hear Carnarvon. But there are several coast stations round Africa which you ought to have no difficulty in hearing. Although it may help in reception, the fact that you are 800 feet above sea level does not mean that you have an aerial of 800 feet in height. The effective height of an aerial is its distance or height from the nearest earth, so that your aerial is only 40 feet high after all.

* * *

A. P. D. (Southampton).—Can you please let me have the wave-length of my inductance ? It is 3 inches diameter and 8 inches long.

Assuming that it is wound for the whole length of the former, and also that you are using the usual gauges of enamelled wire, your inductance with a normal aerial would be as follows :—

22	S.W.G.	900	metres approx.
24	,,	1200	,, ,,
26	,,	1500	,, ,,

"LEARNER" (St. Albans).—I am building a crystal set, and I want to be able to tune to about 1500 metres. I have a former 3¾ inches diameter : how long ought it to be using 24 d.c.c wire, of which I have a lot on hand ?

Approximately 400 turns would give you the wave-length required. This means the former should be about 10 inches long.

* * *

"WORRIED" (Chatham).—I have just been told that the P. M. G. will not allow a reactance on a single valve set, even with an experimental licence. Is this so ? How can I alter my set to comply with his regulations ?

There are two ways which you could use for eliminating the oscillations set up in the aerial by the reactance of the valve. One is to cut out the reactance altogether, joining the plate of the valve straight to the 'phones or telephone transformer. The other is to employ a secondary inductance, loose-coupled to the aerial inductance, and then have the reactance loosely coupled to the secondary.

* * *

G. D. (Barnet).—I have trouble in fixing my crystal in its holder, three-screw type. The crystal is small and I find it difficult to get a firm grip on it. Can I solder it in ? I am using Galena.

If you are using Galena as a crystal, you must not use solder as a means of fixing. Heat tends to destroy or weaken the rectifying properties of the mineral. A good tip is to wrap the crystal round with tinfoil and then try the three-screw method of fixing once again. It is quite likely that it will grip successfully this time.

* * *

"CONTACT" (Grimsby).—Is platinum still used for the contacts of various wireless instruments, or has it been found possible to substitute that for a less expensive metal ?

Platinum is still largely employed, invariably for telegraph apparatus, although a gold and silver alloy (10 per cent. gold, 90 per cent. silver) is used to a certain extent.

What is a polarised relay ?

A relay the movement of the armature of which depends on the direction of the current. This type is employed largely in automatic wireless work, as they are more sensitive than the non-polarised type.

(*Continued on page 492.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 490.)

S. S. (Battersea).—Can ebonite panel, ¼ inch thick, be drilled with a brace and bit as easily as with a drill, and as neatly also?

No. A high-speed drill is the most efficient in this case; a brace and bit could be used, but it would be difficult to make a really good job of it. Of course a metal drill has to be used; those for drilling wood are of no use in the case of ebonite.

* * *

J. R. T. (Liverpool).—What is the use of having an earth arrester? I cannot see why the arrangement should work at all.

The reason for having an earth arrester is to provide safety in the case of heavy atmospherics or lightning. These high-voltage charges, very often capable of doing damage to the receiving set, naturally take the nearest path to earth. This is by way of the aerial. When they come to the earth arrester they have a choice, as it were, of two paths, the small gap or the highly inductive windings of the A.T.I. These windings offer great impedance to such currents, and as they are usually of sufficient voltage to break down the tiny air gap of the earth arrester, they choose the latter path, and spark down to earth, leaving the set and its delicate windings uninjured.

* * *

W. R. S. (Bradford) sends particulars of his single-valve set and states that he is obtaining very poor results.

In the first case 32 is not a suitable wire for winding A. T. I.'s. Re-wind your 10 by 5 inch coil with 22 or 24 S. W. G. Also your circuit shows no grid leak or condenser. Try the effect of connecting a 2-megohm leak from the grid to earth with the grid lead to the coil broken by a ·0003 mfd. fixed condenser.

* * *

A. H. (Croydon).—Across which terminals of my crystal set should I place a fixed condenser?

Directly across the telephone terminals. If it is desired to increase the wave-length range of a set a hundred or two metres, a small fixed condenser can be placed across the aerial and earth terminals. For instance, if the set will tune to 2,000 metres and it is desired to reach 2,600, in order to bring in Eiffel Tower, and no condenser at all is employed, the addition of a ·0005 mfd. fixed condenser would have the desired effect, but should be disconnected when tuning in the lower wave-lengths. It need hardly be added that this latter would not be necessary if the condenser was variable. Even if a variable condenser of a value not exceeding the above figure is employed, further capacity is permissible in order to increase the range, and as a matter of fact, with a large number of sets, is preferable to placing a loading-inductance in series, although the rule is to have a minimum of parallel capacity in open circuits.

"POPULAR WIRELESS."

FATHER: "Hark, Cook, that's The Hague!" **MOTHER** (from the door): "Smell, Cook, that's the dinner burning!"

T/Y

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