POPULAR WIRELESS WEEKLY, November 4, 1922. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

No. 23. HOW TO MAKE A LOOSE COUPLER.

POPULAR WIRELESS Weekly

3d.

No. 23. Vol. 1.
Nov. 4, 1922.

Major Raymond Phillips' Famous Wireless Controlled Aerial Mail.

FEATURES IN THIS ISSUE:

THE BIGGEST STATION IN AMERICA.

How to Make a Long-Wave Receiver.
Wireless Without Aerials.
Useful Hints for Amateurs.
Notes on the London Ether.
Insulating and Mounting Terminals.
A Desk-Mounted Panel.

NEXT WEEK.

Making a Home Broadcast Receiver.

Useful Analogies for the Beginner.

The Story of the De Forest Valve.

Popular Wireless

TOPICAL NEWS AND NOTES.

COMMENCING SHORTLY.

How to Make a D.F. Station.

The Eliminator.
An Invention of great interest to All.

Special New Section for the Beginner.
This section will enable the veriest novice to acquire a good knowledge of wireless in record time.

The Coming Demand.

THE Post Office is preparing for a great demand for wireless broadcasting licences. Orders have been given for printing 2,500,000 forms, and it is expected that they will be ready for issue very shortly.

At present any wireless enthusiast, so long as he is able to satisfy the authorities that he has some knowledge of wireless, can obtain an experimental licence, and already about 16,000 of these have been issued. This enables him to conduct experiments and, of course, listen in, but not to send messages.

* * *

£4,000,000 Capital.

A RECENT extraordinary meeting of Marconi's Wireless Telegraph Company authorised the raising of £1,000,000 additional capital for the development of broadcasting and other wireless business. This will bring the total capital up to £4,000,000. The directors were also empowered to borrow money to the amount of the capital of the company.

Senator Marconi said that, in addition to the construction of telegraph stations in many parts of the world, they had the advent of broadcasting. This was an entirely new business which they had every reason to believe would assume very big dimensions, and would add very considerably to the earnings of the company.

Not only was broadcasting proceeding at home, but likewise it was going ahead in most other important capitals of the world.

* * *

Secret Wireless.

THE "Chicago Tribune" (Paris edition) says Senator Marconi is perfecting a new invention in wireless telephony in the form of a machine for strictly private conversations.

"I am working on a device for sending messages directly between two points," he told the "Tribune" representative in Paris.

"The new apparatus eliminates all chance of outside parties listening in, and enables messages to be sent and delivered with absolute privacy.

"We are already able to send 100 miles. This winter I hope to perfect a device for a Trans-continental service."

Explaining the principle of the invention, he said:

"With an instrument built on the theory of a searchlight reflector, I am concentrating electric waves into beams that can be sent in a straight line in any direction. Up to the present we have had only a circular radiation of waves from a sending point, all stations within range receiving the vibrations.

"Now I expect to see wireless outfits with which London will talk to Paris or America in strict privacy."

* * *

Iddy Umpty.

A FINE way of teaching the youngsters Morse! Buy them the game called "Iddy Umpty." It is just like Snap, only the letters of the alphabet and its Morse equivalent are used; and, instead of shouting "Snap," you have to say the letter in Morse and its name. It really is the greatest fun. These can be bought from any stationer's.

* * *

The Marconiphone.

"IRIS, the golden-winged Goddess of the Rainbow, with the Swiftness of the Wind, penetrates everywhere, leaving the messages of Heaven."

The Iris flower, which is incorporated in the picture painted for the Marconi Company by the famous artist, Mr. Lewis Baumer, has been adopted as the symbol of the Marconiphone; for by means of this most wonderful instrument the actual tones of music and of speech can be conveyed more swiftly than the wind—nay, swiftly even as light—and over vast distances of space to the expectant ears of the world.

Joy and pleasure, entertainment and solace can now be given to tens of thousands simultaneously, whatever their situation or condition—to the humble cottage and to the palace, to the sufferer on his sick-bed and to the lonely traveller far from the amenities of civilisation.

Truly, "Iris, swift-footed messenger of the gods," has become a reality. By the marvels of science, her spirit has been embodied and her visible presence is manifested to all by the Marconiphone.

* * *

Radio and Nelson.

WIRELESS was called to the aid of Nelson's flagship on the 117th anniversary of Trafalgar.

Admiral Sir Dovcton Sturdee wirelessed from Marconi House an appeal for the preservation of the Victory.

* * *

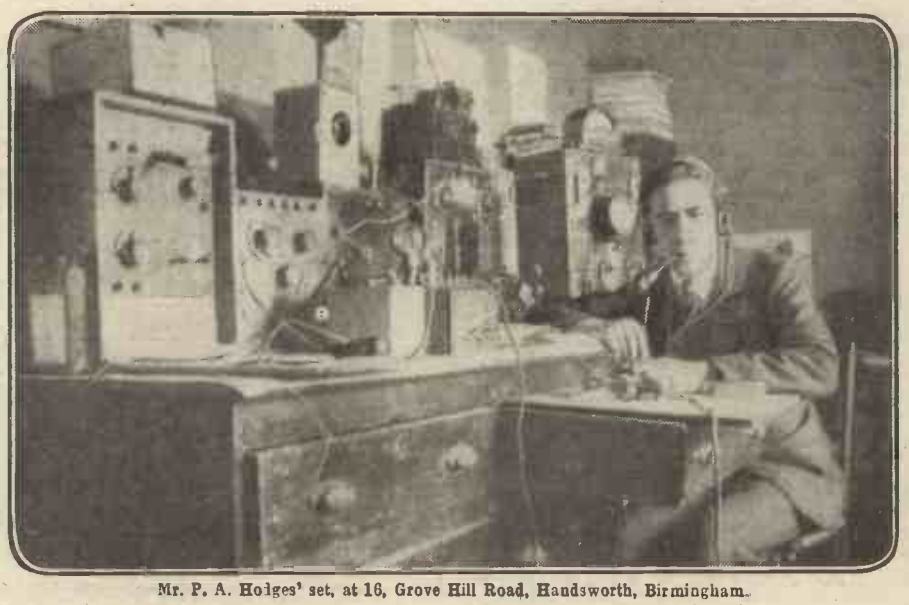
Wireless and Schools.

THE London Elementary Education Sub-committee recommend the inclusion of wireless telegraphy in the curriculum of an approved number of elementary schools, not exceeding 25. So far permission has been given to 13.

* * *

A Radio Dance.

THE Radio Society of Highgate is giving a radio dance at the Gate House, Highgate, N.6, on Saturday, November 25th, 7.30 till 11.30 p.m. Single tickets (inclusive), 7s. 6d., and double tickets (inclusive), 12s. 6d., may be obtained from Mr. J. F. Stanley, 49, Cholmerley Park, Highgate, N.6, and Mr. D. H. Eade, "Gatra," 13a, Sedgemere Avenue, East Finchley, N.2.



Mr. P. A. Hodges' set, at 16, Grove Hill Road, Handsworth, Birmingham.

NOTES AND NEWS.

(Continued from previous page.)

A Royal Patron.

AT the ordinary general meeting of the Wireless Society of London, held on Wednesday, October 25th, the announcement was made that H.R.H. the Prince of Wales had graciously consented to become the Patron of the Wireless Society of London and its affiliated societies, and that he noted it was intended to change the title to that of the Radio Society of Great Britain in the near future. The President had acknowledged this communication on behalf of the societies, expressing the extreme gratification that will be felt by all connected with the Society at this mark of His Royal Highness's interest in the work of Radio-telegraphy.

* * *

An Appeal.

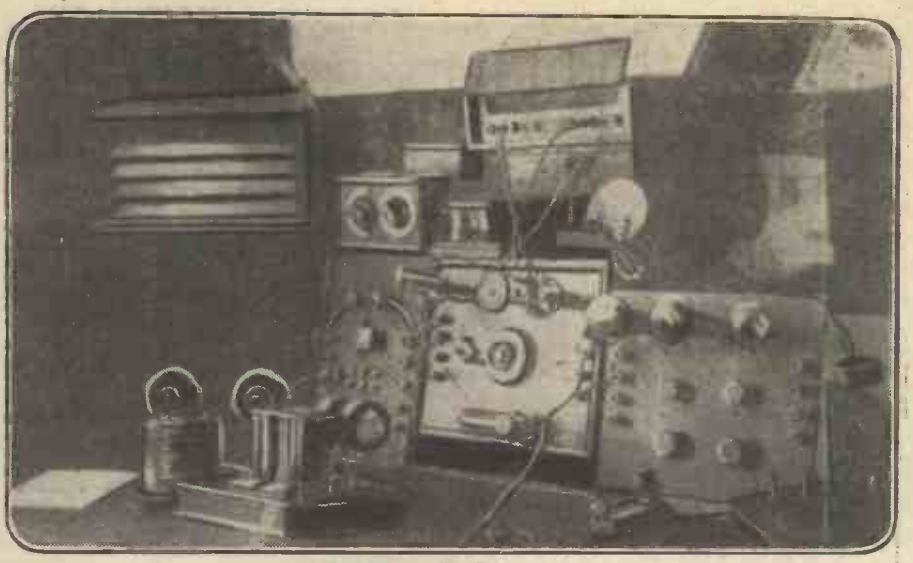
THE following announcement was also made regarding work which the Society is undertaking in connection with St. Dunstan's. His Royal Highness has expressed the desire to associate himself with this work as his first action on becoming Patron of the Society.

The Council of the Wireless Society of London have had under consideration a request from Captain Ian Fraser, the chairman of St. Dunstan's, that they should bring to the notice of wireless amateurs a direction in which they can contribute very materially to the instruction and entertainment of blind people who are, or will be, interested in radio-telegraphy and telephony. Captain Fraser was himself blinded in the war, and has, both before and since he lost his sight, made a hobby of the study of radio and allied sciences. He states from his own practical experience that it is possible for a totally blind person with no more knowledge of the subject than the average ordinary amateur to look after his instruments, accumulators, batteries, etc., and manipulate them with great accuracy, and without any sighted assistance. He further claims that with a little more knowledge of the subject the connecting up of instruments, experimenting with various circuits, and even the building-up of simple apparatus is not outside a blind man's reach. In his appeal to the council, Captain Fraser points out that in spite of the above there are initial difficulties such as the fitting-up of an aerial, leading-in tube, etc., which the most skilful blind man cannot undertake, and that in the case of absolute beginners unusual difficulties present themselves in connection with the choice of suitable apparatus to purchase, learning how to use it, etc.

* * *

You Can Help.

SINCE a blind man is deprived of many forms of enjoyment which are available for those who can see, Captain Fraser asked the council if it would consider these points on behalf of its members, and take steps to place them before the councils or committees of all associated or affiliated societies, with the following objects: (1) To obtain an indication as to whether or no the societies would be willing to make a special point of arranging for one or more of their members to make a particular friend of any blinded soldier or other blind person who might qualify for membership of the society, and undertake to give him the personal assistance which is obviously required in the directions outlined above; and (2) if it is indicated that the affiliated societies are willing to help in this way, it is suggested that a notice should be printed in the St. Dunstan's Magazine, and in the Braille Press, and that all other suitable steps be taken to let blind people know that if they apply to either the Wireless Society of London or to Captain Fraser, they will be put in touch with their local society, the members of which—if the blind person qualifies in all other respects for membership—will be willing to welcome him and give him special assistance.



Mr. J. Dale's set, The Leys, Cambridge.

* * *

Radio for a Hospital.

HAVE you sent a subscription to the Royal National Hospital for Consumption for the purchase of a radio set for the patients? The address of the appeal secretary is 18, Buckingham Street, Strand, and remember "every little helps."

ARIEL.

Broadcasting Programmes

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

TELEPHONY AND MUSIC TRANSMISSIONS.

Station.	Call sign.	Wave-length in metres.	Remarks.
Croydon	GED	900	Throughout day to aeroplanes.
Marconi House, London	2LO	360	Not regular.
Writtle, Essex	2MT	400	Tuesdays, 8 p.m. (Concert.)
Paris	FL	2,600	7.20 a.m., 11.15 a.m., 5.10 p.m. Also occasional telephony at 10.10 a.m.
Königswusterhausen	LP	2,800	Between 6 and 7 a.m., between 11 and 12.30, and between 4 and 5.30 p.m.
The Hague	PCGG	1,085	Sundays, 3 to 5 p.m. (Concert.)
Haren	OPVH	900	Practically every 20 minutes past each hour from 11.20 to 4.20, giving messages to aeroplanes on the Brussels-Paris, Brussels-London, and Brussels-Amsterdam lines.
Brussels Meteorological Institute	OPO	1,500	Slow C.W. and Morse. Easy reading for amateurs.
Messrs. Burnham (Blackheath)	2FQ	440	About 9 o'clock in the evening.
Newcastle*	5BA	440	Between 6 and 7.30 p.m.

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

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

All times given are G.M.T.

An asterisk denotes transmissions made purely for experimental purposes.

The Editor will be pleased to hear from amateurs and commercial experimenters with regard to transmissions made at regular hours.

RADIO CENTRAL

AMERICA'S GREATEST WIRELESS STATION.

By

OUR NEW YORK CORRESPONDENT.

The "lead-in" supports at Radio Central. America's biggest wireless station.

FOR nearly fifty years Great Britain has been the centre of the world's cable systems, a position to which she attained by virtue of her imperative need for swift communications with which to carry on the foreign trade on which her existence depends.

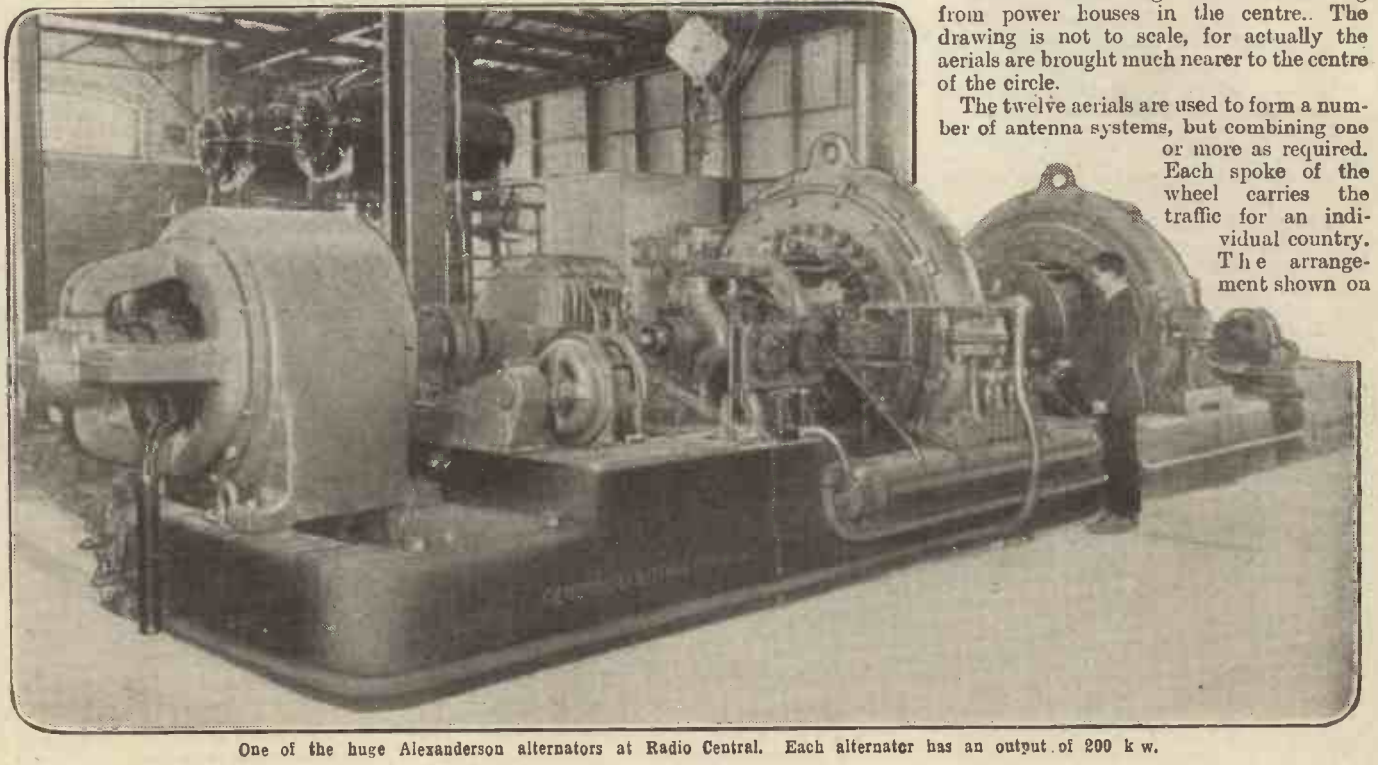
In the last few years a new method of communication has come into being, that of wireless telegraphy. For many reasons, each of them fairly obvious, it should have happened that the focal point of the world's wireless systems should have been, if not in England, at all events at some point in the British Empire.

Until a very few years ago England occupied a leading place in the development of wireless telegraphy, and, indeed, was carrying on business here in the United States. But since then the British interests in American wireless have been relinquished to Americans. And since then, though it was not a consequence of this fact, America has secured an overwhelming lead in the development of wireless communications. The seal on this accomplishment was set by the opening of the great Radio Central station at Rocky Point, Long Island, 70 miles from New York City, which it is the purpose of this article to describe. It has made New York City the focal point of world wireless communication.

For many years it had been the dream of wireless engineers to erect a huge transmitting station at some central point which should be able to command a world-wide field. Radio Central represents the realisation of their dream. In itself it is one of three units which comprise a complete station for sending and receiving messages, but that aspect I will deal with later, first describing the equipment of the sending station, the newest and most wonderful part of the whole.

The diagram showing the ground plan of the station gives a better notion of the idea underlying the conception of the station than any verbal description. It will be seen that there are twelve great aerials radiating from power houses in the centre. The drawing is not to scale, for actually the aerials are brought much nearer to the centre of the circle.

The twelve aerials are used to form a number of antenna systems, but combining one or more as required. Each spoke of the wheel carries the traffic for an individual country. The arrangement shown on



One of the huge Alexanderson alternators at Radio Central. Each alternator has an output of 200 k w.

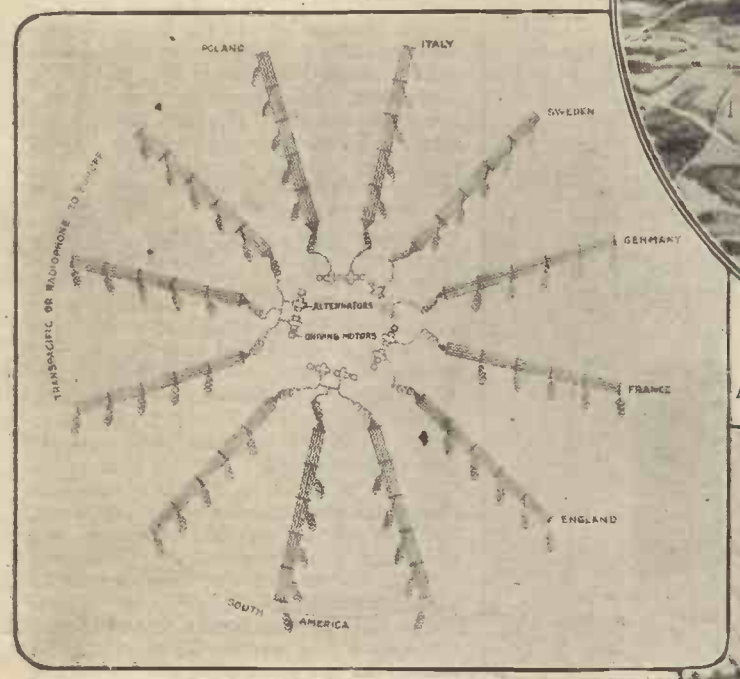
RADIO CENTRAL.

(*Continued from previous page.*)

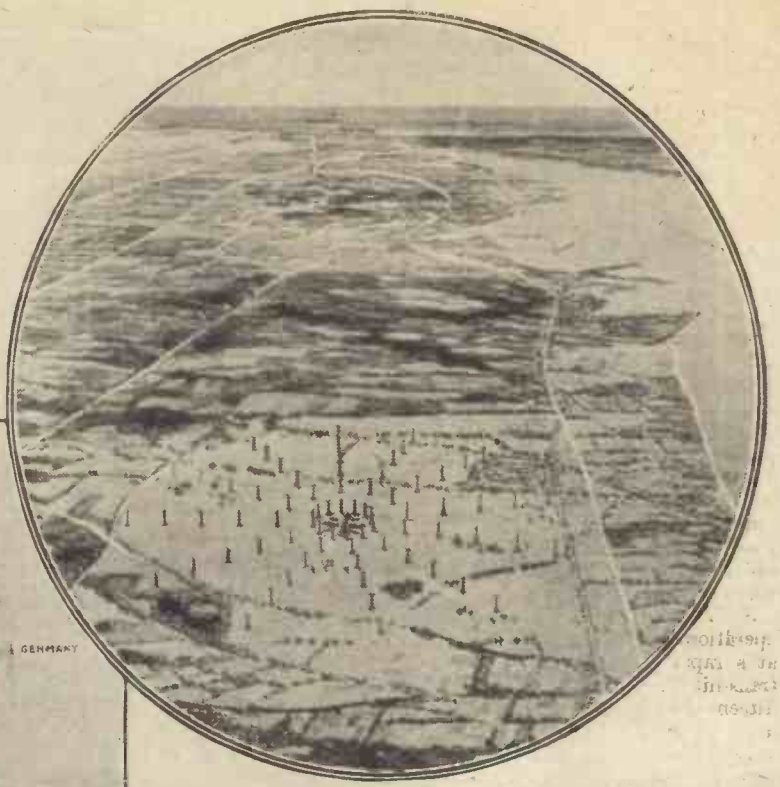
the diagram is not permanent, but can be changed at will. And as I described recently any two units can be combined through the synchronisation of two of the alternators, giving, of course, double the energy. In summer this renders the service completely free from stoppage through static interference, for the signals sent out with the combined energy of two 200 watt alternators behind them, can crash through any static yet encountered.

Each of the spokes of the wheel is a mile and a half long, consisting of steel towers, shown in another illustration, 410 feet high. The cross arms bearing the antenna wires are 150 feet across. Each tower contains about 150 tons of structural steel. The towers are sunk in

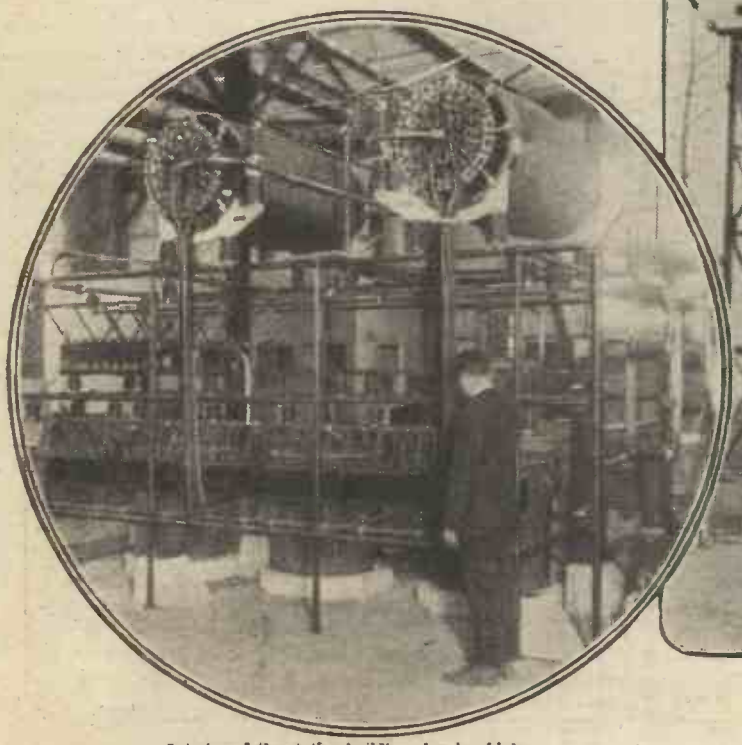
(*Continued on next page*)



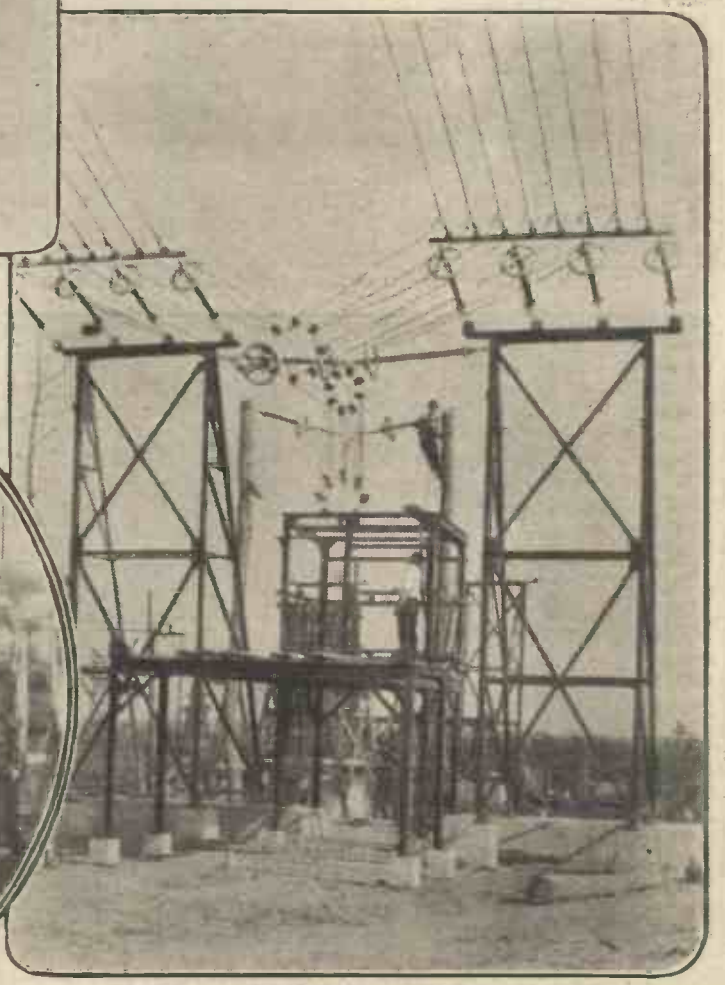
Plan of the aerial system for Radio Central



A bird's-eye view of Radio Central when all the towers have been erected.



Interior of the station building showing high-frequency inductance and condenser packs



This photo shows the "lead in" at Radio Central. The system is rather more complex than an amateurs' "lead in"!!

RADIO CENTRAL.

(Continued from previous page.)

8,200 tons of concrete, forming a bed under each tower nine feet thick.

The whole station is thus three miles in diameter, being the combined length of two aerials. It occupies the astonishing area of no less than ten square miles.

Each antenna consists of sixteen silicon bronze cables, three-eighths of an inch in thickness. There are 25 miles of this cable in each antenna. The ground system for each antenna unit consists of about 225 miles of copper wire buried under the entire length of the antenna. It is arranged in starfish and gridiron fashion.

The power of the enormous station is obtained from a public generating station, which supplies current of 23,000 volts. This is used to drive the motors which are coupled to the 200 kilowatt Alexanderson high frequency transmitting generators, which supply the exciting energy for the antennæ.

So far only two of the antenna units are in operation, but the remainder are being built at a rapid rate. To care for the existing transmitting apparatus there is a staff of fifteen engineers. There are no operators in the station, as will be explained presently.

At present the station works to England on a wave-length of about 23,000 metres, but with its multiple tuning, of course several different wave-lengths can be used.

In the beginning of this article it was stated that Radio Central was only one of three units making up a complete station. The other two are the receiving station, and the operating or controlling centre.

This three-cornered idea was first conceived some time ago and is now standard for all great stations where conditions are suitable. The most recent example is the great new station at St. Assise, near Paris. In the controlling or operating centre is done the actual work of sending and receiving messages. Here are the operators with their automatic high-speed transmitting instruments, which send and receive at 100 words a minute. In the case of Radio Central, the operating centre is in Broad Street, New York City, a few doors from the Stock Exchange and Wall Street, and next to the central offices of the great cable companies. From it the signals are carried over land wires out to Rocky Point, and there they are transferred automatically to the antennæ and sent out into the ether.

There remains the third unit, the receiving station. This is situated at Riverhead, a few miles from Rocky Point. This is an enormous multiplex receiving station, with an antenna system nine miles in length, giving it a natural wave-length approximating to the wave-length of the signals received. Here the signals are intercepted, transferred to land-lines, and again automatically reproduced on slips of paper.

Radio Central is world-wide in its range. Its signals are heard in practically every country of the world, almost instantaneously. It is owned by the Radio Corporation of America, and was built mainly by the General Electric Company. The erection of the first two antennæ with power houses, alternators, switchboards, etc., occupied a little over a year.

Up to the present it is the supreme expression of the wireless art.

HIGH OR LOW FREQUENCY.

By J. KAINE FISH.

THERE are many amateurs who are now building their own wireless sets, or who are thinking of buying the finished article, to whom the question of "What type of amplification shall I employ?" presents itself: "Should I use high or low frequency circuits?" Among the wireless enthusiasts who have given up the crystal and are using valves, I don't think I am far wrong when I say 75 per cent. of them employ two valves. It is principally the "Two Valves" for whom these words are written.

Of the two valves one, of course, must be the detector or rectifier, and it is the remaining one to which the all-important question of "high or low frequency?" applies. The answer to the question depends primarily on the stations one wishes to receive and their distance from the receiving set.

It is a sheer waste of good "juice," to say nothing of the extra initial expense, for a Londoner to use a two-valve circuit with high-frequency amplification for the sole purpose of "listening-in" to the Marconi concerts (2LO). After many experiments I have come to the conclusion that this circuit is only about 10 per cent. more efficient than a single-valve circuit, and is not worth the extra cost of filament current.

The H.F. two-valve circuit has its uses, however; for those residing from 20 to 100 miles from Marconi House it will be found excellent, and Londoners will, with care in building their sets and endeavouring to get the most from them, get fairly good reception of Paris telephony and the Hague concerts.

If two valves are decided upon, let the second be in a low-frequency circuit if the object of the set is to receive the broadcasting concerts, and within 20 miles of the transmitting station. With three valves the same applies, but one has more scope for diversity of circuits, for here can be used both high and low frequency with their respective advantages.

There are, of course, disadvantages with both methods of amplification. When listening to a high-power station such as 2 LO, which is fairly near in the "wireless sense" to all Londoners, and a high-frequency circuit is used, the volume of sound is little more, if any, than that obtained from a single-valve set.

With low-frequency magnification one has to remember that the audio-frequency or sound-frequency is being magnified, and this means that not only are the incoming signals, music, speech, and atmospherics magnified, but all the parasitic noises of the instrument itself, although these are negligible in a well-made two-valve set.

Both high and low-frequency circuits amplify and magnify, for both words mean practically the same thing. From Nuttall's Dictionary it is seen that "amplify" means to enlarge, and "magnify" to make greater; but to distinguish between the two methods, high-frequency is generally spoken of as amplification, and low-frequency as magnification.

Those amateurs using their sets for experimental purposes will, of course, use both types of circuits and will, like all "wireless bugs," find out for themselves. For those who have a knowledge of Morse my advice is H.F. every time.

With high-frequency a greater range is possible than with a single-valve set, but the volume of sound is practically the same.

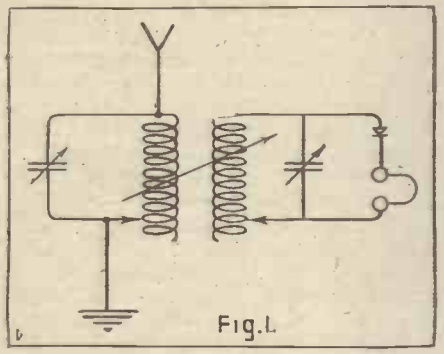
With low-frequency the volume of sound is increased on an average to five times, but its range is little greater than a single valve.

A Motor Car Radio Set, with Frame Aerial.

HOW TO MAKE A LOOSE COUPLER.

By G. V. DOWDING, A.C.G.I.

IT is proposed to detail the construction of a loose coupled two-circuit crystal set with a useful wave-length range of approximately 300–2,700 metres. The employment of a closed circuit inductively coupled to the open circuit represents a distinct advance on the simple single-circuit receiver, inasmuch that it will allow finer tuning, greater selectivity, or the cutting out of unwanted stations and the elimination, to a considerable extent, of such



parasitic noises as atmospherics. The completed set will be easily adaptable for use with valves, and the connections necessary are contained in the concluding remarks.

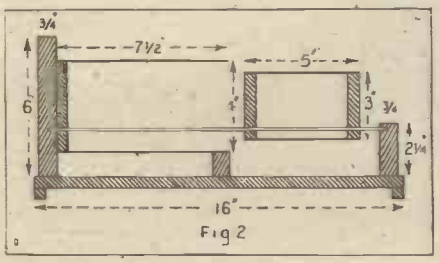
If the following instructions are carefully followed and the work not hurried the result will fully justify the strictest attention being paid to the smallest details.

Materials Required.

Before commencing the actual construction it will be as well to study the theoretical diagram shown in Fig. 1, and the dimensional diagram in section (Fig. 2), in order to gain some idea upon what lines it is intended to work.

Two feet of 12 in. x ½ in. and one foot of 6 in. x ¾ in. teak should be obtained. The wood should be well seasoned, but as an extra precaution it will be as well to place it in a moderately warm oven for an hour or two to drive out any possible residue moisture. Subsequently the re-entry of this should be prevented by means of a coating of shellac or a hard varnish.

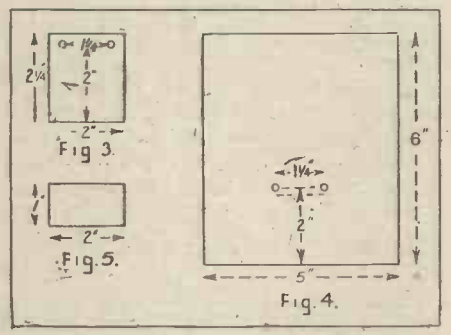
For the base a piece 16 in. x 10 in. of the ½ in. material should be cut out and bevelled slightly to improve its appearance. Two 10 in. x ½ in. strips should be screwed along the two smaller sides in order to raise the base, so that the underneath wiring and projecting bolts can be accommodated. It will be necessary to use screws of fairly fine thread, and holes of slightly smaller diameter should be drilled



to the full depth that the screws will take; otherwise, owing to the hardness of this particular wood, difficulty would be experienced in driving them right home. A few turns with a large drill should be made to countersink the heads of the screws to the surface of the wood.

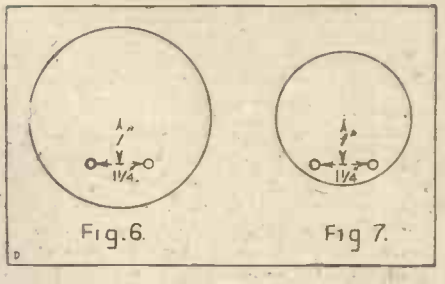
Then the large and small supports and the centre supporting block should be cut from the ¾ in. teak to the dimensions shown in Figs. 3, 4, and 5. It is most important that these should be carefully squared and the measurements checked. Two holes, centred exactly as shown in the diagrams, should be drilled with a $\frac{3}{16}$ in. metal drill to a depth of ⅜ in. in the two supports.

For the two inductance former tubes, which should be exactly 7½ in. x 4 in. diameter and 5 in. x 3 in., one large and two small circular end pieces will be required. Before these can be constructed it will be necessary to purchase the tubes so that the exact sizes can be ascertained. The above figures refer to the outside diameters; the sizes are standard, and no difficulty should be experienced in obtaining them. Waxed cardboard formers are retailed by most dealers in wireless sundries, and these will answer the purpose quite as well as the higher-priced ebonite tubes.



Having obtained the tubes, the exact inside diameters should be measured, if possible, with inside callipers, in order that their end pieces may be cut. It will not be found a difficult task to cut the necessary one large and two small circles from the ¼ in. material. The circles should be clearly drawn on the surface of the wood and carefully cut round with a fret or keyhole saw. If neither of these are available a small tenon saw can be used to cut round, first in the form of squares and then hexagons. The remaining corners can be trimmed off with a sharp chisel and the circles finally completed with coarse sandpaper, to make close, snug fits with their respective tubes.

The drilling of the 1·18 in. holes in the end pieces to take the slide rods is a little operation that calls for extreme care, as upon this will depend the smooth and evening running of the smaller coil. Figs. 6 and 7 show the positions of the holes. In order to ensure balance a circle with a 1·18 in. radius from the exact centre should be drawn. The centres of the holes, 1¼ in. apart, should both be on this line. That applies to both the large and small end pieces. It will be as well to mark these points on both sides of



the wood and drill half-way through from the one side and complete the drilling from the other. To obtain exactly similar positions pins should be fixed to the centre and a thread with a small weight suspended from each side. If 1·18 in. radius circles have been drawn on both sides it will be a simple matter to mark the centres of the holes so that they will be exactly in line.

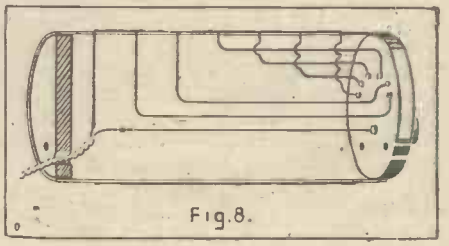
Tapping.

Next comes the winding and tapping of the secondary or smaller coil. Three ounces of 30 S.W.G. double silk-covered wire will be required. The turns should be closely wound in order to get on the required 270. Tappings are to be taken at every 45 turns so that there will be 6 contact studs. The taps should be taken evenly along the top of the coil, and small holes drilled to take the leads through. The commencement of the winding should be ½ in. from the switch end of the coil and the direction should be clockwise. (This latter will apply to the primary coil as well.) The end of the wire can be fixed to the former by drilling this latter with a thick needle, passing the wire through and securing it by means of a carefully tied simple knot in the wire itself.

When the point for tapping is reached it should not be necessary to cut the lead and heat a soldering iron; these should be prepared beforehand. Six leads cut from the 30 gauge wire, about 9 in. long, and a yard of double flex as used for electric-light wiring, should have their ends "tinned" in readiness. The tinned ends of the flex should be cut so that one is 2½ in. longer than the other. At the points of tapping a small hole should be drilled in the former and the lead pushed through.

Having completed the winding, the end of the wire should be soldered to the shorter end of the flex as shown in Fig. 8; it should be pushed through a hole from the inside of the former, and if this hole is so drilled that it proves a tight fit for the wire, so much the better, as the wire can be pulled through and a drop of seccotine will complete the fixing. A ⅛ in. hole should be drilled in one

(*Continued on next page.*)



HOW TO MAKE A LOOSE COUPLER.

(Continued from previous page.)

of the small end pieces between the slide rod holes in order that the flex can pass through.

Plenty of room will be found on the other end piece to accommodate a 6-point switch on the lines described in a recent issue.

Soldering.

The next operation will be to cut the tapping leads so that just sufficient length is allowed to permit of soldering them to the contact studs. Needless to say, this length should be as small as possible. Tin both the backs of the studs and the ends of the leads before commencing to make the final connections, and do not forget to do the same for the end of the flex that will be soldered to the centre of the switch. Having completed the soldering, push both end pieces into their respective positions, but leave the final screwing until the slide rods

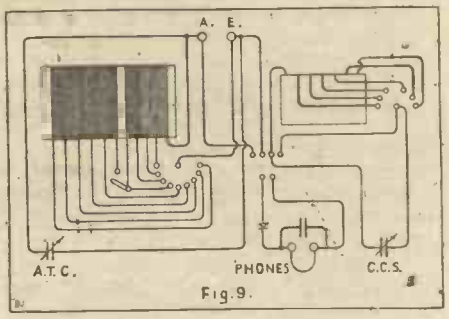


Fig. 9.

have been pushed through. This will ensure that the holes are exactly in line.

The winding of the primary, which will require 4 oz. of 24 S.W.G., S.S.C., can now be undertaken. In this case there will be two sections broken by a "dead-end" switch. Seven tappings will be taken, three from the first section and four from the second. A 9-point switch fixed to the base will be required, but the wiring of this must be left to the very last.

The "Dead End Switch."

Commence winding ¾ in. from the one end and leave 7 in. or 8 in. of wire in order to form the lead to the aerial terminal. A tap should be taken at each 20 turns until 80 turns have been wound, and at that point the wire should be cut, leaving at least 10 in. free to provide the lead to the "dead-end" switch. The wire can be made fast by passing it through back and through two small holes pierced in the former. The winding should be continued after leaving another 10 in. for the second "dead-end" switch connection with a space of about $\frac{1}{16}$ in. between the two sections. Tappings should be at every 32 turns until the remaining 160 turns have been wound on, when the wire should be made fast as in the first section, with at least 12 in. allowed for the lead.

If the wire has been closely and evenly wound there should be a space of ¾ in. to spare at the end of the former, and a ⅛-in. hole should be drilled close to the wire in line with the tappings. This will take the flex from the secondary through to the base.

Two $\frac{3}{16}$-in. brass rods exactly 14¾ in. long should now be obtained. It need hardly be said that these must be absolutely straight. The rods should be threaded through the smaller coil and then through the end piece of the large coil, which should be forced into its position. The rods should be inserted in the holes of the supports, and a brief survey taken of the whole structure. It will be necessary to carefully align it ¼ in. from the back of the base in order that the screw holes can be placed. The best plan is to drill the base and mark the supports through with a bradawl. It will not be necessary to up-end the whole concern to do that. The positions of the supports can be carefully marked round with a pencil, and the coils laid aside. Then the positions for the holes in the base for the tappings and leads should be marked out. It is better to run the tappings straight down from the coil to separate holes than to "bunch" them, more especially if the introduction of valves is a possibility.

Fixing the Coils.

The coils should be mounted with light screwing first of all, as it is doubtful whether it will be found that the secondary coil will slide easily; but the holes where it appears to jamb can be slightly rimed out with the end of a file. After this has been satisfactorily accomplished the position can be marked for the centre supporting block and the screws taken out and the coils again laid aside. Then the centre block can be screwed into position and the holes drilled for wiring and tapping leads. There will be 12 of these in line underneath the primary coil, including the one of ⅛ in. diameter to take the flex from the secondary.

The coils can then be remounted, attention being paid to that aforementioned flex. This must be passed through the primary coil and the ⅛-in. hole in the base. This will apply to all the other leads and their respective holes. A small screw should be driven from inside the primary former into the centre supporting block and further small screws through the formers into the end pieces, care being taken that none of these touch the windings. The large end piece should be screwed to the large support.

Wiring Up.

At this point some amateurs may wish to diverge and arrange the lay-out according to their particular requirements, the only further details necessary for the bare loose coupler being a 9-point switch and a 2-way switch for the "dead end."

A ·0005 mfd. variable condenser will be required for the primary coil and a ·001 mfd. for the secondary, both being placed in parallel. A change-over switch to carry the detector and telephone receivers from one circuit to the other to facilitate tuning is almost essential with this type of set. A double throw-over knife switch, or even two 2-way switches, can be used. These latter coupled together are shown in the diagrams.

A full wiring diagram is given in Fig. 9. The fixed condenser should be underneath the base. Its value should be ·001 mfd.

A perikon crystal detector, zincite pressing against copper pyrites, will be eminently suitable. The "dead-end" switch is a simple 2-way switch operating at "short" up to 1,000 metres.

If it is desired to employ the complete set for valves all that is necessary is to disconnect the crystal and take the "A" and "E" "A.T.I," or "grid" and "filament" of the valve circuit directly to the centre points of the change-over switch.

BOOK REVIEW.

Wireless: Popular and Concise. By Lt.-Col. C. E. Chetwode Crawley, R.M.A., M.I.E.E., Deputy Inspector of Wireless Telegraphy G.P.O. (Hutchinson, 1s. 6d. net.)
Reviewed by William Le Queux, M.I.R.E.

The other day I opened a little book called "Wireless: Popular and Concise." I sighed and exclaimed, "Oh, yet another!" I sank into my armchair and began to read. I had read it half through before I glanced at its author's name. Then I was surprised, for it is a strange fact that every work from the pen of a Government official is dull and uninteresting. But I found that the book in question had been written by "a very old hand," as they say in political circles. Everybody in wireless knows Captain Loring and Colonel Crawley, but—well, I for one did not know that the latter could write such an excellent book.

The "Four Sevens."

First, the reader is taken swiftly through the history of wireless signalling from James Clerk Maxwell's paper before the Royal Society in 1864, when he proved the existence of the waves we now use to-day, to the "Four Sevens" Patent No. 7777 of 1900, of Marconi, the master-patent which provides for the tuning to a common wave-length of the four main wireless circuits, the spark circuit, the sending antenna, the receiving antenna, and the detector circuit.

In concise form Marconi's early troubles and experiments with the coherer are described, and I myself know those troubles, for in those early days I also experimented with the coherer. The discoveries of Fleming, Poulsen, Dr. R. Goldschmidt, and Alexanderson are described in a manner that all can understand, and finally the introduction of the valve, "the revolution in radio," is fully explained, together with that of the continuous-wave system.

It is the sound but simple style in which the book is written which makes it such a valuable contribution to our wireless literature. Energy, wave-motion, screening, and lines of propagation are dealt with in a manner so simple that everybody of ordinary intelligence can understand.

He shows us by simple diagrams how wireless messages are sent, and why they can be received. Since the long-ago day when I stood in the British Consulate in Leghorn, and witnessed the signing of the first Marconi contract, a document destined to revolutionise the world's signalling and save the lives of countless thousands at sea.

Get a Copy.

Colonel Crawley puts to us very plainly the great difficulties under which his department are working in connection with amateur experiments. I have heard many wireless men trounce the Post Office and all its ways. But after reading Colonel Crawley's excellent little book I think they will view the whole situation through quite a different pair of spectacles.

I am an "early enthusiast," like Colonel Crawley, and I congratulate him upon his book, for to all outside the official circle it will be found most helpful, and both to the amateur and the intending listener it will be found of greatest interest. Every wireless society should have a copy in its library.

HOW TO MAKE A LONG-WAVE RECEIVER.

By Y. W. P. EVANS.

PART 4.

THE panel is perhaps the most difficult part to construct, and great care must be taken in observing the various dimensions. I would advise that the reader should first of all make himself thoroughly acquainted with the following instructions, and endeavour to visualise the complete receiver, thereby obtaining a clear idea of what is required.

First, I will explain the lay-out of the panel, as shown in diagram. This is a sheet of ¼-in. ebonite (matt finish), 13 in. by 8 in., and the sketch reproduced here is intended to show the position of the various parts, both above and below the panel, and that is why the reader should exercise his imagination somewhat. The fittings on top of the panel are: One 4-pole change-over switch, two inductance switches, one filament resistance knob, one valve holder or four valve legs, ten 2 B.A. terminals.

Various Parts.

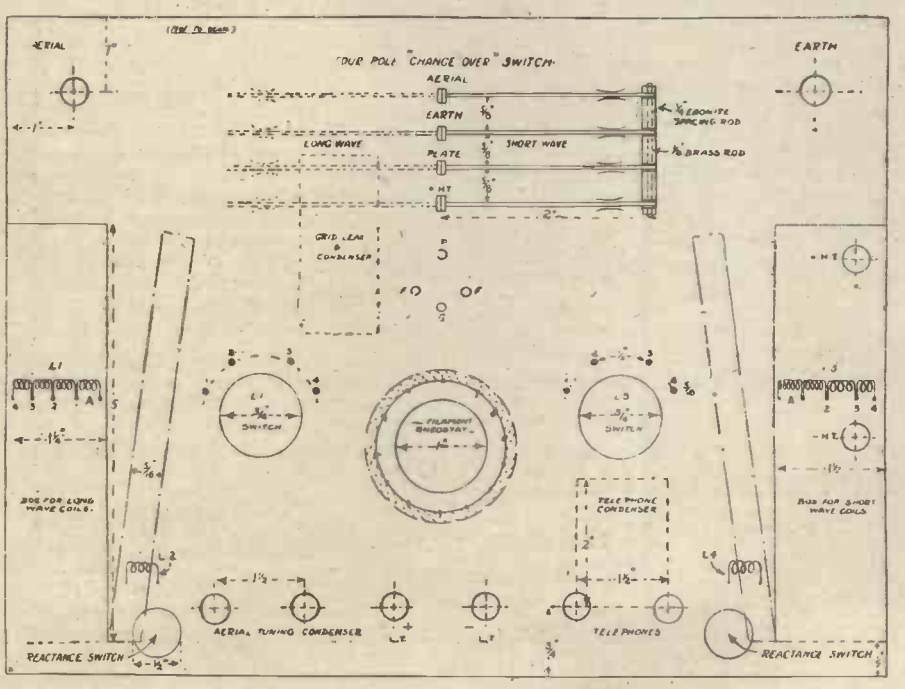
The large switch is at the top of the panel, and is shown in position on the short-wave side. The two inductance switches are marked L1 and L3. The filament resistance knob is in the centre below the valve holder, and the terminals are dispersed two on the top, two at the right-hand side, and six at the bottom of the panel. There are also eight studs shown, four around each switch knob, and marked from 1 to 4 to correspond with the tappings on the coils indicated at each side of the panel. The remainder of the drawing, shown in dotted lines, constitutes the instruments which will be on the under side of the panel or in the receiver box.

These are described clearly on the drawing, but it will be advisable to explain them more generously. The boxes on either side represent the receptacles for the tuning coils, and should be made of ply-wood, 5 in. square and 1½ in. deep. These will rest in the bottom of the receiver box or cabinet, and will be 1 in. clear of the under side of the panel, when the latter is placed in position. The second box, shown at an angle ($\frac{5}{16}$ in. deep), contains the reactance coil, and is hinged on the other box at the lower end of the drawing, and controlled throughout its swing of 90 degrees by the reactance switch, the fitting of which will be described in a further article on connecting up.

The Change-over Switch.

The telephone condenser, grid leak and condenser, explained in previous articles, are shown in their positions, the former underneath the telephone terminals, and the latter below the 4-pole change-over switch (c.o.s.), extending to the valve holder. Should it be decided to have this latter instrument on top of the panel, it will be found most convenient if placed lengthways over L1 switch, between the position of the long-wave box and the valve holder. The filament resistance is generally about 2 in. maximum diameter, and the coil of resistance wire is represented directly underneath the knob.

The construction of the 4-pole c.o.s. will be dealt with first. This is made up of two ordinary 2-pole c.o.s.'s, which are usually sold on a porcelain base at 4s. 6d. The reader can either buy two or make them on similar lines to the trade article. If they are bought, make careful notes as to how the copper strips are secured to the base and also the method of securing the terminal posts, and then dismantle both switches and fit them to the top of the panel in exactly the same manner, except that the distance apart of the copper switch blades should be $\frac{5}{8}$ in., and the extremities of the blades should be joined together with ¼-in. spacing rods (ebonite), having an $\frac{1}{8}$ in. brass rod through the centre, and secured at either end with a brass nut. (See diagram.)



Terminals.

Commencing at the top end of the panel, the first blade should be ½ in. from the edge, the others spaced ⅝ in. from this one, thus giving a full width of 2 in. to the switch itself. The four centre terminals are connected to aerial, earth, plate, and positive H.T. respectively (wiring diagram will be given later). Keeping to the centre line of the panel, mark off 3½ in. from the top, and use this point as the centre of the holder. Two inches lower than this will be the centre of the filament resistance, and 2 in. below this last point forms the centre for the bottom line of terminals, which should be ¾ in. from the bottom of the panel. That completes the measurements on the central line.

Now mark off two points 3½ in. from the bottom of the panel and 2½ in. on either side of the central line, these forming the centres for the inductance switches. Two more points 1 in. from each edge at the top-left and right-hand corners form a centre for the aerial and earth terminals, and two more 3 in. from the top and bottom of the panel, at a distance of ½ in. from the right-hand side, form the centres for the H.T. terminals.

Shop-window Advice.

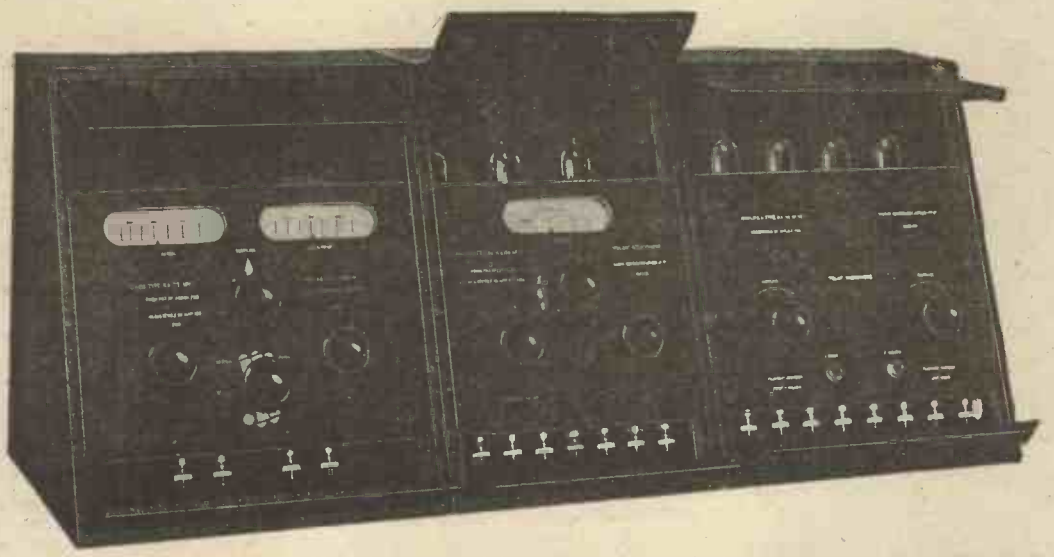
The various circles inscribed are as follows: Switch knobs for L1 and L3, ¾ in. diameter, the studs being displaced evenly on a half-circle 1½ in. diameter. Filament knob, 1 in. diameter, resistance wire 2½ in. diameter. The reactance switch knobs are ½ in. in diameter, but their position cannot be determined until you are ready to fit the cabinet part of the receiver. This will be described later. On the under side of the panel the condenser should be placed as shown, a good method of fixing being by means of shellac. Give the condensers a nice thick coat of shellac and allow it to become "tacky," and then press firmly against the panel and leave for about an hour, when it should then be stuck fast.

If you decide to have the grid leak and condenser on top, proceed accordingly. All terminals, switch-ends, studs, etc., should protrude on the under side of the panel about ¼ in., so that the wires can be soldered thereto.

The filament rheostat can be bought for 3s. 9d., and this is much more preferable to the novice than attempting to construct one. Should you care to try the experiment, there are plenty on show in shop windows, from which you can make notes. The writer has constructed several parts in this way. By noting the various instruments in a shop window, and basing the same on rough calculations, quite good results are obtained.

(To be concluded next week).

"POLAR"



"Polar" Prestige. "Polar" installations have been adopted by most of the leading shipping companies in this country, by the British Post Office, and by Colonial Governments.

"Polar" equipment is installed at North Foreland (G.N.F.), Seaforth (G.L.V.), and many other important stations.

Having built up our reputation on commercial wireless equipment, we are now applying our valuable resources and extensive experience to the manufacture of broadcasting apparatus.

"Polar" Radiophones. Under the title of "Polar" Radiophones we have a wide range of amateur receiving sets. They are well designed, soundly constructed, and finely finished, and extremely reasonable in price.

The set illustrated shows our standard design with sloping Ebonite panel, polished wood case, and silver lacquered fittings. Every type of unit required is available.

Prices from £2 15s. 0d. to £45 5s. 0d.

"Polar" Accessories. "Polar" wireless accessories incorporate many new and exclusive features.

For example, the "Polar" variable condenser is an entirely new design operating on a new principle. The standard unit has a capacity variable from .001 m.f.d. to .0001 m.f.d., being equivalent to a 29-plate condenser of the ordinary type. Dimensions, 3 in. x $3\frac{1}{2}$ in. x $\frac{7}{8}$ in. deep. **Price, for panel mounting, 14s.; or in polished wood case, 20s.**

"Polar" Radio Supplies. By buying all your wireless supplies through the "Polar" organisation you will obtain the benefit of our exhaustive laboratory tests which are used to discriminate between competing items. Everything sold under "Polar" auspices can be relied upon to be the best of its class.

Ask your wireless dealer to give you "Polar" wireless equipment or apply direct to one of our branches or head office.

RADIO COMMUNICATION Co. LTD

34-35, NORFOLK STREET, STRAND, LONDON, W.C.2

Telephone: CENTRAL 1021 & 3005.

Telegrams: "RADIOCOMCO, ESTRAND, LONDON"

WIRELESS WITHOUT AERIALS.

By SEXTON O'CONNOR.

MARCONI, in 1896, was the first to use an upright aerial in combination with a Hertz spark-generator, an inventive step which marks the birth of wireless as a commercial proposition.

Whilst previously the distance over which Hertzian waves could be transmitted and received was limited to a mile or two at most, Marconi's aerial gave an effective range which gradually increased from tens to hundreds, and then thousands of miles. Nowadays it is a commonplace affair to girdle the earth with radio messages. This extreme range has, however, only been achieved by utilising energy of very large wave-length, which, in turn, has necessitated the erection of costly and elaborate aerial systems.

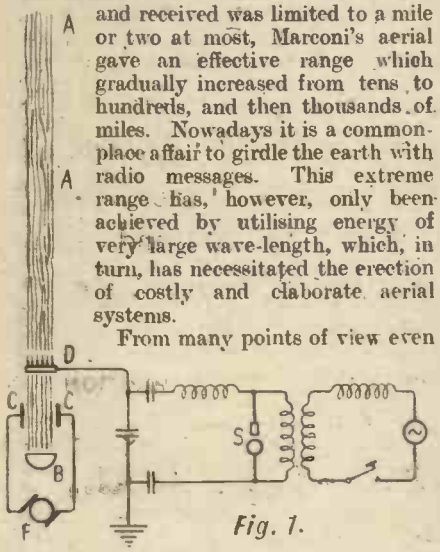


Fig. 1.

From many points of view even the simplest form of extended aerial may be said to constitute an unnecessary and clumsy obstacle to that universal use of the wireless medium which should theoretically be possible. The really essential factor of wireless communication, the ether, is all-pervading, and provides a permanent and ready-made connecting link between transmitter and receiver, wherever these may be located.

A Fascinating Prospect.

Incidentally, it is certain that many who now stand aloof from the cult of amateur wireless do so because they hesitate to undertake the trouble or expense involved in erecting unsightly masts and wires.

Unfortunately, however, a terminal erection of some kind or other appears to be inevitable, particularly for transmission, but there is no doubt that if the present awkward arrangement could either be eliminated altogether, or else replaced by some simpler and more "manageable" device, a tremendous field of development would at once be opened up.

There is a decided fascination in the idea of a new system of wireless by means of which it would be possible to make telephonic connection at any time, with anybody, and in any place, and it is conceivable that this prospect is not so utterly impossible of fulfilment as may at first sight appear. The problem will practically be solved when the right substitute for the aerial has been discovered.

Whilst the final solution still remains with the future, there is evidence that the subject is even now being seriously tackled upon entirely new and revolutionary lines.

Although ordinary air is normally a perfect insulator, it is well known that by means of ionisation it can be made to some extent a conductor of electricity.

For example, in the early forms of "soft" valve, there was usually an appreciable amount of air or other gas left within the globe. Instead of this forming an obstacle to the electron flow between the filament and plate, the ionised particles of the residual gas actually gave rise to an increase in the value of the current passing through the valve. In other words, they enhanced the conductivity of the plate-filament path.

Ionisation.

Again, the upper limit of the atmosphere is bordered by a layer of rarefied air in an ionised condition—generally termed the Heaviside layer—which undoubtedly acts to some extent as an electric conductor. In fact, it is due to the reflecting action of this ionised layer (analogous to that exhibited by metallic conductors when struck by ether waves) that it is possible to get wireless signals around the curvature of the earth, instead of losing them in interstellar space, as would happen if they kept strictly to the theoretical straight path of propagation.

Now, one of the known methods of ionising air is to pass through it a concentrated ray of light that is rich in ultra-violet rays. Such rays are much shorter than normal light-waves, which in themselves are almost infinitesimally small. (Actually, the ultra-violet rays have a wave-length which is commensurable with the size of the air molecules themselves, and therefore with the orbits of the associated electrons.) The result is that in their passage through the air these extremely short light-vibrations displace or set free a proportion of electrons from the molecules, thereby rendering the gaseous path containing the free electrons a conductor of electricity.

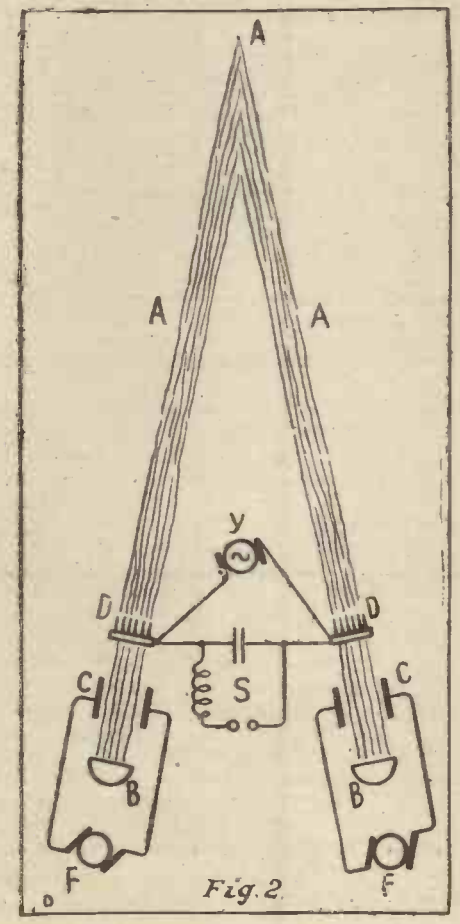
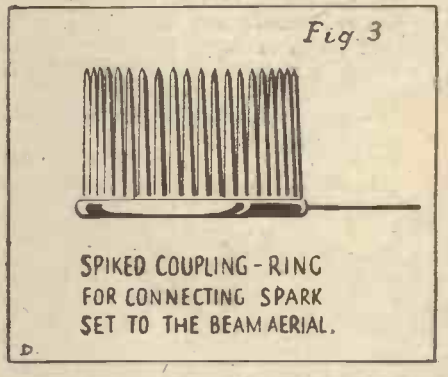


Fig. 2.

A "Beam" Aerial.

It may be pointed out that the modern definition of an ordinary metallic conductor of electricity simply states that it is a body wherein the electrons are so loosely bound to the atoms that they caused to pass from one atom to the next by application of an electro-motive force, the result of such a continuous "electron drift" being what we term an electric current.



Recently investigations have been made as to the feasibility of utilising a concentrated beam of ultra-violet rays as a means of creating a vertical column of ionised air which will be able to take the place of the usual metallic receiving and transmitting aerials. The original suggestion was due to Mr. J. Hettinger, who first put it forward during the War.

The underlying principle is clearly seen from the diagram given in Fig. 1. A search-light beam of ultra-violet rays A is produced by means of a suitable electric arc or mercury vapour lamp B, the light being concentrated and focused by means of quartz lenses.

Transmission.

The upper end of the resulting column of ionised air remains insulated, as in the case of the ordinary wire aerial. The lower end is "tapped" or connected to one lead of any high-frequency generator—for example, a spark set S—by means of a metallic ring or coupling-piece fitted with upwardly pointing prongs D, shown separately in Fig. 3.

The prongs facilitate the discharge current from the metallic ring into the column of ionised air. The other lead from the generator is earthed, as shown, so that the beam aerial forms one plate of a condenser, the place of the other plate being taken by the earth in the usual way.

In order to cut off the conducting path of ionised air between the metal ring or connecting grid and the lamp source, a transverse electric field is interposed, as

(Continued on next page).

NOTES ON THE LONDON ETHER.

By 2 A N.

I SUPPOSE no law, or code of laws, seems fair to every individual—hence rules and regulations have to be passed for the greatest good of the greatest number, and the exceptional person sometimes feels ill-treated. Some of the early Post Office regulations did seem just a little onerous, and, like many others, we felt inclined to clamour for more freedom. Thanks to the well-directed efforts of the Wireless Society of London, many concessions have already been granted, and the friendly and helpful attitude of the Post Office officials to the genuine experimenter is a point for national congratulation. We feel that one additional regulation respecting transmitting licences is urgently wanted, and that its adoption would result in reduction of interference and secure more satisfactory reception for all workers.

We will deal first with the trouble and then with the remedy.

Wireless is becoming too easy and too attractive to suit the view of the early pioneer who was brought up on coherers and magnetic detectors.

It is the mysterious and almost miraculous character of radio science which gives it its uncanny and nearly morbid attraction, for all of us have a touch of the mystic in our mental "make-up."

A "Radio Freshman."

It takes all kinds of men to make our every-day laborious old world, and I think that radio science can claim to have representatives of all grades within its ranks, from the bluff, jovial and genial 2 ? ? to the lean, attenuated and super-intellectual but well-beloved old 2 ? ?. Some are admittedly there for crude commercial reasons—and why shouldn't they be ?—while others are there for pure love of the science itself.

Naturally this big collection of representative types includes many who have rushed into radio without serving their technical apprenticeship, and whilst the more experienced old birds are always ready to extend a helping hand to recent converts to our art, it is a little disconcerting to hear a "radio Freshman" shouting to all and sundry, "Hello, hello, hello, is anybody about ? I want to know what my wavelength is and whether my speech is quite O.K. Changing over."

This is dangerously near the forbidden signal "Hello C Q," which is the official call for all stations and is absolutely "verboten" to the amateur experimenter.

Anyone who listens to the nightly clamour in the London ether cannot fail to be aware that experimenters who are nominally working on a wave-length of 440 metres are actually to be found on wave-lengths of anything between 380 metres and 500 metres.

Cruel.

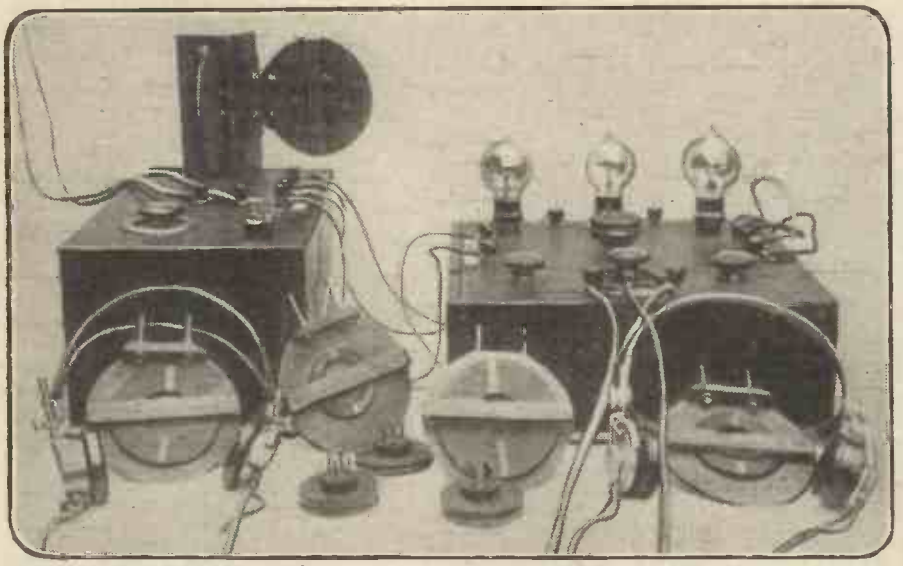
While two bodies cannot, of course, occupy the same space at the same moment, it might be theoretically possible for all the London amateurs to comply strictly with the regulations and work dead on the official 440 metres, but it would result in hopeless confusion, so that a little reasonable latitude would doubtless be permitted by the authorities. At present wide range on either side of the official point, occupied by the amateurs, is altogether inexcusable, and can only be explained on the assumption that many transmitting stations are not provided with wavemeters, or that their owners fail to make use of them.

We would suggest that in future one of the qualifications required for applicants for transmission licences should be the possession of an accurate wavemeter and the ability to use it intelligently.

London amateurs were busy on a recent Sunday night. 2 A J was working at 2 A A, using relatively big power and transmitting very clear speech, which we received with great intensity on the loud speaker operated by two valves only. He gave us clear and lucid directions for constructing model gliders by the aid of paper and seccotine, and told us the length of flight we might anticipate from the finished model under certain conditions. We only regret that the lack of paper, scissors, seccotine, and time prevented us from carrying his directions into effect forthwith.

2 A J was not quite so successful with his music. The modulation produced by the gramophone was nothing like so intense or clear as that obtained by his speech.

The cruellest criticism we have ever heard of amateur musical transmission was intercepted in the ether on the same occasion. One gentleman, who shall be nameless, addressing another gentleman, who shall be equally anonymous, said that his transmission on the occasion referred to was nothing like so good as his normal transmission, but expressed the hope that his friends *might* be able to recognise the tune.



Home-constructed set belonging to Mr. H. B. Wilks, 92, Mayford Road, Balham, S.W. 12.

WIRELESS WITHOUT AERIALS.

(*Continued from previous page.*)

shown at C C. This is created between the two plates of a condenser connected to the terminals of a direct-current generator or a high-frequency alternator F.

Possibilities.

It is well known that certain metals, such as rubidium and alloys of sodium and potassium, emit streams of electrons when a ray of ultra-violet light impinges on their surface. In order to take advantage of this additional ionising factor, the surfaces of the pronged ring facing upwards are coated with a covering of such metals.

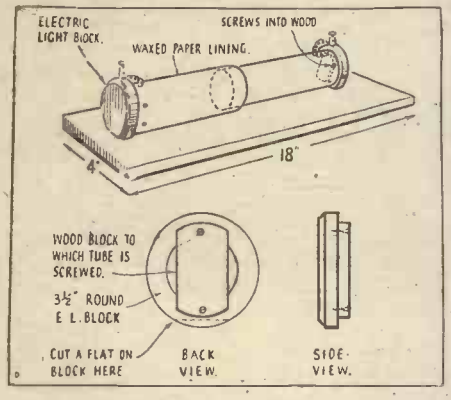
To increase the conductivity still further a constant direct or alternating electric field may advantageously be applied to the beam aerials, upon which the signal currents are superposed.

For this purpose the two terminals of a direct-current generator, or alternator Y, are linked by means of the spiked-ring coupling-piece to two beam aerials arranged to intersect at a given height above the ground. Two such intersecting beams may also act so as to give a directional effect to the transmitted signals, as indicated in Fig. 2.

It is conceivable that such ionised beams might be caused to penetrate the so-called Heaviside layer. Ordinary telegraphic or telephonic messages could then be transmitted by utilising the conductivity of this upper region of the atmosphere as the connecting circuit between two beam-aerials located at a distance from each other and acting as two tapping points for the entry and exit of the signalling currents.

A CHEAP VARIABLE CONDENSER.

VARIABLE condensers of the moving and fixed vane type are rather expensive articles to buy and very difficult for the amateur to make, but a very effective variable condenser, if made in the following manner, will do all that is required for a



few pence and a little patience. The following instructions are for the construction of a cheap condenser, and by little additions, according to the amateur's fancy, it may be made quite a smart-looking instrument.

Construction of Plates.

In the first place you will require two tubes about 2 ins. in diameter. One should be 2 ins., and the other slightly smaller, so that it will pass inside easily. They should be 8 or 9 ins. long, but it is quite a simple matter to make the whole thing.

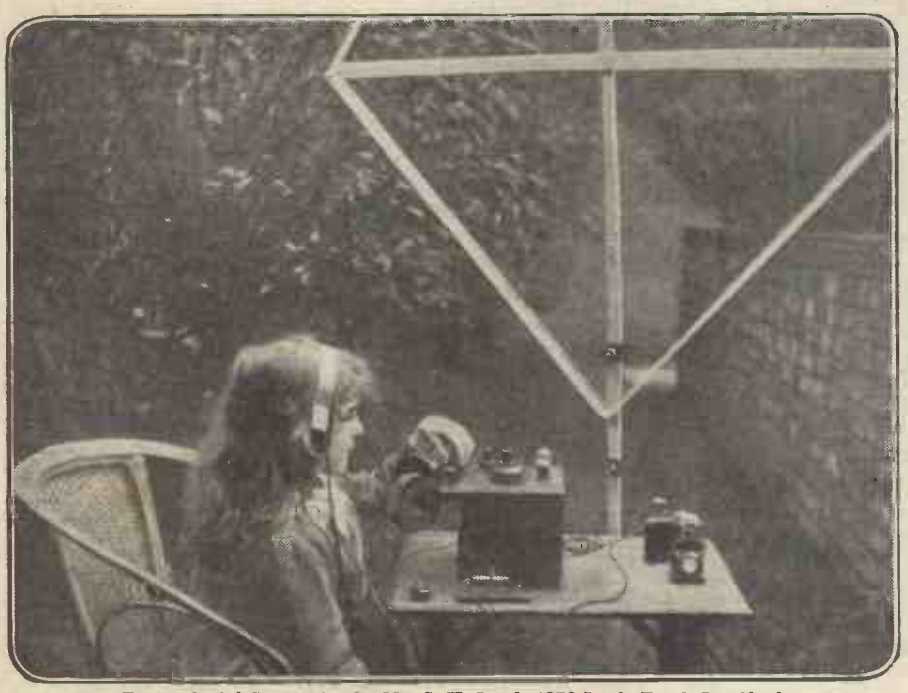
Procure two pieces of zinc, say 2 ins. by 6, and form them into tubes by rolling them round a broom handle, iron pipe, or anything cylindrical that is smaller than the actual size required. You will find that the zinc will spring open, and it is best to warm it first. This will make it easier to handle, and it will not be so springy. Solder the seam, and allow the edges of the first tube to overlap, say a sixteenth of an inch. The other tube that will have to slide inside will, of course, overlap a little more, about $\frac{3}{8}$ in.

The Dielectric.

Next thoroughly "paraffin wax" a piece of foolscap paper of sufficient size to neatly cover the smaller tube. Warm the tube, and wrap the paper round it whilst warm. This will stick the paper to the zinc. Do not have a lot of overlap of paper. When it is cold, try it for a sliding fit inside the larger tube, and by a little opening or closing of the larger tube it will be possible to get a very decent fit.

A neater way will be to line the large tube with paper in a similar manner, and leave the smaller tube quite plain, opening or closing the joint till a nice sliding fit is obtained.

So much for the metal part. You will now want a piece of wood for a baseboard 4 or 5 ins. wide and 18 ins. long, also two $3\frac{1}{2}$-in. electric light blocks. Cut a flat on each, as in the drawing, and fasten a piece of wood on each, so that they fit inside the tubes. Mount the whole as shown in the drawing, and a very useful condenser will result. Soldering the joints will make a much stiffer job of the tubes, and the sliding tube will retain its nicety of fit.



Frame Aerial Set erected by Mr. C. H. Land, 1276 Leeds Road, Bradford.

HINTS ON SCREW CUTTING

MOST amateurs find a time when a thread to take a screw is absolutely essential, and how to get over the difficulty is a bit of a worry.

One hears of "taps" and "dies," so the first thing is to understand the meaning of these terms. The tap is a tool that cuts threads in a hole to take the screw; and the die is the tool that will cut a thread outside the metal—such as a piece of wire that will fit the thread in the tapped hole.

As an instance, we will suppose that a piece of metal is desired to have a hole with a thread in the hole to take a screw. First, the hole has to be drilled smaller than the desired thread, so assuming that we are to put $\frac{1}{8}$-in. thread in, then we will have to drill the hole $\frac{5}{32}$ in.

Method of Tapping.

There are two taps required for each size of thread: one is a taper, and has very little thread at the starting end. This tap gradually cuts the thread, and the next tap, with the full thread, completes the work.

Now for the screw portion. In this case we will assume that the thread has to be on the end of a long piece of wire. This thread will be cut with the die.

It must now be explained that unless you have a costly set there will be no separate dies for each thread, and for such small work this is unnecessary. The easier form will be to buy a screw plate. This will have several sizes of threads in it, but it is advisable to see that you get a good make, and that the thread has "clearance" holes.

These will look as though there are three holes close together: the centre hole has the thread, and the others are to allow the cut metal to clear away from the thread proper.

Sizes of Dies.

If funds will allow, it is as well to buy a set that has the little dies in a sort of frame that will be pressed on to the metal when cutting the thread by means of a thumb-screw at the very end. This pattern also allows of making a thread that is slightly tight or loose as desired.

As a guide, the following sizes will be found most useful to start with, and may be added to at times and when a better knowledge of threads has been obtained: $\frac{1}{16}$ in., $\frac{3}{32}$ in., $\frac{1}{8}$ in., $\frac{5}{32}$ in., and $\frac{3}{16}$ in.

Ask for standard Whitworth size, as this will allow you to cut threads that will take screws that may be in your stock or can be purchased. The taps are made square on the top to take a tap-wrench, but the amateur will find it is very easy to make just a little piece of flat metal about 3 in. long and $\frac{1}{2}$ in. wide with a hole in the centre, or a piece of round metal flattened in the centre and then drilled and the hole made square.

Never try to cut these small threads quickly; put very little pressure on, and take time over it or it will be found that brass will easily break off in the die, and if you happen to have a screw-plate it will give a lot of trouble to remove it.

CONTROLLING MODELS BY WIRELESS.

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

PART 7 (NEW SERIES).

WHEN assembling the selector described in my previous articles, it will be advisable to loosely fit a brass washer $\frac{1}{16}$ in. thick to each of the drum spindles. Such a precaution will obviate any possibility of the brackets, or supports, coming in contact with the ratchet (fitted at one end of the drum) and drum flange, thus reducing friction.

Final Adjustments.

Care should also be exercised when mounting the drum, and particular notice taken that the latter revolves freely when set in motion by magnetic impulses.

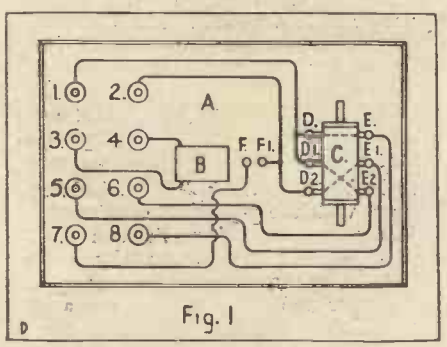


Fig. 1

The contact springs should be so adjusted that any unnecessary friction is eliminated.

On referring to Fig. 1 (No. 21 of POPULAR WIRELESS) it will be observed that the balance-spring H can be adjusted until the desired tension is attained. The adjusting screw G should be so arranged that the distance of the armature D from the cores of the electro-magnet B does not exceed $\frac{1}{8}$ in.

The eight terminals can be attached to the baseboard, and connected up as shown in Fig. 1 (this article).

To simplify matters the diagram is arranged as a skeleton plan, and shows a baseboard A, electro-magnet B (armature not shown), drum C with contacts D, D1, D2, and E, E1, and E2. Contacts F and F1 are for connecting with a de-cohering device to be described in due course.

Connecting Up.

It will be observed that the eight terminals are numbered 1 to 8 respectively, and connected up as shown. No. 18 gauge double-cotton-covered copper wire may be used for connecting the terminals to the electro-magnet B, and various contacts.

The wire should be laid in slots or grooves cut in the baseboard A, and can thus be neatly hidden. The slots, or grooves, should not be cut on the surface of the baseboard upon which the electro-magnet and other component parts are mounted, otherwise the general appearance of the selector will not be enhanced.

After assembling the selector it will be advisable to test all circuits.

On connecting terminals Nos. 3 and 4 with the terminals of a 4-volt accumulator (the latter comprises two cells made up as a complete unit), electric current should traverse the windings of the electro-magnet B, energising the latter, which should then strongly attract its armature.

Testing the Selector.

Immediately electric current is cut off from the windings of the electro-magnet B, its armature should be automatically released, and the pawl (attached to the armature support) engaging with the ratchet attached to the drum C should cause the latter to revolve a step forward.

Contacts F and F1 (Fig. 1) can next be tested. This can be effected with the aid of an ordinary electric bell, one terminal of the latter being connected with terminal No. 7 on baseboard A. The other bell terminal can be connected with one terminal of a 4-volt accumulator; the other terminal of the latter being connected with terminal No. 2.

On further connecting terminals Nos. 3 and 4 with the terminals of the accumulator in question, contacts F and F1 should immediately close, and thus admit electric current to the electric bell (used for testing purposes), thereby functioning same.

The contacts F and F1 (Fig. 1) are marked J and J1 in Fig. 1, No. 21, of POPULAR WIRELESS.

It will be noted that for testing purposes I recommend using a 4-volt accumulator.

Control Motor.

My reason for adopting such a course is that as electric current for the whole apparatus (including the model electric train to be wirelessly controlled) will be provided from such a "source of energy," it is obvious that the tests applied will be the same as those to which the apparatus will be subjected when in actual use.

Contacts D and E can be tested by connecting one terminal of an ordinary electric bell with terminal No. 8 (Fig. 1), and the other bell terminal with one terminal of a 4-volt accumulator, the other terminal of the latter being connected with terminal No. 1.

When the drum C is revolved to the correct position, contacts D and E should close a circuit, and so cause the electric bell in question to function. Contacts D1, D2, E1, and E2 can be tested by connecting terminals Nos. 1 and 2 (Fig. 1) with the terminals of a 4-volt accumulator, and (if available) the terminals of a model (permanent magnet type) electric motor should be connected with terminals Nos. 5 and 6.

On revolving the drum C to the correct position, the armature of the electric motor should revolve in either direction as desired. If the motor in question is not available, the terminals of an ordinary electric bell should be connected with terminals Nos. 5 and 6. It will then only be possible to test the circuits in the ordinary way.

The selector in question has been designed in such a manner that either a "series" or "shunt" wound model electric motor can be controlled, in addition to the permanent magnet type (as described in my last article), but it will be understood that (except by introducing complications) the latter type of model motor is the simplest form to control, as it will be observed in subsequent articles (when I shall furnish a wiring diagram of the complete receiving apparatus) that the conductor, and outer rails of a model electric railway, will be simply connected to terminals Nos. 5 and 6 (Fig. 1).

Series-Wound Motor.

As many wireless enthusiasts have on various occasions asked me to describe a scheme for controlling a series-wound model electric motor, a skeleton plan, Fig. 2 (this article), shows a method of connecting such a motor to the selector already described, and comprises a battery A, series-wound model electric motor B, drum C, with contacts D, D1, D2, and E, E1, E2.

In operation it will be observed that electric current from the battery A would traverse the field magnet winding B1, thence to terminal No. 1, and contacts D1, E2, and terminal No. 6 through the windings of armature with commutator B2 to terminal No. 5, thence to contacts E1, D2, and finally to battery A, thus causing the armature with commutator B2 to revolve in the usual manner.

Reversing the Current.

It will be noted that electric current can be caused to flow in a reverse direction in the windings of armature B2, by revolving the drum C until contact D1 is connected with E1, and contact D2 connected with contact E2.

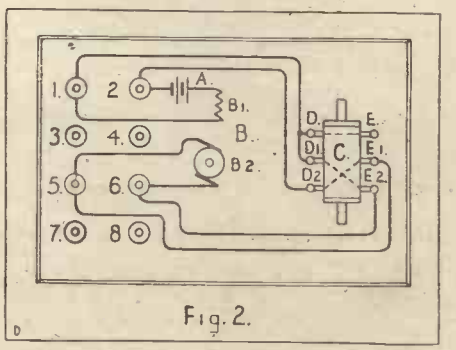


Fig. 2.

The polarity of the current traversing the field magnet winding B1 would, however, remain unaltered, so that the armature with commutator B2 would revolve in a reverse direction to that previously described.

In my next and subsequent articles I hope to furnish constructional details, also diagrams of a coherer, de-cohering device, and baseboard. Upon the latter will be mounted the relay (already described in previous articles), selector, coherer, de-cohering device, etc.

A DESK MOUNTED RECEIVING PANEL.

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

IT will very often much enhance the ease of working, and nearly always add considerably to the appearance of an ebonite valve panel, if it is mounted "desk fashion." This style of mounting is much easier than placing the panel horizontally or vertically so that it forms either the lid or the side of a box, and it is proposed to give detailed instructions as to how it is done in the following article.

If the amateur has a good "jack" plane all the rest is easy, but if not, the good offices of a joiner may be invoked, and the four pieces of hard wood cut to dimensions and shape. It is essential that the edges of the end pieces, at least, be planed up absolutely square.

The panel shown mounted in the photograph is 13 ins. long and 9 ins. wide. A board of half-inch mahogany was cut into, to provide one piece for the base 15 ins. by 8 ins., and the top 15 ins. by 3½ ins., both rectangular.

The two ends were cut so that the base, back, top, and front measured respectively 7 ins., 6½ ins., 3¼ ins., and 9½ ins.

Squaring the Edges.

A "shooting board," a plane and a small wooden bracket should be placed into position in order to true the one side with the other. The shooting board is made up of a baseboard; deal will do, but hardwood is better, 2 ft. long, 5½ ins. wide, and ½ in. thick.

Upon this is placed another board 2 ft. long, 3 ins. wide, and ½ in. thick. If two of the long edges of these boards are made to coincide the other two edges will make the "rebate," or shelf, along which the plane slides when "trueing" up the work, which is pressed against the block. The block is 4 ins. long, 2 ins. wide, and 1½ ins. thick, and is screwed upon the top long piece, so that its edges make an exact right angle with the long edge of the top board.

A little consideration will show that if a shaving is cut off a piece of board by moving the plane along the rebate, while one edge of the board is held firmly against the top block, the edge which is cut must be square with regard to the edge pressed against the block, and also to the surface of the board.

Planing.

If we consider the end boards of our desk mounting, the top and bottom of which must be square with the back, it will be seen that if the backs of these boards are pressed against the block, and the tops and the bottoms are planed on the shooting boards, they will be square back to front, and also sideways.

The plane must be very sharp and very finely set, or else you will only succeed in splitting off the corners of the boards which you are attempting to true up. In any case you had better plane from front to back for two reasons; one that the front at the bottom will have a short grain, and the angle, which is less than a right angle, not being very robust, is certain to chip off. The other reason is that if any little chips do come off the corners, they will be behind the desk and less unsightly.

As there is no great strain exerted on the corners of the boxwood when it is completed, three brass wood-screws in each end of the base, screwed up into the sides, and two in each end of the top, screwed down into the sides will make it strong enough, though the screws will only be driven into the end grain of the wood. The screws on the top should be neatly "counter-sunk" for appearance sake. These screws had better be driven home when the panel is in position so as to avoid ugly gaps between the wood and the ebonite, or perhaps preventing the ebonite panel from going into its place at all.

French Polishing.

Under the top should be a thin "fillet" of wood, screwed up inside for the top of the ebonite panel to rest against. At the bottom, if the woodwork is carefully carried out, this should not be necessary. A screw in each corner to hold the ebonite panel in position will be required.

Just a word on finishing. No hard wood looks its best unless it is french polished, but, like soldering, this is a job which most amateurs "fight shy" of, though it is comparatively easy to acquire the knack. The whole art of french polishing consists in knowing when to leave off rubbing.

By this we mean that up to a certain point, at any one time, you make progress. After passing that point you rub the polish off rather than rub it on.

That "Glossy" Surface.

Buy a small quantity of polish at a good oil shop. A little raw linseed oil and some methylated spirit will also be needed. Take a piece of cotton-wool and fold it so that when squeezed very tightly it is rather larger than a walnut. Place this inside a piece of white linen rag and pull the edges of the rag back round it, so that the front of the pad of cotton-wool, with its skin of linen rag, is smooth and plain, and you have as a handle the bunched-up rag at the back.

Now make the cotton-wool damp (not wet) with the polish by opening the back of the rag and pouring a little on the cotton-wool inside. Hold the pad by the handle formed by the loose ends of the rag and rub all over the woodwork with a helical motion as though you were trying to trace out the rings in a piece of chain armour or a chain purse.

If the pad drags, moisten the face of the linen rag with just a little dab of linseed oil and go on again. Do not use too much oil, or it will "sweat" out of your work later on. You will soon get a glossy surface, but as soon as the surface refuses to become more glossy as you rub, put the work aside and try again on the morrow.

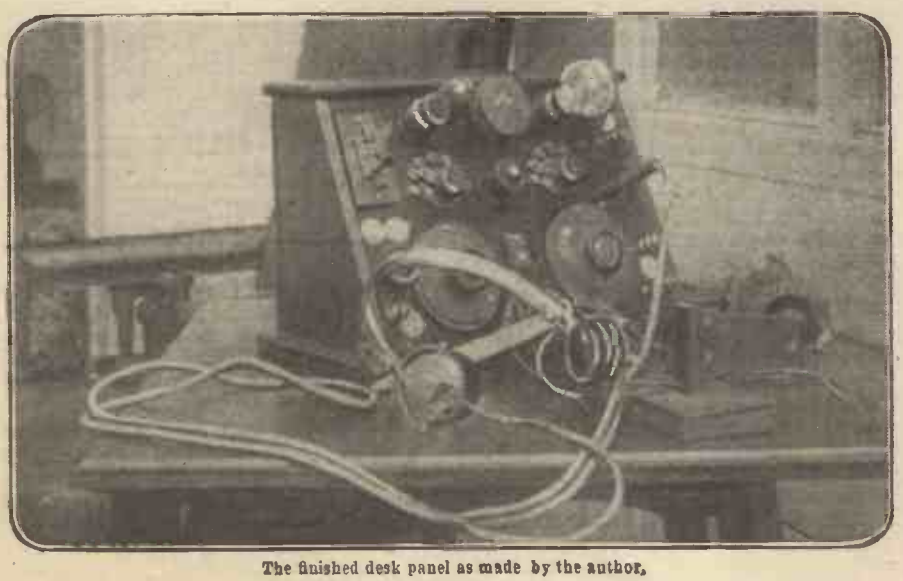
Professional "Finish."

The spirit in which the gums are dissolved to make the polish contains water, and when the wood gets waterlogged, as it is almost certain to do in patches if you keep on applying the polish, it must be allowed to dry out again before continuing the process.

Professional polishers always use "fillers" to stop up the pores of the wood and prevent the polish sinking in, and sooner to get the gloss all on the surface, but this is largely a matter of time.

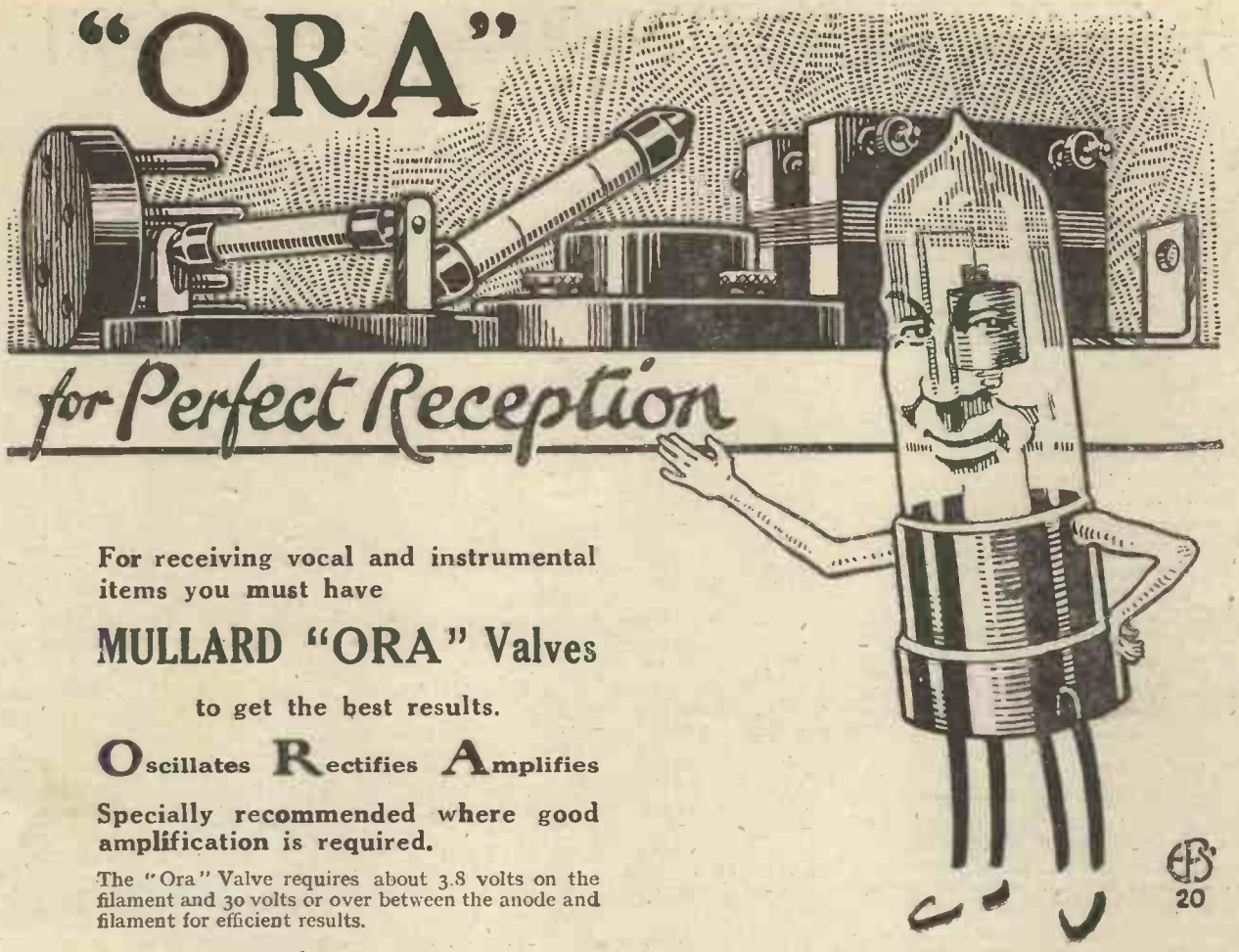
The writer is of opinion that no fillers can produce such a translucent polish as filling up the grain with the polish itself, by steady application. If the grain rises owing to the wet polish, so that the surface gets a little roughened, wait till next day and then rub along the grain with a piece of fine glass-paper. A very slight suspicion of fine pumice powder worked in with the polish prevents the surface getting stringy.

The finishing strokes are straight along the grain. Glide on to and off of your work, or you will mark and mar it. If you prepare the surface of the wood with glass-paper, never rub across the grain, or the scratches will show badly. Considerations of space forbid enlarging now on this matter, but it is well worth the amateur's while to study it.



The finished desk panel as made by the author.

"ORA"



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 London

Trade Mark RADIO MULLARD VALVE

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, '0008 mfd...	2/6 each
.....	Combined Resistance and Condenser...	7/6 each
.....	Valve Bases with Terminals...	5/- each
.....	Valve Sockets ...	1/3 each
.....	Terminal Clips ...	9d. per pair

Name and Address.....

Name of usual Wireless Dealer.....

I enclose (Cheque Money Order, P.O.) value .....

to cover the cost.

To the MULLARD RADIO VALVE CO., LTD., 45, Nightingale Lane, Balham, S.W.12.

SEND THIS TO-DAY.

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.

Ilkley and District Wireless Society.*

On Monday, October 2nd, the fifth general meeting of the above society was held at the headquarters, the "Regent Cafe," Ilkley, the president, Dr. J. B. Whitfield, occupying the chair.

The minutes of the last meeting being read, the chairman called upon the secretary to read the report of the committee appointed to design and draw up the estimates for the society's receiving set.

The report was adopted, and the committee instructed to acquire and assemble the necessary apparatus, which will consist of a single valve receiver and tuner built on the unit system so as to facilitate future extensions and re-arrangement of circuits for demonstration purposes.

The rules of the society were then officially formulated, and it was resolved that a technical library be instituted for the use of members, Mr. C. D. Marshall being elected hon. librarian.

The hon. sec., Mr. E. Stanley Dobson, was then called upon to give his lecture on "Capacity and Condensers."

A vote of thanks was accorded to the lecturer, and before the meeting closed, the announcement was made that the society's affiliation with the Wireless Society of London had become an accomplished fact.

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

The Leicestershire Radio and Scientific Society.

The above society held their bi-monthly meeting on the 25th ult., at headquarters.

The president, Mr. Cyril T. Atkinson, being the lecturer, Mr. H. E. Dyson, vice-president, took the chair.

Mr. Atkinson opened up with the elementary principles of wavemeter design, passing by easy stages to the consideration of one or two sound commercial instruments as follows:—

First, the well-known Marconi crystal type; second, a somewhat more elaborate Telefunken instrument; and thirdly, the popular Townsend pattern. Each of these types received a very detailed analysis, special reference being given to the latter owing to its suitability for home construction, which was next touched upon, detailed instruction being given of a similar instrument having a sample range of from 140 to 240 metres. The lecture was concluded with an explanation of a method of calibration suitable for wavemeters of a comparatively short maximum wave-length, viz., the Lecher wire. A discussion followed, Mr. Atkinson making suitable replies to the sundry questioners. The meeting then concluded by a very hearty vote of thanks from the assembly for the interesting and useful lecture, this being proposed by the chairman, and seconded by Messrs. J. W. Pallett and D. Morton.

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

Ramsgate, Broadstairs and District Wireless Society.*

The inaugural meeting of the above society was held at the headquarters of the society, 22, Princes Street, Ramsgate, on September 28th.

The society was honoured by the presence of two of its vice-presidents, Sir Edward Rigg, C.B., C.V.O., D.S.O., and Sir Cecil Hertslet, K.B.E., J.P., who both expressed their great pleasure at being present at the first meeting of the society, and that they were keenly interested in its future welfare. Mr. C. E. Hume, engineer and manager of the Ramsgate and District Electric Supply Co., Ltd., has been appointed treasurer of the society, and the London Joint City and Midland Bank, Ramsgate, the bankers of the society.

A number of new members were enrolled at the termination of the meeting. A class of instruction in the reading of the Morse code will take up the first half-hour of the weekly meetings, as many members express their desire to be fully conversant with same. Any locally interested parties in the district are invited to apply for membership forms and full particulars from either of the joint hon. secs.

Joint hon. secs., Mr. F. Harrison, "Rochester Cottage," St. Lawrence (Ramsgate); Mr. F. C. Marshall, 6, Ramsgate Road, Broadstairs (Broadstairs and District).

The Eastern Enfield Wireless and Experimental Society.

The inaugural meeting of the above society was held on September 28th at the "Falcon Inn," South Street, Ponders End, when a very satisfactory attendance was recorded.

The chairman announced that Mr. Balfour had very kindly offered the use of the room for meetings and, moreover, was presenting the society with a complete three-valve receiving set with loud speaker and aerial for the use of the members at the meeting room. A hearty vote of thanks was accorded Mr. Balfour, and arrangements were made for the application for the licence immediately.

The subscription decided upon is 10s. 6d. per year; the objects of the society being to assist everybody in the district who is in any way interested in wireless, either from an experimental or "broadcasting" point of view. Meetings are held every Thursday at 8 p.m. at the "Falcon Inn," and the secretary will be very pleased to give prospective members any information if they will write him or attend the meetings. The society has had an enthusiastic commencement and has prospects of being very well equipped, and it is hoped that everybody in the district interested in the now popular hobby will recognise the advantages of the society.

Hon. sec., Arthur I. Dabbs, 315, High Road, Ponders End, N.

The East London Radio Society.*

A highly successful meeting was held at the lecture hall, Woodstock Road, E. 14, on Tuesday, September 19th, with Mr. A. J. Alexander in the chair.

Informal discussion preceded the actual opening of the meeting, and many interesting points were discussed. These short open discussions are proving of great value to the society, and most new members' difficulties are satisfactorily disposed of by the more experienced and competent experimenters. The society's set was then set in operation, and members listened with great interest to 2 M T's fine transmission. This over, the chairman called upon Mr. J. Keens to deliver the second lecture of the present series. The lecturer chose "The Application of the Thermionic Valve to Receiving Circuits" as his subject, and his remarks were very closely followed for over an hour. Those who knew little of the subject were agreeably surprised to find what was to them a difficult matter ably brought within their comprehension. Those who knew a great deal of the subject were equally surprised to listen to the matter being so simply explained. All of which indicates Mr. J. Keens' exceptional ability, and we count ourselves fortunate in the possession of such a member.

The meeting closed at 10.20 p.m. with votes of thanks to the chairman and lecturer.

On Friday, September 22nd, the week's second meeting was held at the above lecture hall. A very pleasant evening was spent with buzzer practice, various discussions, and listening in.

The meeting closed at ten o'clock.

The secretary will be pleased to hear from any East London amateur desirous of joining the society.

A club, to be known as the Kendal Amateur Radio Club, is being formed in this district. As the membership will be limited, will all persons interested please communicate as early as possible with the secretary (*pro. tem.*), H. W. Walker, 24, Highgate, Kendal?

RADIOTORIAL

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

RADIOTORIAL.

The recent political debacle has left amateurs wondering whether broadcasting will be delayed in consequence. It certainly may be so. There is bound to be some delay in the legislation connected with broadcasting until the new Government is fairly on its feet.

Many readers have written to me with regard to experimental licences. They ask whether it would be best to acquire a condensed knowledge of wireless and then apply for an experimental licence, or whether they should begin by applying for a broadcasting licence. My advice is, apply for an experimental licence. It should not be very hard to convince the Postal Authorities that you really have a bona-fide reason for applying for an experimental licence. If you merely intend to be a listener-in with no other thought except for the reception of music, etc., etc., then a broadcasting licence should meet your needs excellently.

But there are many thousands of new amateurs who have recently acquired a strong taste for wireless experiments, and who wish to do rather more than just listen in to music, etc.

In applying for an experimental licence it should be clearly indicated that the applicant is desirous of studying wireless with a view to something more than becoming an efficient knob-twister. Outline for yourself an experimental programme which you feel confident you could undertake, and then write to the P.M.G. explaining lucidly, but concisely, the nature of your intended experiments.

If you really are a novice, apply first of all for an experimental licence for a crystal set. Do not attempt to take out a licence for a valve set until you are fully conversant with the perils of re-radiation caused by valves. A good many new amateurs are trying to jump into a field which they have never explored before. This is not right. It is only fair to bona-fide experimenters who have proved their worth by years of patient work, that they should be entitled to privileges. With knowledge, and a realisation of the responsibilities of an experimental licence, will come a proficiency which will entitle you to those privileges. They should not be hard to obtain, providing you apply for an experimental licence with bona-fide intentions and with all due conscientiousness.

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.

S. C. H. (Colchester).—Is there any duty on wireless apparatus entering into the United States of America?

Yes, 40 per cent. of invoice value.

* * *

W. L. (Colchester).—It would seem to me that a unit for the current-carrying capabilities of a wire would be more logical than a unit that represents the reverse, such as the Ohm.

As a matter of fact, for certain purposes, especially in land-line telegraphy, the Ohm is reversed and styled a Mho, which is the unit of conductivity. We prefer the Ohm and not its reciprocal the Mho, in order that Ohm's Law can be adhered to. What could be clearer than the simple fact that the current flowing in a circuit is directly proportional to the pressure and inversely proportional to the resistance?

* * *

"CURIOUS" (Walsall).—What does T.S.F. signify? I often see it in connection with wireless stations—Bordeaux T.S.F., etc.

They are the initials of Telegraphie Sans Fils, which is French for Wireless Telegraphy

A. J. H. (Bexhill-on-Sea).—Having applied to the P.M.G. for a transmitting licence in order to allow me to test apparatus, I am informed that I may employ an "artificial aerial" with no earth connection. Does that mean that I may use a frame or loop aerial?

Correctly defined, an "artificial" or dumb aerial is a non-radiating closed oscillatory circuit, and therefore must consist only of an inductance and condenser. A two-circuit receiver could be said to be an artificial aerial if the open circuit was entirely removed, including, of course, the earth and aerial.

* * *

V. B. (Carlisle).—Should I be able to hear Paris on a single-valve set?

You should certainly hear Eiffel Tower's spark signals if your tuner will reach 2,600 metres and you have a fairly good outdoor aerial, but although quite possible the telephony will be by no means a certainty.

* * *

E. R. B. (Stockport).—Is the "Diplex" and "Duplex" working the same thing?

No. The former refers to the simultaneous reception *or* transmission of two messages, while the latter refers to the simultaneous reception *and* transmission of two messages by one station.

* * *

P. L. (Wantage).—I find I cannot put up an outdoor aerial as there is not much space. Can I use a frame aerial? If so, as I am thinking of employing valves, how do I fix my resistance? How far shall I be able to receive telephony?

As you do not give the full details of your set we are afraid we cannot give a very definite answer to your question. A frame aerial is of course useless with a crystal set. If you are using one valve your telephony range will be about 5 miles. Two valves would give about 10–12 miles, and three would enable you to hear concerts up to 50–100 miles. If you decide on a frame aerial—and it seems the only thing if you cannot erect an outdoor one—you may find it necessary to add to your valves so as to be able to receive those stations you require. Of course, you need no earth with this type of aerial. For construction of same see the article in No. 2 of POPULAR WIRELESS. Your reactance can be used in either of two ways. You can construct a frame reactance to be hinged near your aerial, and use direct coupling to the aerial; or else you can put a small coil in series with the aerial, and, using an ordinary reactance, couple it to the coil in the aerial circuit.

* * *

T. D C. (South Africa).—I am thinking of putting up a receiving station, but do not know if it would be of much use. I want to have a crystal and one valve set. Could I hear anything with these?

Yes; a crystal or one valve set should be quite sufficient to give you several of the coast stations round about. Cape Town, Durban Radio, Durban (Jacobs), Port Elizabeth all transmit spark telegraphy, and you should be able to hear one or more of these working during the day. No; a crystal is really quite an efficient method of reception, especially for telegraphy. Its range for telephony, of course, is small, but if well handled, and with a good aerial, it should give very good results for telegraphy over quite long distances. There is no reason to despise the crystal at all, though many amateurs are inclined to look down upon it. It is very easy and simple to adjust.

* * *

"IMPATIENT" (Ulster).—Would you kindly inform me and numerous other readers living in Ulster if it is possible to get wireless receiving licences here? Also, would a crystal set be of any use here for hearing Morse code or speech broadcasted in England or Scotland?

The P.M.G. has not yet given permission for receiving licences in Ireland.

We are afraid that a crystal would not be of any use for the purpose you mention. You would probably be able to receive telegraphy from English and Scottish stations, but for telephony you would need at least three valves for good reception. This is, of course, on the assumption that Manchester, Glasgow, and several other north-western towns are shortly to commence broadcasting.

(*Continued on page* 514)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 512.)

G. S. T. (Luton).—I have a diagram, which was given to me by a friend, of a one-valve set. It has a coil on it, apparently coupled to the aerial, marked T. What is this coil, and what does T stand for ?

The diagram you have is probably from an American paper or else copied from one of their diagrams. The coil you speak of is the reactance coil. The Americans call it a "tickler," hence the initial T.

* * *

"INTERESTED" (Aberdeen).—I am afraid this question is only indirectly connected with wireless, but I was discussing atmospherics with a friend and the subject turned upon the "Northern Lights." I should be pleased if you could enlighten me on the subject of their origin.

This is a subject which is really outside the scope of P.W., but briefly, the Aurora may be put down as electric discharges in the atmosphere. How these charges are formed is a subject open to much discussion, but it has been assumed that the earth induces currents into a belt of conductive atmosphere, and this causes a flow of electricity north and south. This is said to be the cause of the numerous thunderstorms of the tropics and of the Aurora at the Poles. These discharges occur in rarefied air, and take the same form as discharges in a partially vacuated tube. This causes the variation of colour—they are produced by gases which have become luminous owing to the discharge.

* * *

T. L. N. (York).—Why is it that naval vessels have aerials of the cone or "sausage" type, consisting of several wires, while merchant ships have only two or three stretched horizontally between the masts ?

The reason is that naval vessels work mainly upon comparatively long wave-lengths. Merchant ships, however, use 600 metres as their usual wave-length. When several wires are used, as in the case of the battleships, the capacity of the aerial is greatly increased, and hence its wave-length is raised. This is desirable as less loss of energy in extra inductances and capacities occurs when working in high wave-lengths.

* * *

"ANNOYED" (Clapham). I have two accumulators—2 volt. 40 amps.—and after using for some time the filament of my valve suddenly went dim and I could no longer use it. This often happens during concerts. I hear them well for about 20 minutes, and then the valve goes dim and I hear no more.

Your trouble probably is that your cells are run low and are beginning to sulphate. To cure them, give them a long overcharge at about ½ amp. rate. Then rinse and refill with fresh acid solution of 1.2 specific gravity and charge until they gas again. This should remedy the fault.

* * *

F. R. D. (Oldham).—If a wireless set is re-sold, does the licence go with it in the same way as a motor licence ?

No. Wireless licences are non-transferable.

Supposing I have two houses, two aerials, and only one wireless set. Would it be necessary to have two licences to cover each address, and, if so, how about a motor-car fitted with a set and touring the country ?

Two licences would be required. In the latter instance it would be possible to obtain a licence covering the use of a portable set within a certain fixed radius of a given address; outside that area it would be necessary to have a further licensed address.

* * *

"PIPPED" (Dover).—I find that signals on my crystal set increase very considerably when I touch certain parts with my hand. Can you explain this curious effect, and tell me how I can make the result permanent ?

If you are touching the set on the earth side of the detector, it indicates that the earth connection is capable of improvement, but if it is on the aerial side it is a capacity effect bringing the circuit more in tune with the signals in question. In the latter case it may be that you have no variable condenser, and therefore cannot obtain the necessary fine tuning in any other manner.

* * *

"STUDENT" (Glasgow).—What is the difference between impedance and resistance ?

None at all, as the impedance offered by a circuit to a flow of current is obviously resistance, but impedance covers the resistance due to ohmic resistance, self-induction, etc. The resistance that you evidently refer to is ohmic or apparent resistance, which is one of the impedance factors of a circuit.

* * *

Why is it that high-frequency currents can be choked back by a highly inductive coil, because, although you state it is due to the impedance of such a coil, I cannot see that it should do so, as the high-frequency current is not necessarily oscillating, but may consist purely of unidirectional impulses in all respects similar to low frequency, except in point of time.

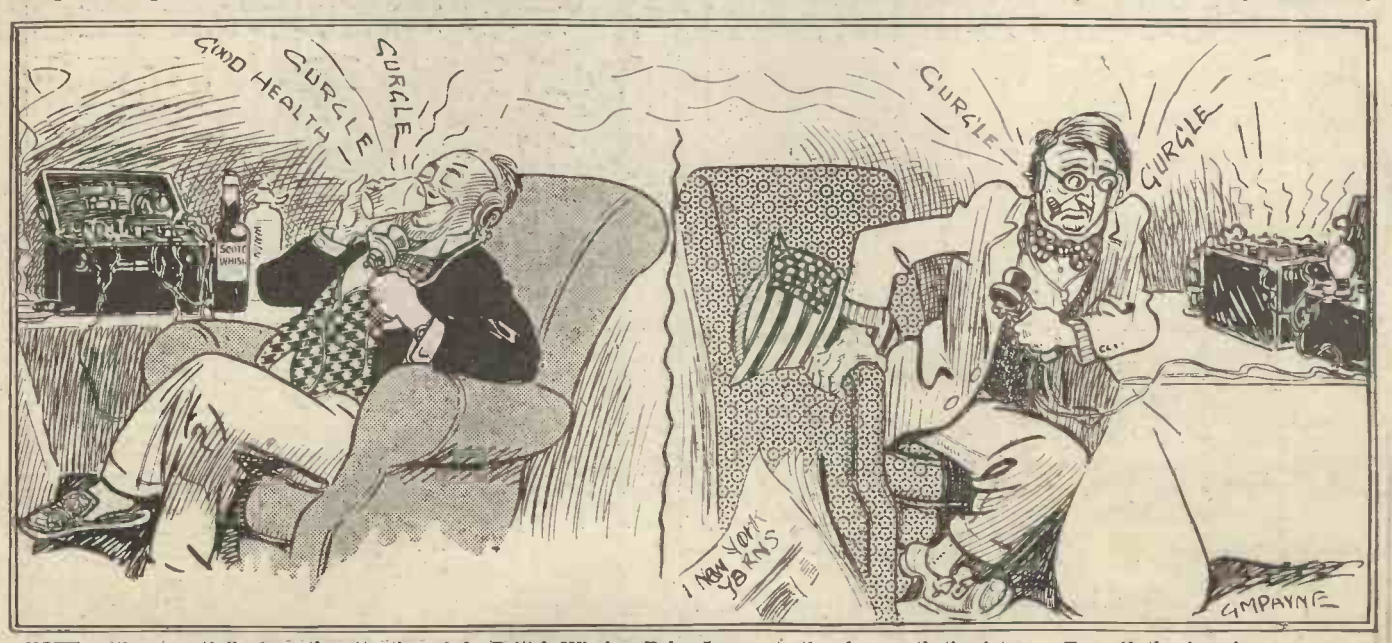
It is because of that latter that the H.F. impulses are choked back owing to the fact that their vastly greater frequency produces a greater back or opposing E.M.F. in a coil by self-induction.

* * *

D. F. (Woking).—Can you tell me what Wood's Metal, as used for mounting crystals is composed of ?

Two parts lead, one part tin, four parts bismuth, and one part cadmium.

HORRORS OF WIRELESS: THE TRANS-ATLANTIC TORTURERS



NOTE: We respectfully draw the attention of the British Wireless Relay League to the above pathetic picture. Even if the Americans *are* dry, amateurs need not be quite heartless.

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 514.)

A. A. (London, N).—I have read with much interest the various remarks concerning the use of rubber-covered aerials, and the idea occurred to me that the most perfect aerial would be a glass tube filled with mercury of suitable length, and suspended at a suitable height. Is that correct?

The idea being, we presume, to maintain a surface of the lowest possible resistance—and that is one of the efficiency factors of an aerial—therefore your theory is more or less correct, but an enamelled copper wire would answer the purpose quite as well.

* * *

"WONDERING" (South Shields).—When I sent my accumulator to be charged I was told that the electrician passed some remark that sounded like "panning," after briefly examining the plates. Can you tell me what that is likely to mean, and whether it is anything to do with the condition of the battery?

Doubtless the remark was "fanning," which means that the negative plates are curling over at the ends, due most probably to faulty construction, such as the separators being too thick. However, it is not at all harmful unless excessive. You must not confuse it with "buckling," which is very much the reverse.

* * *

A. T. M. (Manchester).—I have several old sparking plugs. Do you think I could put them to any use on my receiving set?

Providing the insulation of the sparking plugs is still good—not cracked—they can be used as lead-in insulators. The two nuts which fix the porcelain into the cap of one of the plugs must be unscrewed and the porcelain removed. Then the centre electrode should be unscrewed and taken out. The short piece of china now is clear for the lead-in wire of your aerial. By tapping the centre electrode, and fixing another terminal screw on the bottom end of it, the aerial lead-in wire could be screwed on and off at will, and also the wire leading from the set to the insulator. Make sure, of course, that the inside of the plug is perfectly clean before using, and that the wires make good contact, if the latter method is used.

* * *

"HAZY" (Potters Bar).—I am using a crystal set with a carborundum detector, and whenever I listen in there always seems to be a great deal of interference and jamming. I am using a loose coupler and two variable condensers. Can I do anything to prevent these annoying occurrences?

As you are using a loose coupler and two variable condensers you should be able to tune out most of the interference that you experience. However, if it is impossible, and the signals you require are hopelessly jammed, resort may be had to what is termed "balanced crystals." For this you need two potentiometers—one for each of two carborundum crystals—which are so arranged that one conducts one way while the other is inverted and conducts in the opposite direction. The crystals are, of course, in parallel with each other, but in series with the 'phones. Since the crystals rectify in opposite directions, they nullify each other. They must both be adjusted (separately—one disconnected while the other is used) to their sensitive points. Then, when they are both switched in, there will be practically no signals heard. The crystals used should be as nearly equal in sensitivity as possible. Now, when one of the potentiometers is moved so that the potential across one crystal is reduced, signals will be heard. These signals are due to the difference in rectification between the two crystals. The reduction in signal strength compared with that when one crystal alone is used is fairly small, so that good signals should be obtained using balanced crystals. Of course, for ordinary reception one crystal only is used, the other being switched off altogether. Then, when jamming or bad atmospherics occur, the second crystal—which should be all ready with its sensitive point found—is switched in, and the potentiometer reduced until signals are heard almost as strong as they were with one crystal.

Printed and published every Friday by the proprietors, The Amalgamated Press (1922), Ltd., The Fleetway House, Farringdon Street, London, E.C.4. Advertisement Offices: Messrs. J. H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates: Inland and Abroad, 17/4 per annum, 8/8 for six months. Sole agents for South Africa: The Central News Agency, Ltd. Sole agents for Australia and New Zealand: Messrs. Gordon & Gotch, Ltd.; and for Canada: The Imperial News Co., Ltd. Saturday, November 4, 1922.
Y/Y

No. 24. A BROADCASTING RECEIVER.

POPULAR WIRELESS

3d.

No. 24.-Vol. 1.
Nov. 11, 1922.

Weekly

GETTING A NICE ADJUSTMENT.

FEATURES IN THIS ISSUE:

Experiments with a Portable Set.
The Story of the De Forest Valve.
How to Make a Long-Wave Receiver.
Useful Analogies for the Beginner.
An Easy Change-Over Switch.
A Pan-Cake Coil Winder.

NEXT WEEK.

THE ELIMINATOR.

The story of a most ingenious invention. Of interest to all students and experimenters.

Popular Wireless

TOPICAL NEWS AND NOTES.

NEXT WEEK.

HEAD GEARS AND TELEPHONES.

AN AMATEUR WAVEMETER.

And other interesting articles.

A Vancouver Station.

A CENTRAL NEWS message from Ottawa states that the Canadian Marconi Co., in co-operation with the English company, has applied to the Government for a licence to erect at Vancouver one of the most powerful wireless stations in the world at the cost of 2,000,000 dols., giving direct communication between Australia and the East Coast. The Government has the matter under consideration, as the British Government desires Canada to participate in the Imperial wireless system.

Mr, J. Siegers' set, 156, Kensington High St., London.

A Young Enthusiast.

THE photo on our cover this week shows a very keen radio enthusiast—the little daughter of Mr. Gordon Ward, the proprietor of the City Accumulator Co. Little girls nowadays much prefer radio to dolls!

* * *

Honour for English Wireless Engineer.

THE American Institute of Radio Engineers has awarded the Liebmann Memorial Prize for 1922 to Mr. C. S. Franklin, research engineer of Marconi's Wireless Telegraph Company, Ltd., for his investigations in connection with short-wave directional transmission and reception.

The Liebmann Memorial Prize is awarded for radio work of conspicuous merit.

* * *

Marconi Rates.

MARCONI'S Wireless Telegraph Co. state that the rates for the ordinary and deferred half-rate services "via Marconi" to all places in the United States of America, except New York City, are now amended by adding to the ordinary rate to New York City, which remains at 9d. per word, the respective land-line charges to all points in the United States beyond New York City. The deferred rates are in all cases half the ordinary rates. There is still an appreciable saving "via Marconi" to all points, except the State of Maine, where the rate is the same as the cable rate.

* * *

Radio on Motors.

EXPERIMENTS carried out jointly by the Daimler Co. and Marconi's Wireless Telegraph Co. recently showed that motor users may soon be able to listen to wireless concerts while travelling. Two Daimler cars fitted with wireless receiving apparatus journeyed from London to Chelmsford, and on the way the passengers were able to hear spoken tests sent out from Marconi House. On the return journey conversation and gramophone records from Writtle were also heard. A frame aerial was mounted on the roof of the car, and a receiving set comprising seven or eight valves inside the car was used. These arrangements are, however, temporary, and in the finished apparatus, though an aerial on the roof will probably still be necessary, it will be made to fold down when not in use, and all the receiver will be under the footboard, Bowden wires enabling the controls for tuning to be manipulated from within the car.

* * *

Successful New Accumulator.

ONE of the commonest causes of breakdown in a valve receiving set is the failure of the accumulator, the battery supplying the current for lighting the filament of the valve.

Most accumulators consist of a number of positive and negative plates supporting active materials. They have a well-known habit of losing their charge whilst standing idle, and it is very disappointing to find, as so often happens, that just when they are most wanted the cells have lost their charge when not in use.

There is an accumulator on the market known as the Fuller patent block type, which, it is claimed, will hold its charge for a practically indefinite period when not in use. This type of cell, whilst employing substantially the same materials as the plate type of accumulator, differs in having the electrodes in the form of blocks of taper form in cross section, so that each block is a geometrical solid of such conformation that forms oblong elements.

A neat 2 valve set.

Putting up the aerial.

No Buckling.

Instead of using thin plates, with their liability to buckle, the cells are constructed as explained above. The result is that the electrodes are free from the possibility of injury either by vibration or short-circuiting or sulphating. They have also the special feature that they will hold their charge from 9 to 18 months without the E.M.F. dropping below 2 volts.

The makers are the City Accumulator Co., of 79, Mark Lane, E.C.3, and they claim that even if the terminals are joined by a metal bar, the cells will not be spoiled or injured.

* * *

Wireless Pictures.

THE members of the Society of Motion Picture Engineers, who are now meeting at Rochester (N.Y.), state that the broadcasting of moving pictures by wireless has been successfully demonstrated, and that its universal adoption may be expected within the next year or so. The inventor of the device to broadcast films, it is said, is now at Arlington, conducting tests with the United States Navy officials. The project, if it proves to be practicable,

NOTES AND NEWS.

(*Continued from previous page.*)

as the engineers declare it will be, will deal a death-blow to the film exchanges throughout the country. According to the plans outlined, a central broadcasting station will be established, from which cinemas within a radius of 1,000 miles will receive their films.

* * *

A Broadcast Appeal.

THE first wireless message broadcasted in Birmingham was transmitted on October 28th by the Lord Mayor of Birmingham (Alderman David Davis) from the residence at Moseley of Mr. C. S. Bayton (2 K O), who was granted a special broadcasting privilege for the occasion by the Postmaster-General.

The message took the form of an appeal to the citizens on behalf of the Birmingham Hospital Sunday Fund. An additional £50,000 a year, declared the Lord

Mr. R. Pittock's home-made set, Whitley Road, Eastbourne.

Mayor, was needed to keep up the hospitals, and he wished a sincere effort to be made to help the hospitals out of their financial difficulties.

The appeal was heard by between two and three thousand wireless amateurs who were listening in.

* * *

Secret Wireless.

WE reprint the following from "The Times":—

M. Edouard Belin, who recently invented a process by which photographs could be transmitted by cable, has now invented a method which prevents the tapping of wireless messages. The apparatus used is called by M. Belin the "cryptotele-stereograph" and the "radio-cryptotele-stereograph."

Interesting Details.

The principle of the apparatus derives from results which M. Belin had previously obtained in synchronising by wireless telegraphy two motors placed at any distance, no matter how far, apart. For his present purpose two motors, which are strictly synchronised, are used to set in motion cylinders, one at the transmitting and another at the receiving post, through the intermediary of a series of six concentric discs which turn on an axis joining the cylinder with the motor. Each of these discs, which can be adjusted as desired with regard to the others, carries a notch into which falls at intervals a lever which sets in motion the cylinder. Since the discs can be turned at will the relation of the notches to one another can be varied practically infinitely. In this the apparatus resembles a combination lock, and the transmitter and receiver of a wireless message have only to agree to a combination in order to secure secrecy.

An Objection.

According to the intervals separating the notches as the discs revolve, the cylinder will turn in a series of jumps and the wireless emissions will follow an irregular rhythm with periodic silences due to the stopping of the cylinder. Everything depends on the precise angular adjustment of the discs both at the transmitting and receiving posts.

It may be objected that by long and careful observations, and by noting the duration and periodicity of the silences, it would be possible for a third person to discover the system and adjust the instrument in the same manner. In order to overcome this difficulty there is an arrangement by which false signals are made during the pauses of the cylinder. A third person could not distinguish between these false signals and the real signals.

* * *

Wondering!

WHEN broadcasting will really start? For many months past we have been told with ever-increasing authority that it is going to start "within a fortnight." Well, we live in hopes, though we die in despair!

How many amateurs enjoyed the novel innovation of the "Radio Play," so ably performed by the strenuous tragedians at Writtle?

Who has at last succeeded in showing a well-known official, of a still better known wireless society, how to transmit really perfectly modulated telephony—free from that intolerable "hum" which has hitherto characterised his efforts?

What has happened to those borrowed technical "tit-bits" published by a leading journal under the heading of "Wireless Day by Day"? We *do* miss them.

Why the P.M.G. first announced that the use of "Reaction" would not be permitted by the authorities, now allows it to be employed "with discretion." Is it in any way connected with the fact that one important company were unable to get good results without it? We trust not!

* * *

Not Forgotten.

DAME NELLIE MELBA is proud of the fact that, on the invitation of "The Daily Mail," she inaugurated the broadcasting era two years ago by singing to all England from Chelmsford, in Essex.

"I still get letters from people with regard to that first trill which I sang into the wireless telephone," she told a "Daily Mail" reporter recently. "Only recently I had a letter from a limbless Australian soldier who heard it while in England."

* * *

Licences.

THE cost of the broadcasting licence is 10s., and one taken out now expires on September 30 next.

The Broadcasting Company's apparatus will bear a registered mark—a circle with the initials "B.B.C."—and the words "Patent approved by H.M. Postmaster-General."

Owners of experimental or home-made receiving apparatus have to obtain an experimentalist's licence, the fee for which is also 10s., after filling in a form giving full particulars to the G.P.O.

ARIEL.

Broadcasting Programmes

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

TELEPHONY AND MUSIC TRANSMISSIONS.

Station.	Call sign.	Wave-length in metres.	Remarks.
Croydon	G E D	900	Throughout day to aeroplanes.
Marconi House, London	2 L O	360	Not regular.
Writtle, Essex	2 M T	400	Tuesdays, 8 p.m. (Concert.)
Paris	F L	2,600	7.20 a.m., 11.15 a.m., 5.10 p.m. Also occasional telephony at 10.10 a.m.
Königswusterhausen	L P	2,800	Between 6 and 7 a.m., between 11 and 12.30, and between 4 and 5.30 p.m.
The Hague	P C G G	1,085	Sundays, 3 to 5 p.m. (Concert.)
Haren	O P V H	900	Practically every 20 minutes past each hour from 11.20 to 4.20, giving messages to aeroplanes on the Brussels-Paris, Brussels-London, and Brussels-Amsterdam lines.
Brussels Meteorological Institute	O P O	1,500	Slow C.W. and Morse. Easy reading for amateurs.
Messrs. Burnham* (Blackheath)	2 F Q	440	About 9 o'clock in the evening.
Newcastle*	5 B A	440	Between 6 and 7.30 p.m.

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

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

All times given are G.M.T.

An asterisk denotes transmissions made purely for experimental purposes.

The Editor will be pleased to hear from amateurs and commercial experimenters with regard to transmissions made at regular hours.

A HOME-MADE BROADCAST RECEIVER.

Full Details for the Construction of a Simple Crystal Set.

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

NO matter how advanced the worker may be, or may eventually become, a "home" receiving set of the crystal type will be much appreciated by the less scientifically inclined members of the family, or will serve as a reliable standby when the valve set is being "improved"—and dismantled—for the hundred-and-first time.

The instrument herein described may be largely "assembled" from comparatively cheap purchased components, or may be made almost entirely by the worker, and may be either quite plainly finished or "got up" in a more elaborate style, according to individual taste and skill.

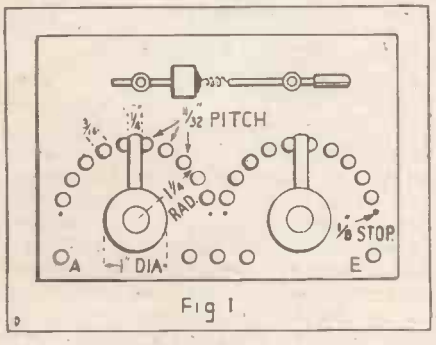


Fig 1.

Such a set would be highly appreciated as a Christmas present, and the pleasure in making, giving, and its reception would amply repay the modest expenditure in time and money entailed in the building.

The type of set selected is of the cabinet pattern, which not only makes for portability, but affords protection to the apparatus when not in use.

The tuning inductance is of the solenoid form, *i.e.*, a single-layer coil wound upon an insulating former, the turns being provided with tappings over the entire range, enabling any amount of the winding to be switched into circuit at will.

The Tuner.

The core, or former, upon which the wire is wound is a fibre or well-shellacked cardboard tube 3½ in. diameter by 5 in. long, wound with 110 turns No. 26 D.C.C. copper wire.

To wind the tube, procure two corks to fit the ends of the tube tightly, centre them, and bore a hole in each to take a ¼-in. rod tightly, and bend the end of the rod into a handle.

The whole affair is now mounted upon temporary bearings, the right-hand upright having a stop to lock the handle when required, a little end-play enabling the handle to be rotated clear of the stop when revolving the former, or tube.

If the windlass used on the country well for hauling up the bucket is brought to mind, the idea will be quite clear without the need of an illustration.

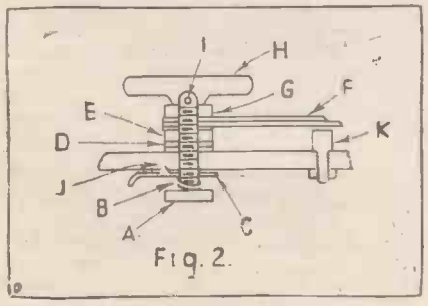


Fig. 2.

Winding the Coil.

Commence by boring a hole about ½ in. from end of tube, push 3 in. of wire through and secure with a wooden peg dipped in shellac; turn the handle through one revolution, and as the wire approaches the starting point lock the handle against the stop, take ½ in. of the wire, twist it into a loop, and proceed thus at every turn until ten turns have been accounted for, "staggering" the turns slightly for ease in connecting up subsequently.

Now wind on *ten* turns, *i.e.*, 11 to 20 inclusive, and make another tap at the twentieth turn, and so on until 110 turns in all have been accounted for, the last turn of all being secured in the same manner as No. 1.

This will give us 20 tappings in all, viz., ten units and ten "tens," and these twists may be scraped clean of the insulation while the tube is still in the winding device, and a 3-in. length of the same wire cleaned at one end and twisted on to the bared tapping.

Each joint is next given a touch of fluxite and followed up with a hot well-tinned soldering bit.

The wound inductance may then be dismounted and immersed in hot paraffin wax until free from bubbles, and then allowed to drain in a warm place, as no excess of wax is to be allowed, owing to its undesirable capacity effect.

For the switch panel ebonite ¼ in. thick is the best thing to use, but failing this, thoroughly dry and well-seasoned mahogany will do, provided it is well treated with wax to increase its insulating properties.

Set out the contact studs as shown in the plan (Fig. 1), and if no screw taps are available, file the ends of screwed shanks down to an easy square taper, drill the holes a shade tight—easing them with a reamer if necessary—and work the studs down, making them cut their own threads.

A touch of shellac on the screwed ends will make all secure when the back nuts are run up tight.

The radial switch arms are shown as 1¼-in. radius, this being a common stock size and easily purchasable for about two shillings each.

Those who prefer to make their own switches will find details in Fig. 2. A is a No. 2 B.A. screw 1 in. long, B spring washer, C contact lug for connecting switch arm to circuit, D packing washers, E nut tapped 2 B.A., to which switch arm F is soldered, G 2 B.A. nut, H ebonite knob

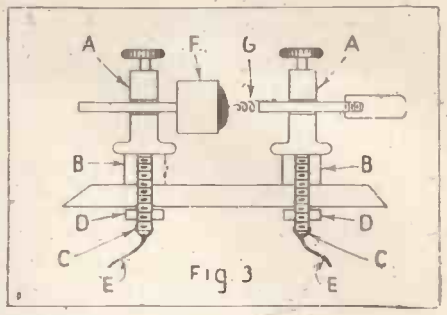


Fig 3.

tapped 2 B.A. The drawing is almost self-explanatory, but a few brief instructions will facilitate the assembling of the various parts.

The contact lug C is a banjo-shaped piece of [illegible]-in. brass nicked at the edge twice and the centre-piece bent up at right angles at J, filed to a blunt point, and inserted in a hole drilled in the underside of the panel to prevent the brass piece from turning with the switch spindle.

The larger end of the lug is drilled an easy clearance for the shank of the screw, and the smaller end is drilled to receive the connecting wire, and then bent down at right angles.

The switch arm can be quite flat for ease of construction, and preferably of two blades, each of [illegible]-in. brass, which are soldered to the nut E, run down the screw A, and secured by the second nut G, the necessary packing washers D being provided to take up the height of the contact stud shown at K.

The ebonite knob H is given a touch of shellac inside the screwed bush and screwed tightly down on the screw A, which may be cut down to dead length after trying everything for a fit.

As a final precaution against the knob working slack, a small hole may be drilled at I and a brass pin driven in tight.

The two switches, with their contact studs, are, of course, the same in every respect.

Making the Detector.

We now take the detector in hand, the design, as shown in Fig. 3, being one adopted by the writer as being very simple to construct and highly satisfactory in use.

(*Continued on next page.*)

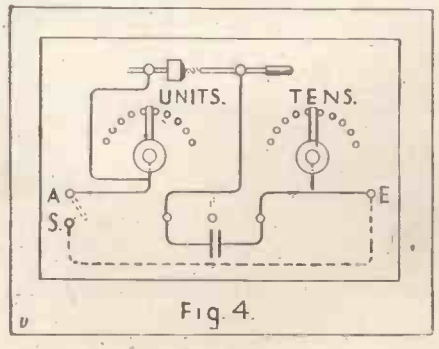


Fig. 4.

A HOME-MADE BROADCAST RECEIVER.

(Continued from previous page.)

Referring to the drawing, A A are two binding screws or terminals, B B two extension or distance pieces of brass tube ¼ in. long, C C fixing studs with nuts D D and connecting wires E E, F crystal cup, and G the "cat-whisker" contact.

To mount the crystal, cut ⅜ in. from brass tubing ½ in. diameter, take a piece of copper wire 14 S.W.G. 2 in. long, bend one end into a right angle, tin this end, and stick the straight end into a cork until the bent end is ⅛ in. clear of the cork.

Various Crystals.

Place the b[illegible] previously tinned inside, over the cork, and, holding the whole affair upright, drop solder from a clean bit into the cup to a depth of ⅛ in. As soon as the solder has set rub the still hot surface with a stick of Wood's metal, which will promptly melt, and place the crystal in the centre of the cup and allow to cool, upon which it will be firmly fixed.

The crystal may very well be silicon or one of the mystery "ites" sold under fancy names and at fancy prices, or two crystals may be used such as zincite and copper pyrites, both set in cups and the wire contact dispensed with.

The worker is advised to make up several crystals in cups while he is on the job, as the design shown makes a change of crystal so easy as to make abundant room for experiment.

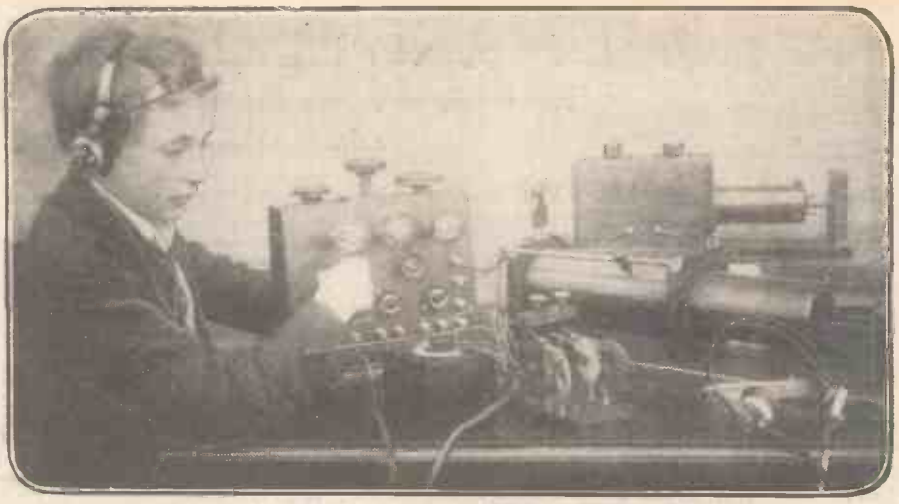
The "cat whisker" G is merely a short piece of brass or copper wire 14 S.W.G.,

"Iris," the new Trade Mark of the Marconiphone.

with a spiral of No. 36 brass wire soldered to one end and a small ebonite handle screwed to the other end.

If the crystal is a little eccentric in the cup so much the better, as by turning the cup round in its holding screw A, contact may be obtained over the whole surface of the crystal bit by bit with the greatest ease.

We are now ready to connect the coil and its tappings to the 20 contact studs. This is rather a tedious business, and all things considered, it is better to solder the



Mr. L. Borrow, of Rosalie, Yarn Road, Darlington, and his receiving set.

tappings to the ends of the studs, which will be greatly facilitated by cutting a slot in the end of each screw with a fine saw and tinning the slots after the studs are in position. By laying the ends of the wires in the tinned slots and following up with a hot iron, a sound joint will result and future trouble thereby obviated.

It should be noted that all wires carrying oscillatory currents should be quite straight, and not coiled into helices, to avoid unwanted effects of inductance.

Have the tappings as short as possible; work with the panel upside down, and slip a piece of insulating sleeving over the ends of the tappings before soldering to the studs.

The radial switches had better go on next, and the coil secured to the under side of the panel by two strips of wood, one passed through the inside of the tube and one facing it on top.

A screw at each end will hold the strips to the coil, and the top strip can then be secured to the under side of the panel by two brass screws run through from the top.

It should be noted that in all cases in fitting up apparatus of this nature it is advisable to assemble all the mechanical elements first, to make certain of their functioning properly before introducing the electrical details.

Make sure in this case that all the contact studs are of uniform height and that the switch arms run freely over them while making efficient contact; any studs that stand "proud" of the others must be eased down with a fine file.

Solder the wires for aerial and earth to the contact lugs of the switches and run the rest of the wiring, preferably No. 2 tinned copper, in insulating sleeving, as shown in the diagram (Fig. 4).

The telephone terminals are shown, with an extra terminal in the middle of the usual pair; this is to enable an extra pair of 'phones to be connected in series if desired.

The condenser shown in the diagram connected across the terminals can be about ·002 mf., and had better be purchased, as these items may now be purchased much cheaper than the cost of making at home. The condenser may be screwed to the under side of the panel at any convenient point permitting of easy connection to the telephone terminals.

The case will naturally depend upon the taste and skill of the worker, or in some cases a suitable box of good workmanship may be at hand or easily picked up second hand. The dimensions will to some extent depend upon the size of the 'phones used, if these are to be accommodated in addition to the receiving instruments.

Let the headset be the best the worker can afford, and not under 4,000 ohms resistance.

Trying Out the Set.

Having assembled the set, connect up the terminals A and E to aerial and earth, and having put on the head 'phones, turn the two switches towards each other, which gives the minimum inductance, viz., 11 turns in circuit. Run the tens switch over a few studs and get a rough adjustment on the crystal. Now cut in the units, and if no signals are heard, switch out the units, increase the tens, cut in the units again until signals are coming in, when, with the right hand on the crystal and the left on the units switch, give a final sharpen up.

As an additional refinement and a precaution against atmospheric charges, a safety switch may be placed in circuit, as shown at S (Fig. 4).

"Earthing" the Aerial.

A very easy type of switch to construct consists merely of two "telegraph" pattern terminals with a brass strap, drilled at one end and screwed down to work easily but not slackly, while the other end has the hole opened out into a slot to enable the strap to enter its terminal without removing the terminal head.

If this idea is adopted take particular care to have an extra milled nut on the terminal A, or trouble will be experienced with the aerial wire slacking off.

The dotted line indicates the extra wiring necessitated; this "earthing" switch must, of course, be in the "off" position when receiving signals.

At the risk of repeating himself the writer would strongly urge that all connections be soldered, as the greatest trouble is caused at the most inopportune moments by reason of screwed contacts slacking off, particularly when the terminals are in frequent course of adjustment during connecting or disconnecting external circuits.

A SIMPLE PAN-CAKE COIL WINDER.

By A. W. DRANSFIELD.

MOST amateurs like to "make" apparatus if possible, and the following coil winder is quite within the range of any amateur and makes quite a handy piece of apparatus. Very little is required for it, yet it is quite efficient.

In the first place a few cycle spokes will be required (pieces 4 in. long will do), and an old wire bobbin not too large on the end will act as the centre portion. Cut off one end and with a compass mark off an odd number of spaces, say 11, then bore holes in the edge and in the direction of the centre of the disc that will be tight-fitting for the pieces of spoke. This will give you a wheel similar to Fig. 2.

The remaining part of the bobbin will serve as the pivot portion. Glue the bobbin end on to a piece of wood that is slightly smaller than the hole in the wheel. If jammed in with a piece of paper it will be quite tight enough for the work; when the whole is assembled it will look as in Fig. 1.

We are now ready to commence winding, but the number of coils to be made should be agreed upon. Prepare the pieces of waxed card that the coils will be mounted on and get say 8 or 9 pieces of cardboard, not too thick. Soak them in hot wax and have them ready for use.

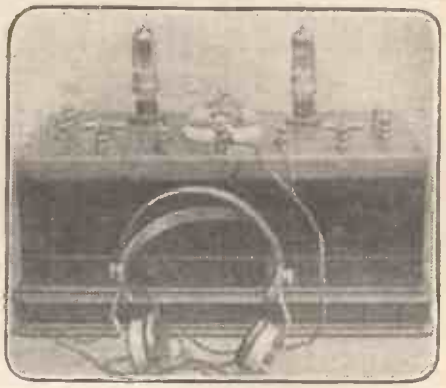
Winding the Coil.

An old lid of a round tin will be wanted to melt the wax in, and this should be about 5 in. diameter.

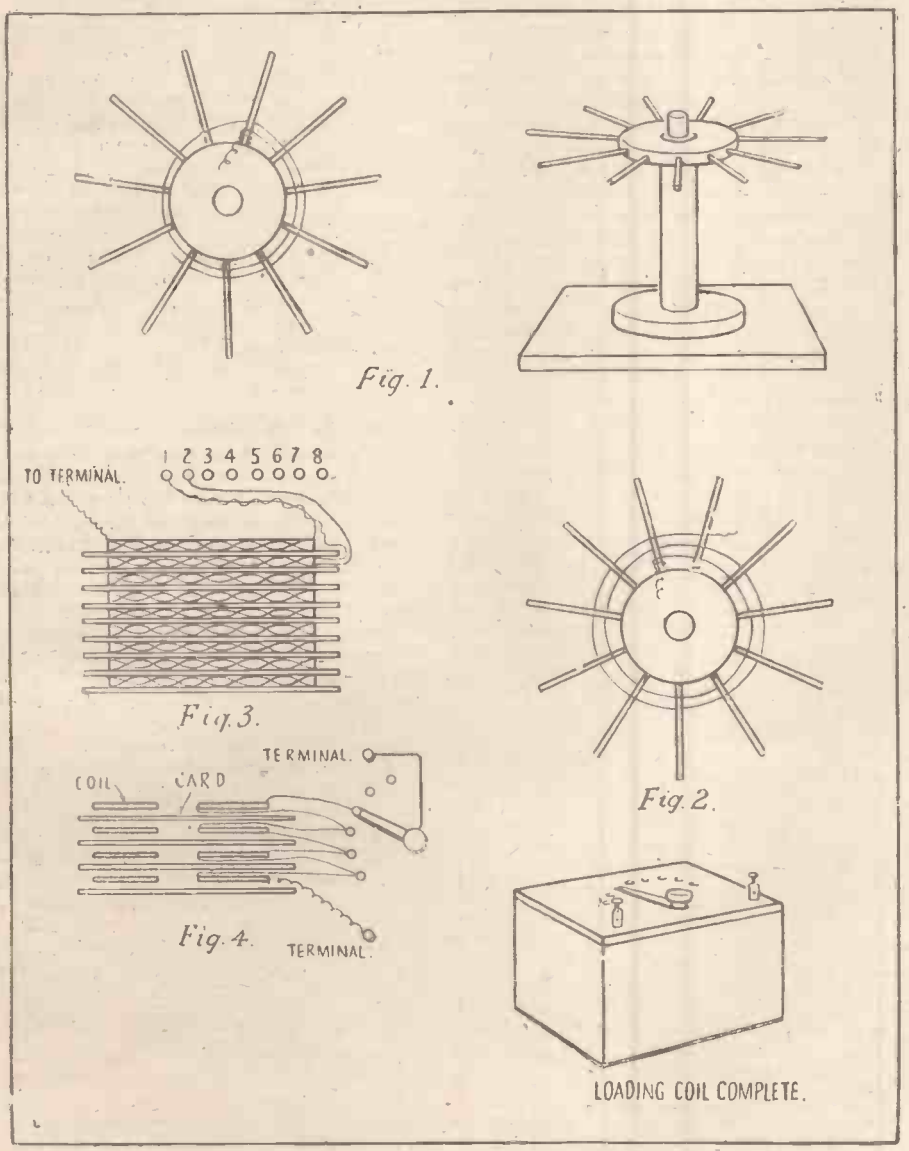
To wind the coils, start by leaving enough wire wrapped round the first spoke to enable a connection to be made later on; then zig-zag the wire on the spokes; that is, over one, then under the next, and so on till the spokes are nearly full up. Take the wheel and wire off the stand and dip it in the molten wax; let it soak well, and lay it on one of the prepared cards, but keep it flat. It will soon set, and then the spokes may be removed by catching hold of the ends of the spokes with a pair of pliers and drawing them carefully through the wire.

This process may be repeated until all the desired coils are made. The coils will be quite good if made up with about 32 gauge double silk wire. Connecting them up is a simple matter, and the coils should be made into a pile, as in Fig. 3. If we start with the first coil, the outside wire will go to one of the terminals, and the inner will go to No. 1 stop on the switch. On the same stop the inner of the next coil will also join up, the outer going to stop No. 2, which also has the outer of No. 3 with it. The inner of No. 3 will go to stop No. 3 together with the inner of No. 4, and so on.

It will be seen that by taking the switch-bar to the other terminal the coils may be added at will. The wiring is more clearly defined in Fig. 4. A set of coils mounted in a box with a suitable number of terminals will make a very compact loading unit.



Two-Valve Panel Set built by Mr. C. Forsters, 1, Bank Foot, Iveston, Leadgate, Durham.



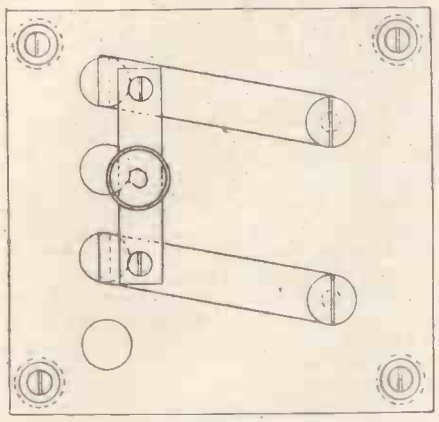
Set built by Mr. C. Rogers, 3, Buxton Road, Chinley, via Stockport.

AN EASILY MADE CHANGE-OVER SWITCH.

By J. E. F. ROBERTS.

IN all electrical or wireless receiving circuits switches of every description are generally essential in the production of good results. A convenient switch in any circuit always saves time and trouble when alternative methods of using the circuit prove of advantage to the operator.

In the following description of a change-over switch, which can be very easily constructed at small expense, no specific dimensions are given, as the size depends upon the class of work to which it will be adapted. The main components consist



Plan, Fig. 1.

of spare contact studs, nuts, bolts, washers, screws, and metal strip, which are usually to be found in any amateur's spares box.

A small piece of ebonite, or any reliable insulating material of medium thickness, should first be obtained for the base on which the parts are to be mounted. Ten holes should then be drilled to take the contact studs and bolts, the relative positions of which will clearly be seen on reference to Figs. 1 and 2.

The parts then required consist of four contact studs, the length of which will depend on the thickness of the ebonite, with nuts and washers to fit. Either one or two nuts may be used, but this is left entirely to the constructor and his method of making connections. Soldered joints are generally to be recommended, especially in valve circuits, as loose connections invariably lead to bad reception and many mysterious noises.

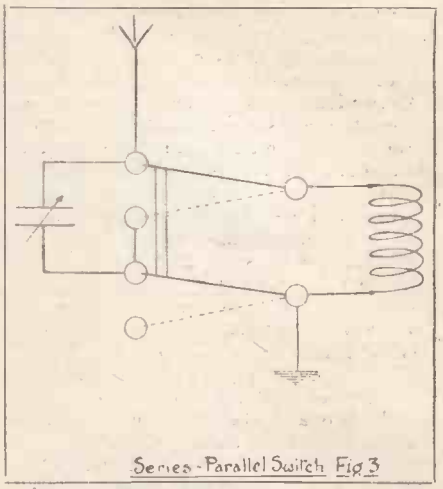
When the contact studs have been placed and secured in their proper positions, the next step will be to cut two strips of metal—brass or copper for preference—to the required length to act as the moving arms. Brass strip of a light gauge can readily be obtained, should none be at hand, and it is here suggested that three or four thicknesses of metal sheeting can be used to advantage in making laminated arms, should the switch be of large dimensions. Care should be taken, however, when cutting the strip, to note that the end touching the contact studs is bent over slightly to ensure good contact and "springiness." At the same time, clearance is left for the under fixture of the cross distance piece to be fitted to carry the operating knob (see Fig. 2).

Four holes remain to be drilled or pierced to accommodate the cross distance piece and the bolts which act as pivots for these two arms. Attention should now be given to the supporting distance pieces or legs. These are quickly made by cutting off sections of insulation tubing to the proper lengths. Altogether, six of these legs will be required, two for supporting the moving arms and four to act as legs for the base, thus improving the insulation of the switch as a whole (see Fig. 2).

Four screws or bolts with washers are inserted through the base and this tubing to keep the switch in a firm position when mounted. This method, however, may be dispensed with by substituting four valve legs and mounting on the "plug in" principle. The length of any legs or supports will rest upon the depth of the contact studs and pivots on the under side of the ebonite.

Now that these legs have been completed, the cross distance piece and operating knob must be fitted. The distance piece consists of a strip of thin ebonite, or similar material, the length of which depends upon the distance between the contact studs. The simplest way to determine the correct length is to mark off two points equal to the distance between the centres of any two alternate contact studs. These marks represent the centres of two holes to be drilled in the distance piece to accommodate a small bolt and nut or rivet for securing the moving arms (see Fig. 2).

Should these two small nuts and bolts work loose through continual "throwing over" of the switch, improvement will result on burring over the ends of the bolts. In the event of small rivets being substituted for nuts and bolts, the correct degree of tightness will be arrived at after several movements of the switch in the appropriate manner, when the



Series-Parallel Switch Fig 3

necessary adjustment can then be carried out.

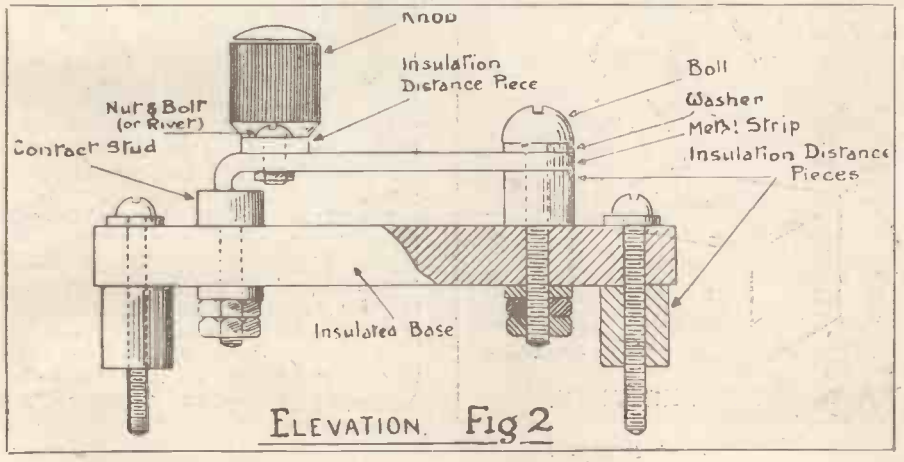
The total length of the distance piece is then obtained by cutting the ebonite to the width between the outer edges of the moving arms. One more hole remains to be drilled in the dead centre of the piece to take the operating knob (see Fig. 1).

Knobs of this description are generally to be obtained from any wireless dealer, but, at the same time, there are numerous ways of making up such a simple article.

One method is by taking another small piece of the insulation tubing already referred to, and to slip a round-headed screw or bolt through a washer to cover the top end of the tube, the whole being secured by passing the screw through the tube and thence into the ebonite. Glass beads and small bobbins can also be used in a similar manner, but a glass-headed drawing pin will probably prove the quickest and simplest remedy.

All that now calls for comment is the assembling of the moving arms. First slip a washer on to the pivot bolt, and then push the latter through the hole in the arm, the tubular distance piece, and the ebonite base. Secure with nuts and a washer to the correct degree of tightness, and make connections in the manner described with the contact studs. It should here be noted, however, that the length of these two tubular distance pieces is determined by the height of the head of the contact studs (see Fig. 2). Two short pins should be screwed into the base in line with the studs to prevent the slipping off of the arms.

(*Continued on next page.*)



ELEVATION. Fig 2

BOOK REVIEWS.

WE have received from the Wireless Press the following books: "The Perry Auto-Time Morse System," by F. W. Perry; "Mast and Aerial Construction for Amateurs," by F. J. Ainsley, A.M.I.C.E.; "Crystal Receivers for Broadcast Reception," by Percy W. Harris; and "Wireless Telephony and How it Works," by Philip R. Coursey, B.Sc., A.M.I.E.E.

It was with great pleasure that we perused the above, discovering that the handy sizes of the small volumes gave little indication as to the exhaustive nature of their contents—exhaustive in respect of the elementary ground they cover, and written in such a way as to form a perfect guide for the absolute tyro. The authoritative nature of the text is guaranteed by the well-known names of the authors.

Possession of these four books would place in the hands of the amateur a miniature library of theoretical and constructional radio lore, as the subjects do not in any way overlap.

"Crystal Receivers for Broadcast Reception" is misleading in its modesty; "Crystal Receivers for all Possible Reception" would more adequately describe its contents, and the appended list of the larger spark stations (giving such useful data as wave-length, time and nature of transmission, etc.) will be greatly appreciated.

In order to be able to enjoy to the full the usefulness of a crystal or any other receiver, a knowledge of the Morse code is essential, and the first-named little brochure details concisely and convincingly (with an original method) how rapid progress may be made in that direction.

The relative advantages of the various types of aerials—and, as a matter of fact, aerials altogether—are more or less a closed book to the majority of amateurs, and therefore "Mast and Aerial Construction" will fill a very long felt want. It ably places the reader in full possession of all the necessary detail in connection with antennæ in a manner that will be appreciated by beginners grappling with the first problem of practical wireless—the erection of the aerial.

Photos of actual apparatus, sketches in perspective of practical "hook-ups," and an abundance of useful analogies render Mr. Coursey's outline of Wireless Telephony both informative and readable, and for the non-technical reader forms a complete introduction to the mysteries of both transmission and reception.

* * *

The Radio Pathfinder. By Richard H. Ranger. (William Heineman. Price 6s. net.)

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

* * *

Wireless Telephony for All. By Lawrence M. Cockaday. (Herbert Jenkins, Ltd., York Street. St. James's. Price 5s.)

This volume—correct in its main facts and lucid in its explanations, with over sixty clear illustrations—is dominated by a spirit of friendly helpfulness, in very agreeable contrast to the style of haughty and academic condescension which disfigures some "elementary" books on this subject.

Chapter I gives an all too brief, but quite useful, summary of the modern electron theory, and Chapter II deals with "Theory of Wireless Waves." We cannot quite agree that "this heat wave is of exactly the same nature as a sound wave, except that it has a different frequency and produces different results." The table of wave-lengths on page 28 relates to conditions in America only, and is not correct for England.

Chapter III, on the "Vacuum Tube," relates to "valves" and introduces some terms unfamiliar to the English reader, but Chapter IV, dealing with "Modulation," is exceptionally clearly written. The explanation of the capacity reaction type of transmitter will be of great interest to readers unfamiliar with this type of circuit and the advantages it has over the usual electro-magnetic reaction circuit for the production of short-wave radiation. The well-known "choke control" is fully described, with many useful practical details under the heading of "Heising" system.

Chapter IX is really the kernel of the volume, and we know that now the writer is in his own territory—speaking not as the scribe, but as a fellow worker who has toiled and fought and won. This is the only kind of knowledge which is *real* and worth while.

We trust the English reader will recognise our old friend the "choke coil" under the (to us) new name of "plate circuit reactor." Personally, we had to refer to the diagram to see what it meant. The alternative term "constant current coil" we greedily commandeer for future use, as it is self-explanatory and euphonious.

Chapter XI, on "Care and Maintenance of Apparatus," is a pleasant surprise, for it is *not* a re-hash of the hoary old perennial platitudes, but a structure of bright, solid facts, cemented by racy anecdote into a palatable and useful whole.

We can commend this book as a useful introduction to those commencing a study of the subject.

CATALOGUES.

The Jeary Electrical Co., Ltd., of 97, Queen Victoria Street, London, E.C.4, have just issued a new catalogue of much interest.

From crystal to valve sets of all descriptions and prices this firm deal in, as well as many useful component parts.

AN EASILY MADE CHANGE-OVER SWITCH.

(*Continued from previous page.*)

It will here be appreciated that, although the switch may be made for mounting purposes, it can be built directly on to a panel, thereby constituting a very neat addition to a home-made set.

Further neatness in appearance will result in bevelling the edges of the ebonite, which should also be slightly polished. Electrical connections for one of many useful circuits in which the switch may be inserted to advantage is seen on reference to the diagram constituting Fig. 3.

In that circuit the switch becomes one of the "series-parallel" variety, and should therefore be wired accordingly. It will be observed that the last contact stud acts merely as a rest, whilst the second and third studs are joined directly. If it is decided that the switch be used permanently as a series-parallel condenser switch, a metal link can easily be slipped under the washers on the contact studs when they are being secured before soldering.

As a last word, it is advisable to use the customary labels indicating *series* or *parallel* in their usual positions in a set.

Captain Ian Fraser, the blind wireless amateur, adjusting his apparatus.

THE STORY OF THE DE FOREST VALVE.

By SIR J. KENNETH D. MACKENZIE, Bart.

WHEN over a hundred years ago James Watt noticed how the lid of his kettle of boiling water rose and fell as the pressure inside varied, he little thought that in this simple fact which millions of others had heedlessly seen lay the germ of all future steam engines; and that because he was the first to ponder over the reason why it did so, and find the answer, would cause future generations to call him the "Father of the Steam Engine" as the discoverer of one of the greatest inventions for the use of man of all time.

So when Dr. de Forest, experimenting in Chicago twenty-two summers ago, noticed how the light from a Welsbach gas burner decreased in brilliancy when a Rhumkorf coil near by was sparking, and how the light increased when it was not doing so, he also probably little thought at the time to what his observance of the phenomenon would lead; though, like Watt, it made him think, and try to find the answer to the question "Why?" It was indeed a real discovery when, after many experiments, he found that heated gas molecules were sensitive to electrical operations of high frequency even as they were known to be to sound waves under certain conditions, and that therein lay the cause for what he had been the first to notice as something remarkable.

"Synthetic" Music.

Many types of arrangements with Bunsen burners were tried by him, and he evolved a kind of "flame detector" which was actually tried in a practical manner in 1903 for receiving ship's signals in New York harbour. Difficulties in the necessary supply of gas under such circumstances caused him to experiment with the electric arc, but this, as any electrician would know, gave only very uncertain results, and proved also far too noisy for telephonic purposes. After trials with arc lamps, Dr. de Forest thought of using the incandescent filament of a glow lamp; thus developing his invention, not from the incandescent light, nor the rectifier, nor from the two-element valve as is commonly supposed, but from the heated gases introduced by him into the bulb valve.

That he fully realised then the importance of his discovery is shown by the fact that when the first valve patents were issued in June, 1906, he said of the invention that he considered it to be his greatest achievement. Not only was it the most sensitive and closely tuned receiver extant, but its principle was absolutely different from any solid or liquid detector hitherto used.

Then came the discovery that his valve could be used as a telephone relay, an instrument long sought for in vain for long-distance telephony by telephone engineers. Even so far back as 1883 the writer remembers how Dr. Orazio Lugo, one of the experts of the U.S. Patent Office, whilst in London spent many weeks trying to design some instrument sensitive enough for telephone circuits, to do what an ordinary telegraph relay would; but all in vain.

It was left for Dr. de Forest to solve the problem years afterwards, and to show that not only could his valve be used as a relay as well as a receiver, but that it was likewise capable of adaptation as a sensitive oscillator or transmitter, veritably a "multum in parvo!" This fact he discovered in 1912 whilst experimenting in California, showing that sustained alternating currents of any frequency could be produced by the very same invention as that on which is now based the present evolution of wireless.

Dr. de Forest had been working for several years on the production of "synthetic" music, and about seven years ago demonstrations of his "musical audion" were given before the New York Electrical Society which proved of great interest to both musicians and scientists.

To the perfecting of this he would probably have devoted more attention had not a still more attractive phase of the audion valve adaptability not diverted his energies towards its development as a talking kinectoscope, or, as he calls it, a "phono-film." Rather a hybrid word perhaps, the idea being probably better expressed by "kinephonectoscope"; but that is by the way.

The Wireless Cinema.

Anyhow, he is now trying to perfect an audion camera and projector of which his original valve still forms the basic principle, and which he thinks will revolutionise the kinematograph industry generally. Probably it will do so when completed, for a film through the medium of which the actors are not only seen but heard perfectly would approach as nearly as possible to "the real thing," especially if natural colours and true stereoscopic effects were produced at the same time.

Up to 1912 over 20 patents, all filed since 1904, had been issued to Dr. de Forest, and at present there are over 100 U.S. patents referring to thermionic valve uses, with a rapidly growing number. Every one of these patents since 1906 is based on the De Forest three-electrode bulb invention, no matter under what name the device is called.

Out of little much may come, and the faculty of observation is one well worthy of cultivation, as the story of the De Forest valve shows.

OUR RADIOPHONE CALLS.

By "LISTENER-IN."

Hallo, hallo, hallo, 2 Q S! Hallo, two Que Ess! We give you a shout to tell you how much we like your Piano Transmissions, only as received here they are more forte than piano. And that is your fault, not ours. Do you really do it with your fingers, or have you got a pianola? It sounds too good to be true. Why on earth does the wave-length change when you open the top of your piano? 2 W Q says that this is what happens. But even 2 W Q does not know why it should be so; it is, therefore, no use for us to try to explain it.

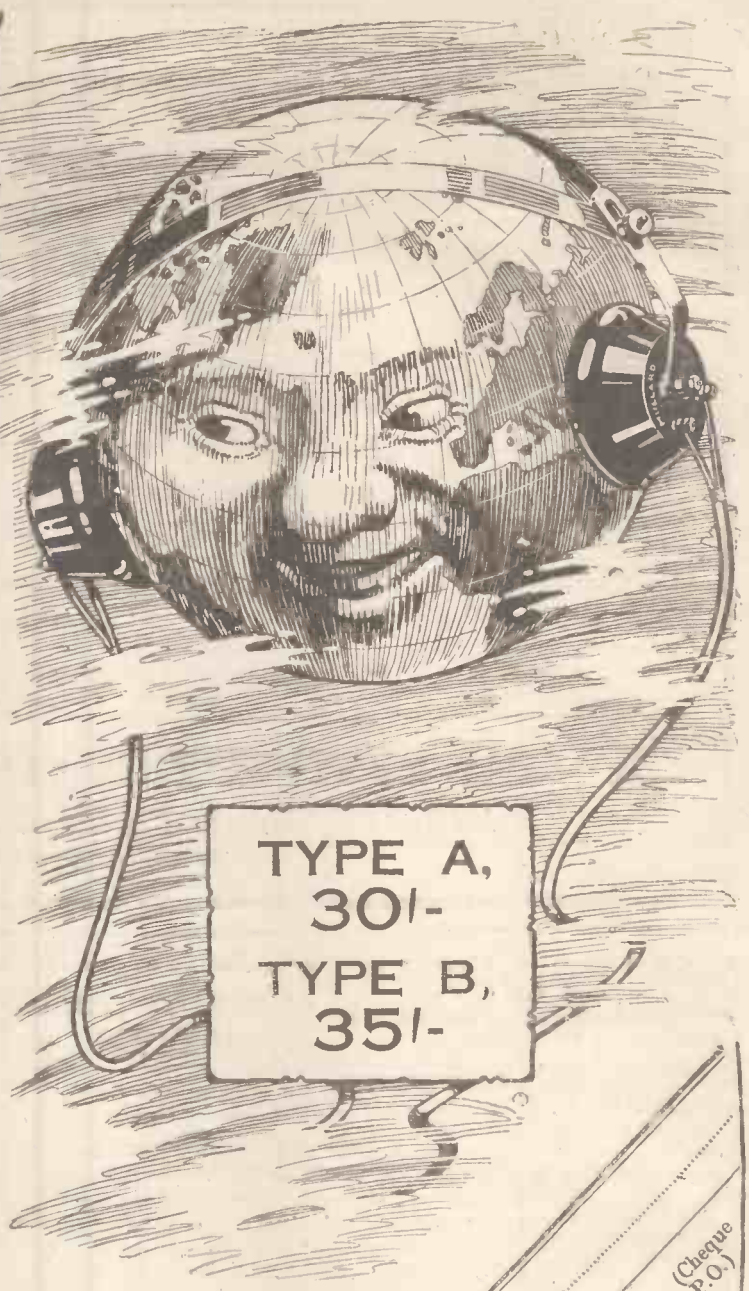
Hallo, 2 K Z! Further concealment is useless. We know now why we did not see you at church the other Sunday morning. You were telling a fellow ether shaker what a delightful place Brussels is for honeymoon purposes. It is no news to us; we have been there; but that is another story. Now, how *could* we have heard you if you were at church? There is no end to the possibilities of wireless.

Hallo, 2 Oh Emma! Hallo, 2 O M! We hardly like to tell you, for your natural modesty is too well known, but, like the notorious Frenchman, "every day you are getting better and better in every way." Have you got a new valve, or is your aerial sprouting? Anyhow, your transmission is simply GREAT.

Hallo, 2 F Q! You have got us into a horrible mess. We have installed a loud speaker. We did not "acquire" it in the usual editorial manner; we bought it honestly for cash. It is one of the black ones which really do talk. Now, we have a fearful letter from a near neighbour, saying that he cannot sleep because we play Harry Lauder records on our gramophone. Now, the point is that it is not our gramophone at all—it's yours. Now, what about it?

Mr. S. W. Woodford and a family gathering "listen in" at 13, Elsinore Road, Forest Hill, S.E.23.

The World listens in on MULLARD PHONES



Specially made for the reception of wireless broadcasting, Mullard 'phones are thoroughly well made and fit comfortably to the head, etc.

British Manufacture

The two high resistance ear-pieces (4,000 ohms total) are flexibly attached to the fully adjustable, double head bands.

The set is nicely finished in nickel-plate and supplied complete with standard flexible cords.

Made in two qualities :—
General purpose quality, Type A, 30 - per set.
Specially high grade pattern of very superior finish, Type B, 35 - per set.

Send the coupon to-day to secure immediate delivery.

These telephones are made by the makers of the famous "ORA" valve and Mullard valve accessories.

MULLARD 'ORA' VALVES

We hope to get a greatly increased output of these famous valves at our large new factory. Meanwhile ***ORDER AT ONCE.***

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(5Ed) Bentley's Telegrams: Radiovelve Hammer Lond?

RADIO MULLARD VALVE

Please send me post free

Quantity.	Description.	Price.
.....	Telephone Head Sets	(Type A. 30/- (Type B. 35/-
.....	"ORA" Valves	15/- each
.....	Grid A Resistances...	6/- each
.....	Anode A or B Resistances...	5/- each
.....	Condensers, '0003 mfd.	2/6 each
.....	B.A. Combined Resistance and Condenser...	7/6 each
.....	Valve Bases with Terminals...	6/- each
.....	Valve Sockets	1/3 each
.....	Terminal Clips	9d. per pair

Name and Address.....

To the MULLARD RADIO VALVE CO., LTD., 45, Nightingale Lane, Balham, London, S.W.12.

I enclose Money Order, (Cheque P.O.) value .....

to cover the cost.

Name of usual Wireless Dealer.....

SEND THIS TO-DAY.

USEFUL ANALOGIES FOR THE BEGINNER.

By MICHAEL EGAN.

WHEN we apply our minds to a particular branch of science for the first time, we are confronted by the problem of "getting the hang of things" before we make any serious attempt to master fundamental principles and laws. Every branch of science may be said to be carried on in a special spirit of its own, and it is in learning to interpret this spirit that the first difficulty arises for the beginner.

Another way of expressing this is by saying that there is a particular point of view from which every scientist surveys the work dealt with by his own branch. No doubt we may still speak of the calm, impartial gaze of science when we refer to science in a collective sense. But it still remains true that the individual scientist exhibits a very definite attitude of mind towards that special group of phenomena which holds the greatest interest for him.

This is the inevitable result of his training. Constant preoccupation with one set of facts develops in him a definite attitude towards these facts. He gets into the habit of looking at them from a single angle, as it were, when he wishes to visualise them as an inter-related whole. I do not mean that he sets up any formal rules with regard to how the subject is to be approached.

Mind Pictures.

The process, even with himself, is largely a sub-conscious one. But the fact remains that he *does* develop an attitude of mind towards his subject, a point of view, a helpful way of looking at things. Without this, in fact, he could never attain any real cohesion of thought, and his mind would not be able to synthesise and correlate his numerous observations.

Chemistry and optics, for example, are quite established branches of science. Yet who will deny that workers in these branches look out upon the universe from very different points of view? It is a necessary result of specialisation, from which we cannot at present get away—however much of an ideal it may be to aim for a universal "single eye" of science.

In coming to a new branch of science for the first time, therefore, the important thing is to "get the hang of things" in your new intellectual environment. You must "learn how the land lies" before you can venture forward into the darkness. The easiest way to accomplish this, usually, is by means of a series of mind-pictures, or concrete analogies.

Now, an analogy can be either the greatest help or the greatest hindrance to the student who employs it in his early attempts to come to grips with a new branch of science. This depends, in the first place, upon whether the analogy is good (*i.e.*, apt) or not. It depends, secondly, upon the amount of discretion with which it is employed, apart altogether from its aptness.

It must never be forgotten that an analogy *is only* an analogy. The best possible analogy will not give as true an illustration of a particular process as would the straightforward technical account of the process itself. But, of course, it is to enable us to avoid technicalities in the early stages that we bring useful analogies to our aid.

Nevertheless, as a word of warning, it may be observed that in many instances the easiest and most interesting analogies are those which contain the minimum amount of truth. That is to say, they present a warped and distorted picture of the process or theory which they are intended to illustrate. They must therefore be taken warily, and with the avowed intention of not placing too much confidence in them. There are no perfect analogies.

Vibrations.

Bearing this important fact in mind with reference to wireless, we can proceed to outline some of those analogies which experience has proved to be of most use to the beginner. To commence with the aerial system, this can be resembled to a vibrating piece of wire stuck vertically in the ground, just as you might stick a hat-pin in a wooden table.

The Mullard "ORA" Valve.

By virtue of the hat-pin having one end fixed in the table it is possible to set up, and sustain, vibrations in it quite easily. Similarly, it is possible to set up and sustain (electrical) vibrations in a wireless aerial that has one end connected firmly to earth. If either the hat-pin or the aerial be disconnected from their respective "earths," it would be quite a difficult matter to vibrate them.

One method of sustaining vibrations in the hat-pin would be as follows: Give it a sharp knock and allow it to vibrate freely. When the vibrations have died down to zero repeat the process, and so on. Another way would be to give it a number of small knocks at a certain regular frequency, thus keeping it vibrating continuously. An aerial system can also be vibrated by two corresponding methods, "spark" and "continuous wave" systems.

Beginners usually experience but little difficulty in understanding the significance of "alternating" and "oscillating" currents. The "wavy" line of the text-books is sufficient to illustrate the processes. When a misunderstanding *does* occur, it takes the form of imagining that the changes in direction of the current take place at the highest and lowest points on the curve. This, of course, is wrong; the change in direction takes place each time the current dies down to zero, *i.e.*, at the points at which the curve touches the normal line.

The simple process of regular breathing (as, for instance, in sleep) may be described as the passage of an alternating current of air in the wind-pipe; allowing for the fact that the "air" that comes out is not quite the same quality as that which goes in!

The question of inductance is often a tricky one for the beginner. Text-books define inductance as the "electrical inertia" of a circuit, and the dictionary defines inertia as "the inherent property of matter by which it tends to remain for ever at rest when still, and in motion when moving." When you juggle these two definitions around for a while in the attempt to correlate them, you can hardly be blamed for coming to the conclusion that inductance is the "sulkiness" or "sheer perversity" of all the electrical circuits that ever were.

You could easily arrive at a worse definition. Perhaps you might go one better, though, in defining it as the "sluggishness" of a circuit. It resists *any* kind of change in the direction or strength of the current flowing in the circuit at any particular moment. And the longer the wire used, the greater the opposition. The longer the wire, therefore, the fewer the changes in direction that can take place in a given time, *i.e.*, the smaller the frequency. That is why reception or transmission on long waves (*i.e.* waves of small frequency) involves the use of big coils of wire.

Capacity of Condensers.

The action of the condenser sometimes provides another stumbling-block to the unwary student. The first thing to learn about a condenser is that it does *not* condense. It is not an apparatus for churning electrons into pulp. It merely collects them, as a reservoir collects water. And just as the reservoir will overflow if you fill it beyond its capacity, so will a condenser overflow (*i.e.*, "discharge") if you attempt to fill it beyond its normal capacity with electricity.

But this does not help very much to explain the action of a condenser in producing high-frequency currents. For this reason it is best to regard a condenser as comprising two containing vessels, which are connected by a narrow pipe—representing the outside circuit. When the one vessel is filled with electricity the resistance offered by the pipe breaks down, and the electricity rushes through into the other vessel.

The resistance in the pipe being now broken down, the electricity surges backwards and forwards from one vessel to the other, *i.e.*, from one set of condenser plates to the other. As there is a certain amount of electrical energy expended in the process, the actual quantity transferred from side to side diminishes imperceptibly at each step, and finally dies to zero.

The more analogies the beginner can call in to help him to grasp his subject, the better. But he is likely to progress much more rapidly if he remembers that an analogy is always a means to an end, and that he must train himself out of the natural inclination of referring all his problems back to a single analogy. No single analogy will illustrate all the facts.

Therefore, when a particular analogy ceases to shed further enlightenment on new aspects of an old problem it must be discarded. Analogies form a temporary scaffolding wherewith the mind can erect the framework of technical knowledge.

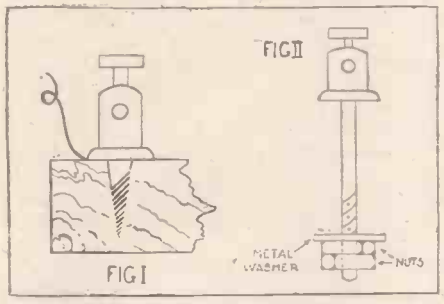
INSULATING AND MOUNTING TERMINALS.

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

NOTE.—The beginner who is about to make his own set will find many useful hints in this article in connection with securing good insulation.

MUCH has been written as to the necessity of insulating the wire leading in from the aerial at the point where it enters the building, and the care which should be exercised in keeping it from touching the walls in its passage to the set. It has been very largely taken for granted, however, that by the time it gets to the set all danger of leakage is past. This is by no means the case, and the wireless amateur should always give a little attention to the insulation of his set, particularly at the point where the signals first arrive, as this is where the greatest pressure exists, and bad leakage may result if not prepared against.

One of the first improvements to attempt is the insulation of the metal terminals. We will suppose that the first to be treated



is the terminal to which we intend to attach our aerial leading-in wire.

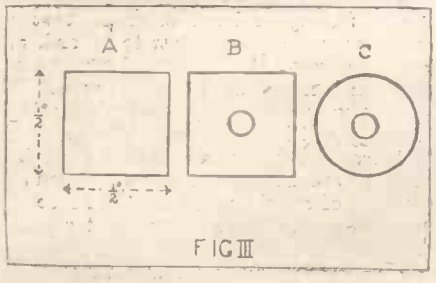
The difference in signal strength owing to taking the aerial terminal out of the wooden base-board of the set and mounting it in ebonite may easily be 300 per cent. To those who are straining their ears with a small crystal set, the necessity for the improvement does not need to be emphasised.

Because he has a wooden base-board, the experimenter has probably bought at the wireless shop, brass terminals, which have a "wood screw," Fig. I., and this, after a hole has been made with a bradawl, has been screwed down tightly on to the board, and the aerial wire of the set pinched down underneath the brass shoulder between the terminal and the wooden base.

It looks all right, but it does not always do to judge a receiving set by its looks. Even the varnish with which you have made the deal board look more or less like mahogany may be of such a nature that it provides quite a big leakage path. Black stains and varnishes are particularly suspicious in this connection.

There is also the point of insulating the turns of wire which are wound on the inductance coil, but of this we will say more presently, if space permits.

Get from your dealers a terminal with a long metal screw tail, and with at least one metal nut, and a metal washer, Fig II.



You can, at the same time, get some thin ebonite sheet, just a bit thicker than ordinary brown-paper. You must handle this carefully, or it will crack and break almost like glass.

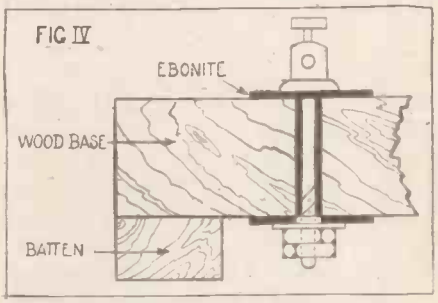
If you warm it a little in front of the fire, not too much, or it gets flabby, you can cut it to shape with a pair of scissors.

Cut a strip, of the same width as the base-board is thick; say it is half-inch board, then cut a strip just under half an inch wide.

Make a hole right through the board, large enough for the screwed tail of the terminal to fit loosely enough to be able to take the thickness of the thin sheet ebonite all round. Now, from the half-inch strip cut a piece half an inch long, Fig. III, A. That is, the piece will be a square of half-inch sides.

Cut two other pieces the same size and make a hole in the middle of each of these just large enough for the tail of the binding screw to be pushed through, Fig. III, B. You can cut off the corners of these if you wish, or may even make them round discs with a hole in the middle—thin ebonite washers, in fact, Fig. III, C. Now put one of these washers upon the screw tail, and push it up to the collar which bears on the board when the terminal is in position.

For a few minutes soak the half-inch square, not having a hole, in boiling water and then wrap it round the tail of the



screw. Bind string or thread round it to keep it curled up till it is cool, when it will retain its shape and the string can be removed.

Now insert the screw with its ebonite washer and sleeve into the enlarged hole, push on the other ebonite washer underneath, put on the metal washer and screw up the nut.

If you have done your work carefully as directed, your terminal will be held solidly in the wooden base, but be protected from contact with the wood by ebonite being everywhere in between, Fig. IV.

All terminals mounted in wood should be so "bushed," as it is called, and until this is done you cannot conceive the difference it will make in the strength of your received signals.

The work you have done will probably result in your not being able to stand your board down on a table now, because of the screw ends and nuts projecting through to the under side of the base-board. In this case, two strips of wood, shown in section in Fig. IV, screwed across under the ends of your board, will provide a firm base and prevent the screws touching the table.

Of course the "battens," as these strips of wood are called, must not come into contact with the metal of the terminals, or else all your work is in vain. If your base-board is too thick for the terminal screw tails to project through far enough to take the various washers and nuts, you may cut a recess underneath the board to accommodate them, Fig. V.

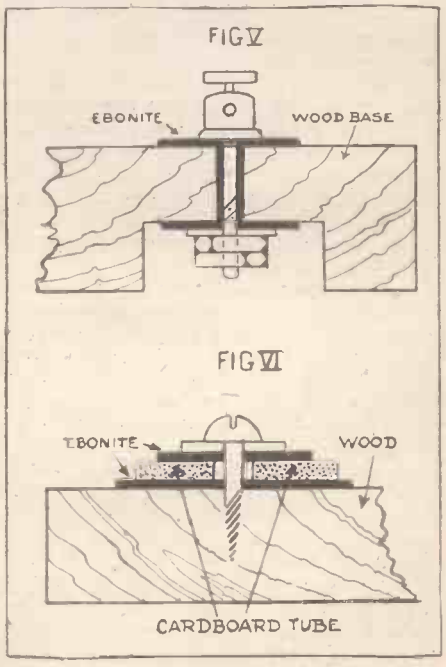
A carpenter's centre-bit, cutting a one-inch hole, is a useful tool to do this with, only you must start the hole with this before enlarging it out to take the bushing, or else the bit will "wobble" as you turn it, and will not cut a round hole. It is always a good plan to go through the actions with a spare piece of wood, of the same thickness as the base-board it is desired not to disfigure; for spoiling a piece which does not matter may save a lot of regret and self-reproach.

To insulate an inductance coil. If you are constructing the 35s. set which we described in No. 1 of this journal, you can make quite a good start by putting a layer of the thin ebonite sheet on the outside of the cardboard tube before you wind on the wire. Whether you do this or not, cut a strip of the ebonite two inches wide, and as long as the cardboard tube. Place it on the base-board so that the windings of enamelled wire are resting upon it as the coil is screwed down, so as to prevent any turn of the wire from touching the wooden base-board.

Now make holes in the cardboard tube through which go the screws to fasten it down on the board, sufficiently large to prevent any cardboard fibre from touching the screw when it is in position.

Use roundheaded screws, and put a round, flat brass washer right up under the head. Next, put a thin ebonite washer to insulate the metal from contact with the cardboard, and when screwed down tightly, the section through the centre of the screw should be as Fig. VI.

It is not so important to do this with the screw upon which the spring brass strip moves, as this is connected to your earth lead, and therefore is at a very low potential.



HOW TO MAKE A LONG-WAVE RECEIVER.

By Y. W. P. EVANS.

PART 5 (Conclusion).

AS will be seen from the accompanying sketch of the wiring, this is very straightforward work, and should not present any difficulties to the novice. The first step is to thoroughly clean all the protruding screws, etc., to which wires are to be affixed, and dab them all with a little soldering flux. (Baker's preparation is recommended.)

After tinning the soldering iron, keep it at a fairly high temperature during the actual operation. The wire should preferably be 20 S.W.G. tinned copper fuse wire, and after fixing one end and cutting off the required length, insulate with systoflex, thereby obtaining a very neat finish. The above-mentioned wire is sold at 2s. 6d. per pound, so that sixpennyworth should be ample for this panel. Systoflex is sold in various lengths, and consists of fine tubes of insulating material through which the wires are threaded.

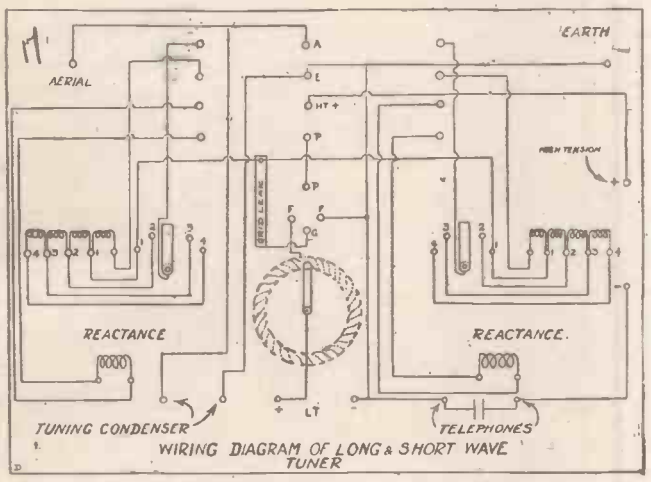


Fig. 1.

The Change-over Switch:

When purchasing mention the gauge of wire you intend to use, and obtain about three yards (approximately 2s. 6d.). Wire up all parts with the exception of the coils, so that all that is necessary will be for you to hold the panel over the cabinet (to be described) and connect the following wires: 1, 2, 3 and 4 on the studs to 1, 2, 3 and 4 on the coils at either side, and also the reactance, aerial, and earth wires. The earth wire from both sides of the C.O.S. to the beginning of first coil in each case. The aerial wire from each side of the C.O.S. to the switch arm, and the reactance wires on each side of the C.O.S. to their respective coils.

A wire is also taken from the grid leak to the first stud of the switch on each side. The condenser is joined across aerial and earth direct, that is, in parallel. Negative leg of valve holder is connected to earth, as also is the negative low-tension battery and one side of the telephones. The other side of the telephones is connected to the negative terminal of the high-tension battery.

The grid leak and condenser is joined between the above-mentioned point and the grid of the valve. Positive low tension to switch arm of resistance, through the latter and thence to the positive, *e.g.*, of the valve holder. The actual diagrammatic sketch of the circuit is shown in Fig. 1, which gives details of the actual circuit when the C.O.S. is either on long or short wave side. Very little trouble should be experienced in joining up the set if the diagrams are studied closely.

Assembling the Set.

Assuming that the reader has adopted the suggestion regarding the receptacles for the basket coils, the method of making these will be explained. Using ¼ 3-ply wood, construct two boxes 5 in. square and 1¼ in. deep, and hinge the lid as shown in Fig. 2.

The reactance coil is fixed by any handy method that might occur to the reader, preferably by means of a wooden screw in the centre, carrying a wood disc large enough to grip the coil outside the centre hole when the screw is driven home. Two pieces of flexible wire are soldered on each end of the coil, and are to be of sufficient length to allow them to be coupled to a pair of wires from the main switch, which will have already been secured to the under side of the panel. Regarding the other four coils, it is assumed that the ends have been twisted together as suggested and brought through the top of the box, and these five ends should be connected to the five studs as shown on the sketch of the panel.

The method of varying the coupling between the aerial coils and the reaction coil is also shown in Fig. 1, where a brass rod is shown as having been screwed or otherwise fixed in the lid of the box and fitted with an ebonite at the top. The length of this rod is determined by the depth of the cabinet, and in this case it is constructed to the requirements of a cabinet 6½ in. deep.

The length of the rod is therefore 2 in.,

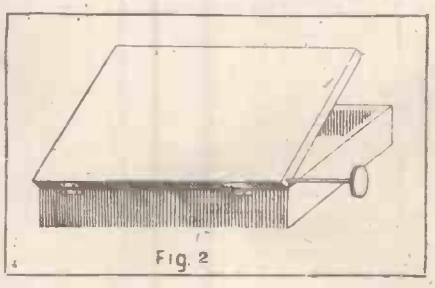


Fig. 2

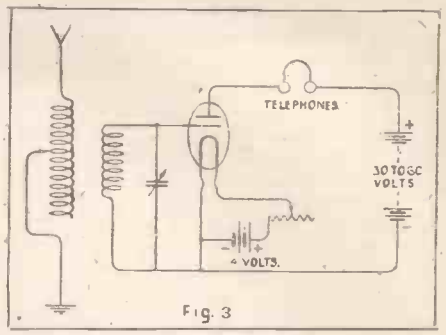


Fig. 3

which, when the set is complete, will give a clearance of ⅜ in. above the top of the panel for the ebonite knob. According to the position of the rod when fixed, the hole in the panel should be drilled so as to allow a free movement when altering the coupling. This should be fairly obvious to the novice.

The cabinet is merely a box without a lid, the latter in this case being the ebonite panel. According to the size of this panel, the inside measurements of the cabinet should be 13 in. by 8 in. by 6½ in. deep.

The thickness of the wood and the quality of the wood, also the method of construction, are left to the discretion of the builder, but a good teak or walnut cabinet, properly dovetailed, presents a splendid finish to the receiver.

It should not be necessary to say what is placed in the cabinet, which is merely a receptacle for the coil boxes, and a rest for the panel. The novice is recommended to study well what lies before him, and it will be found that a moment's reflection saves hours of labour.

In order to fulfil the regulations regarding non-radiating sets, the coils should be connected as shown in Fig. 3, which is simply a coupled circuit without reaction coil. With a little practice the experimenter can very easily adopt any circuit with this receiver.

(CONCLUSION.)

Mr. Hicks Arnold's set, Douai School, Woolhampton, Berks.

EXPERIMENTS WITH A PORTABLE SET

By A. F. H. BALDRY.

A FEW notes on experiments conducted with a portable set may, perhaps, be worth offering to the many people who concern themselves with "wireless" matters.

These experiments were carried out recently during the annual tour of the Marlow and District Motor Cycle Club in Devon and Cornwall, and were welcomed by all who participated in them as adding a real interest to a very enjoyable excursion.

The apparatus used consisted of a two-valve low-frequency set, transformer-coupled, and employing a reactance circuit.

Mr. Baldry and his friend with their portable set.

The approximate range covered was 230 metres to 15,000 metres, and results were good on all wave-lengths.

The aerial was a very simple one, consisting of about 70 ft. of No. 20 S.W.G. cotton-covered wire, held up at the free end by a bamboo pole 10 ft. high, and at the lead-in by attachment to the carrier of one of the motor cycles.

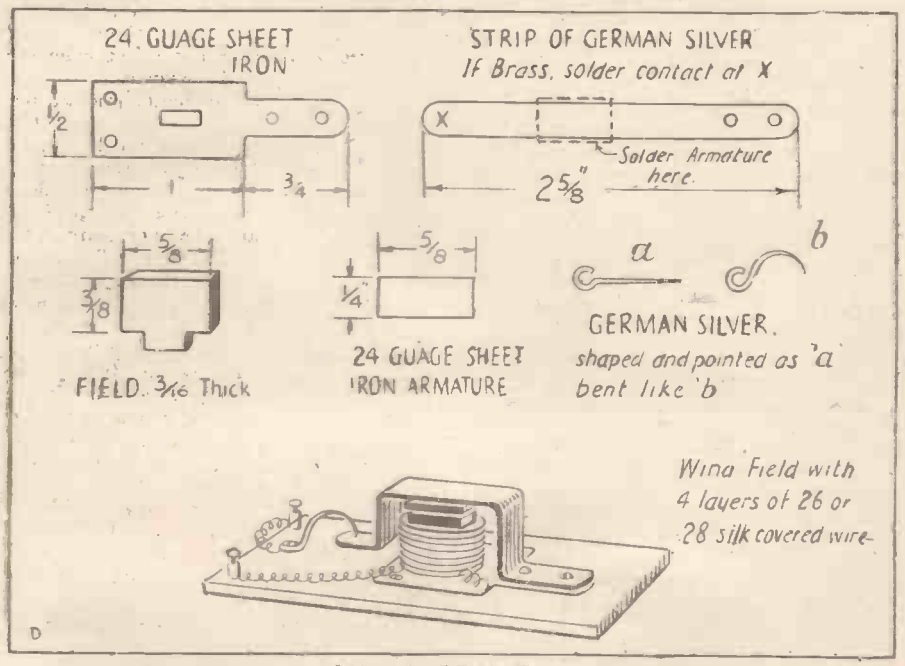
One "Keystone" and one "reel" insulator were used at each end, and proved very efficient. A "capacity" earth was made by bringing a lead from the set and connecting up to a suitable nut on the cycle, and the low-tension current was obtained from the accumulator which supplied the electric headlights. The high-tension battery consisted of three 15-volt Siemens units strapped together.

The first "station" created was at Bruton, near Devizes, and the "listeners-in" were very nearly deafened by the big commercial station (GKU) some ten miles away. Paris (FL), Rome (IDO), North Foreland (GNF), and many other European stations were picked up clearly and distinctly. Some telephony was also heard, and was thought to come from 2OM (Brentford), but this was not confirmed.

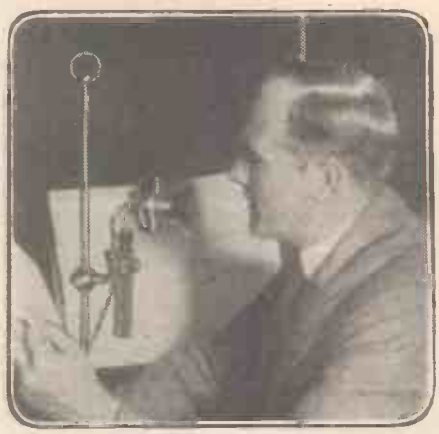
The next point at which the set was erected was at Gunnislake, on the borders of Devon and Cornwall. The results were not quite so good, as the site chosen was in a valley with high hills on either side and thick trees near at hand. Nevertheless, the usual Continental stations were heard, faintly but clearly.

The next station was erected at Newquay, on the north Cornish coast, and, the position being excellent, the reception was very fine indeed. By a stroke of fortune a transmission of telephony was received from the Eiffel Tower, and came out exceedingly clearly, while the music was wonderful in its strength. The results at this station were undoubtedly the best obtained throughout the entire series of tests.

Bude was the next selected spot, and again the site was ideal from a wireless point of view, but owing to heavy rain only a short period of "listening-in" was possible. The outstanding feature of the experiments here was the reception of telephony from Croydon, very clear and strong, surely a remarkable thing considering the distance.



Making a Small Testing Buzzer.



Mr. A. Burrows, of Marconi House, who had the honour of arranging the details for the Prince of Wales' Radio Speech.

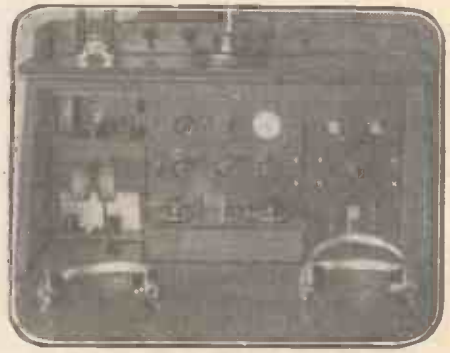
The last station set up was at Savernake Forest, outside Marlborough, and here, although the position was not really a good one, as trees and hills caused a lot of screening, The Hague concert came in quite loudly, and was much enjoyed by those who were listening.

The experiments detailed go to show what excellent results may be obtained with very rough-and-ready apparatus, and make one realise some of the many possibilities of "wireless," even when it is used under conditions which are apparently very unpromising.

A SMALL TESTING BUZZER.

THE following instructions will help you to make a simple buzzer that will operate on very little current, and, at the same time, be efficient at a very trifling cost.

First, a small piece of sheet iron will be wanted (the base dimensions will be seen in the drawing), and, if possible, a small piece of german silver. Of course, the whole thing may be made much more elaborate by the addition of an adjusting screw, etc., but the idea at the moment is to describe the easiest and cheapest thing possible. The wire adjustment may be bent to make various notes, and with a little trouble a very neat buzzer will be the result, the drawing explaining all the remaining particulars.



Mr. H. B. Hyde's set, 423, Edge Lane, Liverpool.

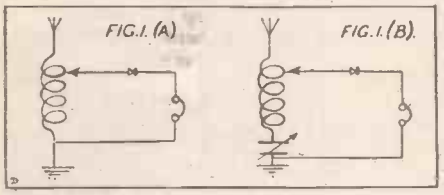
ALTERING WAVE-LENGTH.

NOTE: THE AMATEUR WHO HAS JUST OBTAINED AN EXPERIMENTAL LICENCE WILL FIND MUCH TO INTEREST HIM IN THIS ARTICLE.

MOST amateurs of to-day realise to the full the value of a "loading coil" when they wish to increase the range of wave-lengths over which their apparatus will receive, although perhaps many of them do not know it by that name.

Obliging manufacturers have designed apparatus whereby a variety of coils, each with its stipulated range of wave-lengths, can be "plugged in," one after another, without any more trouble than is occasioned by removing a coil which does not answer the immediate requirements of the operator.

It all comes to the same thing in the end, however, which is the inclusion of a certain amount of inductance in series with the aerial to enable the receiving set to be tuned to a definite wave-length.



Let us imagine, for instance, that a concert has just been received on 350 metres, and that it is required to receive signals from Eiffel Tower immediately afterwards.

It would be necessary in this case to remove the "short wave" coil, and substitute one which it is known will "get up to" 2,600 metres, the desired wave-length.

In other words, more inductance is placed in the circuit, thereby increasing the wave-length over which the set can receive.

Reducing Wave-Length.

Now let us consider the reversal of this action, and that we require to hear a transmission on 350 metres, on the set diagrammatically represented in Fig. 1 (A), which has a minimum wave-length of 600 metres.

It will be necessary to modify the wave-length of the apparatus in some manner, because even by eliminating all the aerial tuning inductance from the circuit we cannot tune in a wave-length lower than 600 metres, and signals on 350 metres would therefore be inaudible.

To bring the circuit to the desired wave-length we might include a condenser in series with the aerial circuit as shown in Fig. 1 (B), and, provided that the condenser in question is of a suitable capacity, we can then hope to tune in signals on a wave-length of 350 metres.

The aerial itself, as we know, contains a certain amount of capacity and inductance distributed over its over-all length—that is to say that, although it contains both capacity and inductance, neither factor is definitely confined to any one specific position of the aerial.

The aerial tuning inductance is of the same value as that shown in Fig. 1 (A), and therefore in adding the condenser to the circuit two "capacities" have been connected together in series.

Taking into consideration the fact that wave-length is dependent upon the amount of capacity and inductance contained in a circuit, this would seem to imply on first sight that in placing additional capacity in series with the circuit the wave-length would be increased—*i.e.*, lengthened.

This is not so, and the reason is as follows:

The capacity of any condenser can be considered as depending primarily upon the size of the plates of which it is composed, the distance between the plates, decided by the "thickness" of the dielectric, and the inductive capacity of the dielectric.

If we, therefore, add to the size of the plates of a condenser we increase its capacity, and when similar condensers are connected together in parallel we are adding their plates together, or increasing the size of the plates of one of the condensers.

Condenser Hints.

This can be better seen than described, perhaps, and Fig. 2 (A) shows diagrammatically three condensers joined together in parallel.

Presuming that the three condensers shown each have a capacity of three microfarads, the sum capacity of the three pieces of apparatus joined up in parallel will be the sum of their separate capacities—namely, 9 microfarads.

If the three condensers are joined in series as shown in Fig. 2 (B), the resultant total capacity will be found to be less than that of any one of them taken separately, and is arrived at from the formula:

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$$

We therefore have

$$\frac{1}{C} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{1}{9}$$

giving a resultant capacity of $\frac{1}{9}$ or ·1$\dot{1}$ microfarads. It is easily seen that had only two of the condensers been connected in series the sum capacity would have been $\frac{1}{6}$ or ·16 microfarads.

The inclusion of a condenser in series with the aerial, and therefore in series with another capacity, will shorten the wave-length.

This can be better explained by considering the formula for wave-length, which states that wave-length = $1885 \sqrt{C \times L}$, where the wave-length is measured in metres, the capacity (C) in microfarads, and the inductance (L) in microhenries.

It is obvious that any reduction in the value of C will reduce the value of the answer to the formula, which is wave-length.

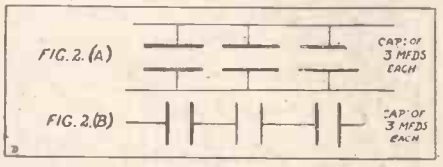
It is, of course, apparent that, given a circuit as shown in Fig. 1 (B), the wave-length could be increased slightly by the addition of condensers in parallel to the one already in circuit.

In practice, however, it would probably prove of more value to remove the original condenser from the circuit. Small capacity condensers, such as are used on the average receiving circuits of to-day, should be given periodical attention, and perhaps a word of advice here would not be out of place.

Most receiving circuit condensers of the variable variety have air dielectrics, and for this reason alone the plates should occasionally be examined.

See that all plates are tightly fixed, especially the movable "bank," which are attached to, and rotated on, the indicator rod. A plate may be quite true mechanically, and yet have an inclination to "droop" if it is not firmly supported.

Do not purchase any air condenser that is not tightly cased, or any instrument in which the plates of the tuning condensers are exposed. Remember that the dielectric is meant to be air, and that dust accumulation on the upper sides of the plates will certainly not add to the efficiency of the instrument, and will probably make very delicate adjustments of capacity impossible by clogging the movable spindle.



The insulated knob attached to the pointer which passes over the calibrated strip will sometimes be found difficult to move accurately for other reasons, especially in new instruments. It may be a constructional fault, and, if so, it should be remedied mechanically. Resist the temptation to oil the shaft connections.

A Difficult Fault.

It is true that in the case of certain large condensers the "banks" are immersed in high-flash insulating oil, but it will be found that this type of instrument is utilised for transmitting purposes, in cases where it is necessary to subject the condenser to considerable electrical "strain," by charging the plates to a very high potential. It is always worth while to remember that oil, either in patches or streaks, if left unattended on an exposed surface, will inevitably collect dirt and dust.

See that the plates are evenly spaced when "interleaved," for upon this point will depend the thickness or thinness of the dielectric, which is one of the factors governing the capacity of the condenser.

In testing an air condenser prior to purchasing, revolve the pointer slowly, with a minimum of effort, from a zero to a maximum value, and then reverse the action.

Should any sudden check in the movement be experienced during the process, or should a slight grating noise be heard at any time during the rotation, it will probably be found that two of the plates are making metallic connection at a certain point during the operation of the instrument.

It is a fault by no means easy to remedy, and the reader would be well advised to ask for another condenser, as in order to properly rectify the error it may be found necessary to dismantle the whole condenser in order to straighten out the faulty plate or to substitute a new one.

Do not, on any account, buy uncalibrated apparatus because it is cheap.

Such condensers are almost useless for serious work, and will be found in the long run to be more expensive than a properly constructed and carefully calibrated piece of apparatus, despite the difference in the amount of the initial outlay.

CONTROLLING MODELS BY WIRELESS.

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

PART 8 (NEW SERIES).

IN my last article I stated that the selector (previously described) is designed in such a manner that it can be used for controlling either a series or shunt wound model electric motor, in addition to the permanent field magnet type. An illustration of the latter appeared in No. 18 of POPULAR WIRELESS (page 372).

The skeleton plan Fig. 2 (last week's article) showed a scheme for controlling a

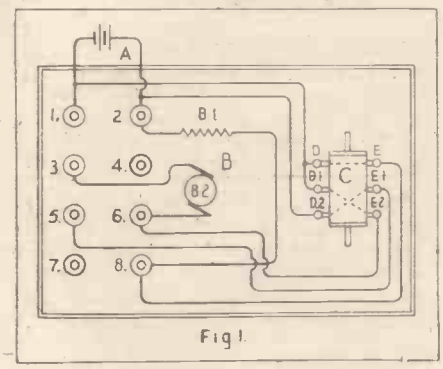


Fig 1.

series-wound motor. Model electric locomotives are invariably fitted with either a series-wound motor or a permanent field magnet type.

Many wireless enthusiasts have asked me to describe a method of controlling a shunt-wound electric motor.

In No. 15 of POPULAR WIRELESS (page 287) I furnished a diagram showing a scheme for controlling four of such motors. I should, however, advise beginners to confine their energies to constructing apparatus for the wireless control of one electric motor before attempting complicated feats.

"Shunt-Wound" Motors.

I had, perhaps, better explain that the term shunt wound (as applied to electric motors) simply means that the field magnet winding is connected in parallel with the armature windings, but the resistance of the field magnet winding of such a motor is so high that only a small amount of electric current passes through same.

A skeleton plan, Fig. 1 (this article), shows a method of connecting a model shunt-wound electric motor to the selector (described in my previous articles), and consists of a battery A, shunt-wound electric motor B (with field magnet winding B1, and armature with commutator B2), drum C, contacts D, D1, D2, and E, E1, E2.

In operation it will be observed that electric current from the battery A would pass through contacts D, D1, E, and E2, thence to terminals Nos. 6 and 8, through armature windings and commutator B2, also field magnet winding B1 to terminals Nos. 2 and 5 respectively. From terminal No. 5 the electric current would flow through contacts E1 and D2, thence to battery A, and being connected with terminal No. 2 forms a common return from the field magnet winding B1.

The armature with commutator B2 would thus revolve in the usual manner, but it will be apparent that by revolving the drum C until contact D1 is connected with contact E1, and contact D2 connected with contact E2, electric current would be caused to flow in a reverse direction in the windings of armature B2.

The polarity of the current traversing the field magnet winding B1 would remain unaltered, so that the armature with commutator B2 would revolve in a reverse direction to that already described.

Fig. 2 shows a model shunt-wound electric motor which clearly shows the field magnet and armature windings connected in parallel.

Remaining Apparatus.

Large shunt-wound electric motors (for working off electric power mains) are provided with a starter. The latter is simply a form of variable resistance, and is employed in connection with the armature circuit of a shunt-wound motor in order to impede the rush of current to the armature windings which attends the connection of such a motor with an electric power circuit.

Having now furnished diagrams, also a description of various types of model electric motors, and having shown the selector in question arranged for controlling such models, the remaining apparatus to be described will consist of a suitable coherer, de-cohering device, and baseboard. I shall also in due course furnish a wiring diagram showing the manner in which the coherer, relay, selector, and de-cohering device should be connected up, so that the whole apparatus will form a complete wireless receiver for controlling the model electric train referred to in my previous articles.

I shall conclude this article by explaining, in the simplest possible language, the functions of a coherer and de-cohering device, so that readers may thoroughly understand the apparatus before constructing same.

The wireless control of mechanism is quite a different thing to wireless telegraphy and telephony, and should not be confused with the latter.

A Primitive "Detector."

Wireless telegraphy involves the transmission and reception of signals (principally Morse signals), whereas wireless telephony involves the transmission and reception of speech. I mention these elementary facts because I was rather surprised when an obvious beginner recently asked me (at the International Radio Exhibition and Convention, Central Hall, Westminster) if the transmitter which I described in No. 12 of POPULAR WIRELESS could be used for wireless telephony.

Many people also imagine that in telephony sound is actually transmitted. Such a fallacy is apparent when it is realised that sound waves only travel in air at the rate of eleven hundred feet per second.

The modified form of Hertz oscillator which I described in No. 19 of POPULAR WIRELESS is a form of spark transmitter fitted with two rods (forming an antenna) of equal length; wireless waves being radiated from the latter when the spark coil of the transmitter is functioned.

If a metal ball were fitted at the end of each of two rods the same length as those fitted to the spark transmitter in question, and the rods mounted upon insulated supports in such a manner that only a very small space separated the ends of the rods fitted with a metal ball, it would be found that when such rods were placed near and parallel to those fitted to the spark transmitter, each time the latter functioned minute sparks would jump across the small space separating the metal balls fitted at the ends of the rods in question.

The Coherer.

Such a piece of apparatus is known as a spark detector, and is interesting in connection with laboratory experiments.

It would, of course, be useless as a detector for controlling models by wireless. I have merely referred to the apparatus in order to show the effect of a transmitted wireless wave.

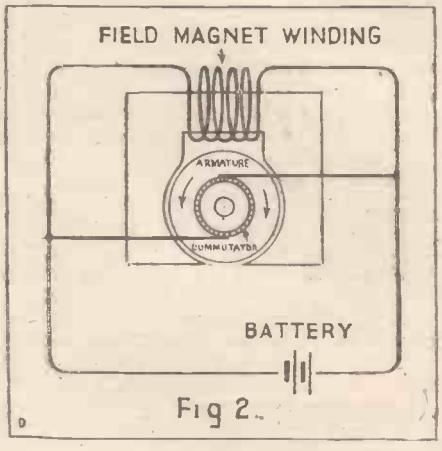


Fig 2.

A coherer is generally classified as an imperfect contact detector, and was used for detecting wireless telegraph signals in the early days of radio-telegraphy. Although now obsolete for that purpose, it still has many advantages for controlling mechanism at short distances.

A coherer consists of a non-conducting tube (suitably mounted) containing contacts upon which rest metallic filings. The latter offer a high resistance to the passage of an electric current, but the arrival of an incident wireless wave causes such filings to short-circuit the contacts, and so close a local circuit connected with same.

The operation of shaking the filings (called de-cohering) restores their resistance, and so opens the local circuit previously referred to.

In my next article I shall deal more fully with the matter, and at the same time furnish diagrams.

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.

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 October 5th, Mr. Walley (member) exhibited his three-valve set. With the aid of this set, members clearly heard items of the concert sent out by the Dutch station at the Hague, and a host of Morse signals from British and Continental stations. Mr. Walley had entirely constructed this set himself during the previous seven days.

Mr. A. H. Wilson was appointed delegate to represent the society at the forthcoming conference of the Midland Wireless Societies, at Birmingham, in order to arrange the interchange of lectures.

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

The Radio Society of Highgate.

The second annual general meeting of this society was held on September 29th, with Mr. P. R. Coursey, B.Sc., F.Inst.P., A.M.I.E.E., in the chair. Mr. Coursey gave a presidential address, dealing chiefly with the question of broadcasting and its effect on the amateur experimenter.

As a result of the meeting, it was decided to change the name of the society to the Radio Society of Highgate, instead of the Wireless Society of Highgate, as formerly. The headquarters of the society, where meetings are held every Friday at 7.45 p.m., are now at the 1919 Club, South Grove, Highgate.

On Friday, October 6th, a debate was held on the very interesting and provocative subject: "That in the opinion of this house, high frequency amplification is more suitable than low frequency amplification for amateur experimental purposes." Space forbids the publication of full details, but this proved to be a highly interesting discussion. The motion was carried by 8 votes to 7. Five members present did not vote.

A very successful demonstration was given on Saturday, October 7th, to an audience of 120 people, this number being the maximum possible seating capacity of the 1919 Club. Many people were unable to get in, but, thanks to the Magnavox, the Marconi concert could be heard some distance away from the hall.

Hon. sec., J. F. Stanley, 49, Cholmeley Park, Highgate, N. 6.

Cambridge and District Wireless Society.

The extraordinary general meeting of the Cambridge and District Wireless Society took place at the new headquarters in the Central Liberal Club, Downing Street. Mr. A. J. Winship, the chairman of the society, opened the meeting by welcoming the members to the new headquarters. He then gave a detailed account of the activities of the society since the last meeting, held at the end of April, and how the committee had successfully raised funds by giving exhibitions at the Royal Show and also at the Mammoth Show. Special mention was made regarding two friends of the society, who had kindly loaned the necessary money in order to purchase a transmitting apparatus to enable the committee to carry out their scheme. It was announced to the members that Sir Douglas Newton, M.P., had kindly consented to become patron of the society. Six new members were elected during the evening. It was proposed that the meetings be held each alternate Thursday and Tuesday fortnightly, this proposition being duly carried.

Hon. sec., Mr. J. J. Butterfield, 107, King Street, Cambridge.

Wireless and Experimental Association.*

The Wireless and Experimental Association, at the Central Hall, Peckham, on Wednesday, October 4th, held the deferred "gadget" night, and many members brought examples of their ingenuity in getting round some square corner in wireless, or making the circumnavigation more easy.

Indeed, one young man brought a leather portmanteau full of various contraptions, and so bewildered the judges that he had to specify by which one he desired his genius to be immortalised. He chose one, a prize-winner. The result of the judging was: Mr. Voigt, first prize for an anti-dog clip to fasten into his headgear telephone leads to prevent the domestic dog or cat dragging delicate valve gear from the table to the floor when they got mixed up with the so-called flexible cord. It proved a "weak link" in the chain which parted and saved the situation. Honourable mention was accorded to Mr. S. J. Prior, who exhibited a well-made and workable potentiometer, made up from odd scraps of material.

The meeting opened with buzzer practice under Mr. Sam Middleton, and showed that the new members were making considerable progress. The Broadcasting Company and the amateur's relative position provided a considerable amount of reading matter for the secretary to wade through, but all present thought it very reassuring and well worth while.

Hon. sec., Geo. Sutton, A.M.I.E.E., 18, Melford Road, S.E. 22.

Eastern Enfield Wireless and Experimental Society.

The second meeting of the above society was held at its headquarters on Thursday, October 5th at which a good attendance was present. The minutes of the previous meeting were read and signed, and the chairman stated that it was hoped to have the licence for the society's set in the course of a few days.

A set of rules was presented by the committee for general discussion, and after having been gone into by the meeting, were passed. A programme for future meetings was also arranged and will now be in force.

It was decided to purchase certain books as the nucleus of the society's library, and these will be on loan to all members. Various apparatus will also be purchased by the society, which can be borrowed by the members for home use.

The subscription to the society is 10s. 6d. per annum, and a good financial position is already attained. Three new members were enrolled, and it is hoped that everybody in the district interested will join and help to swell our numbers. Applicants for membership will be welcomed at any of the society's Thursday meetings, and the secretary will be pleased to give particulars to any intending member.

Hon. sec., Arthur I. Dabbs, 315, High Road, Ponders End.

Glasgow and District Radio Club.

Weekly meeting of above club was held in the club-room before a very large attendance. The hon. president, Mr. W. K. Dewar, presided after the usual preliminaries. The chairman called on the convener of the club apparatus committee to explain the building of the club set, which his committee had been working on during the close season. It was originally intended to build the set on the unit principle, but through certain difficulties this one was not found possible, and a three-valve set was built, viz., one valve tuned anode method of H.F. amplification. one detector, and one L.F., the usual tuning condensers being included in a separate panel but permanently fastened to valve panel, and having a three-coil holder for taking standard makes of honeycomb or other type of coil to tune over all wave-lengths.

As there was a large number of new and prospective members present, the chairman asked Mr. McLellan to give a short lecture on the general principle of wireless. This he accomplished in a very satisfactory manner, his simple explanation of technical terms being much appreciated. A hearty vote of thanks was asked, and enthusiastically given both gentlemen.

A short discussion followed on several points regarding the working and welfare of the club, after which the meeting was declared closed.

Hon. sec., W. Yuill, 93, Holm Street, Glasgow.

RADIOTORIAL

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

The announcement that M. Edouard Belin has discovered a means of transmitting radio signals with perfect secrecy has caused considerable interest among wireless men. The explanation and details of M. Belin's invention are given briefly on another page, but even from the meagre details yet to hand it will be readily seen that the inventor has worked on the most ingenious lines. Should this invention prove all that is claimed for it, radio will again be revolutionised, as it was when the valve was brought so close to perfection a few years ago.

POPULAR WIRELESS has every hope of publishing full details of this new invention in the near future, and next week will describe another ingenious invention called the "Eliminator."

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have decided to reply individually by post. A weekly selection of questions will, however, be printed on this page, together with the answers, for the benefit of readers of POPULAR WIRELESS in general. Questions should be clearly and explicitly written, and should be numbered and written on one side of the paper only.

All questions to be addressed to: POPULAR WIRELESS, Queries Dept., Room 131, The Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send necessary postage for reply.

C. H. Y. (Winscombe, Somerset).—I have a single layer tuning coil, wound with 700 turns of 28 S.W.G. wire, the diameter of coil being 3ins. What are my highest and lowest wave-lengths? Also, what are the dielectric constants of glass, ebonite, and mica? Can I use a condenser across H.T. battery and 'phones? If so, what capacity must I use?

(1) Using suitable condensers and a normal aerial from about 300 metres to 3,100.

(2) The specific inductive capacities of glass, ebonite, and mica are given approximately as Plate-glass, 5·83 to 6·34, ebonite from 2·21 to 2·76, and mica as 5·0. These values are very difficult to obtain owing to what is called "soaking in" of the charge when the dielectrics are tried practically, causing in some cases a diminution in the value for the specific inductive capacity of the dielectric in question.

(3) Yes, you can use a condenser across both the H.T. battery and 'phones. It should be of about ·001 or ·002 mfd. capacity.

* * *

R. T. P. (Lymington).—I have an old magnetic detector, which is in quite good order, and which I should like to compare with a crystal I am using. How do I connect up, and how do the magnetic detectors rectify?

Connect the A.T.I. to one end of the primary coil, and the earth side of the circuit to the other end of the primary. The telephones are connected to the two ends of the secondary. The action of the magnetic detector is difficult to explain briefly, but the following may give you some assistance. An iron band is rotated in front of two magnets whose "like" poles are together. Each portion of band, when passing under one pole, is magnetised, and then when passing under the other pole there is a change in magnetism. But iron always has a certain amount of hysteresis—or lag—and does not change its magnetism directly, so that the band goes some distance past the first pole before the magnetism is changed completely. If, however, the band is given a sharp tap when passing under one magnet to the next, the tap destroys the magnetism in the band and helps the second magnet to undo the work of the first. Now, high-frequency oscillations, passing through the primary from the aerial, have the same effect as the blow, causing a more rapid change of magnetism than is normally the case. Therefore, when no oscillations are received the magnetism lags, and the magnetic field between the magnets will be drawn out past the magnets in the direction of travel of the iron band. As the band is continuous this "drawing out" is continuous. Immediately an oscillation passes through the primary, the magnetism does not lag, and the field of magnetism springs back, as it were, into its unstretched position. This sudden change in the magnetic field at every train of oscillations causes an induced current in a secondary coil which is wound round the primary. This means a current through the 'phone circuit each time; or a click each time a train of oscillation is received from the aerial. Thus the signals are made audible in the 'phones.

* * *

T. D. (Leeds)— What exactly is "plain" aerial transmission and is it employed for any special type of station?

"Plain" aerial is a phrase employed when the transmission of signals takes place without the aerial being tuned to any definite wave-length. What happens is that the discharge of the coil, or condenser, takes place across a gap directly in the aerial circuit—between aerial and earth. This forces oscillations up and down the aerial. The usual method, however, is that of "tuned" aerial. In this case the oscillations take place in a closed circuit containing the gap, and an inductance coil. This coil is inductively coupled to another in the aerial, and thus induces oscillations in it, leaving the aerial to oscillate by itself, and to its own natural frequency. This gives waves of a certain definite wave-length. The other method causes the aerial to oscillate violently, and sends out ragged waves which have no definite wave-length. It is often used by ships for S O S purposes to ensure them being heard, no matter to what wave-length the receiving station may be tuned.

* * *

"INTERESTED" (Portsmouth).—Why are the cores of transformers made of plates of iron instead of being solid right through?

The reason why the transformer cores are built as you describe is to reduce the production of "eddy" currents. You know, of course, that in a transformer the magnetic lines of force set up by the current in the windings are always varying. Also that when varying lines of force cut a conductor, they induce an E.M.F. in that conductor which tends to cause a current at *right angles* to the path of the magnetic lines. The iron core of the transformer is there to help the lines of force along—to provide an easier path than that of air. But as these lines are continually changing with the current in the windings, they are continually cutting the iron core. That means that E.M.F.'s are always being induced in the iron and that currents are being produced in it. These are known as eddy currents. Besides being wasted energy, they cause the iron to become hot, and so decrease the efficiency of the transformer. To stop them it is necessary to break their path. This is done by making the core of plates of iron and by separating each plate from its neighbour by pieces of waxed paper or varnish. Thus the E.M.F.'s induced cannot give rise to currents. Also, as the magnetic lines of force will be at right angles to those E.M.F.'s induced, the breaking up of the iron path will not hinder them. Thus the eddy currents can be to a great extent avoided without interfering with the original purpose of the iron core.

* * *

"A WIRELESS KID" (Hamilton).—I am making a wireless crystal set and would be obliged if you could tell me: (1) What is the wave-length of a coil 4 inches diameter, 12 inches long, wound with 377 turns of 26 D.C.C. wire? (2) Is enclosed wire good enough for an aerial?

(1) Using an average aerial, your wave-length is approximately 1,600 metres. (2) No, the wire is not suitable. Use 7/22 stranded copper enamelled wire.

* * *

"BLUEBIRD" (St. Ives).—I have a soft valve, and when the filament current is passed the lamp gives off a peculiar blue glow. Why is this, and should it be so?

This "blue glow" is a phenomenon that occurs in "soft" valves. Soft valves are valves which have

(*Continued on page 538.*)

The Great Valve Case : Mullard v. The Pavement.

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page 536.*)

not been very highly evacuated, and consequently there is a considerable amount of residual gas. When the valve is in operation there is a stream of electrons between the filament and the plate. These high-speed electrons constantly collide with the atoms of the gas, and this bombardment of the atoms causes them to split up—electrons being liberated. This process is known as "ionisation by collision" and is accompanied by an emission of light, especially when the ionisation is occurring in a high degree. This light is the blue glow which you mention.

* * *

"THEORIST" (Hastings).—Being very interested in wireless telegraphy from all standpoints, I have been wondering as to the meaning of the phrase "quenched spark." Does this mean that the spark is put out or blown out? Why is this necessary, if I am correct?

Yes, approximately your supposition is correct. To go into the full details regarding spark gaps would take too long, but briefly the answer to your question is as follows: When a condenser discharges across a spark gap, the air in the gap is heated and ionised, becoming highly conductive. Then, when the condenser has discharged, the air across the gap is still very hot, and the small amount of energy radiated back from the aerial into the gap circuit will cause a continuance of the spark. This will go on until the condenser is ready to discharge again, and so on; the result being that we have a "persistent" spark. Unfortunately, this takes a great deal of energy from the aerial at a time when we want the aerial to oscillate at its own natural frequency and to use as much energy as possible in forming ether waves. To avoid this waste of energy—and incidentally bad tuning and ragged note—a method is employed to break the circuit as soon after the spark as possible. This means that the gap must be cooled so as to make it of too high a resistance for the smaller voltage induced back from the aerial. This will stop the continuance of the spark after the condenser is discharged. To cool the gap two methods are used: (1) A rotary gap—or rather a series of gaps formed by a rotary plate with points on it. These points pass the fixed electrode very rapidly, and of course break the circuit directly the spark has passed. (2) Use is made of the conductivity of heat by certain metals. A series of large discs—placed close together but insulated (except at the edges) by mica—are used as a series of tiny gaps. Being made of copper, they rapidly transfer the heat generated by the spark taking place at their edges—away and so keep the gaps cool. To facilitate this cooling, fans are often employed, and by this means a very well "quenched" spark is obtained. This leaves the aerial to oscillate at its own natural frequency, and is the method largely employed by the Telefunken spark transmitters. This accounts for the high-pitched, clear note that is the characteristic of the German spark stations.

* * *

"CURIOUS" (Perth).—Why are single aerials sometimes better than twin?

Because for short-wave reception the greater capacity of the two-wire aerial is not desirable, as it might be necessary to reduce this by means of placing capacity in series in order to bring in, for instance, the short wave-length broadcasting stations, and that would mean a certain loss of efficiency. This naturally supposes that full advantage can be taken of length, but where this must be limited, then the twin becomes desirable owing to its increased area.

Is there any difference between a blocking and a fixed condenser?

No, because a blocking condenser is invariably a fixed condenser. The latter term covers all condensers that are not variable, whereas the former indicates the function to which a fixed condenser is adapted in certain circumstances, such as where it may be necessary to detune one circuit from another in order to prevent loss of energy.

Need earth wires be any special distance apart?

No, but the larger the area they cover, the better.

By touching one 'phone pin on the crystal holding the other and moving the crystal I hear a noise like signals. Why is that?

That is probably due to a thermo-electric action of your body producing very small currents, which, however, would be sufficiently powerful to actuate the phones.

Would 22 single silk-covered copper wire do for the aerial?

Yes, but a stouter gauge enamelled wire would be better.

* * *

"NO NAME" (Southend).—My aerial is about 9 to 12 feet high and 20 to 25 feet long. Is that any good for a crystal set?

We are afraid that if you cannot increase the length somewhat and the height considerably, you will obtain little or no results with a crystal set.

* * *

R. P. L. (Peterboro').—If I cover the plates of my variable condenser with shellac, will it increase its capacity?

Yes, but owing to the fact that you will not be able to cover them with a very thick layer of that material the increase in capacity will not be very appreciable. Thin plates of ebonite can be cut to correct sizes and fixed between the fixed vanes with marine glue, allowing just sufficient clearance for the moving vanes in order to double the capacity of an air dielectric variable condenser.

* * *

A. H. (London).—What wave-length would I obtain with an inductance 3½ inches by 9½ inches, wound with ·25 S.W.G.?

250–1,500 metres approx.

It is a crystal set. Would a ·0005 mfd. variable condenser be suitable?

Quite.

* * *

J. F. M. (Peckham).—How can I construct a basket coil tuner to tune to 4,500 metres?

Refer to reply given to "Meteor" (Barnsley) in No. 15.

* * *

"NOVICE" (Stepney).—Your aerial will be quite O.K., but the free ends of the two wires should not be joined together. The two wires, which are otherwise quite separate, are joined at the instrument end of the aerial by taking [illegible]wn lead from each and soldering these together [illegible] common lead-in wire a few feet below the ae[illegible] You cannot have too many insulators.

* * *

E. K. S. (Hampstead).—How many fixed and moving vanes 3½ and 2½ inches diameter, using ⅛-inch spacing washers, will be required for condensers of ·0001, ·0002, and ·0003 mfds?

Six fixed, 5 moving; 10 fixed, 9 moving; and 15 fixed, 14 moving.

What are the constructional details of H.F. plug-in transformers to suit the wave-length range of the "Loose Coupler" described in the last issue?

Using 2 inch diameter suitably grooved formers and 42 S.W.G. S.C.C. and winding, a similar number of turns for both primary and secondary in the same groove, 50, 100, 250, and 400 turns. A ·0003 mfd. variable condenser will be required across the primary.

* * *

P. S. C. (Dublin) is experieneing considerable trouble with a five-valve set, the most annoying being a "deafening roaring" in the 'phones when tuning in.

The latter may be due to a faulty accumulator or to the H.F. battery. Endeavour to substitute both experimentally. Probably you may remedy the trouble if you run through the L.F. transformers, changing over their connections. Do this periodically, as there are, of course, a rather large number of variations of connections in relation to each other if you employ two or three of these transformers. Also you should carefully go over all terminals and general connections, as quite deafening noises can be caused by a dirty or loose connection. Telephone cords are to be suspected, and also the individual earpiece leads.

* * *

"INVENTOR" (Patricroft).—I have a short-wave crystal set with a P.M.G. aerial. What will be my broadcasting reception range?

Twenty miles or so.

Is the sample of wire enclosed suitable for winding a potentiometer?

No; copper wire is useless for that purpose. 36 gauge "Eureka" resistance wire would be more suitable.

Is the tubular condenser (shown in sketch) suitable for this set?

Quite.

* * *

"RADIO" (Slough).—(1) Please could you tell me the wave-length of an inductance 7½ inches by 4 inches wound with gauge 24 enamelled wire with a ·0005 mfd. condenser used across it? I am using a double aerial 30 feet long.

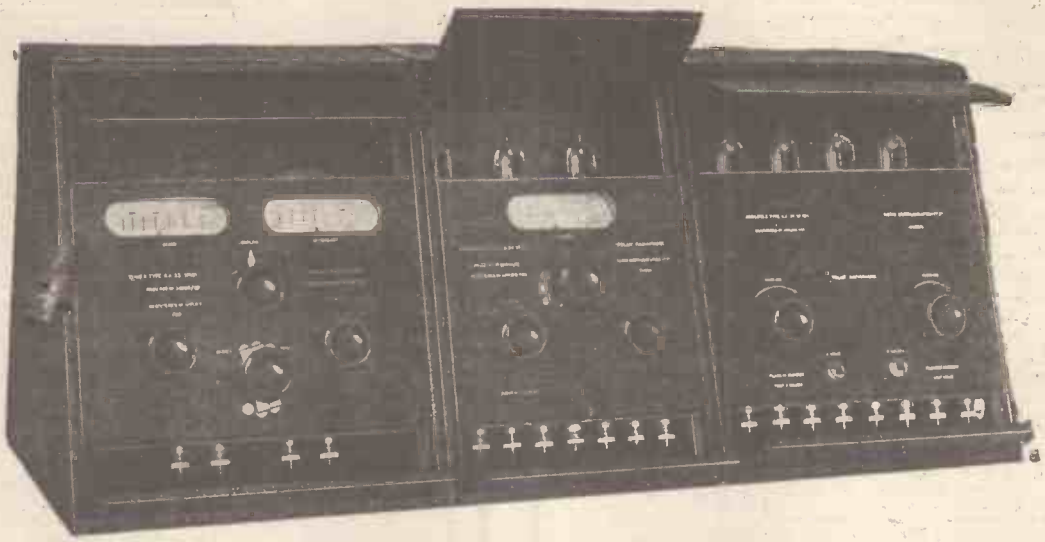
The wave-length of your coil is approximately between 300 and 2,800 metres.

(2) What is the natural wave-length of a frame aerial with 1 foot 4 inch arm, wound with 27 turns of gauge 24 wire? The windings are ⅜ inch apart, and diminishing towards the centre.

Your natural wave-length is about 1,000 metres, but the design of your aerial is not at all efficient and is not usually employed. The turns should not

(*Continued on page 540.*)

"POLAR"



"Polar" Prestige. "Polar" installations have been adopted by most of the leading shipping companies in this country, by the British Post Office, and by Colonial Governments.

"Polar" equipment is installed at North Foreland (G.N.F.), Seaforth (G.L.V.), and many other important stations.

Having built up our reputation on commercial wireless equipment, we are now applying our valuable experience and extensive resources to the manufacture of broadcasting apparatus.

"Polar" Radiophones. Under the title of "Polar" Radiophones we have a wide range of amateur receiving sets. They are well designed, soundly constructed, and finely finished, and extremely reasonable in price.

The set illustrated shows our standard design with sloping Ebonite panel, polished wood case, and silver lacquered fittings. Every type of unit required is available.

Prices from £2 15s. 0d. to £45 5s. 0d.

"Polar" Accessories. "Polar" wireless accessories incorporate many new and exclusive features.

For example, the "Polar" variable condenser is an entirely new design operating on a new principle. The standard unit has a capacity variable from .001 mfd. to .0001 mfd., being equivalent to a 29-plate condenser of the ordinary type. Dimensions, 3 in. x 3½ in. x ⅞ in. deep. **Price, for panel mounting, 14s.; or in polished wood case, 20s.**

"Polar" Radio Supplies. By buying all your wireless supplies through the "Polar" organisation you will obtain the benefit of our exhaustive laboratory tests which are used to discriminate between competing items. Everything sold under "Polar" auspices can be relied upon to be the best of its class.

Ask your wireless dealer to give you "Polar" wireless equipment or apply direct to one of our branches or head office.

RADIO COMMUNICATION Co LTD

34-35, NORFOLK STREET, STRAND, LONDON, W.C.2

BRANCHES: Liverpool: 67, Dale St. Newcastle-on-Tyne: 17, Sandhill. Cardiff: Atlas Chambers, James St. Southampton: 19, Queen's Terrace. Glasgow: 10, Blythswood Square.

E.B.

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 538.)

be diminishing towards the centre, but should be all of exactly the same size. This means that the turns should be wound round the outside or periphery of the frame.

* * *

S. W. W. (Manchester).—I want to use a coil for loading purposes in conjunction with my A.T.I. Can this be done, and how do I connect up?

Provided the coil you intend to employ is of suitable size to give the desired wave-lengths, the method is quite O.K. Join it in series with the A.T.I., being careful to see that the windings of both the A.T.I. and of the new coil go in the same direction. This latter is most important, as if the windings of one are reversed, the reception of signals will be interfered with. The reason for this is, of course, fairly obvious, as you probably know that a coil through which a current is passing throws out a magnetic field of a polarity according to the direction of the current round the core. If, therefore, the windings of one coil travel in one direction, and the windings of the other in the opposite direction, the two magnetic fields will tend to nullify each other, and the effect of the inductance of the coils will be practically negligible.

* * *

"EFFICIENCY" (Liverpool).—I have been advised by a friend to use a variometer instead of the usual variable inductance and condenser. Can I use this method? What advantage is obtained by using it over the other type of inductance?

The main reason why variometers are used instead of the coil and condenser type of tuning is to employ as much of the initial aerial energy as possible and waste no more than is absolutely necessary. Capacity always tends to waste some of the energy, and by cutting down the capacity as far as possible the signals are strengthened considerably. The trouble is that with the ordinary inductance coil we cannot obtain fine enough tuning without using a condenser as well. But using a variometer we can vary the wave-lengths very considerably, and also have fine tuning without using a condenser. This obviously cuts out all avoidable capacity and will thus give the strongest signals possible with the incoming aerial voltage. Of course, suitably sized variometers must be used in accordance with the wave-lengths required, but the result will be well worth the extra trouble their construction entails.

* * *

"HYDROMETER" (Totnes).—I have been advised by a friend not to rely upon my voltmeter for testing the conditions of accumulators, but to use a hydrometer. Why is this? What should the hydrometer give as a reading?

Your friend is quite right. It is always best to test the condition of cells with a hydrometer, because the density of the acid solution is the best indicator you can have as to the state of the accumulator. The more dense the solution is, the higher the amount of charge in the cell, provided, of course, that the right strength of acid has been placed in the cells originally. A voltmeter, however, may give a high reading even when the cells are run down. The voltage is there, but there is no power behind it, and if you attempt to draw current, the voltage drops immediately. The hydrometer readings on an average should be, fully charged, about 1·215, and they should never be allowed to drop below about 1·17. A Hick's suction hydrometer is a very useful type to use with regard to accumulators, and the reading is taken from three coloured beads, yellow, blue, and purple. Yellow floats at 1·7, blue at 1·85, and purple at 1·2.

* * *

M. G. R. (London).—Can I use the electric light mains as my aerial? I am rather cramped for room, and will have to employ an indoor aerial. How far could I receive by the above method, using either a crystal or a one-valve set?

We do not advocate the use of the electric light mains as an aerial, but if used, a proper adapter, such as can be obtained from several firms, should be employed. There is always risk of damaging the receiving set in this method, or even disorganising the wiring system of the house, if the utmost care is not used. With regard to reception, it would be useless with a crystal set, and would only give very near stations if one valve were used. A frame aerial and several valves is far the better arrangement if it is impossible to erect an outdoor aerial.

Guaranteed New and Unused.

All 'phones sold by us under our express guarantee that we will refund

FULL AMOUNT PAID

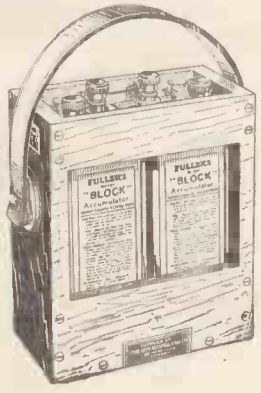
if you are not fully satisfied with your purchase and the 'phones are returned to us within 7 days.

BROWN "A" TYPE HEADPHONES

120 ohms - - £2 2 6
8,000 ohms - - £2 9 6

Postage 1/- extra. **Cords, 3/6.**

Only a few hundred now left.



FULLER BLOCK ACCUMULATORS

Volts.	Amps.	Price.
4	40	£1 12 6
6	40	2 8 9
4	80	2 8 0
6	80	3 12 0
4	120	2 16 0
6	120	4 4 0

PLATE TYPE (FULLERS)

4	30	18 0
6	30	1 7 0
4	80	1 8 0
6	80	2 2 0

Prices of other capacities on application.

WE HAVE THE FINEST ACCUMULATOR CHARGING PLANT IN THE TRADE. CHARGED ACCUMULATORS OF ALL SIZES ALWAYS IN STOCK. NO OTHER FIRM CAN OFFER THIS FACILITY.

THE "PARLIPHONE" LOUD SPEAKER. 32/6

The only Loud Speaker that does not distort. EACH

We cordially invite everyone to visit our showrooms—the largest and most up-to-date in the City of London.

Our experts are always in attendance to give free advice to amateurs.

A SPECIAL LINE WORTHY OF NOTE.

We are supplying Component parts for making a COMPLETE SINGLE VALVE PANEL of finest quality, comprising—

1 Handsome polished Mahogany Cabinet,
1 piece Ebonite cut to fit,
1 Valve Holder,
1 Filament Resistance,
5 Pair Brass Terminals,
1 Mullard Condenser, ·0002 mfd.,
1 Ditto ·001 mfd.,
1 Mullard Grid Leak,
Systoflex, copper wire, etc.,
Blue print Wiring diagram,
AND FULL INSTRUCTIONS FOR

Post Free **30/-**

This is a reliable panel of finest quality throughout, and cannot be improved upon irrespective of price paid.

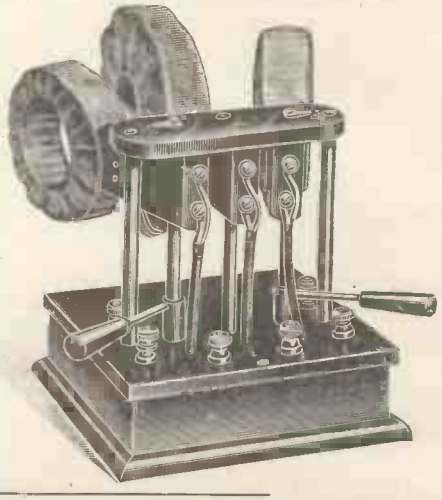
WE SUPPLY THE TRADE ENQUIRIES SOLICITED.

VALVES
VALVE HOLDERS
FILAMENT RESISTANCES

The best Coil Holder on the Market.

25/- EACH

FIXED CONDENSERS, VARIABLE CONDENSERS, TRANSFORMERS, GRID LEAKS, SYSTOFLEX, H. T. BATTERIES, EBONITE (cut), :: and every :: accessory in :: stock ::



ONE QUALITY ONLY—THE BEST.

The City Accumulator Co.,

79, Mark Lane, E.C.3.

'Phones: AVENUE 1316: AVENUE 91; AVENUE 9936.

Agents: LONDON: A. W. GAMAGE, LTD., Holborn, E.C. SELFRIDGE & CO., LTD., Oxford Street, W. RICHFORD & Co., 153, Fleet Street, E.C.4.
YORKS: BARNSLEY BRITISH CO-OPERATIVE SOCIETY, LTD., Barnsley.
GLOS.: BRISTOL WIRELESS CO., 52, Cotham Hill, Bristol.
S. WALES: SOUTH WALES WIRELESS INSTALLATION CO., LTD., 18, West Bute Street, Cardiff.
N. WALES, LANCS., CHES. & I.O.M.: THE "ALL-BRITISH" WIRELESS MANUFACTURES CO., LTD., 18, Vauxhall Road, Liverpool (Telephone Central 1914)

Printed and published every Friday by the proprietors, The Amalgamated Press (1922), Ltd., The Fleetway House, Farringdon Street, London, E.C.4. Advertisement Offices: Messrs. J. H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates: Inland and Abroad, 17/4 per annum, 8/8 for six months. Sole agents for South Africa: The Central News Agency, Ltd. Sole agents for Australia and New Zealand: Messrs. Gordon & Gotch, Ltd.; and for Canada: The Imperial News Co., Ltd. Saturday, November 11, 1922.
Y/Y

POPULAR WIRELESS WEEKLY. November 18, 1922.

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

No. 25. THE STORY OF THE ELIMINATOR.

POPULAR WIRELESS Weekly

3d.

No. 25. Vol. 1.
Nov. 18, 1922.

A SUPER "BROWN" LOUD SPEAKER.

FEATURES IN THIS ISSUE:

Head Gears and Loud Speakers.
A Cheap Aerial "Plug In."
Useful Coil Winder.
A Variable Grid Leak.
Simple Vacuum Pumps.
A Spare Crystal Device.
Hints to Amateurs.
Double Detector Circuits.

NEXT WEEK.

HOW TO MAKE A VALVE DETECTOR PANEL

NOTES ON THE LONDON ETHER

MAKING A VOLT OR AMMETER

HINTS TO AMATEURS

And other useful articles

Popular Wireless

TOPICAL NEWS AND NOTES.

NEXT WEEK.

HOW TO MAKE AN AMATEUR D.F. STATION

A new series of articles giving full details for the construction of a Direction Finding Station.

Temptation.

FOUR boys who pleaded guilty at Godalming recently to stealing electric batteries and other apparatus from a box at the base of a signal on the L. & S.W. Railway, were said to have been led away by their enthusiasm for wireless.

One parent, reports the "Westminster Gazette," said that his boy would forgo his sweets money to buy his magazine on wireless. The boys were bound over.

The point is—I wonder what magazine they buy?

* * *

Mr. Le Queux's Latest.

MR. WILLIAM LE QUEUX, the master of the mystery story, has written the first novel to be cast in the atmosphere of wireless telephony, a subject with which Mr. Le Queux is thoroughly familiar, for he was one of the early amateur experimenters in wireless, the owner of the finest amateur wireless telephony installation in Great Britain, and he is a member of the Institute of Radio Engineers. The novel, which will be called "The Voice from the Void," will be published by the House of Cassell on the 16th inst.

* * *

Provincial Broadcasting.

BROADCASTING in Birmingham is supposed to begin officially on November 15th. The Birmingham area broadcasting station will be run by the Western Electric Co., London, and the call sign will be 2WP. The station which has been established is being tested in London, and is giving very good results, while it is very plainly heard in Birmingham.

The Manchester broadcasting station, which is being run by the Metropolitan Vickers Electric Co., with 2ZY as the call sign, is already running, and it is hoped that this will be running on its full programme by November 15th. By that date, however, there should be three broadcasting stations working.

* * *

The Favourite Hobby.

WIRELESS telegraphy is now the favourite hobby of the London schoolboy. His talk is of wireless, and he spends hours in attendance on it. Authority is taking practical note of his interest. The London Elementary Education Sub-Committee recommend the inclusion of wireless in the curriculum of an approved number of elementary schools. The sub-committee report that applications have been received from certain schools for sanction to include the principles of the science in the curricula, and to obtain a licence from the Postmaster-General for the installation of the equipment. The equipment, it is stated, is made by the boys in their handicraft lessons. So far permission has been given by the sub-committee to thirteen schools, and they have made a limit of twenty-five schools.

* * *

MR. E. H. SHAUGHNESSY, head of the Wireless Section of the General Post Office, recently gave a lecture at the Polytechnic on recent developments in radio telegraphy and telephony, when he dealt with the work which was being done at Leafield. In the course of his lecture, he mentioned that the daily news service maintained from Leafield to Halifax, Nova Scotia, was regarded by Americans as the fastest Transatlantic service in existence.

Miss R. H. Mawer, 118, West Parade, Lincoln, and her "P.W." fancy dress.

During the evening, by permission of the Postmaster-General, and with the co-operation of the Marconi Company and the British Broadcasting Company, a demonstration of wireless telephony was given. Sir William Noble, speaking from Marconi House, introduced the Lord Mayor of Bristol, who delivered an address from his own home. This was transmitted by "wired wireless" to Marconi House, and thence broadcasted.

An instrumental and vocal concert was afterwards broadcasted from Marconi House.

* * *

Preliminary Transatlantic Test Results.

OBJECT.—The object of these tests was to enable the American Radio Relay League to select suitable stations to compete in the official tests to take place between the American and English amateur stations during the month of December. Power was limited to 1 kilowatt and the wavelength from 200 to 300 metres.

RECEIVING STATION.—Owned by Mr. J. H. D. Ridley, Woodside Green, South Norwood, S.E. 25.

APPARATUS USED.—Standard Burndept 111 receiver fitted with V.24 valves as amplifier and magnifier and Q.X. as detector.

TUNING CIRCUIT.—Burndept Mk. IV tuner, using triple coil circuit and Burndept short-wave (concert) coils in conjunction with a separate heterodyne which is in effect a Burndept heterodyne wave-meter. A No. S1 coil was used in the primary, which was in series with the condenser; S1 coil in the secondary with condenser in parallel, and S3 in reaction.

AERIAL.—Single wire 180 feet long directional N.W., 37 feet high. Badly screened on all sides.

EARTHING SYSTEM.—Copper wire buried 3½ feet deep, and also connected with the gas service piping of the house.

Extracts From Log.

October 28th. Started listening 3.15 a.m. G.M.T. Nothing heard.

October 29th. Started listening at same time. Heard 2ZK calling "Test." Three waves used. (1 H.F.). Strength very good and constant (R.6.). Signals were easily read 18 in. from 'phones. 0553 G.M.T 2HJ heard. Signals from this station swung in, and were audible for about 45 seconds at about R4. Earlier in the morning with call 5VL was heard, but reception is probably doubtful owing to heavy jamming from Leafield harmonic.

October 30th. No watch kept.

October 31st. Station with call 9CT or

NOTES AND NEWS.

(*Continued from previous page.*)

9CTE was probably heard, but was again jammed by GBL.

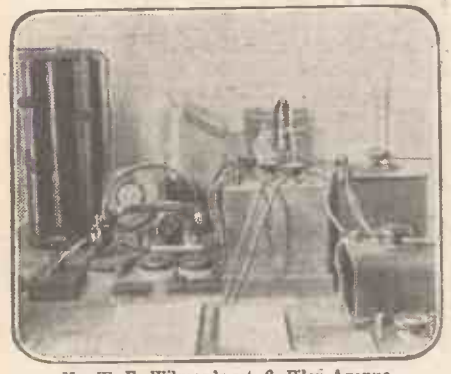
November	1st.	Nothing heard.
,,	2nd.	Nothing heard.
,,	3rd.	Nothing heard.
,,	4th.	No watch kept.

The results were cabled to K. B. Warner, secretary of the American Radio Relay League, and a cable has been received from him confirming 2ZK, 2HJ, and 9CTE.

* * *

2 Z Y.

SOME little mystery has been caused by the music transmissions from 2 Z Y. No one seems to know who 2 Z Y is, but I have reason to believe it is the new Metropolitan Vickers Station at Manchester, which will be used for broadcasting. If I'm wrong, I hope somebody will correct me.



Mr. W. E. Wilman's set, 6, Filey Avenue, Stamford Hill, N.16.

Arctic Stations.

IT is stated that the Dominion Government of Canada proposes to provide a chain of six wireless stations extending into the Arctic circle. Five of the stations will be constructed at Forts Smith, Resolution, Simpson, Norman and Macpherson, on the Mackenzie River, and the sixth at Dawson City. The primary object of the chain is to keep Federal officials in touch with one another.

* * *

The Largest Tube.

W. G. HOUSEKEEPER, of the Western Electric Company, is the inventor of the largest vacuum tube in the world.

The tube is about two feet high, weighs about ten pounds, and delivers 100 kilowatts of high-frequency energy. While larger tubes may be made it is interesting to note that two of these tubes operated in parallel can do the work of thousands of pounds' worth of machinery.

* * *

The Radio Association.

OWING to the unprecedented rush of applicants to enrol as members of the Association, it has been found necessary to acquire larger offices.

Arrangements have been made with the council of the Institute of Patentees (Inc.) whereby the Association can have the use of the offices at 44, Great Russell Street. The numbers enrolling daily indicate clearly to the organisers of the Association the appreciation which their efforts are met with. They feel that the Association will be in an extremely strong position in the very near future.

With the rapid increase of membership adequate staff has to be engaged to deal with the work, and in order to meet this expense the executive committee have decided that for those enrolling on and after January 1st, 1923, the annual subscription will be 5s.

The executive committee has already held two meetings at the new offices on November 1st and 7th, and arrangements have been concluded at these meetings and space has been taken at the Small Power Engineering and Scientific Exhibition to be held at the Royal Horticultural Hall from January 5th to 12th, 1923. The stall, which is a large one, will be shared jointly with the Institute of Patentees and Popular Wireless.

Many letters have been received by the executive committee from members pointing out difficulties they are already experiencing, and these matters are being given due consideration, and in many cases it has been decided to take it up with the authorities concerned at once.

All those interested in radio science, and in the protection of the interests of users of wireless sets, as well as manufacturers, are urged to support the Association.

A six-valve set shown at the recent Halifax Wireless Club Exhibition.

Full particulars of membership may be obtained from Capt. G. Drury Coleman, the organising secretary, of 44, Great Russell Street, London, W.C. 1.

* * *

Amateur Photos.

THE Editor asks me to point out that, although dozens of amateur photographs are sent in every week, fully 75 per cent. are rejected because the prints are badly produced. All photos must be sharp and clear; a blurred or dark photo is quite unsuitable, as it will not print except as a black smudge. So if you send any photos, make sure they are clear and sharply outlined.

ARIEL.

Broadcasting Programmes

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

TELEPHONY AND MUSIC TRANSMISSIONS.

Station.	Call sign.	Wave-length in metres.	Remarks.
Croydon	G E D	900	Throughout day to aeroplanes.
Marconi House, London	2 L O	360	Not regular.
Writtle, Essex	2 M T	400	Tuesdays, 8 p.m. (Concert.)
Paris	F L	2,600	7.20 a.m., 11.15 a.m., 5.10 p.m. Also occasional telephony at 10.10 a.m.
Königswusterhausen	L P	2,800	Between 6 and 7 a.m., between 11 and 12.30, and between 4 and 5.30 p.m.
The Hague	P C G G	1,085	Sundays, 3 to 5 p.m. (Concert.)
Haren	O P V H	900	Practically every 20 minutes past each hour from 11.20 to 4.20, giving messages to aeroplanes on the Brussels-Paris, Brussels-London, and Brussels-Amsterdam lines.
Brussels Meteorological Institute	O P O	1,500	Slow C.W. and Morse. Easy reading for amateurs.
Messrs. Burnham* (Blackheath)	2 F Q	440	About 9 o'clock in the evening.
Newcastle*	5 B A	440	Between 6 and 7.30 p.m.
Manchester Broadcasting Station	2 Z Y	440	This station may be heard at irregular intervals, transmitting music, etc., for general broadcasting tests.

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

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

All times given are G.M.T.

An asterisk denotes transmissions made purely for experimental purposes.

A CHEAP AERIAL "PLUG IN."

By G. K. SIMPSON.

IT is always advisable to earth your aerial when you are not using the set, as a protection against lightning. Here is a cheaper and easier way of doing this than by the usual double-pole switch. It also has the added advantage that if you have not a permanent place for your set you can connect or disconnect from your aerial and put it away with a minimum of time and trouble.

All you want is a piece of ¼-in. ebonite 1 in. by 4 in., and a couple of old cycle tyre-valves. Drill the ebonite as shown in Fig. 1.

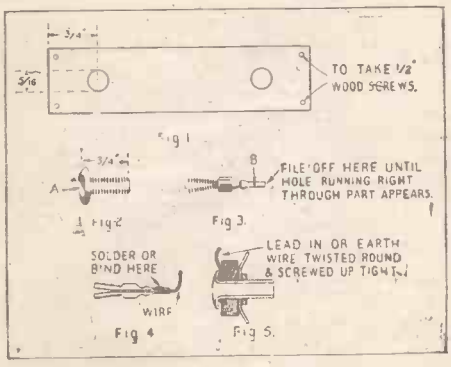


Fig 1 Fig 2 Fig 3 Fig 4 Fig 5.

Now take the old tyre-valves. These should be well cleaned up inside and out, seeing that no bits of valve rubber are left inside. The larger portion which is fastened to the tyre should be cut or filed off ¾ in. from the end, as shown in Fig. 2.

The other portion, which carries the valve rubber, should have a slit cut down the screwed portion, as shown in Fig. 3. If this is then gently sprung out with a screwdriver it will be found to be a firm, sliding fit into the hole A (Fig. 2). File the other end down until you reach the end of the hole which runs right through the part. This will be about ⅛ in. from the small hole B (Fig. 3).

Take a suitable length of insulated wire and bare about ½ in. of one end; this should be inserted in the plug as shown in Fig. 4, the loose bit being soldered or bound to the plug with fine copper or brass wire. Treat the other valve in the same way, attach the free ends of the wire to the E and A terminals of your set respectively, and your plugs are complete.

How it Operates.

Fig. 5 shows the method of mounting the jacks. The aerial, or earth, may be taken to the front or back, whichever is more convenient. The panel may now be mounted on a board about 2 in. by 6 in. by 1 in., by four ½-in. brass screws.

Of course, suitable holes should be cut in the wood to clear the nuts, etc., on the back of the panel. Fig. 6 shows the finished panel. The whole may be fixed to the wall, window-ledge, or other suitable place.

To use the set you merely plug in the A and E wires from your set into their respective jacks, and you are ready to start. Fasten two ordinary split pins together by a short length of copper wire, as shown in Fig. 7.

Plug this in when you are not using the set, and your aerial is effectually earthed.

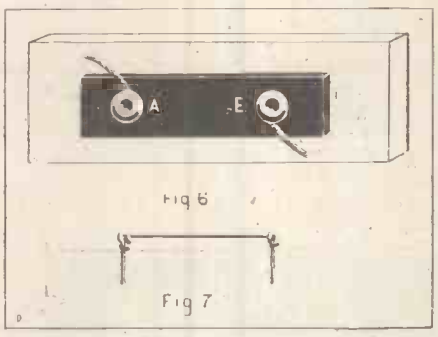


Fig 6

Fig 7

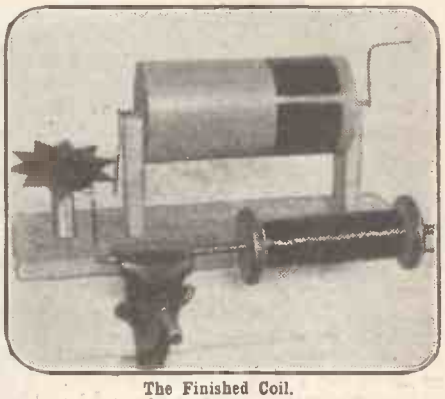
Mr. A. Stock, Cross Lane, Salford, with his compact 3-valve, home-made set.

A HANDY COIL WINDER.

By S. MOUNTIER.

WINDING a tuning inductance, especially the secondary coil, with fine wire is not such an easy operation as may be at first supposed. Difficulties are soon met with when one has to "count the turns" and tap them off at intervals.

The simple contrivance in the accompanying photograph is quite easy to



The Finished Coil.

make, and will repay for the trouble taken by the ease with which any coil can be wound.

Any odd pieces of wood will do. First fit wooden ends to the cardboard former; these can easily be cut out with a fretsaw. In the centre of each make a bradawl hole, so that wood screws will fit tightly. Now solder a stout wire handle to the head of one screw, and a straight piece of wire, which will act as "striker," to the other.

This having been accomplished, a stout piece of wood is required for the baseboard, and some smaller pieces for the former supports. The latter are screwed to the baseboard from underneath. Mount the former between supports as shown, and put a staple into each end over the screws so that it will turn freely.

The counter is made from a piece of tin divided into ten equal parts. A simple way to do this is to scribe a circle with dividers or compass 3⅛ in. in diameter; then adjust compass to 1 1/10 in. and mark off round circumference, which, if done carefully, will divide it near enough into ten equal parts, which should be cut into points ¾ in. deep.

This is mounted on another piece of wood and screwed to the baseboard in such a position that the wire strikes and moves a point every revolution. One of the points is painted or chalked, and a nail driven into baseboard as shown. This will be found a great help in counting, as it is much easier to count in "tens."

It very often happens that the turns run on top of one another, which necessitates unwinding. The counter, of course, reverses, and on winding up again you have only to look for the white point finishing its revolution. When taking off tappings for connection inside coil, make a bradawl hole in the former, push a loop through, and plug the hole with a pointed match-stick, the end of which can be broken off flush with the coil.

SIMPLE VACUUM PUMPS.

By A. LUTMAN.

THE advanced radio amateur will inevitably turn his mind to the construction of wireless valves. To a certain extent he may be successful, using a portion of a nickel cartridge case for a plate, platinum wire for the filament, and nickel wire for the grid, with a test tube serving for the glass tube in which the electrodes are sealed. But the time comes when he must devise some means of exhausting this latter of air; of course he cannot expect to reach a high degree of vacuum, so he must be content to experiment with the soft variety; so after spending many weary hours with mechanical pumps, he finds that it is a harder task than was anticipated.

Method of Construction.

A good vacuum can be produced by the following simple mercury pumps. Fig. 1, of a simple constructional nature, is known as the Sprengel pump. The action is as follows: The mercury in the funnel A is regulated by the glass tap B; it then drops down the large tube with the annex tube D attached, and strikes the smaller tube C; it then spreads out in the form of a piston as shown in the sketch, driving the air out in its downward plunge. When the pressure in the receiver or radio valve lowers, the mercury in the tube C rises slowly to barometer height. The funnel is of glass, and can be obtained from a scientific instrument firm for a shilling or two. The large tube with the tap and annex attached can also be obtained from the same makers for three or four shillings. The dimensions are: Length of tube above tap, 2 in.; length of tube below tap, 5 in., in the centre of which is placed the annex tube, the bore of which is about ¼ in. The smaller one, C, should be three feet in length, the bore being ¼ in., and should be fastened in the larger tube by means of sealing-wax.

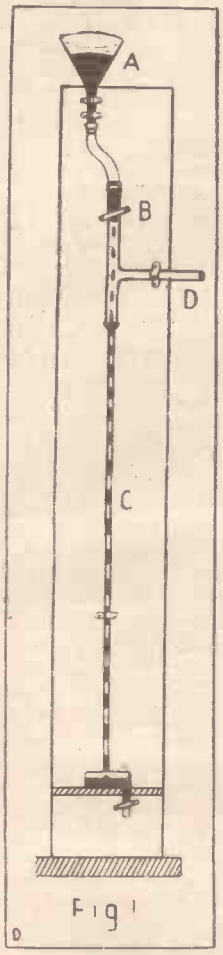


Fig 1

Fig. 2 shows a pump of my own design, being a modification of a Toepler pump. The action is as follows: The mercury rises in the vessel E, due to the operator lifting the funnel connected via rubber tubing to the long tube J. The tap F being open, the air is driven out, and the tap closed. On lowering the mercury a vacuum is left in E. The tap G, which was closed, is turned on, and the air expands out of the vessel to be exhausted into E. This is repeated until the receiver is practically exhausted. It is a speedier way of producing a fairly high vacuum than with the Sprengel. I have one in use at present, and it has given me very satisfactory results in the construction of Geisler tubes, etc.

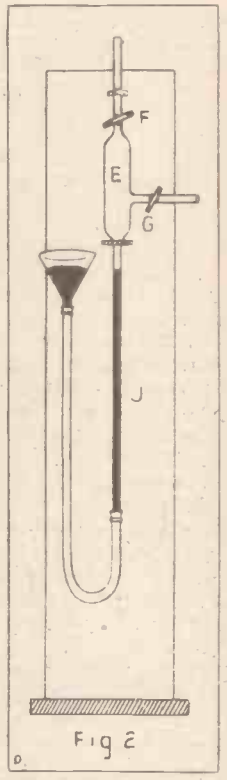


Fig 2

This pump is similar in construction to the Sprengel, the long vertical tube being not less than two feet in length, and the rubber tube about three feet; about four pounds of mercury will be necessary. All joints must be carefully made with sealing-wax liberally applied, including that between the vessel to be exhausted and the annex tube. The whole should be firmly fastened down by brass clips to a suitable piece of hardwood, which in turn should rest upon a heavy base.


Trouble with the Aerial.

NEXT WEEK:
HOW TO MAKE A D.F. STATION

SOLDERING HINTS.

By A. J. RODGMAN.

THE secret of soldering, if there is any at all, is cleanliness. Providing the wires are perfectly free from grease or dirt of any description, and the iron has a clean tinned surface, failure is impossible.

Obtain a soldering iron of reasonable size, and before tinning it, file a groove across one of its sides, as this will greatly facilitate soldering large wires, such as Aerials, etc., as the wire can then rest in the groove, and the solder applied more effectively (of course the groove must be well tinned). Heat the iron sufficiently to melt the solder and scrape or file clean one side, preferably that side of the groove, and immediately apply the flux and solder, repeating this until the whole surface is completely tinned. This surface will last a considerable time (providing the iron is not allowed to become overheated), but will, eventually, gradually burn off, and then a fresh surface must be made.

Testing Solder.

It is best to heat the iron on a gas-ring, as the iron can then be kept at a more or less definite temperature and there is not the possibility of it becoming red-hot, and thereby burning off the tinned surface while the work is being prepared.

The wires to be soldered must be cleaned thoroughly and separately with a blunt knife rather than emery cloth or sandpaper, as the latter leaves behind quite a lot of dust on the wires which, if not wiped off, would be detrimental to soldering.

For Wireless work the best solder should be used, *i.e.*, the solder that contains a large proportion of tin. Solder can always be tested by bending a stick near the ear, and if a good cracking sound is heard, it indicates the presence of a good proportion of tin. If, on the contrary, very faint or no sound is heard, the solder is composed mostly of lead.

How to "Tap."

For a flux, the writer gives preference to resin, but any well-known flux can be used, providing it is not spirits of any description, because, while spirits is splendid for outdoor work, it is unwise to use it for instruments, as the smallest residue will in time corrode the wires.

When soldering, for instance, a number of tappings from an inductance to a number of studs, it is best to do it systematically. First, clean the ends of all the tappings, tin them, and then tin the tops of all the studs. Take one tapping and place the tinned end on the top of its respective stud, and apply a warm iron, and it will be found to adhere almost immediately. A repetition of this, and the whole lot of the connections will be soldered in a very short time.

This having been accomplished efficiently and thoroughly, the amateur has the satisfaction of knowing that should any trouble arise, he will not have to hunt inside the instrument for a loose connection.

THE ELIMINATOR.

By E. BITTON and A. W. DRANSFIELD.

THE Eliminator is the title that has been given to an instrument that has been designed to overcome all interferences experienced during the reception of wireless messages—such as atmospherics and other electrical disturbances. It has also the reputation of being able to sort out and separate a multiplicity of signals either for wireless, land, or cable telegraphy.

Like most inventions of its kind, it had a very small beginning, the instrument of to-day being evolved from a very primitive start.

The history of the Eliminator, although making very brief reading, was the result of many months of continual research; parts of every description being made and scrapped, and an endless number of coils of every description wound to attain the perfection that exists with the Eliminator of to-day.

In the first place, an idea was submitted that, if some sort of break could be formed between the incoming signal and the actual receiver, and that said break could be controlled, interferences would become extinct. The break suggested was the sympathetic action of sound transference.

Resonance Experiments.

This was food for thought for the experimenter, and prompt steps were taken to see if this sympathetic action could be utilised. In the first place, it was necessary to see if this action was sufficient to be of any utility. Glasses were purchased that were all of the same size, weight, and thickness. This was done with a view that all glasses, if tapped with a pencil and made to ring, would all give out the same note. They were then placed in a row, and it was found that if one glass was tapped it gave out a certain note.

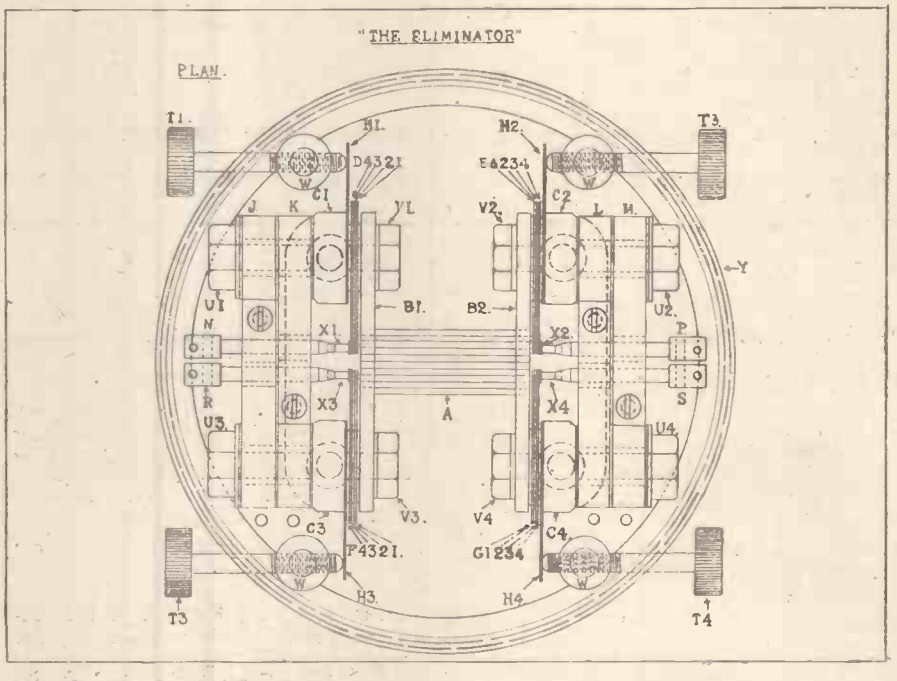
This glass was then held by the hand to stop the vibrations and ring, but, although the tapped glass had ceased to give out its note, the remaining glasses were found to be ringing, proving that they had responded in sympathy, and had accepted the vibrations that were NATURAL to them.

Then a glass of a *different* note was placed in the line, and the same experiment carried out: but it was found that, although the glasses of the same note or frequency had accepted the vibrations, the glass of different note was silent. This proved that sound transference was a positive fact; but it was necessary to so arrange this force that it could be applied to electricity.

The outcome of the experiments, which extended over two years, was the Eliminator, which, we claim, will entirely eliminate atmospherics, will select signals to within 2 per cent. of any audio-frequency, will amplify signals.

Further, we are prepared, given reasonable notice, to demonstrate our claims, and to prove that the Eliminator is all that we say it is.

In giving a résumé of the Eliminator, we (with all due deference to experts, whom we respectfully request will give us their consideration) propose to deal with the instrument from an elementary point of view.

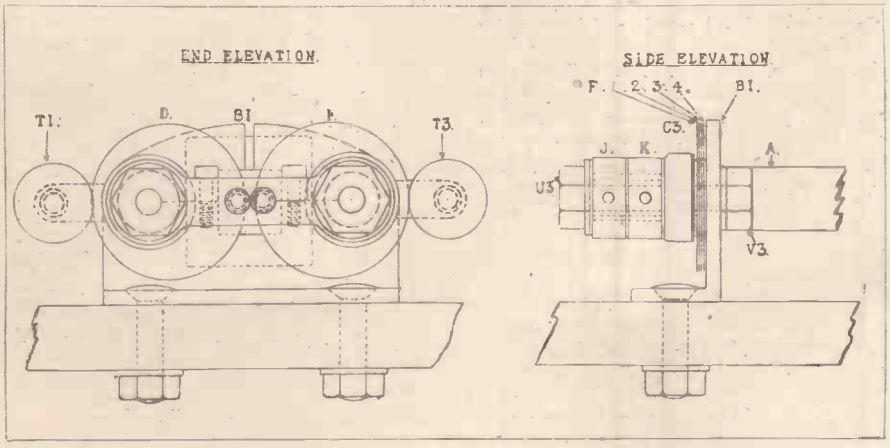


It is our experience that the instrument is often compared with an ordinary relay, particular note often being made to "tuned relays." Whilst our instrument is actually a tuned relay the principles which we employ have never before been employed. "Tuned reeds," air columns, etc., *are*, we are aware, used in many cases, but the application of the natural phenomena of "sympathetic action of sound" in its natural form has *not* been employed. In making the foregoing statements we would also say in particular: (1) That we are prepared to prove all our claims. (2) That the principles employed *are* such as we state. (3) That the instruments actually do the work. In our claims we make certain points. These points are the actual results of tests applied in the leading laboratories in this country.

The principles employed were originally conceived from experiment: (1) A number of wine glasses, 1, 2, 3, 4, 5, 6, all being of exactly the same size, thickness, shape and quality, *and in consequence* all having the same "natural frequency of vibration," were placed *at different points* around a room. No. 1 glass was flicked with a pencil, which caused the glass to vibrate at its natural frequency and to give off a certain "note." *This vibration was immediately stopped by the operator gripping the glass and removing same from its stand.* THE NOTE CONTINUED and it was found that the other glasses, Nos. 2, 3, 4, 5, 6, were giving off the note (*i.e.*, they were in a state of vibration at *their* natural frequency "in sympathy or unison" with the original note made by glass No. 1).

Experiment 2. Nos. 2, 3, 4, 5, 6 glasses were again used, all having the same natural frequency. Another glass *not having the same natural frequency* was now used instead of the original No. 1 glass, and operated in exactly the same manner. Immediately this glass was gripped, thereby stopping its vibration, THE NOTE CEASED.

(*Continued on next page.*)



THE ELIMINATOR.

(Continued from previous page)

From the foregoing it will be seen that objects no matter what their formation (as *all* things have a natural frequency): (1) vibrate in sympathy or unison with one another; (2) are not vibrated in sympathy or unison by one another unless the frequency *is* the same.

Further experiments were now carried out, and an organ was requisitioned for this purpose and used in conjunction with glasses 1, 2, 3, 4, 5, 6, again placed around a room. When a note was played having the same frequency of vibration as the aforementioned glasses, *all the glasses picked up that note.* When a note which was a "true harmonic" of the first note was played the glasses *nearest* to the organ picked up the note, but not at their previous strength. "All other notes failed to operate at all." We now reach a point where we know that:

(1) Similar notes operate. (2) True harmonics operate *weakly.* (3) Other notes do not operate.

Continuing our experiments, we decided to find the actual "degree of selectivity" that could be obtained. For this purpose a "note-making machine" was made by using an electric motor, variable speed, in conjunction with a rotary brush electrical circuit.

We now found that any degree of selectivity could be obtained from *less* than 2 per cent. variation upwards, by suitably placing the vibrating factors.

Construction of Eliminator.

From this data we decided to construct instruments for Wireless, Land and Cable Telegraphy, the result of this decision being "The Eliminator," which instrument is a combination of *two separate* electric circuits, magnetism and the aforementioned phenomena.

We will now describe the instruments which we have brought to a point of perfection that justifies all our claims (which we make anon. Part 1). An electro-magnet was placed upon an insulated *solid* base and there firmly fixed, the ends of the wires being connected to two terminals. (Note: All currents pass from the operating instrument to one or other of the terminals, through the magnet winding and out through one or other of the terminals, *and is not taken to any other part of the Eliminator.*)

A strongly constructed column of non-magnetic material was now fixed in position. Upon this column we mounted a number of fine steel diaphragms *all* of exactly the same size, thickness and temper. The actual frequency of these diaphragms *we control when assembling* the instrument by using "separators" (non-magnetic) of given diameters. These separators when fastened *limit* the "mass in motion" of each diaphragm (thereby controlling its frequency of vibration), and the frequency of the diaphragm *cannot be altered* without dissembling.

Current was now applied to the electro-magnet at known frequencies. The diaphragm nearest to the magnet was made to vibrate as each frequency was applied. When its own natural frequency was applied, it vibrated with much greater amplitude than at other times, *but* the current applied was sufficiently strong to vibrate it no matter what the frequency.

At this point (having No. 1 diaphragm in vibration) we make no further use of the incoming current, and the instrument ceases to be electrical or magnetic until we again take up electricity by applying a "local circuit." Having now No. 1 diaphragm in vibration (as current is applied to the electro-magnet), at *whatever frequency* the current is applied the following action takes place. (Note: Let it be thoroughly understood that No. 1 diaphragm is of exactly the same natural frequency as those fitted adjacent to it, *i.e.*, Nos. 2, 3, 4, shown on the drawing. Assume No. 1 diaphragm to be 500 cycles frequency.)

Experiment A.—Current is applied to electro-magnet at 300 cycles. No 1 diaphragm immediately vibrates at 300 cycles. Nos. 2, 3, 4 remain motionless.

Experiment B.—Current is applied at 500 cycles. No. 1 diaphragm now vibrates at 500, which is its natural frequency. Diaphragms 2, 3, 4 also vibrate in sympathy or unison with No. 1, the amplitude of vibration gradually decreasing as diaphragms come into action, *i.e.*, No. 2 vibrates with slightly less amplitude than No. 1, No. 3 slightly less than No. 2, and so on.

Further Experiments.

Experiment C.—A number of frequencies are now applied simultaneously, say 300, 325, 380, 420, 480, 550. No. 1 diaphragm will now vibrate at the frequency *nearest to its own natural frequency*, in this case 480 cycles.

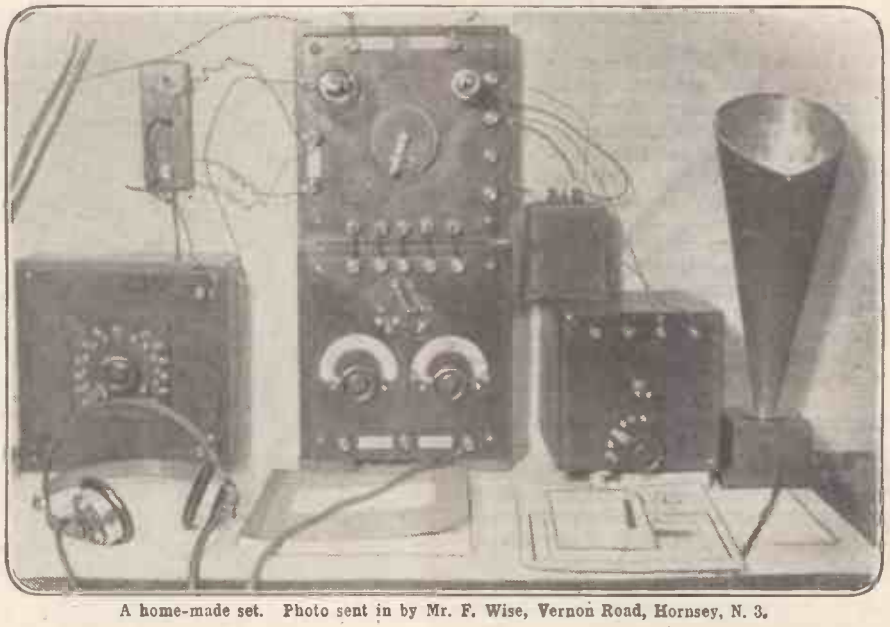
Experiment D.—A frequency which is a true harmonic of 500 cycles (*i.e.* 250, 1,000, or 2,000) is now applied. No. 1 diaphragm vibrates at the frequency applied as example 1,000. Diaphragms 2, 3, 4 accept this vibration as an harmonic, and they also vibrate, *but* at *their* natural frequency. From the foregoing we get: Experiments B and D (frequencies of 500 and 1,000), all diaphragms are in motion. Experiments A and C, only No. 1 diaphragm in motion.

At this point we should like to say that, having so far explained the instrument to scientists here, we were asked to prove that diaphragms 2, 3 and 4 actually operated *by sympathetic action only.*

To do this we constructed another instrument in the following manner.

(1) An electro-magnet was set up as before. (2) A column of non-magnetic material, phosphor bronze, was also set up. (3) A tuned diaphragm, No. 1, of fine-tempered steel was fitted to the column. (4) Diaphragms 2, 3, and 4 were now made of non-magnetic material, but having the same natural frequency as No. 1.

Current was now applied, and when frequency was incorrect it did not operate, when frequency was correct it did operate.



A home-made set. Photo sent in by Mr. F. Wise, Vernon Road, Hornsey, N. 3.

Thus our "action claim" was proved, as only one diaphragm, No. 1, was of magnetic material and therefore capable of being controlled by an electro-magnet. Look again at the drawing, and it will be noted that on No. 4 diaphragm a small contact is fitted. At this point we again take up electricity by applying current, using (1) the diaphragm contact, (2) the insulated contact screw as the *break* in the applied circuit. (Note: To this circuit we have applied current up to 6 amps.)

Action now is as follows:

Experiments B and D cause all diaphragms to vibrate, and in consequence the second circuit which we have just set up is *made* and *broken* at the contact points at the frequency at which No. 4 diaphragm is vibrating. Experiments A and C, the contacts remain *broken.*

Complete Selectivity.

In this circuit may be placed a "relay," "syphon," or other recording apparatus, or "low-resistance telephones." If telephones are used it will be found that experiments B and D give a note in the 'phone as frequencies are applied. Experiments A and C, silence in the 'phones. Having now established our principles, we would say that:

(1) We have constructed instruments that operate with applied current of ½ milli-amp.

THE ELIMINATOR.

(Continued from previous page).

(2) That current of 6 amperes has been applied to the same instruments, *and unless at correct frequency does not break through.*

(3) Satisfactory reading of signals *required* was obtained *whilst* 16 *simultaneous signals were applied.*

(4) Signals of several large stations were tuned in simultaneously, using 4-valve amplifying, and a heavy 5-kilo discharge was transmitted direct into an adjacent aerial.

Result in 'phones without the Eliminator, "pandemonium."

Result in 'phones with Eliminator, any signal required was read comfortably *without* interference by heterodyning the note of the required station to suit the natural frequency of the diaphragm set.

The following results have been obtained by using the Eliminator:

(1) Atmospheric discharges and jamming signals are entirely eliminated.

(2) Signals that would jam in the ordinary course can be received separately *if required.*

(3) Small current only is required (1 milli-amp. is sufficient to control the instrument).

(4) Selectivity has been brought to within 2 per cent of any audio-frequency. This selectivity may be *increased or decreased as may be required.*

(5) Strength of signals can be amplified.

(6) Recording instruments may be used in secondary circuits instead of telephones. We have used "B" type G.P.O. relays and syphon recorders with distinct success, passing current of 5 milli-amps. in secondary circuits, with 1 milli-amp. of applied current operating the diaphragms.

(7) Reliability.—The instrument requires careful adjustment in *position where it is to be used.* Thereafter no further adjustment is required, conditionally that it is kept free from *damp.*

(8) Instruments may be made at comparatively low cost.

(9) Any required power may be applied to the secondary circuits, contacts of which can be adjusted to pass up to 20 milli-amps.

Explanation of Diagrams.

The following résumé of the functions of the different parts shown on accompanying drawing will fully explain the principle of the instrument.

A.—An electro-magnet of a particularly sensitive nature which accepts all frequencies of current that are transmitted to it. Experiments have proved that sixteen audio-frequencies are accepted simultaneously without "resultant" frequencies occurring. This electro-magnet is connected in place of the usual receiving telephones, and current of 1 milli-ampere is sufficient to carry out the object in view. In use, as much as 6 amperes of current—*i.e.*, six thousand times as much current as is required—has been applied without breakdown to the instrument.

B1 and 2.—Two supporting carriers for "A" and the sets of diaphragms, also forming "earth" connection for secondary circuits.

C1, 2, 3, 4.—Carrier bolts for diaphragm fittings and contact fittings.

D1, E1, F1, G1.—Fine steel diaphragms, each of a known "tune" or "natural frequency of vibration."

The magnet "A," when receiving current, is sufficiently powerful to vibrate all No. 1 diaphragms *at the particular frequency or frequencies* being received by "A," *i.e.*, assume that D1 is tuned to 250, E1 to 300, F1 to 350, and G1 to 400 per second. Let "A" then receive a frequency of 275. All four will vibrate at 275. Again let "A" receive three frequencies—say, 275, 360. 420. Then D1 and E1 will vibrate at 275, being the *nearest* to their "natural frequency." F1 will vibrate at 360 and G1 at 420, for the same reason. Therefore we should have two at 275, one at 360, and one at 420, it being always understood that in each case the No. 1 diaphragms vibrate at the speed nearest to their natural frequency, even though the current applied at another frequency may be more powerful. At this point it will be well to mention that *true* octaves of frequency (which we have proved electrically to be in exact ratios as 2 to 1 per octave) have exactly the same control as the exact frequency; *i.e.*, assume D1 to be tuned to middle C (which is 256 per second), then higher C (which is 512 per second) will vibrate D1 at its natural frequency of 256. D1 would therefore be controlled at its correct frequency by 256, 512, 1,024, 2,048, and so on.

Vibration of Diaphragms.

Having now reached a point where we have all No. 1 diaphragms in motion, we finish with magnetism and electricity for the time being, and take up "sound" by means of additional diaphragms shown on the drawing as D2, 3, 4; E2, 3, 4; F2, 3, 4; and G2, 3, 4. Now D2, 3, 4 are of exactly the same "tune" or natural frequency as D1; E2, 3, 4 as E1; F2, 3, 4 as F1; and G2, 3, 4 as G1, the "mass in motion" (which decides the natural frequency) being governed by the diameter of separators placed between and about 1, 2, 3, and 4. When No. 1 diaphragms are vibrating, *but not at their natural frequency,* diaphragms 2, 3, 4 remain motionless. When No. 1 diaphragm of a particular set of diaphragms is vibrating at its natural frequency, diaphragms 2, 3, 4 of that set also vibrate in "sympathy" or "unison" with No. 1.

Cabinet set made by Mr. R. T. Hains, 6, Whittington Street, Pennycomequick, Plymouth.

Therefore, assuming that D1 and G1 are vibrating at their natural frequency, and that E1 and F1 are vibrating, but *not* at their natural frequency, we then get D1, 2, 3, 4, G1, 2, 3, 4, E1, and F1 vibrating, with E2, 3, 4 and F2, 3, 4 motionless. It will now be seen that by applying current to A at correct frequencies—*i.e.*, the natural frequencies of the sets of diaphragms—*all* diaphragms will vibrate as their corresponding frequencies are applied, and that when the frequencies are incorrect, only No. 1 diaphragms will vibrate. Assuming now that four frequencies which are of the natural frequencies of D1, E1, F1, and G1 are applied to A, we shall then have D2, 3, 4, E2, 3, 4, F2, 3, 4, and G2, 3, 4 vibrating as their particular frequencies are applied to A, and motionless for such time as their particular frequencies are not applied to A. Now, D4, E4, F4, and G4 are fitted with small platinum contact pieces to engage with platinum contacts X1, 2, 3, 4 fitted to screws N, P, R, S.

Operation of Contacts

These contacts remain *broken* until No. 4 diaphragms are vibrating. At this point we again take up electricity by making circuits (to which any power required may be applied), which may be termed secondary circuits, and are broken at the contacts X1, 2, 3, 4, adjustable screws N, P, R, S (mounted in insulated carriers J, K, L, M) being provided, and connected as follows:

Power applied	+	to N,	−	to	Earth B.
„	„	+ to P,	−	„	„
„	„	+ to R,	−	„	„
„	„	+ to S,	−	„	„

The recording instruments in use (which may be telephone receivers or relays) are connected in series in each case.

This arrangement now gives us the following: Frequency applied to A, if of the natural frequency of D1, vibrating D2, 3, 4. Contacts X1 fitted to D4 and N then become "made," completing a secondary circuit in which recording receivers are connected. Meanwhile, as this frequency applied to A is not correct for E, F, or G, E2, 3, 4, F2, 3, 4, and G2, 3, 4 remain motionless and *their* secondary circuits broken, and in consequence the recording instruments in such circuits do not operate. As explained previously, the electro-magnet A will accept sixteen different frequencies without jamming, and therefore sixteen signals may be transmitted simultaneously, or otherwise, and only such as are of the particular frequency of the receiving diaphragms will be received by that particular instrument.

H1, 2, 3, 4 are pressure plates designed and fitted to give fine adjustment to the contacts X1, 2, 3, 4. T1, 2, 3, 4 control pressure on H1, 2, 3, 4. V1, 2, 3, 4 and U1, 2, 3, 4 are fitting nuts. W, carriers for T1, 2, 3, 4. Y, covering case with glass top.

A NEW TYPE OF DIRECTIONAL AERIAL.

ONE of the outstanding problems now facing the radio engineer is the question of minimising interference arising from the overcrowding of the ether.

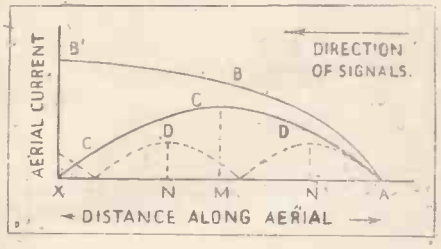
The most promising remedies lie, on the one hand, in the development of optimum selectivity, so that a receiver will refuse to respond to any wave-length other than that to which it has been tuned, and, on the other hand, in the perfection of directional transmission and reception.

There are at present two types of directional aerial in common use. One is the Marconi inverted L type, which gives a maximum effect along the plane containing the two limbs of the aerial and in the direction opposite to that in which the horizontal limb is pointing. The other is the Bellini-Tosi system, which in its most simple form becomes the ordinary loop aerial, as used in direction-finding. Here the maximum energy is picked up when the planes of the two upright sides of the coil point towards the source of the signals.

Controlling Velocity.

Recently, however, experiments have been made with a directional receiving aerial which depends for its selective effect upon an entirely new principle.

The aerial itself consists of a long horizontal wire earthed at both ends, and provided along its length at certain intervals with inductances and capacities either



in shunt or in series. The purpose of adding these electrical elements is to control the velocity with which the current wave induced by the received signals travels along the aerial.

In the simplest case we can assume that the current induced in the aerial by the first impact of the signal energy will travel along the aerial wire with the same velocity as the signal energy itself travels through the ether, both being identical with the velocity of light.

The Selective Principle.

If the horizontal aerial is lying in a direction pointing towards the transmitting station, then the signal current in the aerial and the outside signal energy in the ether will be travelling along parallel paths.

Referring to the figure, the incoming signal energy shown by the arrow, as it strikes the near end A of the horizontal aerial, will induce a small current which will be propagated as a wave along the aerial towards the point X. But as this current is travelling practically in contact with the outside ether wave, its amplitude will gradually increase, as indicated by the curve ABB1, because it is continually absorbing small additional amounts of energy from the outside ether wave, with which it is always in phase.

Owing to resistance and other losses in the aerial, the rate of growth of the current amplitude will gradually become slower and slower until, in the case of a long aerial, it reaches a saturation value at B1.

If, however, the aerial is suitably loaded by the insertion of inductance and capacity, so that the speed of the induced current is *less* than the speed of the outside ether wave, then the variation of current amplitude will be represented by the curve ACC. For a certain distance the two waves will add together, but a point will be reached where one wave will be so much in advance of the other that the two will be in phase opposition, and interference will occur.

A Directional Effect.

The induced current will consequently rise to a maximum value and then sink to zero, subsequently increasing again if the aerial is sufficiently long. The curves ADD show a still more pronounced effect when the aerial has been heavily loaded so as to introduce a considerable lag between the induced current and the external ether wave.

Mr. J. S. Roberts, Gorphwysfa, Cobham, Kent.

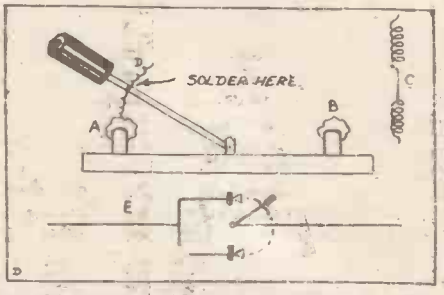
The inductance and capacity loading of the aerial differs in its effect upon the velocity of the induced currents with different signal frequencies or wave-lengths. This affords a method of selectivity based upon the difference in signal wave-length. For instance, signals due to the curve ACC can be heard by tapping the aerial at the point M without interference from signals corresponding to the curve ADD. The latter, on the other hand, can be heard at the point X, where the signals corresponding to the curve ACC have zero amplitude.

It is obvious that such a horizontal aerial will be most responsive to signals originating from points lying in the direction of its length.

In order to cut out signals coming from the opposite direction to that of the arrow in the figure, the end A of the aerial may be grounded through an ohmic resistance equal to what is called the "surge impedance" of the whole line. This merely shunts to earth all signals coming from the undesired direction without giving rise to any "reflection" effects along the aerial.

A SPARE CRYSTAL DEVICE.

TO those amateurs who prefer to use the simple crystal detector in preference to the more expensive vacuum tube or "valve," the device shown in the illustration should make an appeal. It is a well-known fact that even the best of crystals will at times fail to rectify, with the result that signals in the telephones immediately cease. By adopting the device shown it is possible to change over to the spare crystal without any waste of time, thus enabling signals to be received which

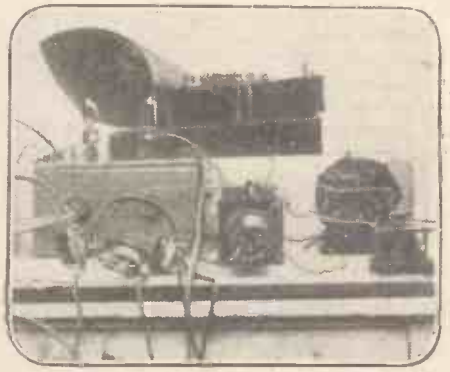


would otherwise have been missed. This little contrivance is also admirably suited for experimenting with various crystals, as different values of signal strength for different crystals can more easily be defined when the change from one detector to another is rapidly accomplished.

The Construction.

It is quite simple to construct, the only articles required being an ordinary single-pole double-throw switch, and a short length of brass wire, about 24 gauge. The two grip contacts for the switch arm are gently prised open until they are sufficiently large to receive the crystals, as shown at A and B in the drawing. The piece of brass wire is then wound into the form of a spiral, with a straight length left in the centre for winding on the switch arm, see illustration (C). The wire is also shown in the drawing at D, the straight portion having been wound round the arm and firmly soldered, thus ensuring a good connection.

The diagrammatical sketch E shows the device connected in a receiver circuit so that either crystal is ready for immediate use. When the brass spring is brought into contact with the sensitive point of either crystal, the circuit through the telephones will be complete, and to change from one crystal to the other is simple.



Home made set by Mr. R. F. Terry, The Limes, Overcliffe, Gravesend.

HEAD GEARS AND LOUD SPEAKERS.

By ALEXANDER SHARMAN.

FEW, if any, departments of electrical engineering are complete in themselves. They nearly all depend for their efficiency upon the specialised product of some allied industry. The X-Ray Department, or, as it prefers to be called, "Radiography," serves as an example. Here the object of all the complex apparatus is to produce "radiographs" or X-ray pictures on dry plates or bromide paper, so that the whole industry depends directly upon the skill of the plate and screen maker for its final and useful result.

Telephone Receivers.

In wireless telegraphy and telephony we meet another example of the same kind; here the final intention of all the complex tuners and receivers available is to produce sound signals,—music or telephony (unkind people say noise)—in a specially designed and highly sensitive telephone receiver.

In practice this telephone receiver takes one of two general forms—head gears or loud speakers. The head gear simply consists of two highly sensitive watch type receivers conveniently mounted upon a spring-like head band and adapted to rest comfortably upon the operator's head. It is designed to hold the receivers over his

Detachable Ear-piece Phones.

ears, where they press gently but with sufficient firmness to exclude external noises. For comfort, the whole head set must be light in weight, and the effective length of the head springs *must* be adjustable, for the distance over the top of the head from one ear centre to the other varies to the extent of some two inches in the case of different individuals.

Head springs are now usually formed of two metallic strips, which can be arranged some inches apart upon the head, thus serving to distribute the weight and contributing to stability and comfort.

If there is any truth at all in phrenology, some of our best known wireless experts have good reason for self-congratulation, for judging by the extension of the head springs required to embrace their skulls, they must be very liberally supplied with the "grey matter" upon which mental qualification is supposed to depend.

Another point of the utmost importance when selecting head sets is to see that the method of attachment used in fixing the individual receivers to the head springs permits of movement in every direction, *i.e.*, it must be what is known as a "universal movement."

Sometimes this is brought about by the use of a well-known "ball and socket" movement, but more generally by a double gimble, which in some makes is so arranged that either or both receivers may be readily detached from the supporting frame. This latter is a great convenience to the amateur who perhaps has only one set at his disposal, for by its means he may permit a visiting friend to share the pleasures of reception by passing him one of his own receivers.

The telephone receiver is really the most important part of a wireless installation. With badly designed or inefficient telephones it is hopeless to expect really good results. Hitherto the most sensitive telephones available for the reception of telegraph signals were of the reed type. This type employs an aluminium diaphragm of conical form, which is moved by a stiff steel reed in close proximity to a polarised magnetic system.

A Modern Development.

It is more complicated to construct than the usual watch type, and hence much more expensive; and, moreover, it is not suitable for the reception of telephony, since its sensitiveness differs very considerably for notes of different frequency. Thus its use tends to distort the received speech or music, because certain notes are received with undue intensity while others are unduly diminished, and the original proportion, or relation, between the various sounds is lost, causing the general result to become distorted and unsatisfactory.

For reception of music and speech, a super-sensitive instrument provided with a flat diaphragm formed of magnetic material is essential. In its latest and best form the magnetic pull is applied by a single, centrally placed pole, while the magnetic circuit is completed through the substance of the diaphragm itself by the aid of two poles of like design placed near the edges of the diaphragm.

To obtain and maintain the highest possible sensitiveness, this active central pole *must* be adjustable in respect to its distance from the diaphragm. Its optimum setting is achieved when it is almost, but not quite, touching the diaphragm.

The general construction of the watch type telephone receiver is now so well known that we need do no more here than just refer to the main principle involved, and then concentrate our attention upon those all-important details upon which its efficiency depends.

Diaphragms.

All telephones consist essentially of two parts, the sound emitter and the electro-magnetic system or prime mover. In some constructions these two parts are so closely inter-related that it is difficult, without careful inspection, to say where one begins and the other ends.

In the reed type telephone this difficulty does not arise, for in this case the diaphragm or sound emitter is quite complete in itself, and only united with the prime mover by a physical connection by which the movement of the latter is transferred to the former.

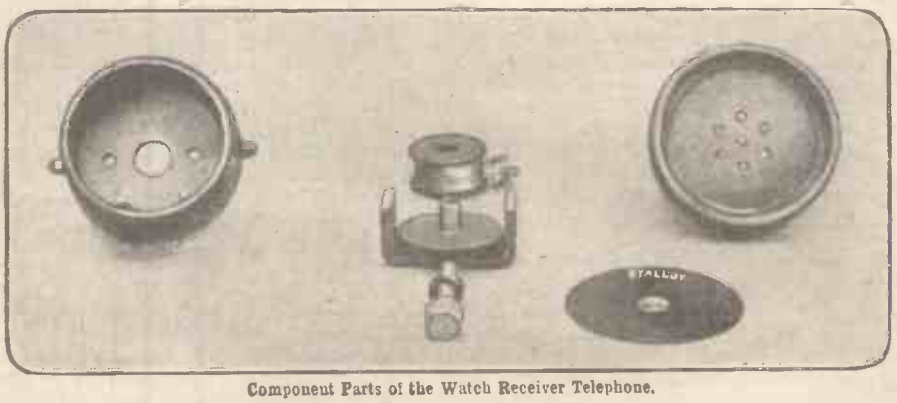
In the case of the watch type receiver, these two components have certain parts in common, for the diaphragm, or sound emitter, not only functions in this capacity, but also forms an integral part of the magnetic system or prime mover.

This introduces a difficulty in the design, since the prime mover requires that the diaphragm shall be formed of some purely magnetic material of high permeability, while its duty as a sound emitter would probably be better performed if we were able to benefit by the experience obtained in the manufacture of gramophone sound boxes, and form our diaphragm of either glass or mica.

In one type of American watch receiver this latter material is actually used, but this necessitates the use of an independent prime mover, to which it is mechanically connected by a system of light motion-multiplying levers.

It is unfortunate that the examples at present available embodying this principle do not appear to be as efficient as the cheaper and simpler type. Like all engineering problems, the final design of a receiver, cheap to produce yet efficient in action, must be a matter of compromise. The material usually selected for the construc-

(*Continued on next page.*)



Component Parts of the Watch Receiver Telephone.

AN AMATEUR WAVEMETER.

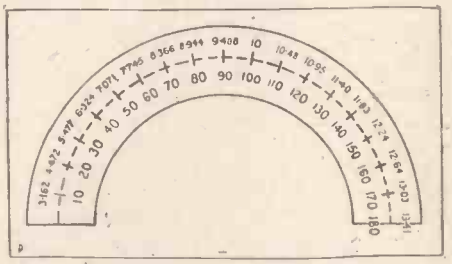
By G. V. DOWDING, A.C.G.I.

CALIBRATED wavemeters are very expensive pieces of apparatus, and the usual mathematical procedure for discovering wave-length admits considerable error, but most of the well-known stations such as Eiffel Tower transmit on very accurate tuning, and this article is intended to indicate a method whereby the wave-lengths of unknown stations can be calculated by comparison. The results must not be expected to be correct to a metre, but will be sufficiently accurate to assist in identifying the unknown stations, and will also serve other useful purposes, as will be indicated later.

The apparatus required consists of a fixed inductance—preferably of the solenoid or honeycomb type, as the smaller the self-capacity of the coil the less the resultant error—with a value such that it will, with a suitable variable condenser, cover the range over which it is desired to carry out the measurements. The coil can be changed at any time for another of greater or less value as desired.

The above apparatus is arranged to form a complete circuit, with a battery and a small buzzer—an old electric bell with the gong removed would serve—for the purpose of energising the circuit and causing it to transmit weak signals on a wave-length directly proportional to its capacity and inductance. All leads and connections should be as direct and as short as possible, and great care should be taken to exclude the possibility of the circuit being disarranged.

It will now be possible to tune the "wavemeter" circuit to any adjustment of the receiver by switching on the buzzer and varying the condenser until the loudest signals are heard indicating that the "wavemeter" is transmitting weak buzzer signals on a wave-length similar to that to which



or for which the receiving set is tuned. To obtain sharp adjustments it is necessary to tune to the weakest possible signals, and therefore the "wavemeter" should not be brought too close to the set.

A Useful Principle.

The precise value of either coil or condenser is immaterial. A cylinder 5 in. by 5 in., wound with 28 S.W.G. D.C.C. wire, will, with a ·001 mfd. variable condenser, cover measurements between 700 and 2,700 metres; and a smaller coil, 3 in. by 3 in., wound with similar wire, would easily cover the shorter wave-lengths. If a tuned circuit employing interchangeable coils of fixed values is employed, the above apparatus will not be necessary, and the readings can be taken directly from the closed circuit condenser. In either of the above cases the final result must be that, using a fixed coil, a condenser reading between 40 and 150 degrees for a station of known wave-length is obtained. Accuracy becomes less difficult if one is lucky enough to intercept the readings of experimental stations exchanging measurements. The square root of this reading must be ascertained. For the sake of an easy example, let us suppose that it is Eiffel Tower on 2,600 metres, and that the condenser reading is 100 degrees.

The square root of 100 is 10, and that will be the standard for that coil from which it will be possible to discover the wave-length of any other reading, because the relation between the wave-lengths will be exactly the same as the relation between the square roots of their condenser readings. Let us suppose that a station of unknown wave-length is tuned in on the same coil and condenser, with the latter reading 64 degrees. The square root of 64 is 8, therefore the wave-length of this unknown station will be to 2,600 metres as 8 is to 10, and that is 2,080 metres.

Direct Readings.

The above few lines should be re-read several times in order to thoroughly grasp the principle involved. It will not be found at all difficult to considerably extend the idea. For instance, two coils of the basket or honeycomb type could be wound and mounted permanently with a variable condenser in such a way that either coil could be brought into circuit in order to cover a fairly comprehensive wave-length range, and scales could be prepared to give direct wave-length readings. Again, the idea could be adopted in order to calculate the values of multi-layer coils, an otherwise practically impossible task by pure mathematics. The purpose of this article was not to deal at all exhaustively with the subject, but to briefly indicate to the more advanced amateur useful material with which to experiment.

Some variable condensers are graduated in degrees, and some are not, but in any case it is a good plan to substitute a scale with the degrees and their corresponding square roots drawn on a semicircle of cartridge paper carefully gummed into position. A specimen scale is shown in the accompanying diagram with a number of square roots marked in to facilitate calculations.

In the case of flat sliding plate condensers, a straight scale, with an evenly spaced numbering from minimum to maximum capacity, could be fixed to the base, or even on one of the sliding plates. The exact capacity of the condenser, whether of this or any other type, is immaterial, but the scale must be accurately spaced and numbered from, say, 1 to 50, calculations commencing at 12.

One more example. A station known to be transmitting on a 900 metres wave-length is tuned in with a condenser reading of 130; with the same coil a station of unknown wave-length is tuned in on 58 degrees. Where x = the unknown wave-length, $11{\cdot}4 : 7{\cdot}6 :: 900 : x$. $\therefore x = 600$ metres approx. To summarise in the simplest manner possible, the wave-length of a known station is divided by the square root of its condenser reading; this result multiplied by the square root of any other reading will indicate any wave-length within the limits of the coil in use.

HEAD GEARS AND LOUD SPEAKERS.

(*Continued from previous page.*)

tion of the diaphragm was, until quite recently, either ferro-type metal or tinned iron plate.

Ferro-type metal consists of thin soft iron sheet coated with a film of enamel and possessing a high polish and quite fair magnetic permeability. It was originally produced to meet the requirements of the photographer, but it was greedily seized upon by the electrician on account of its cheapness, its availability, its good appearance, and the fact that it did not rust or oxidise when subjected to the influence of moisture.

Eddy Currents.

The magnetic permeability of this material is quite good, but, unfortunately, its electrical resistance is relatively low. It may perhaps not be apparent why this quality should be objectionable, since we obviously have no desire to pass an electric current through the diaphragm itself. A little thought, however, will show that, whether we wish it or not, there is yet a great tendency for a current to be produced in the diaphragm when the instrument is in use.

It is well known that if we pass an electric current, which is varying in strength or direction, through a circuit consisting of a number of turns of wire, in close proximity to any suitably placed conducting material, additional currents will be set up by induction in the conducting material itself.

This is, of course, the principle upon which the ordinary transformer works, and we have unintentionally produced a transformer, of a kind, in our telephone receiver, for the telephone winding is our circuit, and the diaphragm is the conducting material in which the undesirable currents are generated.

When we form a combination of this kind intentionally we call it a transformer, and refer to the currents induced as "secondary currents." When, however, we do it unintentionally, we express our contempt for the currents generated by referring to them as parasitic or eddy currents. These objectionable currents cannot be completely obviated; all we can do is to reduce them, and this would automatically happen if we could only find a material possessing high magnetic permeability and zero conductivity.

This is a philosopher's dream at present unrealised, but we have a very fair substitute for this ideal material in the form of "stalloy," which is a special form of iron alloy possessing high permeability and great specific resistivity.

By forming our diaphragm of this material we can reduce the eddy currents to a negligible quantity. The reason why these currents are so objectionable will be apparent when we remember that the total energy available for the telephone is exceedingly small. If we misapply any of this energy by transforming it into eddy currents, it is obvious that the power available for the generation of mechanical motion will be diminished and the telephone rendered less efficient.

(*To be continued.*)

A COMPARISON OF TRANSMITTING SYSTEMS.

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

IN comparing the various systems of radio transmission it is necessary to take into account much more than the capital expenditure involved in their purchase and installation, because for this to be properly appraised it must be examined in parallel with the corresponding running costs and traffic "capacities" of the stations.

Whereas the first cost of one type of plant may be higher than that of another, its percentage of efficiency as a transmitter may also be higher; it may occupy less space, require less personnel to operate, be less susceptible to breakdowns and depreciation, and may produce as good results as the cheaper type for a smaller energy input, and a smaller wastage of consumable parts.

Wave Characteristics.

On the contrary, a transmitter cannot be properly judged, even from a purely technical point of view, by its output efficiency alone, that is, by the power it is calculated to deliver to the antenna for a given input. This is so because, firstly, that factor is in practice modified by the antenna itself, which, though it does not fundamentally affect the apparent efficiency of a transmitter, does nevertheless possess the power either to lower or to enhance the "true" efficiency according to its design. In fact, the antenna together with the "earth" system is really part of the transmitter, and for a high-power station may involve a very large fraction of the total cost.

Secondly, a transmitter obviously must be judged, *inter alia*, by the characteristics of the waves it produces—their purity of form, freedom from harmonics, constancy of frequency, and whether they are "damped" or "continuous."

Traffic Capacity.

In brief, on the principle that a transmitter is of no use whatever without a receiver, it cannot be fairly criticised without a consideration of its suitability for use in conjunction with the most up-to-date methods of reception and transmission, including high-speed working.

The best telegraph transmitter should serve the following ends: To produce the required results at the receiver at the lowest possible cost per word, which in turn implies a certain reserve of power for varying atmospheric conditions which are beyond control, and a high traffic "capacity." The last factor pre-supposes a transmitter suitable for operation at high speed.

For the fullest advantage to be taken of the most recent developments in tuning as applied to reception, transmission must take place by means of a pure wave of unvarying frequency. The sharpest "tuning" possible with the "damped" waves emitted by spark transmitters would be considered very "flat" compared with that which can be accomplished with pure continuous waves; that is one of the most important reasons why "spark" transmission is being abandoned except for ship stations and the coast stations serving them.

The commercial arc transmitter, which, apart from the existence of harmonics, produces a relatively pure wave, does not maintain a perfectly constant frequency. The high-frequency alternator, owing to the difficulty of keeping the machine running at a constant speed, also emits a wave liable to variation of frequency, though it is almost a pure continuous wave.

The valve transmitter is the only type which gives a perfectly pure wave of absolutely constant frequency.

Through the Spectrum.

The comparison of the various types of transmitters from the point of view of wave purity and wave-length constancy, and therefore their relative values for use in connection with super-tuned receivers, may be illustrated by considering what would be the appearance of the spectrum of the wave emitted by each type. The spectrum of the "damped" wave would appear not so much as a line as a broad band, denser in one region. The wave from the arc transmitter would show a fairly well-defined line associated with a number of fainter lines due to harmonics, and the whole collection would exhibit a slight tendency to move up and down the scale during transmission. The spectrum of the alternator wave would consist of a well-defined line with a slight up-and-down movement on the scale.

On the contrary, the wave produced by the valve transmitter would show a single, sharply defined and perfectly steady line. Hence, as sharp tuning in the receiving circuit may be taken as analogous to looking at the spectrum through a narrow slit, it is obvious that on account of the constancy of wave-length maintained by the valve generator this latter type is superior to all others, from the standpoint of reception, which, as already mentioned, must not be ignored.

Tuning.

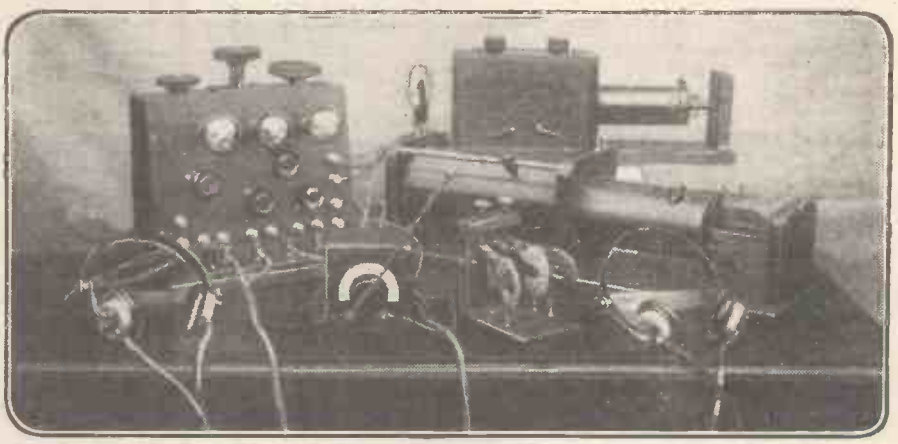
It should be pointed out, with regard to super-tuning, that the decrement introduced during transmission at high speeds, and the consequent broader tuning which is thus called for, are phenomena which apply equally to all transmitters.

If we now compare transmitters in other ways the valve still maintains the premier position. A spark apparatus gives neither the range nor the possibility of superlative tuning of a C.W. plant, and so far as the best telegraph engineering practice is concerned is a candidate for the museum.

Duplicating Apparatus.

The arc gives rise to harmonics, which cause jamming on other wave-lengths, as amateurs who have been hunted up and down the ether by Leafield are well aware. In efficiency of power output the normal arc probably does not reach fifty per cent., and on account of its liability to breakdowns and the need for regular overhauling the arc transmitter has to be installed in duplicate.

High-frequency alternators are expensive, elaborately constructed machines, and in case of breakdowns need the attention of skilled, specially trained men with an engineering workshop at their disposal. This type of generator also requires duplication.



Experimental Station built by Mr. L. Borrow, Rosalie, Yarn Road, Darlington.

Superiority of Valves.

The valve transmitter, being subject only to breakdowns of parts which are more or less independent and easily and quickly replaced or repaired, such as valves or condensers, does not require duplication. The power plant of a valve station is no more liable to breakdown than that of any station of another type. A further advantage of the valve generator is that it may be operated at high speeds without the necessity of "making" and "breaking" heavy currents at high voltage, and for wireless telephony the valve, with its perfect carrier wave, is without equal.

As a practical example of the superiority of the valve transmitter, it may be of interest to mention that the Marconi Company replaced one of the most efficient spark stations in existence, of 150-kw. power, by a 25-kw. valve station, and obtained distinctly better results.

Needless to say, the huge stations which that company have engaged to erect for direct communication between Great Britain and Australia and South Africa, will be of the valve type.

HINTS TO AMATEURS.

Paper washers may be cut very easily with a pair of sharp-pointed dividers. The paper should be held flat on a piece of hard wood that has a smooth surface.

* * *

When soldering zinc plates, remember that zinc is a very soft metal and will run if you get the soldering iron too hot. Another thing to remember is that spirits of salts do not need to be "killed"—*i.e.*, pieces of zinc put into the solution before using. This is the only occasion that one should use spirits of salts when soldering in electrical work, otherwise always use resin fluxite or such-like flux.

* * *

Long or short wires under a board may be covered with paper tubes quite effectively. The plan is to wrap paper round a piece of wire the size required, then tie the ends with cotton and soak in paraffin wax. When dry, they are quite stiff, and may be cut to any length.

* * *

Small twist drills are very apt to break off when being used in their full length. The life of a drill may be added to by making small sleeves to slip on the drill, allowing just as much of the drill exposed as you will want. The sleeve should be made of copper tube. If possible, split it lengthwise; but if the tube fits fairly tight it need not be split, as the soft tube will spring in enough to grip the drill and allow also the "chuck" to get a grip.

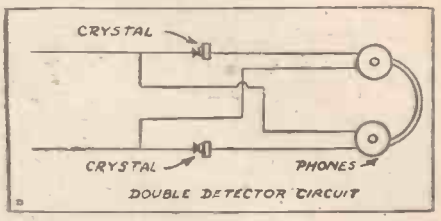
One of the wrecked 400 ft. aerial masts at the Turkish station, Bagdad.

HAVE YOU IDEAS?

The Editor will be pleased to consider short, interesting constructional articles from readers of POPULAR WIRELESS WEEKLY. Copy should be written on one side of the paper, and diagrams, if submitted in rough, must be clearly drawn. Articles accepted will be paid for at our usual rates.

DOUBLE DETECTOR CIRCUITS.

AN idea for employing two crystals in one receiving circuit is shown in the accompanying illustration. It is claimed that by connecting up two crystals in the manner indicated, signal strength is almost doubled, the theory being that by employing twin crystal detectors with a divided head set, each telephone earpiece is placed in a separate detector circuit.



The Hartlepool Y.M.C.A. Wireless Society's Set.

In the event of one of the crystals failing to function, the signal strength would, of course, be considerably reduced. There is, however, a great advantage in having such a detector, as should one earpiece fail to respond, *i.e.*, one crystal cease to rectify, signals would still be heard in the other telephone, and uninterrupted reception could be carried out while the faulty crystal was being readjusted.

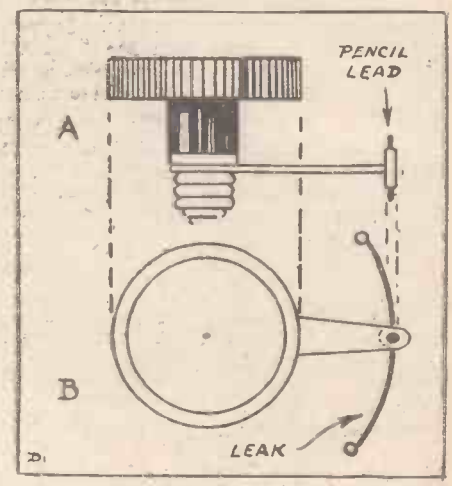
It is possible that interesting experiments along the same lines could be carried out with valves, although the circuits utilised would be considerably more complex.

A VARIABLE GRID LEAK.

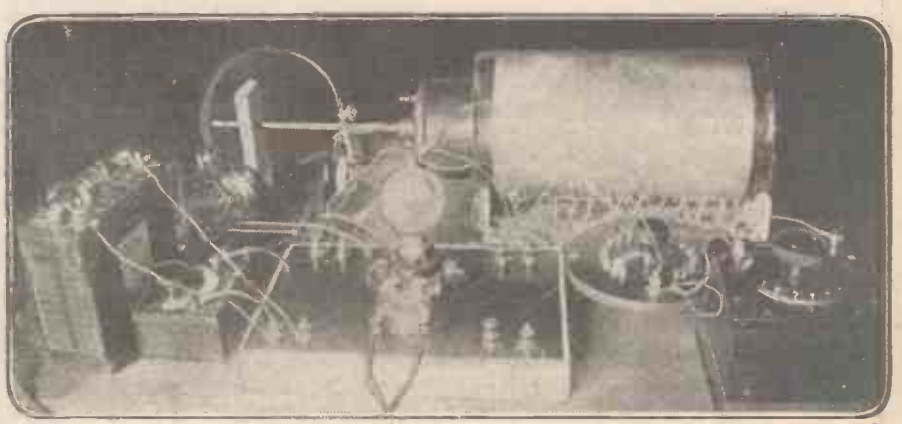
IN some instances it may be found advantageous to vary the value of the grid leak resistance, and the description of a simple yet variable grid leak may prove of interest to readers of POPULAR WIRELESS. The actual "leak" consists of the well-known pencil mark, and is made in the following manner:

Procure an ordinary switch arm such as is used for the circular type of filament rheostat, and solder a small metal tube on to the free end. (See Fig. A in the illustration.) This tube is used to firmly grip a piece of pencil lead with which the leak is constructed by rotating the insulated knob of the switch arm to and fro several times, causing the pencil to make a fairly thick semi-circular line on the base, which might consist of prepared paper. The plan of the switch arm, together with the pencil "leak," is shewn at B in the illustration.

It is easy to see that once the leak has been properly constructed, its valve may be altered by merely turning the insulated knob controlling the switch arm, until the required adjustment is obtained.



The pencil lead should make just sufficient contact with the leak to ensure a good connection, and should not be pressed tightly on to the leak, for obvious reasons.



Experimental Set made by Mr. A. E. Howe, 21, Oakdale Road, West Ewell, Surrey.

CONTROLLING MODELS BY WIRELESS.

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

PART 9 (NEW SERIES).

IN my last article I briefly described the action of a coherer on the arrival of an incident wireless wave.

I also explained that a coherer is generally referred to as an "imperfect contact detector."

Many years ago experiments were conducted with various types of "self-restoring" imperfect contact detectors, but the latter appeared to need such extremely fine adjustment that at the time a coherer with "tapping" device (the latter for shaking up the filings in a coherer) was generally used.

For controlling models by wireless the simplest, but at the same time most efficient, form of coherer should be installed in the "receiving" apparatus.

A simple form of coherer can be con-

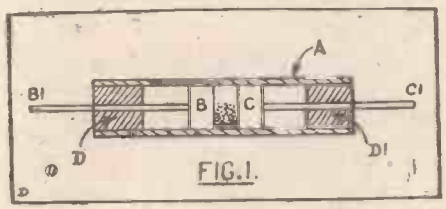


FIG. 1.

structed as shown in Fig. 1. It consists of a glass tube, A (1½ in. long x $\frac{5}{16}$ in. inside diameter), with two brass plugs B, C and rods B1, C1 attached. The latter may be passed through small holes cut in corks D and D1.

The corks may also form plugs for sealing the ends of the glass tube A. A space of $\frac{1}{8}$ in. should be left between the brass plugs B, C, and should be half filled with nickel filings. The latter can be made by filing a piece of nickel and collecting such filings on a sheet of clean paper.

Comparison by Results.

The efficient working of a coherer will be seriously impaired if the filings contained therein are touched by an operator's hands, as the latter (due to perspiration and other natural causes) would coat the filings in question with a film of grease, thus producing obvious deleterious effects.

The coherer as shown in Fig. 1 can be mounted in a "horizontal" position, in any suitable manner upon an insulated base, and it functions satisfactorily if properly adjusted, but its large contact surfaces might sometimes tend to make it sluggish in "de-cohering."

Vertical Types.

Such a defect would be a source of annoyance if a coherer controlled a circuit connected with a relay, on account of its tendency to cause the latter to intermittently operate other apparatus which might be connected with same. For instance, the resultant effect upon a model electric train (as described in previous articles) would be to cause the electric locomotive to function in an erratic manner.

If such a defect had become apparent in the receiving apparatus attached to my well-known wireless-controlled airship, it can be better imagined than described what the effect would have been when the craft in question floated over the heads of ladies and gentlemen seated in the auditorium of a theatre, more especially in such large halls as the London Coliseum or London Hippodrome.

It is, of course, possible to construct a more elaborate "horizontal" type of coherer to that shown in Fig. 1, but, after conducting various and numerous experiments, I formed the opinion that a "vertical" type of coherer proved more reliable for controlling my apparatus. Fig. 2 shows a simple "vertical" type of coherer which was used with great success in connection with my early experiments, and has proved quite satisfactory for controlling models by wireless.

A Vertical Coherer.

It consists of a wooden base A, brass support B with clamping screw C, coherer D with glass tube D1, cork plug D2, brass cap D3, vulcanised fibre bush D4, and supporting rod E, contact spring F, terminal screws G and H.

The wooden base A can be made of white pine (shellac varnished or French polished) 8 in. long x 4 in. wide x ½ in. or ⅝ in. thick.

The brass support B can be circular in form; the flange at the base being one inch diameter x ⅛ in. thick. The "shank" can be $\frac{5}{16}$ in. diameter, whilst the total height of the support can be ¾ in. The brass "cheese head" clamping screw C can be ⅜ in. long x ⅛ in. diameter.

The coherer supporting rod E should be made of No. 14 gauge hard drawn brass wire 1½ in. long, and one end of the rod should be screw-threaded to engage with a similar screw-threaded hole in the vulcanised fibre bush D4.

The glass tube D1 should be approximately 1¼ in. long x $\frac{5}{16}$ in. outside diameter, and inserted in the vulcanised fibre bush D4, as shown in Fig. 2. The glass tube may be secured to the fibre bush with "seccotine," or other suitable cement. If desired the glass tube D1 may be dispensed with, and the fibre bush D4 made 1¼ in. long, and bored out, so that the cork plug D2 can be used for sealing the end of the bored-out portion of the bush. The glass tube D1 is handy for the purpose of inspecting the filings contained therein, but the coherer will function equally well without it if made in the manner described.

The brass cap D3 should be made of brass tube ½ in. outside diameter, and should fit tightly over the vulcanised fibre bush D4 as shown.

The contact spring F should be made of No. 24 gauge spring brass ½ in. wide and bent as shown.

The Filings.

The contacts in the base of the coherer should be made of No. 25 gauge hard drawn brass wire, and passed through holes drilled in the vulcanised fibre bush as shown in Fig. 2. The sum of the total length of the two outer contacts should equal the length of the centre contact. The latter should (by soldering) be connected to the brass supporting rod E, whilst the former should be connected to the brass cap D3.

When the coherer is completed as described sufficient nickel filings (made as previously referred to in this article) should be placed in the glass tube D1, so that the contacts in the base of the coherer are completely covered.

De-Cohering.

In next week's article I hope to furnish a complete wiring diagram of the whole "receiving" apparatus, when it will be observed that an incident wireless wave would have the effect of "short circuiting" the contacts of the coherer in question, thus closing a circuit connected with a relay.

I explained in my last article that the operation of shaking the filings in a coherer causes same to "de-cohere," or, in other words, restores their initial resistance to the passage of an electric current.

An ordinary electric bell movement (minus the bell, or gong) makes a suitable piece of apparatus for effecting the "tapping" of a coherer, and thus "shaking up" the filings contained therein, as and when required.

The New Coherer.

An ordinary electric bell (fitted with a 2½ in. bell) can be purchased at a small cost,

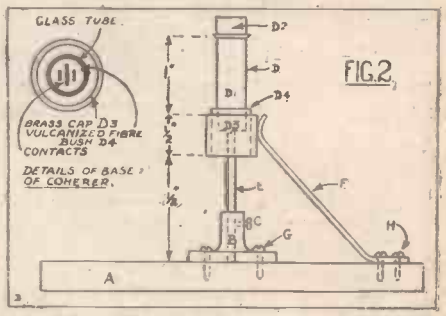
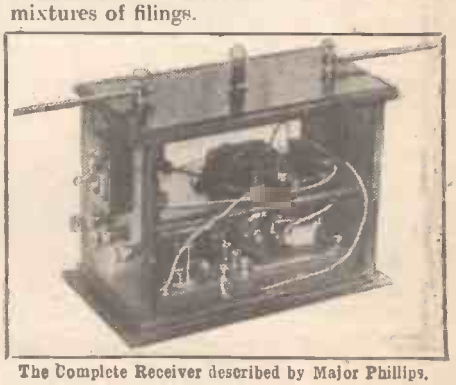


FIG. 2.

and the movement consisting of an electromagnet with armature, also hammer, should be removed from the bell-base board, and suitably mounted upon the wooden base A (Fig. 2) in such a manner that when the electric bell movement in question is caused to function its hammer should strike the brass cap D3 fitted to the coherer D at a point opposite the contact spring F.

I am not furnishing constructional details of my latest and very reliable type of coherer, as readers will understand that its present efficiency has only been attained after a considerable amount of experimental work in connection with metal contents and mixtures of filings.



The Complete Receiver described by Major Phillips.

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.

Durham City and District Wireless Club*.

The eleventh meeting of the above took place on Friday, 6th October. The chairman, Mr. F. Sargent, F.R.A.S., opened the proceedings by giving a hearty welcome to Mr. Guy Stephenson, of Crook, who was present for the first time. Unfortunately, the lecturer for the evening, Mr. Ainsley, of the Henley Cable Co., could not deliver his lecture upon "Capacity" owing to being ill. In spite of this, however, the meeting proved a huge success, the members considering the evening to have been one of the very best so far.

Mr. Stephenson, B.Sc., A.I.C., etc., drew up a tabulated result of his latest experiments for the benefit of all present. Lecturing in a clear, concise fashion, and using the blackboard, he showed all the relative positions of condensers, transformers, tuning coils, etc., on his own set to achieve the best results at the various wavelengths.

At the close of his excellent address, Mr. Barnard pointed out that none of these figures could be accepted as a standard, but one must become thoroughly accustomed to one's own apparatus, and keep a log book of capacity and inductance variations in relation to the wavelength received. The above opened out a large amount of discussion.

Mr. R. W. Holmes, B.Sc., A.M.I.C.E., A.M.I. Mech. E., explained an ideal method of drawing up graphs from tabulated results of experiments, whereby a great deal of labour would be saved, expecially when changing duolateral coils. One glance at the chart and the tuning for the desired wave-length would be accomplished in a few seconds.

After a short discussion upon valves, Mr. Widdas, of Trindon, described his crystal set and the various crystals he had tried. Mr. R. W. Rushworth, a keen crystal experimenter, pointed out that he had a great respect for the carborundum and steel arrangement.

The questions which had been placed in the question box the week previous were then dealt with by the hon. sec.

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

Cowes and District Radio Society.

In presenting the first annual report of the Cowes and District Radio Society, it is possible to feel somewhat gratified at the progress the Society has made since its inception on Sept. 23rd, 1921, our present chairman being the prime mover in setting the society on foot. At that date the membership was seven; today it is twenty-four.

It is noteworthy, as indicating the interest the society has created or assisted, that a year ago the number of persons in the district owning wireless sets did not exceed six; the number now must be over twenty.

That the interest has been so well maintained is largely due to the valuable assistance given throughout the year by Mr. Mugliston in a series of lectures on the principles of wireless, also to Mr. Ball for many practical hints on the manufacture of sets and for the reading of papers at short notice. The committee are indebted to these gentlemen for their assistance and particularly to Mr. Ball for the provision of the club set.

The interesting discussions that have often followed the lectures have proved that the aims of the society has been very largely achieved.

The committee regret that owing to increasing pressure upon his time, Mr. Ball, who kindly undertook the duties of hon. secretary, and who did valuable work in the formation of the society, found it necessary to resign the secretaryship.

Before retiring from office at the end of the year the committee have prepared a programme for the coming session which they sincerely trust the members will take full advantage of.

Hon. sec., L. Ingram, 1, Mill Hill Road, Cowes, I. of W.

Hackney and District Radio Society.

The society meets every Thursday evening, at 7.30, at the Y.M.C.A., Mare Street, Hackney, E.8.

Sir Arthur Lever, Bart., has been elected a patron to the society, and Mr. L. L. Robinson an honorary member.

The society has applied for affiliation to the Wireless Society of London, as well as for an experimental licence. A technical sub-committee is at present engaged in constructing the society's wireless set, which will enable practical demonstrations to be given.

Since its inception a great deal of keenness and enthusiasm has been shown, the more expert members giving all the assistance and advice possible to new-comers. There are at present over seventy members, with an average attendance of seventy-five per cent. At every meeting there are one or more ladies present, showing that interest in radio matters is not confined to the male sex. Members are of all ages, from fourteen to sixty, all equally desirous of obtaining better knowledge of this wonderful science.

A cordial invitation is extended to all persons, especially ladies, who are interested in the subject, whether they possess radio sets or not, and it is hoped that in the near future membership will be doubled, as it is only by uniting their efforts will amateurs be able to protect their interests.

Hon. sec., Mr. E. R. Walker, 48, Dagmar Road, South Hackney, E.8.

The North London Wireless Association.

An extraordinary general meeting was held on Monday, September 25th, to reorganise the association for the winter.

A hearty vote of thanks was accorded to both Mr. Prior and Mr. Auckland for the services they have rendered the association in the capacities of secretary and chairman respectively. The loss of their services through pressure of business is greatly regretted.

A programme has been arranged with a view to interesting both the beginners and the more advanced workers, and it is hoped that large numbers who have recently taken up wireless will join the association's ranks, and increase their knowledge of our interesting subject.

We shall also be glad if members will endeavour to attend regularly at the meetings and assist in the arranging of future programmes by volunteering to read papers and give demonstrations. Items such as descriptions of sets, discussions of difficulties met with, useful hints, etc., are very useful and assist in providing both profitable and interesting evenings. The association is very fortunate in having much of the Polytechnic's valuable apparatus available for demonstration and test purposes.

All interested in wireless, whether beginners or expert, are invited to write to the Hon. Sec., or to attend one of the association's meetings, which are held weekly at the Northern Polytechnic, Holloway Road, N.1, commencing at 8 p.m.

Hon. sec., Mr. V. J. Hinkley, Northern Polytechnic, Holloway Road, N.

The Hornsey and District Wireless and Model Engineering Society.

On Friday, October 6th, a successful meeting was held.

A three-valve set was in use later, and good reception of the concert transmitted by 2LO to the Wireless Exhibition was enjoyed by all present. Also music and telephony from several amateur stations was quite clear. Weather forecasts from GFA and FL in Morse were taken down by several members.

Our membership is steadily increasing and a new programme has been formed. For particulars send stamped envelope to the secretary.

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

RADIOTORIAL

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

Broadcast licences can now be obtained for 10s., presumably at any post-office.

It is some six months ago since these licences were promised, but the fact of their being issued inclines one to think that broadcasting really will start—"in a fortnight's time."

I have heard some extraordinary rumours lately—and not idle rumours at that—from semi-official quarters which, to say the least of it, are disconcerting. Not to beat about the bush, I understand there is another little movement on foot to restrict amateurs, this time in connection with the size of frame aerials.

Details are scarce, but it appears that the official mind does not regard large frame aerials with favour, or some such nonsense, and that amateurs are to be so informed. However, a rumour is a rumour. There may be something in it, and there may not. In any case, I understand the Radio Association are quite wide awake.

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.

M. E. P. (Leeds).—I have in my possession a large number of condenser vanes which I should like to utilise. The vanes are 3 inches in diameter and ·035 inch thick. I also have some spacing washers of ·086 inch thickness. Can I use these for condensers of ·001, ·0005, ·0002 mfd. ?. If so, how many plates do I require for each ?

You would require 31 plates for the ·001 mfd. condenser, 17 for the ·0005 mfd., and 7 for ·0002 mfd.

* * *

A. P. C. K. (Letchmore Heath).—What is meant by the dielectric strength of a material ?

The dielectric strength of any substance is the property of that substance to resist the passage of a current through it. The dielectric strength is measured in terms of volts or kilovolts required to break down, or pierce, a given thickness of the material. The dielectric strength is a difficult quantity to determine, as it varies according to the conditions under which the experiments are made, such as the time for which the voltage is applied, presence of moisture, etc.

* * *

C. S. (Bedford).—As reactance is forbidden by the P.M.G., I wonder if you would tell me whether it is really necessary to employ it ?

Although reactance is a considerable help, especially for stations which are a fairly long way off, it is not absolutely necessary. In the place of the reaction circuit you can employ an H.F.—or radio-frequency—amplifying valve. This will help matters for the reception of some of the further stations, so that if you have a one-valve receiver with reactance, the addition of an H.F. amplifying valve will help to take the place of your reaction circuit, which is not allowed. If the signal strength is to be increased, an audio-frequency amplifier should be employed.

* * *

"REGENERATION" (Skipton, Yorks).—I am quite a novice with regard to wireless, but as I am a long way from London, and without much space to erect an aerial, I would like your advice about the Armstrong circuits. Which is the best to use ?

We are afraid that you will find the Armstrong super-regenerative receiver rather difficult to construct unless you have some fairly good experience with ordinary valve circuits. However, the receiver, when once completed successfully, will fully repay any difficulties or set-backs experienced during construction. The three-valve circuit is said to be slightly less complicated in constructional details than the one-valve circuit, and will give wonderful results. As you have no room for an outdoor aerial, it seems that you will have to use a frame aerial. Why not get experience with a frame aerial and four or five valves first, and then go on to the Armstrong circuits ?

You ask if it is necessary to employ inductance and earth with a frame aerial. Inductance may be used as "loading" when very high wave-lengths are required, but it is usual to wind the aerial so that it will cover the desired band of wave-lengths. The reactance coil may be coupled direct to the aerial, or else to a small coil inserted in series with the aerial. No earth is required with a frame aerial.

* * *

"YRNEH" (Edmonton).—What is the "silent point" in tuning in ?

In C.W. reception when the adjustments are such that the induced and plate oscillations are of similar frequency, and, therefore, no signals are audible.

* * *

G. M. N. (Oxford).—Upon what depends the efficiency of a transformer ?

Its efficiency for transferring energy from the one circuit to another with a minimum of loss. This latter can occur to a considerable extent should eddy currents that would tend to oppose the induced energy be generated in the core.

Why are some intervalve transformers wound with a ratio of 1-1 and others 1-5 ?

That will depend to a considerable extent upon the circuits in which they are employed. Where it is desired to transfer the energy from one L.F. circuit to another 1-5 is a useful ratio, inasmuch as all valves are potential operated devices, and that will mean a step up in pressure.

* * *

Why are the cores of transformers earthed in some circuits and not in others ?

The only reason for that is presumably owing to diversity of opinion as to the advantages of so doing. Earthing the core is said to materially increase the efficiency of the transformer, because it allows eddy currents to run to earth instead of creating noises and opposing the induced energy, and there seems no logical reason to suppose that such is not the case. Practically, however, we have found that although appreciable benefit appears to result in the majority of cases, in others there appears to be no difference at all.

* * *

J. L. S. (London).—Sound-waves are supposed to travel with a speed directly proportional to the elasticity of the medium through which they travel in air 1,090 feet per second, in water 4,707, and in steel 10,000 feet per second. If that is correct, why is it that the speed or velocity of wireless waves is said to be constant, without exception, when we are told that wireless waves are similar to any other waves ?

Your figures are correct except with regard to steel, which will vary with the mass of the metal to an enormous extent. Working to Young's Modulus of Elasticity, sound is supposed to travel through steel at about 15,500 feet per second. The general law which determines the velocity of a wave is that the velocity is directly proportional to the square root of the elasticity and inversely proportional to the

(*Continued on page* 562).

Horrors of Wireless : The Valve Tax Merchant.

Take up the sale of these Radio Sets

The "Cosmos" Crystal Type Radiophone, complete with aerial wire, insulators, "leading in" tube, one set of double receiver telephones and earthing materials.

THE "COSMOS" RADIOPHONE

makes an ideal

CHRISTMAS PRESENT.

The "Cosmos" Radiophone illustrated above is a thoroughly efficient Crystal Type Radio Receiving Set. It is made by the firm with a vast experience in every branch of the Electrical Industry, and can be thoroughly depended upon to give satisfactory results within its range.

We are also manufacturing a series of valve type "Cosmos" Radiophones, Note Amplifiers and Loud Speakers. All these types are designed to give perfect results and no technical knowledge is necessary. IT SHOULD BE NOTED THAT WE GIVE FULL PATENT INDEMNITY TO ALL PURCHASERS OF THESE SETS.

Important Note

All types of "COSMOS" RADIOPHONES conform with the Postmaster-General's Regulations.

Belfast
Birmingham
Bristol
Cardiff
Dundee
Edinburgh
Glasgow

THE Mark of Efficiency

METROPOLITAN Vickers ELECTRICAL CO. LTD

TRAFFORD PARK WORKS, MANCHESTER.

Send for Lists.

Leeds
London
Manchester
Newcastle-on-Tyne
Sheffield
Southampton
Swansea

Z02

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 560.)

square root of the density of the medium through which they travel and wireless waves travel through, or are presumed to according to the theory accepted by our leading scientists, that all-pervading, undefinable substance—ether. Therefore the velocity of wireless waves will depend upon the elasticity and density of this. No analogy holds good from every point of view, and waves in water, etc., serve but as a visible illustration of what wireless waves might look like if we could but see them.

* * *

"BEAVER" (Forest Gate).—On these automatic transmitters that work with a paper slip with holes in, does the contact for transmitting get made through these holes, and, if so, how does that happen, seeing that all the holes are of the same size?

No there is no actual electrical contact made through those perforations. It will be noticed that the perforated slip has a line of smaller holes running down the centre and that these holes are exactly in line with the larger ones that run along above and below. A small cogwheel engages the centre line of perforations and draws it through the machine. There are two little pegs that jump up and down rising so that they strike the paper slip exactly in line with the centre perforation. The paper will prevent it rising to its full extent, but the peg will not even mark the paper to any considerable extent owing to a fine spring arrangement. If no paper meets the peg as it rises a small lever is actuated in a direction according to whether it is the top or bottom peg. "No paper" while the instrument is running with a tape indicates a perforation in place as one or other of the two little pegs rise, and the transmission of signals will therefore depend upon the position and frequency of the larger perforations. If no slip is in the machine at all while it is running the little pegs jump up and down uninterruptedly, and the result is that the small lever inside moves backwards and forwards and causes the transmission of a series of "dots" such as can often be heard coming from one of the large stations just after the letters "NW" ("Now Wheatstone") have been sent, indicating the slight delay between the switching on of the automatic transmitter and the placing in position of the perforated slip. As a matter of fact that delay is often to allow the transmitter to gather up speed, which is necessary when the slip commences abruptly with the perforations.

* * *

"PUZZLED" (Burnham).—Why do you speak of the resistance of a long earth lead and advise the use of several leads, each one of which I note is of the same size as that used for the aerial?

Because a maximum of current exists at the earthed end of an aerial system. A very rough analogy would be that of a very high tower, say, 800 feet high. It would necessarily require to be much greater at the base than towards the top.

Would you consider 12 feet a long earth lead?

No, not unduly long.

* * *

"IGNORAMUS" (Ipswich).—Will a valve function horizontally or in any position, or must it be vertical?

It will function equally well in any position.

* * *

G. T. S. (Walthamstow).—I have been told that several stations—amateurs—transmit upon a wave-length of 60 metres; is this so? If I am correct, how is it that they can get down to that wave-length; surely their aerial and the necessary windings will prevent it?

We have heard of amateurs transmitting on the wave-length you mention, but not very recently. The method employed for such low wave-lengths is, of course, to place capacity in series with the aerial and the earth. This will mean a great loss of energy and efficiency, however, and this is why the low wave-lengths are not more often used for commercial purposes.

* * *

"DISTRESSED" (Tunbridge Wells).—I have been using a crystal receiver, and the other day I unfortunately broke a piece of the crystal off. What shall I do? I have only quite a small piece left, and, of course, the broken piece

You do not state the kind of crystal you have been using, but in all probability you will be able to use both the broken pieces. It not infrequently happens that a fresh series of sensitive points are discovered upon the new surfaces of a broken crystal. Test the pieces separately and it is quite likely you will find you have now got two good crystals in the place of the one you thought you had destroyed.

* * *

R. F. C. (Radlett).—I am still very hazy as to the difference between the various waves, wireless, light, heat, and sound. I cannot understand, for instance, why wind has no effect on wireless waves, but it blows sound waves all over the place; also it seems that heat waves are blown away as well, because on a hot day the wind very soon cools things down. I should be glad if you would clear these matters up.

In the first place, wireless, heat, and light waves are ether waves; sound waves, however, are air waves. As you know, ether is unaffected by air and air currents, therefore the wireless waves are unaffected by wind. Sound waves, however, being air waves, are, of course, destroyed or deviated by wind. With regard to the heat-wave problem, the reason you feel cooler in a breeze on a hot day is not due to the blowing away of the heat waves, but to the constant change of air—cooler than you are—and this causes heat to flow rapidly from you to the air. This, of course, raises the temperature of the air, but as the air is continually moving—owing to the breeze—the hot air is replaced continually by the cold, and so the heat keeps on flowing from you into the air. This loss of heat naturally makes you feel "cooler."

* * *

"VACUUM" (Aberystwyth).—I understand that the electric light bulbs are partly evacuated so that the filament will last longer. Why is this? Could I not evacuate bulbs by passing an electric spark through them, thereby using up the oxygen?

The reason why electric light bulbs are partly evacuated is, as you say, to prevent the burning out of the filament. If the air was allowed to remain in the bulbs, the heated filament would be oxidised by the oxygen present and thus "burn out." It is to prevent this oxidation that the bulbs are evacuated. Your idea is quite good, but unfortunately would not work, owing to the chemical side of the experiment. When an electric spark is passed through air it does not use up all the oxygen. Instead, it causes the oxygen atoms to rearrange themselves. Some of them attach themselves to the nitrogen atoms that are present, forming oxides of nitrogen, while the other undergo a curious change. Usually, oxygen atoms are in pairs—O_2—but the electric spark breaks up these little groups and causes the atoms to join up in "threes"—O_3. This is known as ozone, and is the cause of the peculiar smell accompanying an electric discharge through air. So that all you would do by passing an electric spark through a bulb of air would be to change the positions of the atoms of the oxygen present. Instead of each three groups of O_2, you would have two groups of O_3,—and thus you would be no nearer the vacuum you were hoping to create.

* * *

M. J. H. (Nuneaton).—What is the function of the two jacks in the Armstrong circuit shown in No. 22 of POPULAR WIRELESS? Can I use anything in the place of the jacks?

(*Continued on page* 564)

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page* 562).

The jacks shown in Fig. 3, page 468, perform the function of bringing in either two or three valves as required. The single jack on the right of the diagram is for the telephones and can be replaced by terminals. The double jack between No. 1 and No. 2 valves operates in two ways. As shown it connects the primary of the intervalve transformer to the variometer and the plate of the second valve, thus bringing the third valve into operation. When the telephone plug is inserted the above circuit is automatically broken, the third valve being disconnected while the 'phones are in circuit with only the first and second valves operating. Instead of this jack a double-pole single way switch could be inserted, connecting the variometer and the plate of the second valve to two terminals and to the centre of the switch while the other ends of the switch are connected to the primary of the intervalve transformer. When the switch is open the two valves are used—the 'phones are onto the two terminals—and when the switch is closed, the third valve is brought into operation.

* * *

"PUZZLED" (Ipswich).—I understand that I cannot use a reactance coil at all now, not even with a secondary coil coupled to the A. T. I. I have a two-valve set, one H.F. and one detector, can I do anything about the reactance problem ?

Yes, if you care to use a basket type transformer for your valve coupling, the reactance can be coupled to the transformer.

* * *

Y. K. (Oldham).—What is the difference between honeycomb and lattice coils ?

In winding a honeycomb coil the turns wave from side to side in such a manner that alternate layers do not cross in parallel. In the case of lattice coils every other layer is wound straight round as in the case of single layer solenoid coils.

* * *

Why do not H.F. transformers have iron cores ?

Because the intensifying of the magnetic field by introducing an iron core would provide an impedance to H.F. currents. An L.F. transformer acting as a choke to these latter is provided with such a core.

* * *

"PERPLEXED" (Wansfead).—Are licences still to be issued for home made sets, as I cannot obtain any information from the local post office ?

Yes. Experimental licences to be obtained from the Secretary, G.P.O., London, will still be issued in exactly the same way as previous to the inception of broadcasting. The granting of broadcasting licences is for a specific purpose and will in no way affect the issue except in point of hours and wave-lengths of transmission and the use of reaction in order to prevent interference.

* * *

H. A. (Tonbridge).—What would be the capacity of a variable condenser of 31 plates effective area of moving plates 15 sq. cms., distance between fixed and moving plates 1313 cms. ?

.0003 cms. approx.

* * *

B. V. D. (Bristol).—What is the principle employed in the construction of electro-static measuring instruments; is it anything to do with capacity, as I notice that the electro-static voltmeter looks extremely like a variable condenser ?

In these electro-static instruments there is no current flow as in the moving coil and electro-dynamic instruments, hence the term static—stationary. The principle is that the attraction between two oppositely charged conductors is proportional to the square root of their difference in potential. Interleaved brass vanes are employed, but as the distance between the fixed and moving vanes varies from '2 in. for 2,000v. instruments up to 2 in. for 20,000v. capacity value is small. It will be observed that the construction in simplicity and compact ness (only 10 or so vanes are required) is ideal for high pressure work.

* * *

"COLONEL BOGEY" (Chadwell Heath).—Referring to the article on the construction of the Armstrong Super-regenerative circuit, do the figures L-1250, etc., refer to the number of turns ?

No. L is the symbol for inductance, and the practical unit for this is the microhenry. Therefore the above figures represent the microhenries of inductance value required for the coil.

* * *

"ONLY AN AMATEUR" (Renfrew).—What dimensions should my former be to cover all wave-lengths using 22 S.W.G. ?

We advise you to use 24 S.W.G., otherwise you will need such a large former. To cover the most important wave-lengths 250 or 300 metres to 2,600 metres, use a 10 in. by 5 in. former wound with about 380 turns of 24 S.W.G. This will easily take you up to about 2,800 metres. The set you mention should certainly satisfy the P.M.G.'s requirements.

T/Y

I've got Mullard Accessories

The wireless components with a world-wide reputation of many years' standing.

They will ensure your getting a set which looks well, works well, and "speaks" well.

For receiving vocal and instrumental items you must have the

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.

Trade RADIO MULLARD VALVE Mark

Please send me post free

Quantity.	Description.	Price.
	Telephone Head Sets	Type A. 30/- Type B. 35/-
	"ORA" Valves	15/- each
	Grid A Resistances	5/- each
	Anode A or B Resistances	5/- each
	BA Condensers, mfd.	2/6 each
	.0003 mfd. Combined Resistance and Condenser	7/6 each
	Valve Bases with Terminals	5/- each
	Valve Sockets	1/3 each
	Terminal Clips	9d. per pair

Name and Address

Name of usual Wireless Dealer

I enclose (Cheque, Money Order, P.O.) value ..... to cover the cost.

To the MULLARD RADIO VALVE CO., LTD., 45, Nightingale Lane, Balham, London, S.W.12.

SEND THIS TO-DAY.

Printed and published every Friday by the proprietors, The Amalgamated Press (1922), Ltd., The Fleetway House, Farringdon Street, London, E.C.4. Advertisement Offices: Messrs. J. H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates: Inland and Abroad, 17/4 per annum, 8/8 for six months. Sole agents for South Africa: The Central News Agency, Ltd. Sole agents for Australia and New Zealand: Messrs. Gordon & Gotch, Ltd.; and for Canada: The Imperial News Co., Ltd. Saturday, November 18, 1922.
Y/Y

POPULAR WIRELESS WEEKLY. November 25, 1922.

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

No. 26. BROADCASTING HAS BEGUN.

POPULAR WIRELESS

3d.

Weekly

No. 26. Vol. 1.
Nov. 25, 1922.

LEARNING THE MORSE CODE.

FEATURES IN THIS ISSUE:

How to Make a D.F. Station.
An Accumulator H.T. Unit.
Making a Volt or Ammeter.
Notes on the London Ether.
A Valve Detector Panel.
Hints to Amateurs.

Popular Wireless

TOPICAL NEWS AND NOTES.

At Last!

BROADCASTING began on November 14th. I have been waiting a long, long time to write those brief words, and now that I have written them I find it hard to realise they stand for something that has at last been accomplished.

When I heard the news I could at first hardly believe it.

Some friendly fellow 'phoned up the office and warned the Editor to prepare for a great shock; but no one spared *my* feelings, and can you wonder that I fainted right away when I opened "The Times" and saw the amazing news?

The Latest Recruit.

Press News.

TRUE, broadcasting is not yet quite on its legs; but it was a happy thought of the powers that be when they decided to give us a limited service until the final formalities had been completed.

It is gratifying to learn that the Broadcasting Company has come to a complete understanding with the Press with regard to the broadcasting of news matter. We may yet get our football results and the verdict of the 3.30 by Radio.

* * *

Sir William Noble.

I WONDER how many amateurs realise what a deep debt of gratitude they owe to Sir William Noble, the chairman of the Broadcasting Company? Sir William has devoted considerable time to broadcasting problems, and in no small measure is due to him the fact that broadcasting began the other day. His position as chairman of the Broadcasting Company has not been an easy one by any means; it is a position calling for any amount of tact and patience.

But, although we have not seen his name in the papers displayed with as much ostentation as those of lesser lights in the broadcasting firmament, readers of POPULAR WIRELESS can take it from me that Sir William Noble is the chief navigator of that somewhat overdue ship, the Broadcasting Company. The voyage has been perilous and difficult, but Sir William has proved a first-class pilot. Our best thanks to him.

* * *

The B.C.'s Plans.

SIR WILLIAM outlined his plans to "The Times" recently. "At the beginning," he said, "broadcasting will be conducted purely from a social point of view. Each evening there will be given a brief synopsis of the world's news, prepared by the four Press agencies who are acting together to supply the company with such a synopsis twice nightly. Then the Meteorological Department of the Air Ministry is supplying us, at first at any rate, with two weather reports. It may be that we shall arrange for a third report, but that has not yet been fixed up. The first of the two reports will be given directly the station opens, and the other between 9 p.m. and 10 p.m. In addition to this news there will be concerts, instrumental and vocal, and it may be that later we shall arrange for speeches written by popular people to be broadcast."

* * *

2 LO.

IT was only fitting that broadcasting should begin from Marconi House, for after all, Marconi's are the pioneers of the great game of ether shaking, and their services to the world have yet to be fully appreciated.

The transmissions from 2 LO have, as all amateurs will agree, been consistently good; and it will be a lucky broadcasting station that secures the services of such an excellent "announcer" as that gentleman whose voice we are so familiar with at 2 LO.

How many times have we heard him say: "We hope you have enjoyed our concert," and how many times have our feminine friends, invited in to hear the music, involuntarily cried out: "Yes, thank you, we have!" as 2 LO regretfully announced "We are now closing down?"

* * *

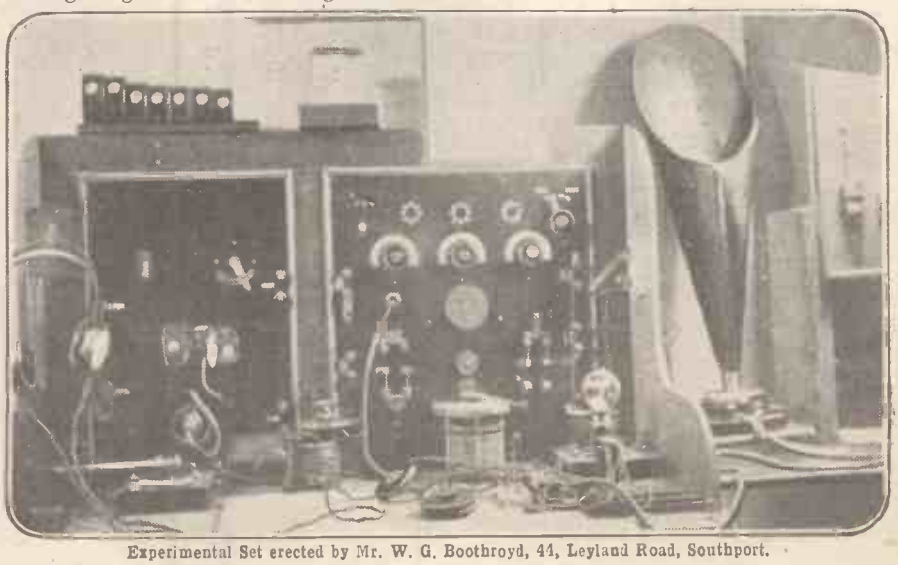
A Radio "Big Ben."

THE Election Results from 2 LO were well received by amateurs in many parts of the country. The "Big Ben" effect, caused by a chiming clock in the transmitting room at Marconi House, came out wonderfully well on my loud speaker and rather puzzled the household. The sonority of the "bell tone" is really remarkable, and the accuracy of the time given likewise.

* * *

The New Broom.

I HAVE been making enquiries among various manufacturers, and many assure me that there is already a noted revival all over the country in broadcasting. It was only natural that public interest should wane when broadcasting was delayed again and again, but now that it has really commenced the old enthusiasm of six months ago has broken out afresh, and business will certainly be brisk in the wireless line.



Experimental Set erected by Mr. W. G. Boothroyd, 44, Leyland Road, Southport.

NOTES AND NEWS.

(*Continued from previous page.*)

For the Beginner.

THE Editor asks me to say that a new special supplement for beginners will shortly commence in POPULAR WIRELESS. This supplement will in no way interfere with the present standard of technique attained by the paper. Readers who have taken in POPULAR WIRELESS from No. 1 will, naturally, not want to start all over again, but for new readers a special section will appear weekly to cater for their needs. The instruction given in the supplement will be elementary, well condensed, and not in any way wholly technical. I feel sure this supplement will meet with general approval.

* * *

Wireless and the Show.

IN connection with the broadcasting of messages by 2 LO on the occasion of the Lord Mayor's Show, the sounds of the passing bands, conveyed by the transmitting microphone on the seventh floor of Marconi House, were heard clearly in many London and suburban districts and at the following provincial towns:—Towcester, Tamworth, Rye, Peterborough, Horsham, Reading, Margate, King's Lynn, Nottingham, Ramsgate, Coventry, and Cambridge.

Many correspondents also heard the cheering of the crowds and the marching of the troops.

* * *

Various Items.

Messrs. Burne-Jones & Co., Ltd., of Kennington, exhibited, by means of their automatic advertising machine, the election results a few seconds after their reception by Broadcast Wireless.

* * *

The call letters 5 H X have been allocated to Mr. Colin H. Gardner for telephony and C W stations to be utilised for the purposes of carrying out experiments with radio from racing-cars at Brooklands.

* * *

Messrs. Fuller's United Electrical Works, Ltd, of Chadwell Heath, point out that they are the patentees and manufacturers of the Patent Block Accumulator described recently in these notes. The City Accumulator Co. is one of their many dealers.

* * *

Seven of the largest manufacturers of wireless apparatus are seeking the Australian Federal Government's permission to form a company to establish a general broadcasting system for wireless telephony.

* * *

The Programme.

It may interest some readers who have not yet listened in to the broadcasting from 2 L O to know exactly what can be heard. Last Sunday evening, for instance (Nov. 19th), 2 L O rang up the curtain sharp at 6 o'clock. The announcer then read out some late news items, a weather report, and then an amusing description of the Broadcasting Studio. This latter item was obviously for the benefit of the children. I should not be surprised to learn that the speaker is a happy father! Anyway, he knows how to interest children.

From 8.0 to 9.0 there was a concert, and from 9.30 to 10.0 another batch of news items, a weather report, and, to conclude with, another short concert.

Mr. J. H. Shaw's set, Rock Cliff, Gratrix Lane, Sowerby Bridge, Yorks.

* * *

The Chimes.

By the way, the mystery of the chiming clock was given away last Sunday evening. It isn't a clock; it's a batch of tubular bells and a brass gong!

* * *

A Correction.

The author of the article, "Altering Wave-length," wishes to thank F. G. F. (Stanford Grove), H. G. (Manchester), and S. P. S. (Ulster) for pointing out the arithmetical error contained in the above article.

It is, of course, obvious that $\frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3} = 1$, and that $\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$, and the author expresses his apologies to any readers of POPULAR WIRELESS whom he may inadvertently have misled by the wrongly given figures.

ARIEL.

Broadcasting Programmes

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

TELEPHONY AND MUSIC TRANSMISSIONS.

Station.	Call sign.	Wave-length in metres.	Remarks.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Marconi House, London, Broadcasting Station	2 L O ..	360 ..	Every evening, 6 p.m. and 9 p.m. Continuous service to be given shortly.
Writtle, Essex	2 M T ..	400 ..	Tuesdays, 8 p.m. (Concert.)
Paris	F L ..	2,600 ..	7.20 a.m., 11.15 a.m., 5.10 p.m. Also occasional telephony at 10.10 a.m. and 9.20 p.m.
Königswusterhausen ..	L P ..	2,800 ..	Between 6 and 7 a.m., between 11 and 12.30, and between 4 and 5.30 p.m.
The Hague	P C G G ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert.)
Haren	O P V H ..	900 ..	Practically every 20 minutes past each hour from 11.20 to 4.20, giving messages to aeroplanes on the Brussels-Paris, Brussels-London, and Brussels-Amsterdam lines.
Radio-Electrique, Paris	—— ..	1,565 ..	Concerts at 9.45 p.m.
Brussels Meteorological Institute	O P O ..	1,500 ..	Slow C.W. and Morse. Easy reading for amateurs.
Messrs. Burnham* (Blackheath) ..	2 F Q ..	440 ..	About 9 o'clock in the evening.
Newcastle*	5 B A ..	440 ..	Between 6 and 7.30 p.m.
Manchester Broadcasting Station	2 Z Y ..	385 ..	Every evening, 6 and 9 p.m.
Birmingham (Witton) Broadcasting Station	2 W P ..	425 ..	Every evening, 6 and 9 p.m.

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

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

All times given are G.M.T.

An asterisk denotes transmissions made purely for experimental purposes.

HOW TO MAKE A D.F. STATION.

By MICHAEL EGAN.

PART I.

MANY people think that wireless direction-finding instruments are altogether different from those that are ordinarily employed for purposes of reception and transmission. In some cases direction-finding instruments *are* quite different, but not necessarily so.

Practically everyone who has begun to take an interest in wireless matters is already acquainted with the "frame" aerial. Well, a frame aerial *is* a direction-finding aerial, when used in a certain manner.

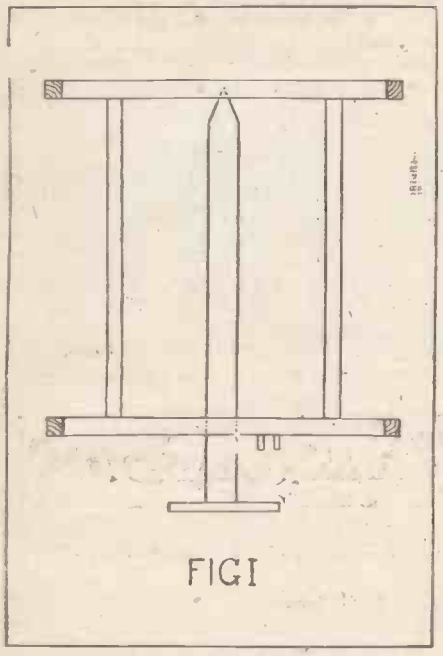


FIG I

A frame aerial is also frequently referred to as a "closed" or "loop" aerial, and of these terms the latter best expresses its particular character. That is to say, an ordinary loop of wire constitutes a simple direction-finding aerial.

As has been suggested, however, certain conditions have to be fulfilled in order to get accurate results. For instance, the aerial should be symmetrical. That is, its shape should be *regular, i.e.*, in the form of a triangle, a square, or an oblong. It must be capable of being rotated freely round a fixed axis. Also, it must be used in conjunction with a compass card, which is set with reference to some fixed point, e.g. true north. The method of doing this will be explained later.

First of all, with regard to the making of a directional aerial, it may be said that a square frame is the most suitable form. By means of a spindle passing through its centre it can be made to rotate freely. This is illustrated in Fig. 1, which shows a frame ready to receive the aerial windings.

Four lengths of wood are screwed together as shown. For an aerial of, say, 3 foot sides, the actual dimensions of the wood used should be 2 ft. 10 ins. by 2 ins. by 1 in., except in the case of the lower horizontal piece, which should be 3 ins. instead of 2 ins. wide, in order to allow ample width for the passage of the spindle through it.

At the corners of each of the horizontal pieces, four smaller pieces of wood, 6 ins. by 1 in. by 1 in., are screwed on. In the illustration the 1 in. sections of all pieces of wood are seen. These smaller pieces can, in fact, be 8 ins., or longer, their sole function being to allow room for the spacing of the wire as it is wound round the frame.

The size of the frame does not, of course, depend upon the wave-length which it is desired to receive. It depends on one thing only, namely, the amount of space at your disposal. In other words, the bigger the frame the better.

The number of turns of wire wound on the frame governs the wave-length, just as length of wire used governs the "natural wave-length" of an ordinary outdoor aerial. In the case of loop aerials, moreover, this factor of natural wave-lengths is much more sharply defined than in the case of open outdoor aerials.

Winding a Frame-aerial.

In other words, if the natural wave-length of a frame aerial is, say, 400 metres, you will hear extremely little on wave-lengths below 350 metres or above 450 metres, even though you use a condenser to vary the value of your circuit. For this reason it is advisable for the amateur who wishes to carry out direction-finding experiments to decide upon what wave-length he wishes to receive (e.g. the broadcasting wave or the amateur transmitting wave), and wind his aerial accordingly.

The number of turns of wire to be used in each case will depend therefore upon (1) the size of the frame you have built, and (2) the particular wave-length you have chosen for reception. For this reason the best rule to follow in practice is: Make your frame first *as large as possible* and then find by experiment the number of turns of wire required for your purpose.

As a rough guide, a frame aerial of 4 ft. sides with 7 complete turns spaced at half an inch apart should give good signals from broadcasting stations. With a larger frame, of course, fewer turns of wire would be required.

The direction-finding powers of a frame aerial are due to the following fact. It is characteristic of a closed loop of wire that when it is set with its plane pointing towards a transmitting station it will pick up a maximum amount of energy from that station, or, in other words, signals of maximum loudness will be heard in the receiver attached to it. Similarly, when it is set with its plane at right angles to the transmitting station, no signals will be heard at all.

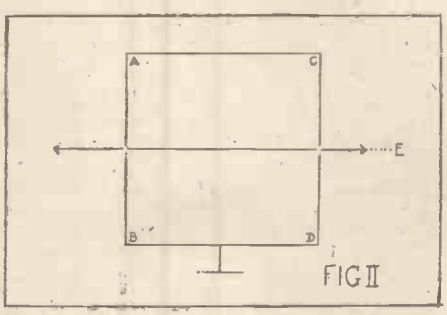


FIG II

These two positions are usually referred to as maximum and minimum (or "zero") positions, and, in revolving the aerial from the former to the latter (*i.e.*, through 90°) a constant diminution in strength of signals will be observed. Furthermore, if the revolution of the aerial be carried on in the same direction, signals will commence to be heard again after the zero point has been passed, and, when the aerial has been swung through another 90°, signals of maximum strength will once more be heard.

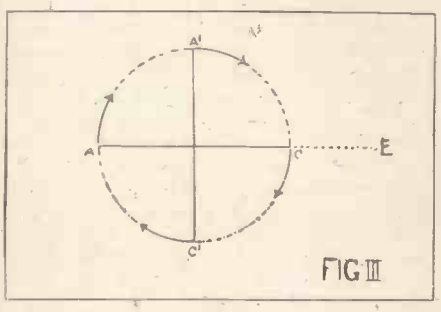


FIG III

This merely means that, with reference to any particular transmitting station, there are two maximum and two minimum positions for each frame aerial. Reference to Figs. 2 and 3 will make this clear. Fig. 2 shows the plane of a single loop aerial. The line with the arrows, drawn across the plane, shows the two directions from which maximum signals could be received. Similarly, if we imagine the transmitting station at E, maximum signals will be received whether the side AB or CD is nearest to it.

First Principles.

Fig. 3 shows the plan of the aerial, A^1C^1 representing the position taken up by the aerial after it has been revolved through 90° in a clockwise direction as indicated by the arrows. In this latter position, therefore, no signals would be picked up from the station at E.

How, then, can we find the direction of a transmitting station in practice? Let us assume that we have just heard signals from a station of whose whereabouts we know nothing. On swinging our frame aerial in, say, an anti-clockwise direction, we find that signals get gradually louder. Continuing they get still louder, until, after a certain angle has been passed through, they begin to diminish in strength again.

If we stop the rotation of our aerial just before this diminishing process begins, *i.e.*, at the maximum position—we now know that the transmitting station is in a line with the plane of our aerial, as explained in reference to Fig. 3. It must be remembered, however, that we have as yet no means of telling which side of our aerial it is on. We only know that it does lie along that line on one side or the other. Similarly, we cannot as yet tell how many miles away it is.

(To be continued.)

THE CONSTRUCTION OF A SIMPLE VOLT OR AMMETER

THE first component will be a bobbin of the shape and size shown in Fig. 1, and should have a space in the centre 1¼ by ¾ by ⅞ in. deep. On the inside of the bobbin are fastened two bearings of brass, shaped as in Fig. 3, in the position indicated by Fig. 2.

The armature is a piece of steel 1 by ⅜ by ⅛ in., and is pivoted upon a mild steel spindle ⅝ in. long and ⅛ in. diameter, and is filed at the ends to a knife-edge to fit the bearings. The armature is fixed below the spindle in order that its own weight may keep it in a horizontal position. The pointer is next made from a piece of aluminium wire, the three being fastened by sealing-wax or soft solder, as in Fig. 4. If the spindle is countersunk in the top of the armature a better job will be the result, as the element will be more delicately balanced.

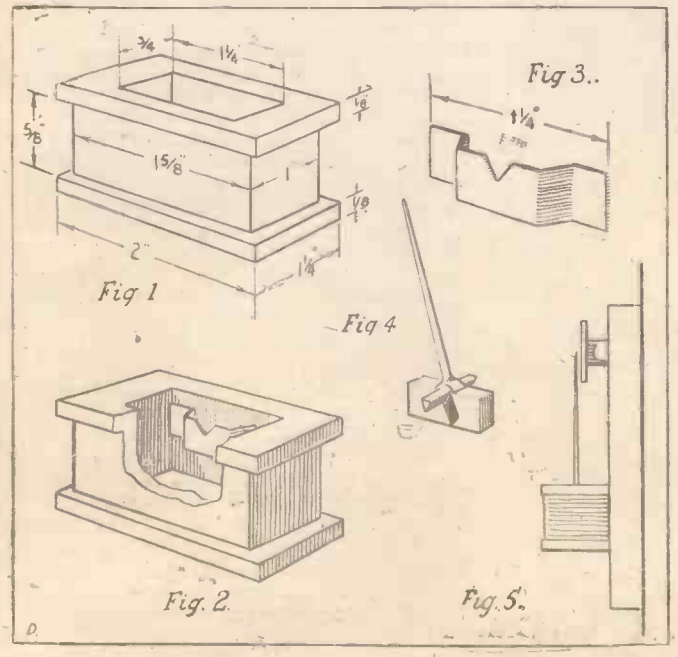
The Windings.

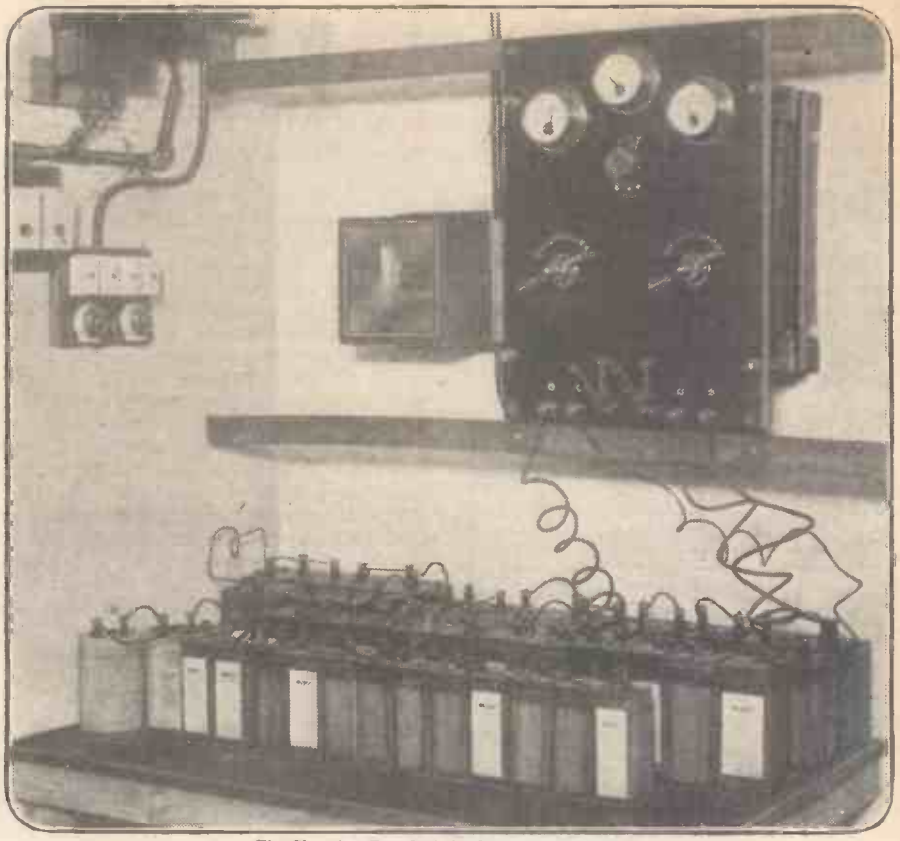
The armature should be magnetised by stroking it in one direction with the one pole of a fairly powerful magnet. The bobbin should now be wound full of 40 S.W.G if required for a voltmeter, and with 18 S.W.G. if for an ammeter. After winding, the bobbin should be given a coat of shellac, and can then be fixed on a hard wooden base 4½ in. diameter. Fig. 5 shows the position of the bobbin, together with the needle and scale, the two wires being brought to terminals on each side.

A cover may be made to fit over the working parts, but as this is very simple to construct, I will leave that to the taste of my readers.

To calibrate the scale a standard meter will be required; for a voltmeter the meter must be connected up in parallel with the standard voltmeter, and the scale marked in ink with the readings the standard meter indicates.

In the case of the ammeter the two instruments should be placed in series.





The Charging Board of the City Accumulator Co.

USEFUL CONDENSERS.

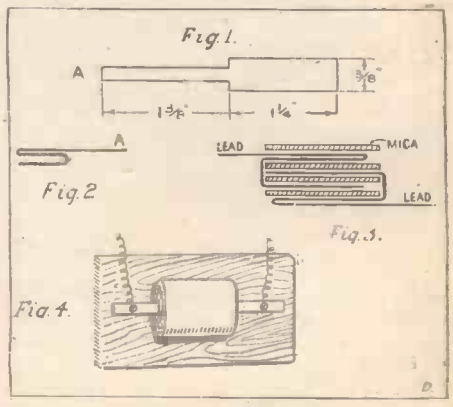
AS the inventor of the H.F. resistance coupled multi-valve sets, M. Brillouin writes in the Paris "T.S.F. Moderne": "The intervalve condensers should have a capacity of 0·0005 Mf. with the exception of the last stage, which should be 0·0001 or 0·00005 Mf."

The materials required are: 5 sheets of very thin mica ¾ in. square, 2 sheets of lead about $\frac{1}{24}$ of an inch thick, a few inches of adhesive insulation tape, some rubber tape, and a sheet of paper.

The lead is cut as shown in Fig. 1, then folded as in Fig. 2. The sheets of mica and lead are then put together as in Fig. 3. To keep the whole together, first roll around, perpendicular to the ends of the lead, a bit of the rubber tape, then some adhesive tape, and, last of all, a few inches of paper ribbon. Take a hammer, and with light strokes flatten the whole.

The two ends of the lead are used as terminals; a hole is made in them, and with two screws the condenser is fixed to the base of the set, two copper wires being fixed with the screws to the lead (Fig. 4).

Experimenting has proved that those condensers are as good as the very best on the market; but, instead of costing a lot of money, they can be made for a very small sum, and are everlasting. Instead of mica, waxed paper can be used for the condenser of 0·00005 Mf., or the sheets of lead cut smaller.



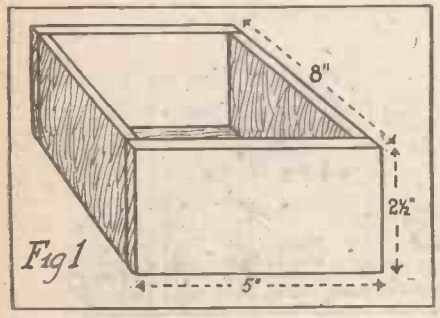
HOW TO MAKE A DETECTING PANEL.

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

THE first and all-important component in valve panels is the detecting panel. From an electrical dealer a piece of ebonite is purchased, 8 in. by 5 in. by $\frac{3}{16}$ in.; it is upon this the various parts are to be assembled. A case should next be made to mount the ebonite upon, a suitable and economical wood for this purpose being satin walnut of $\frac{3}{8}$ in. thickness.

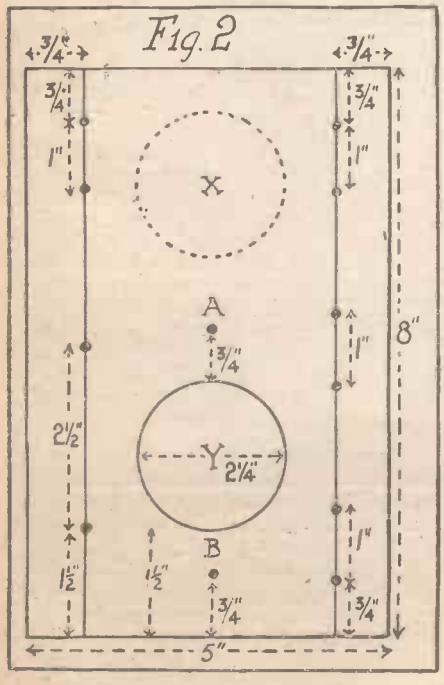
This should be built up as per Fig. 1. The case, having been made, is now ready for the ebonite, which should be marked out as per Fig. 2.

It is now necessary to drill the holes to take the ten terminals, and the size of these



will naturally depend upon the type of terminal the reader should choose to employ. To those possessing a drill this will be a simple matter, but to the less fortunate this can be easily overcome by piercing small holes with a red-hot bradawl, afterwards stretching them to the desired size by the use of a small round file.

We are now ready to mount the valve holder and filament resistance. The first should be mounted in the position X, Fig. 2, and the method of fixing will depend upon the type of valve holder employed. A very good valve holder can be purchased from



the various manufacturers at a price from 1s. 6d. to 3s. 6d.

The reader will not be ill-advised should he purchase an ex-Army valve holder taken from a Tb 3-valve amplifier, price 2s. In this case four holes are drilled to take the connecting wires from the plate, grid, and filament, and the holder can be conveniently mounted to the ebonite panel by two small screws and nuts passed through the flange (already drilled) and the panel.

We next come to the filament resistance. This is mounted below the valve holder in the space Y, Fig. 2. A suitable and cheap resistance can be purchased from the same source as the valve holder, also being taken from a Tb valve amplifier, and this should be mounted as follows:

Grid Condenser.

A circle is cut out of the ebonite 2¼ in. diameter (see Y, Fig. 2) with a fretsaw. The resistance is now placed up under the panel, and the spiral will be found to nicely fit into the circle cut.

The holes A and B should now be drilled through the panel and the ebonite of the resistance, to take two small screws and nuts, in order to hold the resistance in position. The resistance should be so placed that the stop against the switch is opposite the screw B.

Should there be any difficulty in purchasing a resistance of the type mentioned, any of the resistances advertised for panel mounting can be employed, the various methods of mounting being left to the choice of the reader. The foregoing parts being assembled, it is now necessary to construct the grid condenser and grid leak.

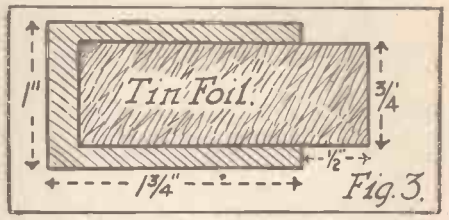
The condenser is made up as follows:

A piece of stout, good notepaper is taken, and thoroughly immersed in melted paraffin wax. When cool, six pieces are cut 1¾ in. by 1 in. A sheet of tinfoil is now purchased, and cut into four pieces each 2 in. by ¾ in. Upon one of the pieces of waxed paper a piece of tinfoil is placed, as per Fig. 3, leaving an overlap of ½ in. on the right-hand side. Another piece of waxed paper is then placed over the tinfoil. A second piece of tinfoil is placed, this time the ¼-in. space being upon the right-hand side and the ½-in. overlap upon the left-hand side.

This process is repeated, and the finished condenser should appear as per Fig. 4, with two thicknesses of paper upon the top. The two ends of overlapping tinfoil should now be folded over the top of the waxed paper, and a short length of flex soldered to each, care being taken not to have the solder too hot, or the foil will melt. The whole should now be placed between two pieces of waxed cardboard, 1 in. by 1¾ in., and bound with waxed tape, the two ends of flex protruding one each side for about 3 in.

The grid leak is next constructed. A piece of slate pencil 2 in. in length is taken, and for a distance of ½ in. from each end thoroughly rubbed all round with a copying-ink pencil. The pencilled ends of the slate are now bound for ¼ in. from each end with thin, bare copper wire about 30 S.W.G., the ends being twisted as a lead for soldering to. A good connection from the wire ends to the pencilling is now ensured. The intervening space X, Fig. 5, between the pencilled ends should now be lightly rubbed all over with an ordinary lead pencil, and tested in the following manner:

A battery (H.T.) of about 40 volts is connected in series with a good pair of 'phones and the grid leak. Upon making and breaking the circuit a faint click should be heard in the 'phones. Should this tend to be a



heavy click, the portion X (Fig. 5) should be rubbed with the finger to remove a little lead until the desired result is obtained. The actual resistance value of the grid leak is not critical, and can be best adjusted under working conditions. Our panel is now ready for wiring. The best wire for this purpose is rubber-covered wire of about No. 20 S.W.G.

The lettering of the terminals can be followed by Fig. 6.

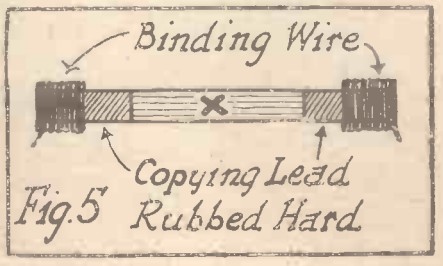
From the L.T. + terminal a lead is soldered to the end of the filament resistance wire. (This will be found to be finished off round a brass screw.) A second lead is taken from the centre of the switch arm to the right-hand side filament leg of valve holder. From the L.T. − terminal a lead is taken direct to the left-hand filament leg.

The filament lighting circuit is now completed, and should be tested. Place a 4-volt accumulator across the terminals marked L.T. and a valve in the valve holder. The valve should now light up, and its brilliancy should be adjustable by the filament resistance.

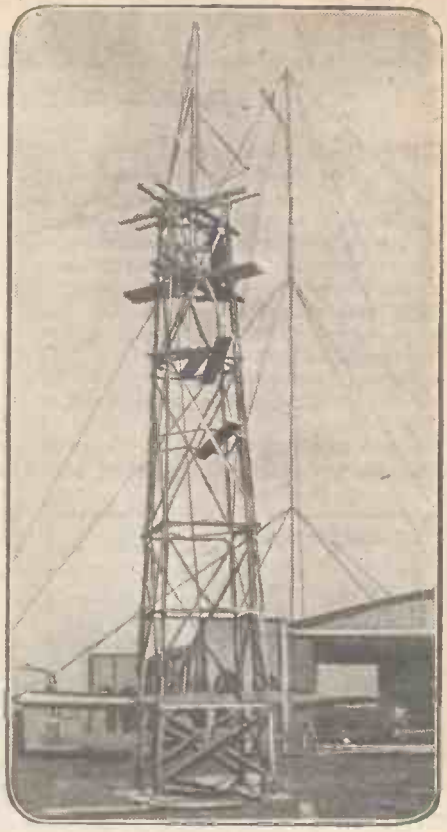
We now wire the H.T. circuit as follows:

From the H.T. + terminal a lead is soldered and taken to the top terminal marked R1, from the R2 terminal another lead is taken to the terminal P1, from P2 a lead is taken to the anode or plate leg of the valve holder.

(*Continued on page 570.*)



Will the owner of this very fine experimental set please communicate with the Editor? The above photo was sent in, but minus both name and address.



Erecting one of the wireless masts at Croydon.

HOW TO MAKE A DETECTING PANEL.

(*Continued from previous page.*)

A lead should now be soldered from the H.T. – terminal to the L.T. – terminal, thus completing the H.T. circuit.

The earth lead should now be soldered from the terminal marked F (filament) to the negative filament leg. The grid condenser should now be mounted against the left-hand side of the case by means of a piece of fibre screwed across it to clamp it, or by four screws, so as to come just under the terminal G when the panel is placed in position.

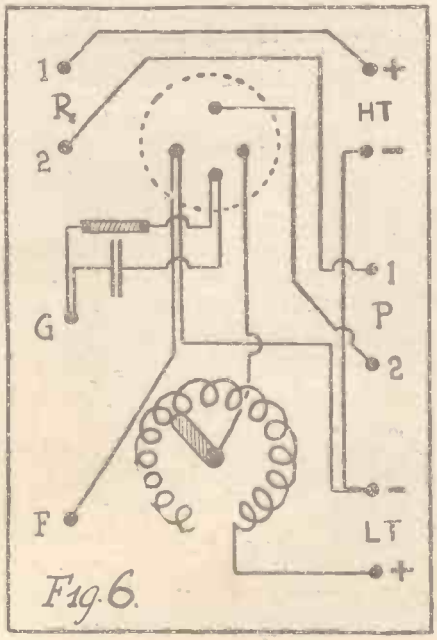


Fig. 6.

The panel should now be screwed down to the case by means of eight $\frac{1}{2}$-in. brass screws along the edges, two to each side and $\frac{3}{16}$ in. from the edge, and countersunk. A piece of fine glasspaper is now used to finish off the ebonite flush with the woodwork. One of the grid condenser leads should now be soldered to the terminal lettered G and the other to the grid leg of valve holder.

The Complete Panel.

The grid leak should next be connected by stout pieces of wire soldered to the binding wire at each end, one connection to the G terminal and one to the grid leg as with the condenser, the stout wire holding the leak in position; thus the grid leak will be seen in parallel or across the condenser.

Having accomplished this, it now remains to make a suitable base to cover the bottom, and the woodwork should be finished with varnishing or polishing to suit the taste of the reader.

Our valve detecting panel is now completed, and if constructed as above will be found to equal both in appearance and performance any of the panels advertised at £2 2s. It will be observed that the 'phones are placed in the plate circuit and not the filament side of the high-tension supply. This is because it is intended to add low-frequency panels, when it will be essential for the transformer employed in a second panel to be placed in the plate circuit of th detecting valve.

Cost of Materials.

	s.	d.
Ebonite (8 in. by 5 in. by $\frac{3}{16}$ in.)	1	6
Satin walnut	1	6
Ten terminals	3	0
Valve holder	2	0
Filament resistance	4	6
Screws and nuts, etc.	0	9
Tinfoil and slate	0	3
Sundries, wire, etc.	0	6
Total—	14	0

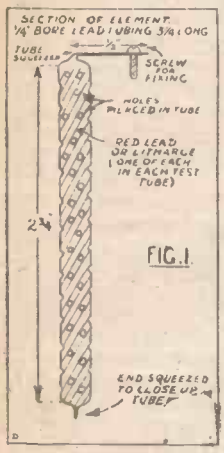
P1 and P2 are the 'phone terminals and "G" and "F" aerial and earth respectively, across which will be the coil or coils and variable condenser used for tuning purposes. When the panel is employed in a single valve-receiving circuit, reaction cannot be used and it will therefore be necessary to connect the terminals R1 and R2 together with a short brass strap or length of wire. The inclusion of these terminals will prove useful where intervalve reaction is contemplated, or for the the purpose of bringing into series a second pair of telephone receivers.

AN ACCUMULATOR H.T. UNIT.

By W. HILL.

THE size of the battery will vary with requirements, but if it is remembered that one cell will give approximately 2 volts, then the number of cells required to furnish the given voltage can easily be found.

The following are the constructional details and diagrams of a battery which will furnish a potential of 32 volts, necessitating 16 cells.

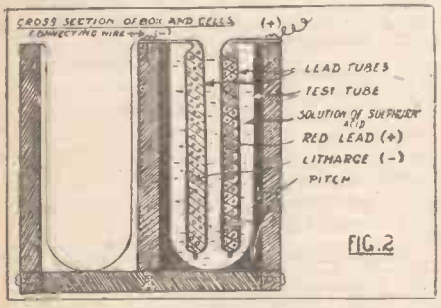


Materials Required.

1. 16 test-tubes, ¾ in. to 1 in. diameter by 3 in. long.
2. About 10 ft. of ¼ in. bore lead gas-tubing.
3. ½ lb. red lead, ½ lb. litharge; the filling from old accumulator plates can be used.
4. 2 lb. pitch, obtainable from local gasworks.
5. Wooden box 1 ft. long by 3 in. deep by 2½ in. broad, with a wooden division dividing it into two 1¼-in. sections.

Construction.

As shown in Fig. 1, the elements or plates of each separated cell consists of two 3¼-in. lengths of the lead tubing, with holes pierced all round. From one end a length of ½ in. is squeezed and bent at right angles, with a hole bored near the end. One tube is



then filled with red lead and the other with litharge, the open ends being squeezed for ¼ in. to close them up. The positive tube will be the one filled with red lead (oxide of lead); 16 tubes with red lead and 16 with litharge will be required.

The test-tubes are then put in box and the box filled up with molten pitch. There should be sufficient to reach the mouths of the test-tubes.

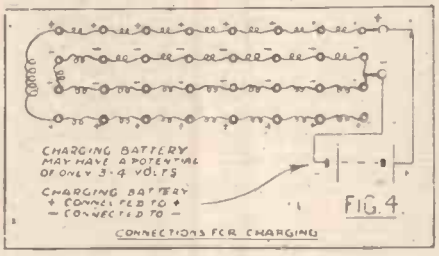
The lead tubes are then put into each test-tube and fastened, as shown in Fig. 2, care being taken that the flattened portions of tubes do not touch each other. All the positive tubes should be on one side and negative on the other.

When using battery for potential of 32 volts, positive lead tube of one cell should be connected to negative tube of the next cell, as shown in Fig. 3, short pieces of thick-gauge wire being used for connections.

The cells should be filled to within ½ in. of top of test-tubes with a solution composed of one part sulphuric acid to four parts water, taking care to add acid to water, not vice versa.

This battery can be charged by connecting the cells in parallel, as shown in Fig. 4.

All positive tubes should be connected and all negative tubes. The positive pole of the charging battery should be connected to

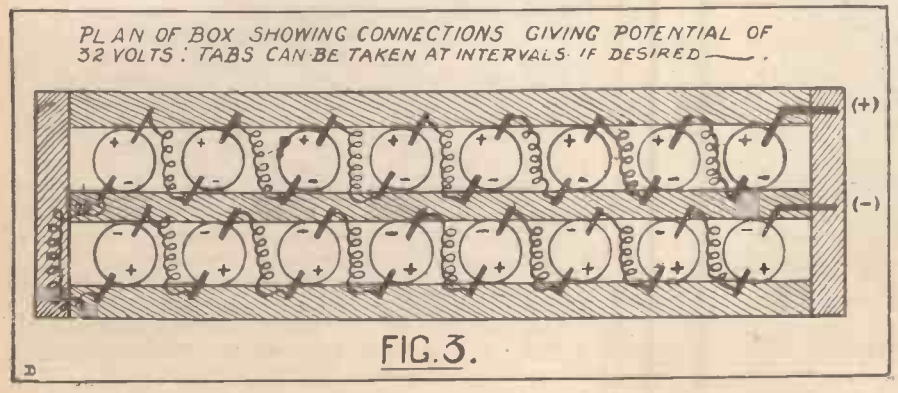


positive of this battery, and negative to negative. Charging battery can be an accumulator, Bunsen, or large dry cell.

HINTS TO AMATEURS.

THOSE amateurs who wind their own tuning coils and loose couplers will be able to obtain sharper tuning if they wind a thread between each turn of wire when they wind the coil. This reduces the "distributed capacity" of the coil, and spaces the turns so that a slider will make better contact and hence give sharper tuning. If a coating of varnish is given, it should be as thin as possible—consistent with holding the wires firmly—because thick coats tend to increase the capacity of the coil and thus reduce its efficiency.

(Continued at foot of next column.)



CORRESPONDENCE

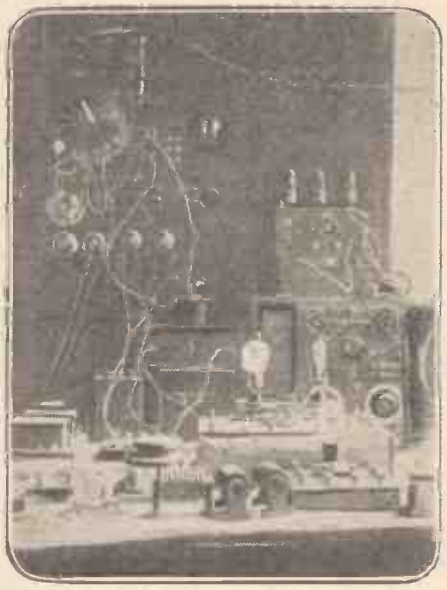
To the Editor, POPULAR WIRELESS WEEKLY.

DEAR SIR,—As a keen reader of your valuable publication since its inception, would you kindly spare me a few lines in reply to 2 A N's remarks and notes on the London Ether?

I have read with interest 2 A N's notes on the London Ether, and quite agree with all his remarks, especially his wave-meter remarks, and it may interest him to know that I was listening-in to 2 L O last evening, and during the usual three-minute intervals I heard two of the loud experimental stations discussing 2 L O's wave, and as far as I can remember the conversation was as follows: "Hallo, old chap, what do you make of 2 L O's wave-length? He seems to me to have altered, but I have no means of measuring his wave excepting on my condenser"!

Well, I leave 2 A N and others to judge for themselves the results of transmitting stations working without wavemeters. Is it a wonder that we cannot get a word in on 440 metres now?

"TEN WATTER."



Mr. B. W. Harvey's set, 25, Shakespeare Avenue, Pontowood, Southampton.

If you are doubtful as to the continuity of the 'phone circuit, place the terminals or 'phone leads across a small battery; if there is no click there is a break either in the 'phone leads or else in the windings themselves. To test the leads, fix them across a battery and carefully bend them to and fro. If a click is heard there is a break at that point; if not, then probably the windings are at fault.

* * *

If you are using a home-made tinfoil fixed condenser, make sure that the terminal wires make good contact with the tinfoil. Always keep the receiving set well dusted and dry, or serious leakage may occur; never use any kind of paint, such as black shellac, which contains conductive materials. Many black varnishes contain lampblack, which is highly conductive.

CALCULATION OF CAPACITIES.

THE capacity of condensers depends upon: (*a*) the area of plate surfaces that are acting in one direction; (*b*) inversely as the thickness of dielectric over which the action of each plate takes place; (*c*) the specific inductive capacity, or constant, of that dielectric. But as all these factors are in various terms: cms., sq. cms., etc., a fixed constant has been derived whereby the result is obtained in farads—or more conveniently, as farads are such large units, in microfarads.

This formula is not so terrifying as it looks:

$$K = \frac{Ak}{11{\cdot}31 \times 10^6 \times d} \text{ mfds.}$$

where K = required capacity in microfarads,

A = total working area of plates connected to one terminal or pole in sq. cms. (this will be clear after a moment's thought),

d = distance in cms. between + and − plates,

k = dielectric constant.

The 11·31 is a necessary constant, and the 10^6 brings the farads to microfarads.

Let us suppose we have a variable condenser whose moving plates are 2½ in. diameter, and whose fixed plates are 3¼ in. diameter. Let there be 29 plates in all, and let the spacing between "like" plates be ⅛ in. The plates are usually given as $\frac{1}{32}$ in. thick.

To find the capacity of such a condenser we must find the *total* working area of the plates. There are 29 plates, each 2½ in. diameter of *working area*. The over-size of the fixed plates does not count.

The effective area is, therefore, the area of the both sides of 27 plates and one side of the other two, *i.e.*, both sides of 28 plates in all.

To find the area of the plates, we must know how to find the area of a circle.

The area of a circle $= \pi r^2$ where $\pi = 3{\cdot}14$ (approx.) and r = the radius of the circle. That is, the distance from the centre to the edge or circumference = half the diameter.

In the case in point, we have the diameter of one plate = 2½ in. This means that the radius is 1¼ in.

Therefore the area of the circle whose radius is 1¼ in. $= 3{\cdot}14 \times (1\frac{1}{4})^2$.

∴ area = 4·925 sq. in.

∴ area of whole circle = 4·9 sq. in. approx.

But we are dealing with plates of semi-circular shape, and so their area will be half that of the whole circle.

∴ plate area = 2·5 sq. in. approx.

It is necessary, however, to have all measurements in cms., therefore the above has to be reduced. There are 2·5 cms. in one inch, and therefore $(2{\cdot}5)^2 = 6{\cdot}25$ sq. cms. in one sq. in.

That is, 2·5 sq. in. (our plate area) $= 2{\cdot}5 \times 6{\cdot}25$ sq. cms. $= 15{\cdot}625$ sq. cms.

There is 28 times this area to be considered, ∴ the total area $= 15{\cdot}625 \times 28$ sq. cms. $= 441{\cdot}7$ sq. cms.

Now, k for air is unity:

∴ $Ak = 441{\cdot}7 \times 1 = 441{\cdot}7$ sq. cms.

d = distance between + and − plates.

= (distance between + plates − thickness of −*ve* plate) ÷ 2.

$= (\frac{1}{8} \text{ in.} - \frac{1}{32} \text{ in.}) \div 2 = \frac{3}{64}$ in.

In cms. this is equal to $\frac{3}{64} \times 2{\cdot}5 = {\cdot}117$ cms. approx.

$$\therefore K = \frac{441{\cdot}7}{11{\cdot}31 \times 10^6 \times {\cdot}117} \text{ mfds.}$$

$$\frac{441{\cdot}7}{11310000 \times {\cdot}117} = \frac{441{\cdot}7}{1323270} \text{ mfds.}$$

∴ K = ·0003 mfds.

NEXT WEEK.

THE ORIGIN OF THE FLEMING VALVE.

By

Dr. J. A. FLEMING, F.R.S.

Don't miss this Splendid Article.

The Crystal Receiving Set Erected at the Council School, Old Whittington, Chesterfield.

SOME RADIO BRAIN WAVES

By SIR J. K. D. MACKENZIE, Bt.

NOW that broadcasting will very soon be upon us, the thought naturally arises as to whether the late Government did not seize the opportunity for resigning so as to make use of the chance afforded of disseminating their views and opinions upon a long-suffering public which has eagerly been awaiting the decision of the G.P.O. in order to equip itself with receiving sets. Whether this be so or not, who can tell? But seeing that the G.P.O. are now having printed some two and a half million licence forms, it seems evident that they contemplate using the services of the new Broadcasting Company to a certain extent for other purposes than concerts, singing, and "bye-bye" nursery tales.

No Defence?

If this be so, the outlook is indeed terrible! What defence or protection has a poor listener-in got when, after enjoying a delightful ballad, his or her ears are suddenly assailed by a notice stating that such or such a politician will now speak, followed by the raucous voice of some candidate proclaiming his views and opinions as being the only ones upon which rest the prosperity and welfare of the nation; and bitterly descanting on those of his opponent.

None, except that of switching off, and waiting until he has exhausted himself and his vocabulary. Either that, or altering the wave-length, and tuning up to something more agreeable and interesting.

No opportunity is given to the unfortunate person of "answering back" and telling the speaker what is thought of him, or of expressing his feelings as one could in the good old days by the aid of a prehistoric egg! No, wireless broadcasting will make speechmaking a safe amusement for would-be members of Parliament, to say nothing of such hardened sinners as Cabinet Ministers, and certainly far less expensive so far as sartorial bills are concerned.

Truly "Loud-speakers."

Probably meetings of that nature held in public halls, so that politicians in different parts of the kingdom can address audiences gathered to hear what they have to say about themselves, their opponents, or politics in general, will have to be presided over by a chairman in control of the loud-speaking receiver.

"Ladies and gentlemen," he will say, "having heard what the Right Honourable Lungstrong has had to say, we will now listen to his opponent, the worthy Mr. Golightly; and with your permission I will switch him on, so that we may hear what arguments he has to advance on the subject of the abolition of clogs in Lancashire, which may possibly interest you."

On the other hand, such public meetings might be equipped with two or more sets of loud speakers, so that the various candidates could address the constituents simultaneously, in which case the most powerful stenterphone would stand the best chance of winning by shouting down its opponent. If ever that came to pass, electors in their senses would prefer to remain at home, and go early and quietly to bed.

HEAD GEARS AND LOUD SPEAKERS.

By ALEXANDER SHARMAN.

PART 2 (*Conclusion*).

THE diaphragm is not the only part of the telephone within the influence of the winding, and consequently liable to cause the formation of eddy currents. The soft iron core, or pole piece, within the winding itself is frequently the seat of serious eddy currents. This can be obviated by forming the core not of one solid piece, but of a number of thin sheets, each separately insulated either by paper, varnish, or by a film of oxide.

A telephone embodying this construction is said to have laminated pole pieces. This point is so important that we would advise amateurs to examine the inside of telephones before purchase and make sure that this specification has been complied with.

A telephone head set possessing many of the refinements of detail referred to above has recently been placed on the market by a well-known firm, which has, in addition, a very novel and ingenious type of head band. In this form the receivers are mounted upon a wire frame of sufficient diameter to completely avoid contact with any part of the head, or even the monumental coiffeur adopted by the fair sex. In use, the set is supported on the head by a band of fabric

Component Parts of a Loud Speaker.

which, I understand on the authority of a member of the said fair sex, is known commercially as "elastic webbing."

The lightness and comfort of this set should commend itself very strongly to those who have to listen-in for long periods.

Types of Receivers.

In the early days of radio, when signals were faint or light, and the only type of amplifier available was a primitive form of microphonic relay, the head gear was the only form of telephone receiver which could be used for effective reception.

With light signals, the only method of getting effective stimulation of the auditory nerves is to bring the sound-emitter, or diaphragm, of the telephone as near as possible to the ear; and for a given intensity of signal current the best mental effect is obtained by dividing the total energy equally between both ears, thus affecting the brain by stimulation from each ear simultaneously. This is most conveniently brought about by the use of the common type of head set.

The same idea has been carried even further on the Continent—apparently to its logical, if rather insanitary, conclusion—by reducing the dimensions of the receiver so greatly as to admit of its introduction within the meatus of the external ear itself.

Fortunately, the great improvement effected in both transmitters and receivers has rendered this extreme and unpleasant expedient quite unnecessary, and the normal type of head gear retains its utility.

The advent of the valve-operated note amplifier makes it an easy matter to magnify the strength of the initial signal to any reasonable extent, so that we are no longer obliged to keep the sound-emitter close to our ears—for we can use a receiver of larger dimensions capable of producing a much greater sound, and provided with a trumpet-shaped aperture which projects the sound well into the receiving room, so that any number of people can hear the music or signals without the inconvenience of wearing head sets. These instruments are called loud speakers.

Loud Speakers.

Head gears, even the best of them, are not comfortable things to wear for any length of time, and if several sets are operated from one receiver the signals are reduced in volume, to say nothing of the initial cost involved in the purchase of several sets.

It is obviously impossible to conveniently carry on a conversation between several friends when all are wearing head sets, and, furthermore, you cannot move about the room freely when chained to the receiver by a flexible conductor. When working alone, I use an unusually long, flexible cord suspended from the central point of the ceiling of my room, so that I can walk to the mantelpiece (where I keep my tobacco and matches) without having to remove the head set.

Whilst, I suppose, all amateurs will retain at least one head set for solitary working, there is no longer any reason why a loud speaker should not be installed in addition, and its adoption will increase the pleasure derived from reception to an extent only appreciated by those who have tried it.

The technical problem before the designer of an efficient loud speaker is similar in its broad principles to that involved in head-gear design. The limitations respecting weight and dimensions are, however, removed, so that there is ample room for originality and even eccentricity. This increased scope has been very fully utilised by certain inventors.

Scripture, speaking of Christians, remarks that "many are called but few are chosen," and the quotation is a useful guide to the would-be purchaser of a loud speaker, for, alas, they do not all speak loudly.

A performance test with conditions similar to those under which it will be used is always welcomed by the maker of a good instrument, and should always be carried out, for the proof of the telephone is in the speaking thereof.

The most robust and reliable form of loud speaker seems to be simply a well-designed receiver of the normal type, built to generous dimensions, provided with a permanent magnet system of ample proportions carrying fully laminated pole pieces, highly insulated winding, and preferably a stalloy diaphragm.

A durable type of pole clearance adjustment is essential, and a long and gradually expanding sound conduit, terminating in a liberal trumpet orifice, is indispensable.

Distortion.

Many modifications of the above ideal simplicity of construction are available commercially, several giving equal volumes of sound, but lacking the mellow and musical quality of the simpler type.

A reed-operated form of loud speaker, similar in principle to the reed type of watch receiver, already described, has been widely adopted; but, although sensitive and efficient and beautifully constructed, it has at times an unpleasant habit of giving painfully "tinny" or shallow reproduction and much redundant noise, particularly if overstimulated, when it is apt to express its internal discomfort by shrieking lustily in a highly disconcerting manner.

When this instrument is wound to a low resistance and operated from the secondary of a suitable transformer, it is possible, by the introduction of condensers of correct capacity, both in series and parallel with the winding, to annul the reed resonance to obtain mellow and really musical results. There is ample scope for low cunning and high technical skill in applying these filter circuits, but it is a little beyond the ability of the average experimenter.

Another type of loud-speaker, much used in America, and now manufactured in this country, adopts the principle first described and given freely to the world without restrictive patents by our greatest philosopher and pioneer, Sir Oliver Lodge.

It is fully described by Sir Oliver, with that unequalled lucidity which characterises all his writings, in an old number of the Transactions of the Institute of Electrical Engineers. This old volume, which ought to be reprinted in an easily accessible form, contains a full exposition of the principle of resonance and its application to wireless transmission and reception together with the fundamental formulæ. You have

A New Type of Loud Speaker.

HEAD GEARS AND LOUD SPEAKERS.

(Continued from previous page.)

only to change the value of the term expressing the frequency to demonstrate the principle upon which all modern systems work, and which is usually attributed to another and later inventor.

The Lodge moving coil telephone, of which the Magnavox is the latest, and, I do believe, the only commercial type, makes use of the same principle as the prime mover of the Kelvin cable recorder. This movement is better known to the wireless amateur as the "D'Arsonval" moving coil system, used so extensively in connection with high-grade current-measuring instruments—milliameters and ameters.

Electro-Dynamic Principle.

The simplest type of galvanometer consists, as is well known, of a small magnet capable of rotation and placed within a fixed current-carrying coil. Even with the same arrangement we could rigidly fix the magnet and suspend, or pivot, the winding. In this case, when a current is passed through the winding, the coil will be deflected, while the magnet remains where it was fixed. We should then refer to the instrument as a moving coil galvanometer in contradistinction to the first form, which we should call a moving magnet type of galvanometer.

Now, it is evident that if the magnet is sufficiently strong, and the coil made light in weight and nimble in action, we might adapt the device for use as a telephone by attaching a light lever to the side of the moving coil, and also to the centre of a suitably mounted flexible diaphragm. If we then pass a voice-modulated current through the coil, its physical struggles will be transferred to the diaphragm, and the original voice sounds reproduced.

The device as described would be terribly inefficient, although it serves very well to illustrate the principle involved and also to show what can be done by progressive improvement in design. By way of illustration, let us see what should be done to improve it and make it into a practical instrument. Since we want as large a twisting action as we can get, we must strive to get as intense a magnetic field as possible, usefully cutting through the winding.

Step towards Efficiency.

The arrangement described above constitutes what is known as an open magnet circuit, *i.e.*, the magnetic lines developed in the short magnetic needle are returned from one end to the other through the surrounding air space. We can greatly increase the number of the magnetic lines generated by our magnet if we substitute for the air space an iron return path. Iron is the most perfect conductor of magnetic lines we can employ, and we can apply this method to the instrument described by using a U-shaped strip of soft iron with its ends arranged to embrace the coil, thus forming an easy return path for the lines and greatly increasing the field intensity.

The weak point of this design is the unavoidable length of the iron return path, which, although vastly better than the original air return, can be still more improved by interchanging the relative position of the magnet and the soft iron magnetic line conductor. We therefore replace the soft iron strip by a hard steel magnet, and fill the space within the coil with a soft iron armature.

Our instrument will now be found to be quite efficient; but it still presents one glaring defect in design, for we are producing a rotary movement in our coil, whereas what we require is a reciprocating movement of the diaphragm centre, although we can, and we do, convert this rotary movement into a "to and fro" motion of the diaphragm by means of the mechanical lever joining the two.

Matter of Economy.

It is obviously far better to rearrange our magnet system so that the initial movement of the coil as a whole is not rotary, but directly reciprocating without the necessity of using mechanical transformation. This is easily done by forming what is called a concentric magnetic field, in which one magnet pole is arranged in the centre of a field and the second pole arranged as a hollow cylinder surrounding the first pole.

The magnetic lines will now take a radial all in the same direction from the pole centre. If a simple helical coil is suspended within this field space, current flowing through the coil will cause it either to be sucked into the field space or pushed out from it, according to the direction in which the current flows. This gives us directly the "to and fro" motion which we require to actuate our telephone diaphragm, so we have only to suspend the coil from the diaphragm centre to obtain exactly the movement we want.

This is the construction adopted in the Magnavox, with the one exception, that instead of a hard steel permanent field magnet, a soft iron electro-magnet is used in its place. This practice is a little objectionable because it eats amperes, and the accumulators of the average amateur are already fully occupied in furnishing filament current for the valves.

A corrugated aluminium diaphragm is usually used in this type of loud speaker. One of the manufacturing difficulties of making a really good instrument is to secure uniform quality in respect of hardness and elasticity throughout the whole area of the diaphragm. Even if the material is quite uniformly annealed to start with, the tooling of the material tends to harden it irregularly, with the result that, when the diaphragm is subjected to violent vibration, numerous nodal points, or, as adverse critics call them, "noodle" points, develop, resulting in the production of harsh overtones and ringing noises which mutilate the fidelity of the reproduction.

MY RECEIVING STATION.

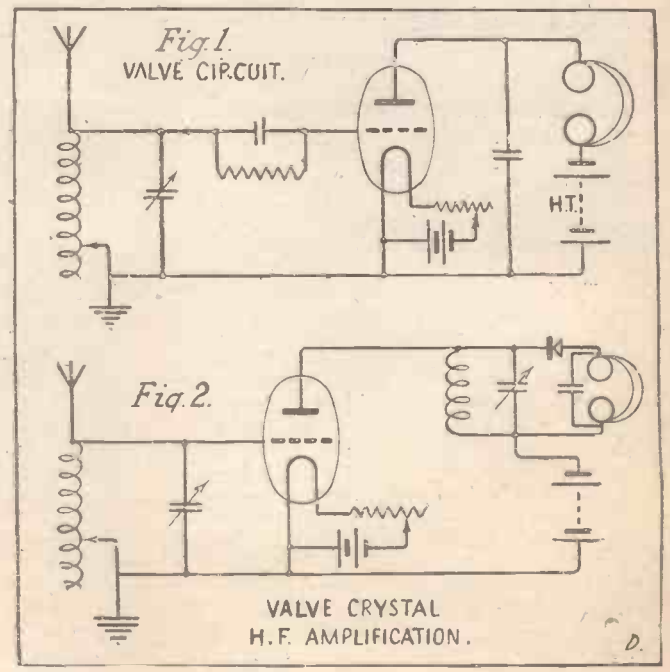
By "CRYSTOR."

IT may be of interest to readers if I describe my receiving-set and give the results I obtained, especially as most of the parts are home-made. The set consists of two parts, a crystal receiver and a single valve, either of which can be used separately or both together.

The crystal set contains a double slide tuner (200 to 2,600 metres), a block condenser, and a "Rectarite" detector. I keep my testing buzzer in an adjoining room. The aerial is a single wire 50 ft. long and 40 ft. high; on this set I can hear 2LO, Croydon, and even Writtle, in spite of the fact that the aerial is badly screened. The crystal is rather apt to be despised, but I can hear Writtle using an indoor aerial slung among the rafters, living in North London.

The valve set is a very simple one (Fig. 1). A box contains the tuner, filament resistance valve holder and variable coupling. There is a double-pole switch for the filament current, and I use two .001 mfd. condensers and a "vernier." This set, on the same aerial, gives me the Hague and Paris concerts quite clearly, while Marconi House and Writtle are loud enough to be able to use a loud speaker.

I can combine the two sets by using the valve as a H.F. amplifier (as shown in Fig. 2), an extremely efficient method of bringing in weak telephony.



NOTES ON THE LONDON ETHER.

By 2 A N.

WE understand on good authority that it is possible to arrange a circuit containing capacity and inductance in combination with the usual receiver so that the additional circuit acts as a "rejector" which prevents the interference otherwise caused by undesired messages.

It is possible that some such arrangement would eliminate sounds we would rather not hear, such as:

"Ding dong, ding dong—hello, hello—two Low Wobbly *working*, two Low Wobbly *working*—ding dong, ding dong."

The use of the word "working" is rather unusual. We trust it does not imply that others are only playing at it! But why the introductory and ultimate tintinnabulations?

The New Epidemic.

Another ether torturer recently put on a record, entitled, "Should I Be Missed?" and asked for comments. After consultation with several etheric eavesdroppers, we are able to report that the reply is emphatically "in the negative"; but we fear he might be, as we have no expert gunman in the ranks of radio.

Here is another example:

"Hello, hello, 5 je-ah tick he-ah!!!! 5 je-ah, tick, he-ahhhh!"

Little verbal idiosyncrasies of this kind are harmless, but, like some physical ailments, have a tendency to spread.

A short time ago 2 O N introduced the use of the phrase "replying to you" as a characteristic substitute for the more usual "answering you." We tremble lest this should become amplified to "responding to your esteemed inquiry."

This contagion has already spread as far afield as an experimenter at Brentford, the similarity of whose call-sign has perhaps rendered him peculiarly susceptible.

A short time ago there was an epidemic of the use of fraternal and convivial terms of endearment, more monotonous than original. The time-honoured telegraphist's idiom, "old man," has developed a modern equivalent, "old chap," and if the process is continued we may be faced with the horrors of "old bean," "priceless old bird," "old thing," etc.

Trade Reviving.

Broadcasting has, at last, arrived, and the radio trade generally is already conscious of increasing activity. The foretaste of broadcasting, as so ably demonstrated by 2 L O, assures us of musical delights to come, but we venture to think that the interests of trade would be better served by maintaining a good musical programme of unimpeachable quality than attempting experiments of too ambitious a character which, although of great scientific interest, may not be such a certain means of establishing universal popularity. Simple broadcasting, well performed, is of greater advantage to the industry than imperfect transmission achieved in the face of technical obstacles. It is more worthy to walk uniformly than to fly erratically.

The excellent transmissions of 2 W P have become an outstanding feature of the evening ether; we have never heard better music than that emanating from the pianola working at the station.

We understand that the sale of French text-books is experiencing astonishing stimulation; can it be due to the wide desire on the part of amateurs to fully understand the exciting (?) French stories which are quivering through the London ether?

THE RADIO ASSOCIATION.

By WILLIAM LE QUEUX, M.Inst.R.E.

OF Radio Societies and Associations—a number of which I assisted to found—there are many, all of them doing good and valuable experimental work, and most of them affiliated with our pre-war organisation, the Wireless Society of London.

Its Aims.

A new and virile organisation has, however, been found—The Radio Association. By many it is believed, and perhaps naturally, that this association, with its solid foundation and influential promoters, is intended to compete with the Wireless Society. At the start I would wish to dispel any such absurd idea. The objects of the Radio Association are different and much more comprehensive than those of the Wireless Society. A glance at the prospectus will immediately prove it. The Radio Association is a most comprehensive organisation, and though still in its early infancy has the active support of many men whose names are as household words in wireless.

As one who had a good deal to do with the formation of the Automobile Association and was a member of the committee of the Motor Union, I know to what enormous extent motorists and the motor trade benefited in the early days by the establishment of the former. There is not a motorist or a manufacturer of cars in Great Britain to-day who is not indebted to the Automobile Association.

The same programme as in automobilism is to be followed by the Radio Association. In addition to furthering the development of radio-telephony and other forms of radio science, its first aims are to co-operate with the authorities, as well as to protect the interests of all licence-holders from onerous or restrictive legislation.

The New Era.

Here arises a most important point! Much as the fact may be to-day disguised, the authorities at the present moment have no love for the wireless amateur, or the man who listens to broadcasting. The genuine experimenter is first tolerated perhaps as somewhat of a nuisance, but facilities are given him to prosecute his research work. Yet, after all, the difficulties of the Post Office, the Admiralty, and the War Office—"the powers that be"—may easily be imagined, and must no doubt increase as radio becomes more and more popular. However, we amateurs will one day require a strong, universal, and united body consisting of every wireless amateur in the kingdom to protect our interests and arrange for our just facilities. In this we shall have the Radio Association, but only if properly supported.

I make no complaint against Post Office regulations. They often seem arbitrary, but they are highly necessary for the well-being of official and commercial communication. Still, we amateurs must have some big and influential body to represent us, not only to the authorities, but also in Parliament itself. Hitherto the wireless amateur has existed only upon sufferance, and many believed him to be a crank for his pains. I was one of them! To-day all has changed, and with broadcasting we are entering upon a new era of radio.

With that era this Radio Association has arisen. And it has come to stay. Not only will it protect the amateur, but it will disseminate all the latest information and discoveries to him by means of lectures by experts, and the publications similar to the valuable reports of the Institute of Radio Engineers. In addition, it will act for the protection of the radio trade itself, providing expert technical and legal advice to its members concerning questions of patents, infringements, and licences.

Unity is Strength.

The trade is at present without any adequate organisation, and here the Radio Association will be found invaluable in cementing the interests of the manufacturers with those of the users, amateurs or research workers.

Half-a-crown annually is surely not an exorbitant subscription to a body which is ready to act in the interests of both amateurs and manufacturers alike, and I think it behoves everyone who possesses a pair of wireless 'phones to at once send his name and subscription to the Treasurer, 44, Gt. Russell Street, London, W.C., and he will become an original member. As an early enthusiast and experimenter through many years, I feel that I cannot urge this too strongly upon every one of my radio friends. To be united is to be strong. We must be a consolidated body to work with the Wireless Society if we are to face the future with full confidence.

Radio has gripped our little island kingdom, but I anticipate that in the immediate future attempts will be made to further curtail our experiments. It is then, if we are united, we shall be able to hold fast, and co-operate with the authorities in our best interests.

The successful pilot on the broad seas of life is the man who ever looks ahead. Both amateurs and manufacturers should, I feel confident, look ahead to unite the common interests in supporting the Radio Association to avoid the rocks that may be hidden. Every other trade and profession has its association for its furtherance and protection, so surely the new science of Radio should not be unrepresented.

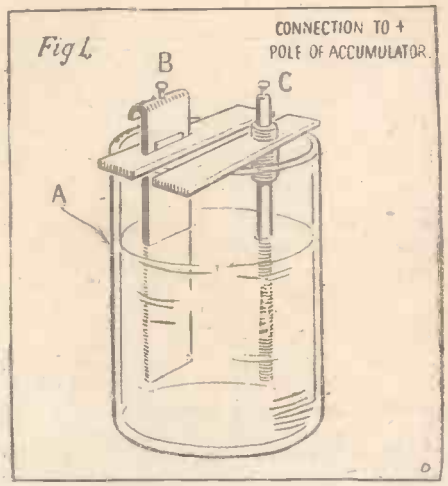
AN ELECTROLYTIC RECTIFIER.

By G. L. COCKLE.

THE rectifier, sometimes known as a Noden valve, consists of an active electrode of aluminium immersed in a suitable solution (common salt or ammonium phosphate) together with an indifferent electrode of lead, carbon or iron; the containing cell consists of a glass bowl. The action of the cell depends upon the peculiarity of aluminium that as a kathode it allows a current to pass freely, but as an anode it offers high resistance. This resistance is due doubtless to polarization whereby a thin insulating film of oxide is formed on the surface of the metal. The other phase or direction of current easily breaks through this, but, up to a certain voltage, the cell automatically allows only that phase to pass. By suitable combination of cells both phases may be utilised, and a unidirectional current obtained from an alternating supply. Heating of the liquid will interfere with the efficiency of a cell if the temperature rises above 70° F.

Simple Construction.

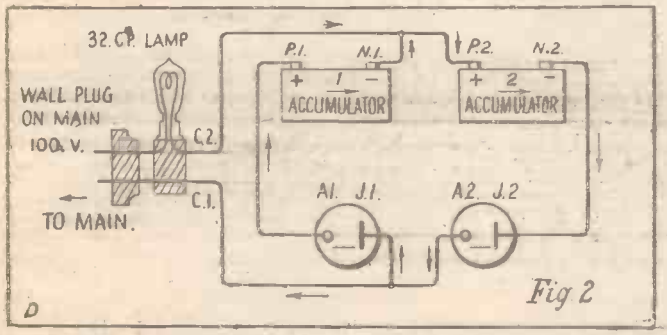
First of all procure a large jam-jar, glass one for preference, containing a strong solution of neutral ammonium or common salt. Now into the jar place an electrode of aluminium of about the thickness of a pencil, and a second electrode of thin iron, such as a piece of hoop iron from 2 to 3 in. broad, each electrode being about 9 in. long. Each electrode is shown suspended in the solution by being passed through



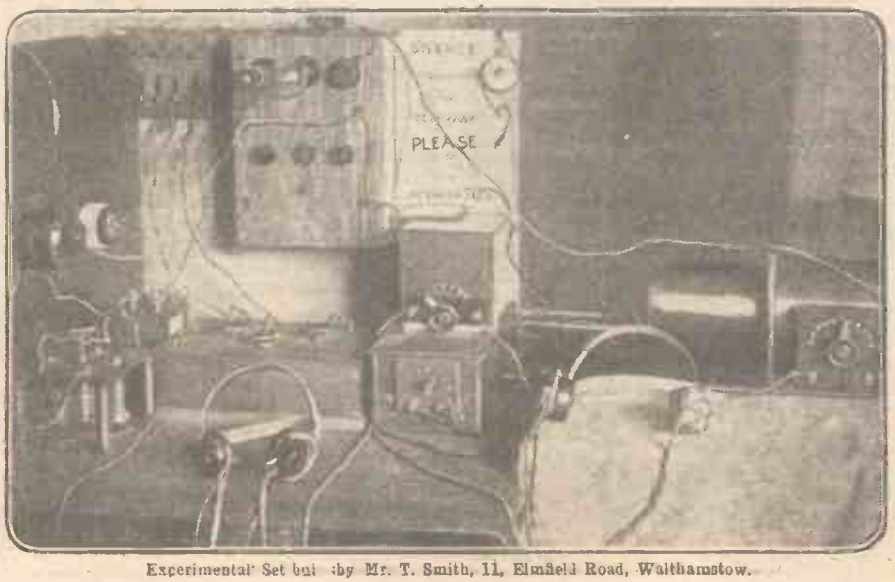
a piece of wood which rests on the top of the jar. The aluminium is made fast by passing it through a cork, and the iron is wedged it in, as shown in Fig. 1. At the top of each electrode is a screw for connecting wires.

Charge in Pairs.

An arrangement of two electrolytic rectifiers to use both phases of alternating current is shown in Fig. 2. One phase passes from C1 by J1 and A1 to P1, charges accumulator 1 and returns from N1 to C2; other phase passes from C2 to P2, charges accumulator J1, and returns by J2 and A2 to C1.



The above arrangement assumes that two accumulators will be charged simultaneously, as it is always best to charge a pair if possible. In any case, single cells of one battery can be arranged according to the same plan.



Experimental Set built by Mr. T. Smith, 11, Elmfield Road, Walthamstow.

ASSORTED TIPS

A USEFUL "dead-end" switch consists of an ebonite knob with a number of brass arms of a fair width. These arms make contact with the studs of the inductance tappings. The windings of the inductance are in sections, the first and last winding of each section being taken off to studs. The studs of the last of one section and first of the next, are close together, so that the arms of the switch will make contact with both studs and thus connect up the two windings in circuit. The number of groups of two studs is the same as the number of arms on the switch, so that when all the arms are in use they connect up all the studs, and thus put the whole coil into circuit. Of course, all these arms are insulated from one another by the ebonite knob. One more arm is necessary—one that is narrow enough to make contact with only one of the studs at a time. This is the arm that taps the coil at the desired places, and is so placed that it makes contact with the stud next to the ones covered by the other arms. All arms must make firm contact with the studs. The small arm is connected to a terminal, from which a lead goes to the receiver, the second lead to the receiver going from the beginning of the coil. With this switch any number of sections may be used, while the rest of the coil is entirely disconnected from the circuit.

* * *

A point which is sometimes disregarded and may cause trouble is that a very heavy plate voltage is often the cause of a burnt-out transformer. Should, however, the primary of a transformer be defective, the instrument may still be used if the secondary windings are O.K. The secondary may be connected up to the valve, thus making it directly coupled by means of a choke coil.

* * *

Always test each piece of apparatus upon the completion of its construction. Also it is advisable to test the whole circuit connected up on the bench; before it is carefully put in its final form. Connections which have been carefully packed away, and perhaps soldered, are a nuisance to rearrange if found to be wrong after the set has been neatly fixed in a cabinet or other container.

* * *

Never let your accumulators run too low. The best method of testing their condition is by means of a hydrometer. This instrument will show the specific gravity of the cells, and is a far safer way of testing how far they are discharged than is the voltmeter. The voltmeter may give you a fair voltage when the cells are really very low, but immediately you attempt to draw any current, the voltage will drop right down. This is because there is no energy in the cells and they need recharging. The hydrometer, however, shows the exact conditions, for the density of the acid solution varies according to the charge in the cells. The higher the charge, the greater the reading on the hydrometer. A general rule about accumulators is that the specific gravity should never drop below about 1.17. This is the safety limit; below this, sulphating is likely to occur. When fully charged, the hydrometer should read somewhere about 1.2 or 1.215.

CONTROLLING MODELS BY WIRELESS.

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

PART 10 (*To be Concluded next week*)

BEFORE proceeding to connect up the coherer, de-cohering device, relay, and selector described in my previous articles, it will be necessary to provide a suitable baseboard.

The baseboard in question can be made of white pine 15 in. long by 12 in. wide by $\frac{5}{8}$ in. thick, and should be shellac varnished or french polished.

A lath 12 in. long by 3 in. wide by $\frac{5}{8}$ in. thick should be secured at each end of the baseboard to prevent the latter warping, and at the same time improve its appearance.

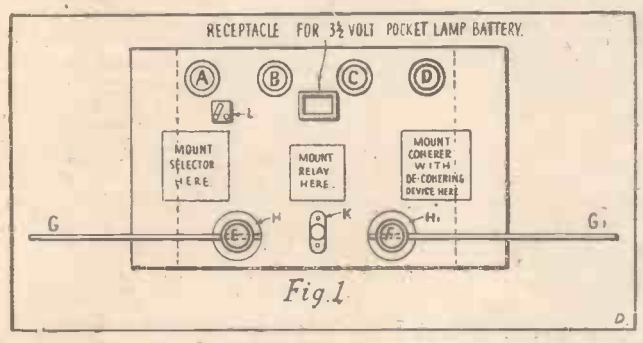


Fig. 1.

A small box or receptacle should also be provided to accommodate a 3½-volt pocket-lamp battery. The latter will furnish current for the coherer circuit.

The coherer, with de-cohering device, relay, and selector, can be mounted upon the baseboard as shown in Fig. 1. Six large terminals—A, B, C, D, E, and F—should also be fitted as shown.

The Aerial Tubes.

It will be observed that terminals E and F are for supporting metallic tubes G, G1 (brass, copper, or aluminium), each 2 ft. 6 in. long by $\frac{3}{16}$ in. outside diameter. The latter represent an aerial for receiving transmitted wireless waves.

It is advisable for the metallic tubes G and G1 to be at least six inches from the baseboard. This can be effected by connecting the terminals E and F to a length of screw-threaded brass rod $\frac{3}{16}$ in. diameter, and passing the latter through a length of ebonite or vulcanised fibre tube $\frac{1}{2}$ in. outside diameter. The screwed brass rod can be secured by means of nuts and washers under the baseboard in such a manner that the lengths of ebonite or vulcanised fibre tube will rest on washers H and H1 (made of similar material), thus producing a neat appearance.

A miniature flanged lamp holder (which can be purchased for 6d. from practically any dealer in electrical material), also coherer circuit switch, can be mounted upon the baseboard as shown at K and L respectively (Fig. 1).

The whole of the apparatus comprising the receiver is now ready for connecting up.

When the receiver is completed it will be found that on connecting terminals A and B (Fig. 1) with the terminals of a 4-volt accumulator, and terminals C and D with the "conductor" and "outer" rails respectively of a model electric railway, it will be possible to control at will a model electric train (the locomotive being fitted with a permanent magnet type of electric motor) by means of wireless waves radiated from the transmitter described in Page 403, No. 19 of POPULAR WIRELESS.

Fig. 2 shows a wiring diagram of connections between the coherer, relay, and antenna of the wireless receiver in question.

It will be observed that on the coherer A detecting a wireless wave, and the switch S being closed, current will flow from the coherer battery C B (an ordinary 3½-volt pocket-lamp battery) through coherer A, contact spring D, and the winding of relay F, thence returning to battery C B.

It will be further observed that the contact spring D and coherer base B are respectively connected to contacts E and F (Fig. 1), thus providing (through the coherer A) a circuit or path for an oscillatory current such as would be received from a wireless transmitter as previously decribed.

The circuits as shown in Fig. 2 are extremely simple, and it will be apparent that in connection with the wireless control of models, detecting a wireless wave and the consequent functioning of a relay only involves one step in what might be (according to requirements) a complicated series of operations.

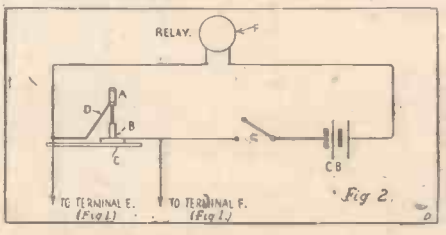


Fig 2.

I explained in my last article that an incident wireless wave would have the effect of short-circuiting the contacts and filings contained in a coherer, but that if such filings were shaken up the resistance of the coherer contacts would be restored to normal, thus "opening" a circuit connected with same.

On referring to Fig. 2 it will be apparent that the function of a coherer is somewhat similar to that of an ordinary press button, in that it opens or closes a circuit as desired.

Final Connections.

Having regard to the function of a coherer, it will be obvious that a "tapping" device (as described in my previous article) should be so arranged that the filings contained in a coherer will not be shaken up until such time as a selector has completed its cycle of operations.

For that reason the contacts J and J1 (of the selector shown in Fig. 1, page 455, No. 21 of POPULAR WIRELESS) are arranged in such a manner that the armature D (of the selector) practically completes its stroke before the contacts in question admit current to a de-cohering device, or tapper.

Fig. 3 shows a wiring diagram of connections between the antenna, coherer, de-cohering device or tapper, relay, and selector. The circuit shown in Fig. 2 is included in this diagram.

It will be observed that on the coherer A detecting a wireless wave, and the switch S being closed, current from the coherer circuit battery C B will flow through the windings of relay J, causing the latter to attract its armature K, thus closing contact K1, and admitting current from the relay battery R B to the windings of the selector electro-magnet G, causing the latter to attract its armature L, and close contacts H and H1, thus admitting current from the relay battery R B to the de-cohering device or tapper D.

The latter will strike the coherer A (somewhat similar to the action of an electric bell) and shake up the filings contained therein, thus opening the circuit connected with the relay J, causing the latter to release its armature and cut off electric current from the selector electro-magnet G, and releasing armature L, which will cause the selector drum to move a step forward.

The relay battery R B is a 4-volt accumulator connected to terminals A and B (Fig. 1), as previously referred to. In the complete wiring diagram to be furnished with my next article, the simplicity of all the circuits described will be apparent, more particularly to those who have carefully studied all the diagrams previously furnished.

Quite apart from controlling model electric trains by wireless, it will be found that the wireless receiver in question can be used for numerous other experiments.

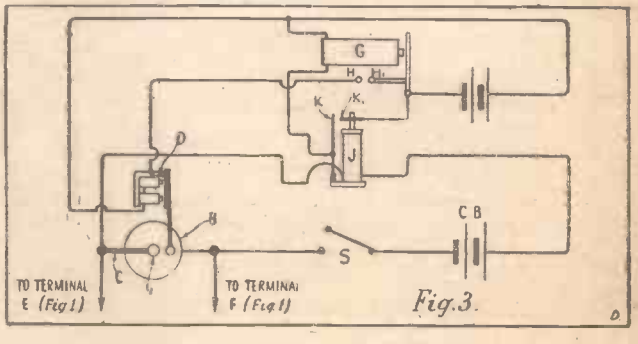


Fig. 3.

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.

Plymouth Wireless and Scientific Society.

A meeting of the above was held on Tuesday, October 10th, at Plymouth Chambers, where the society is establishing its headquarters. The main business of the evening was the discussion of the society's wireless set. It was resolved to begin with a three-valve set with one stage of high frequency amplification and one stage of low frequency, and the set should be so designed as to permit readily of experimenting with various types of inter-valve coupling. Offers were received from members present of five valves, two variable condensers, a three-coil holder, aerial wire, and £1 in cash, so that an immediate start is to be made with the construction.

The programme for the year and copies of the rules and proposal form are now available, and can be obtained from the hon. sec.

Hon. sec., G. H. Lock, 9, Ryder Road, Stoke, Devonport.

* * *

Croydon Wireless and Physical Society.*

At a meeting of the Croydon Wireless and Physical Society, held at the Central Polytechnic, Croydon, on Saturday, October 7th, Mr. W. A. Saville gave a lecture and demonstration on different methods of reception, one special feature being a circuit to enable one to switch in or out at will extra L.F. valves.

The society invited members of local Boy Scout Troops to hear the Prince of Wales' message, which was received very well by Mr. Saville on his set.

Another interesting piece of apparatus which was demonstrated was a Japanese valve which had two filaments. The lecturer explained that they could be used separately or together.

The meeting then terminated with a hearty vote of thanks to Mr. Saville for coming down and giving such an interesting lecture.

The secretary will be pleased to give all particulars of the society to anyone desirous of joining.

Hon. sec., Mr. B. Clapp, "Meadmoor," Brighton Road, Purley.

The East London Radio Society.*

On Tuesday, October 3rd, the usual meeting of the above society was held in the Lecture Hall, Woodstock Road, E.

It being the first Tuesday in the month, the management committee held their monthly meeting in the committee-room.

There was no lecture, but the rest of the members spent a very pleasant evening with all the society's apparatus in full swing. Interesting experiments were carried out in the testing of the society's loud speaker, and comparing it with those loaned for the occasion by various members.

Bromley Radio and Experimental Society.

A very successful meeting of the above society was held at the White Hart Hotel on Monday, Oct. 9th, when a wireless demonstration was given.

A temporary indoor aerial was erected and connected to a four-valve receiver equipped with a loud speaker, signals were received from many ship and Continental stations, as well as music and speech from several amateur transmitting stations.

Excellent results were also obtained by utilising instead of the usual aerial, the electric light circuit, connected through a very simple device to another four-valve receiver.

As a result of the meeting several new members were enrolled, thus bringing the total membership to well over 40.

Hon. sec., Mr. J. Fergusson-Croome, 26, Wendover Road, Bromley, Kent.

Clapham Park Wireless Society.

Meetings are now held weekly on Wednesdays, at 7.30 to 9.30 p.m., at headquarters, 67, Balham High Road, and visitors are cordially welcomed.

Membership is increasing rapidly, new members being elected at each meeting.

The sixth quarterly meeting was held on Wednesday, the 4th October, under the chairmanship of Mr. A. E. Radburn.

Report of a Meeting of the Liverpool Wireless Society.*

A meeting of the above society was held at the Royal Institution, Colquitt Street, Liverpool, on Thursday, October 12th, Mr. J. Wainwright in the chair, and the proceedings commenced promptly at 8 p.m., there being a record attendance.

The chairman opened the proceedings by informing all present that this was the first meeting of the winter session, which promised to be one of the greatest interest, and, after confirming the minutes of the previous meeting, he called upon Professor E. W. Marchant, D.Sc., to deliver an address.

The professor addressed the meeting at some length, dealing with the subject "Wireless Broadcasting" in a most able and pleasing manner. Briefly tracing the early history of wireless telegraphy point by point, right up to the latest developments of the science, he entered upon the main features of his address, which were, the advantages and disadvantages of wireless broadcasting as we might expect to develop into in the course of a very short space of time. The professor concluded his remarks amidst great applause, and Mr. Hengler proposed a vote of thanks.

Secretary, Mr. C. L. Lyons, 76, Old Hall Street, Liverpool. Telephone: 4641 Central.

Newport and District Radio Association.

On Thursday evening, 12th inst., before a large gathering of members, Mr. W. D. Lewis Evans, M.A., Abertillery, gave a very fine address upon "The Construction of an Amateur Three-Valve Station."

Added interest was given to the lecture by Mr. Lewis Evans placing on view a three-valve instrument which he himself had built up. A highly instructional address, punctuated by anecdotal references to the humorous side of the "mysteries" of wireless, being thoroughly enjoyed and appreciated.

Hon. secretary, Edward R. Brown, 92, Corporation Road, Newport.

Fulham and Chelsea Amateur Radio and Social Society.

At the last meeting of the above society, Mr. Scott introduced to the meeting a visitor, Mr. Gunning, who gave a lecture on the Leclanché Cell, its construction, chemical action, and deterioration. On his conclusion, the lecturer was heartily applauded for the able way in which he gave his lecture, a vote of thanks being moved and given. One and all expressed the desire for a continuance at Mr. Gunnings' earliest. Attendance, 55. Total membership, 79. New members enrolled, 9; and visitors, 3.

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

Wolverhampton and District Wireless Society.*

At a meeting of the above society, held at headquarters on the 27th inst., a most instructive and unique lecture was given by Mr. F. G. Redhead on "Psychic Phenomena and Wireless."

The subject proved an exceedingly attractive one, the lecturer endeavouring to prove that a similar action took place with the human brain as that of wireless telegraphy, the various organs acting on each other by induction, and the nerves and fibres being the conducting bodies. This was due to the electric forces of the brain. Telepathy, as he expressed it, was really a human wireless.

The lecturer went on to say that the human brain is not only a transmitting and receiving machine for electric waves, but the human body is a complete electric generating station.

RADIOTORIAL

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

The news that broadcasting has at last begun was received with general satisfaction wherever radio enthusiasts foregather.

At the moment of writing, a limited service is in operation from Marconi House, consisting of news items, musical items, weather reports—and chimes from a very deliberate-sounding clock who, I feel sure, must be a blood relation of Big Ben's.

However, perhaps by the time my readers receive this copy of POPULAR WIRELESS, the full broadcasting service will be in operation.

It is certainly good news to hear that Manchester has also begun regular transmissions; and I hear that Birmingham is almost ready to follow suit.

The remaining stations will, I understand, all be in operation before the expiration of the year.

Meanwhile, if you have not yet taken out a licence, make for the nearest post-office and get one, and enjoy the fruits of your patience in the shape of broadcasting from 2 L O and 2 Z Y.

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.

"No Name" (Rassan, Brec.).—Will you kindly tell me how many plates of copper foil, 2 in. by 1 in., separated by waxed paper, I need for a fixed condenser of .0003 mfd. capacity, and also for a telephone condenser?

For a condenser of .0003 mfd. use two sheets of foil measuring about 1.15 in. square. For the telephone condenser three sheets of 2 in. by 1 in. should be O.K.

I have an accumulator and the positive and negative terminals are not marked; there are also no instructions as to charging. What would be the rate? Which is positive and which is the negative terminal? There are 7 plates 2 in. by 3½ in.

The positive terminal is the one which belongs to the darker coloured plates. These also will be less numerous than the others. The light grey will be the negative plates—4 in number probably. The charging rate will probably be about 1 amp.

* * *

"Super-regeneration" (South Molton).—I cannot quite understand the connections of the batteries in the Armstrong super-regenerative three valve circuit. Where do the batteries go? Which valve is which?

The L.T. battery is connected to the filaments of the three valves and to "earth." The first H.T. battery goes to the plates of the detecting valve and the oscillating valve. The second H.T. goes to the amplifying valve. Both the negatives of the H.T. batteries go to L.T. negative. In addition to these batteries there is the grid biasing battery which is connected to the grid circuit of the oscillator (+ to plate — to grid). With regard to the valves, the first—connected to aerial—is the detector, the second or middle one is the oscillator or regenerator, while the last is merely a note magnifying valve.

* * *

"Telephone" (Stratford-on-Avon).—Why should telephone wires have any bad effect upon a receiving set whose aerial is earth?

The trouble is that telephones use alternating current, and this is likely to radiate electro-magnetic waves for a short distance. If the aerial is close to the wires and parallel to them, these radiations may cause interference if you are using a delicate detector—such as a valve. That is why it is always best to keep your aerial as nearly at right angles to the telephone wires as possible, and also above their level. Besides this effect the telephone and telegraphy wires absorb a certain amount of energy from the wireless waves you are waiting for, thereby weakening your signals.

* * *

"Amateur" (Layer-de-Laye-Haye).—Upon what is the efficiency of an accumulator based?

The efficiency of an accumulator can be based upon either a quantity or energy basis. The quantity or ampere hour efficiency is equal to the output of the cells in ampere hours, divided by the input in ampere hours while the energy or watt hour efficiency is equal to the watt-hours output divided by the watt-hours input. The former, quantity efficiency, is denoted by the symbol Q and that of energy E. Q will always be greater than E owing to the charging voltage always being greater than the corresponding discharging voltage. Q and E on a good cell should be some 90 per cent. and 80 per cent. Rapidly alternating charge and discharge will give a higher efficiency than prolonged charging and discharging. The energy efficiency of an accumulator subject to periods of these conditions of but few minutes' duration may be 90–97 per cent., but in the case where it runs to hours it may be but 70 per cent. Therefore it is advisable to have accumulators charged every three or so weeks, whether they require it or not, if it is desired to retain maximum efficiency. In any case, voltage per cell while in circuit should never be allowed to drop below 1.8 volts. It is interesting to note that the ampere hour efficiency will vary with the number of cells in parallel but not in series, but the energy or watt-hour efficiency will vary with the number of cells, however arranged.

* * *

E. T. W. (Edinburgh).—What exactly is the difference between the grid and plate circuit of a valve set?

The grid circuit includes the space in the valve between the grid and the filament and the path of the external conductors from the filament to the grid, while the plate or anode circuit includes the space in the valve between the plate and the filament and the external conductors between the filament and plate

* * *

"Radio Hopes" (Forest Gate).—With regard to the Armstrong Super-regenerative Circuit, there are no plug connectors shown to fit the jacks. Can you tell me what happens to these connections?

The plug connection goes to the 'phones, both leads of the 'phones being connected to one special plug which fits into the jacks.

2. What is the approximate wave-length of the coil described as "60 turns of No. 19 S.W.G. on a 3 in. former"?

Approximately 200 metres.

3. What is the meaning of L. 1,250 and L 1,500 when speaking of the Honeycomb coils?

These refer to the inductance of the coils in microhenries. L is the symbol for inductance.

4. Is it possible that the P.M.G. will license this set? If not, can anything be done regarding the reaction?

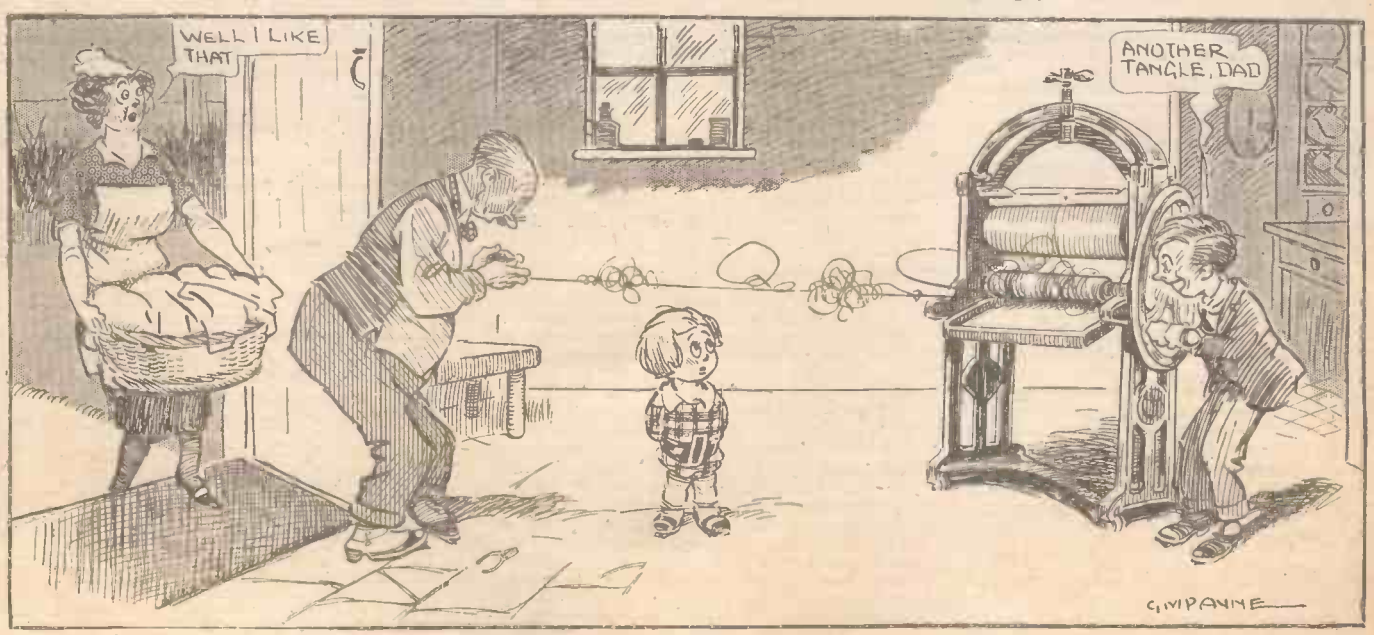
It is not at all probable that the P.M.G. will pass the set, as it reacts violently and has to oscillate before regeneration is carried out. No, nothing can be done to make the set incapable of radiation.

5. Could other coils be put into the tuning coil circuit to increase the wave-length?

No, this would upset the values of the inductances and capacities and would rob the set of its powers.

(*Continued on page* 586.)

THE ART OF COIL WINDING.



RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 584.)

The circuit is essentially a low-wave receiver, ranging from about 300-700 metres.

* * *

R. D. K. (Hemel Hempstead).—Could I use a sparking-plug as a lightning arrester?

Yes, the method you propose is quite a good one. Connect the aerial to the centre electrode of the plug, and the earth to the outside part of the plug. The points of the sparking plug will have to be closed considerably so that only a tiny gap occurs between the centre electrode or aerial, and the earthed points. The gap should be just sufficient to allow a thin piece of paper to pass between the points. The lead to the A terminal of the set of course is connected to the same electrode as to the aerial.

* *

"AMPLIFIER" (Walton-on-the-Naze).—I have an ordinary crystal set, using a one-slide inductance and permanite crystal. Can I add a L.F. valve amplifier? Where should I place the valve?

You can certainly add a low-frequency amplifying valve. Connect the crystal set as usual, but in the place of the 'phones connect the primary of an L.F. intervalve transformer. The secondary of the transformer goes to the negative H.T. and L.T. and to the grid of the valve. The plate of the valve goes to the H.T. positive and the 'phones. L.T. positive, of course, is connected to the filament of the valve.

* * *

"L.T. BATTERY" (Thundersley).—I have a one-valve set and find great difficulty in getting my accumulator charged, having to send it a considerable distance and wait a long time before I get it back. Is there no way of charging other than by a generator?

Yes, the accumulators may be charged by means of a Daniell (copper sulphate) cell. For a 4-volt accumulator you need about 6 cells, while 9 or 10 will be O.K. for a 6-volt accumulator. Large cells should be used, and they will need no attention for quite a considerable time. See that the zincs are renewed when eaten away, and that the copper solution is kept to its original strength. The copper solution should be a saturated solution, and the liquid in the porous pot is, of course, dilute sulphuric acid. The Daniell cells are, of course, connected in series, the end being connected to the negative of the accumulator and the copper to the positive terminal.

* * *

"BUZZER" (Newton Abbott).—I have a crystal set which I have just rigged up and tested with a buzzer. The buzzer was arranged in another room with a tiny aerial sticking up from one of the terminals. I got signals in my crystal quite well, but on varying my inductance and capacity the signals were just the same. Is my set O.K.?

Your set is quite O.K. The buzzer test proves that the crystal is operative and also that the crystal circuit and 'phones are quite all right. The reason why you could not cut out the buzzer signals by means of your tuner is that the buzzer is a small transmitter, and sends on "plain" aerial. This has the property of having no particular wave-length, and it "comes in" on all positions of the tuner switches.

* * *

L. S. P. (Ilfracombe).—I have been told that the straight horn type of loud speaker is better than one with a curved horn. Why is this?"

In dealing with loud speakers, the idea is to magnify the sound without distorting any more than can possibly be helped. Every metal loud speaker horn, and a good many others, have a certain amount of natural resonance due to the material employed. It is obvious that a curved horn must have more resonance than a straight one. This extra resonance will tend to impart a note to the sound waves in the same way as a bugle; and also it must tend, due to its curves, to baffle and thereby muffle the sound from the diaphragm. This means that there is likely to be far more distortion in using a curved speaker than when a straight horn is employed.

* * *

A. N. O. (Dalston).—Are "feed-back" and "tickler" circuits both the same meaning in American, reaction?

"Feed-back" refers to any circuit giving regeneration. The "tickler" circuit is the more usual reaction coil method of giving it, but there are others, such as the "tuned plate," where the reaction is replaced by a variometer not coupled with the A.T.I., or closed circuit inductance. In this latter method, the capacity effect between the plate and the grid is relied upon for coupling.

"NOVICE" (Bath).—If the velocity of a wireless wave is 186,000 per second, and the length of the wave 372 metres, there will be a frequency of 500 per second; therefore, as that is a low frequency, why should it not actuate the telephones directly without rectification?

Because the velocity of a wireless or any ether wave is 300,000,000 *metres* per second. Your figures refer to miles, and, therefore, your other factor, wave-length, should also appear in miles; therefore, the frequency of a 372-metre wave-length would be roughly 800,000 per second—decidedly a high frequency.

* * *

"DENSE" (Cleethorpes).—I cannot understand how it is that my set will not function when it rains. I should have thought that the damp atmosphere would have conducted the wireless waves more easily. Can you enlighten me?

It is not a question of the conductivity of the atmosphere because wireless waves are not currents of electricity. These latter are generated in your aerial when the waves cut it much in the same way as a current is induced in a coil when a magnetic field rises and falls and cuts any adjacent conductors. The weak currents of high frequency generated in your aerial will, however, very quickly leak to earth if the insulation is not of a very high order. When it rains the moisture on your insulators will tend to coagulate, and present a path to earth via the damp supports or mast. A very good tip is to smear a ring of vaseline round the centres of the insulators to prevent this coagulation. Insulators that are constructed in such a way, with a hood or similar device, so that water cannot fall over the whole surface at least are extremely advisable in this country. You should thoroughly overhaul the insulation of your aerial system, and the results will prove very gratifying.

* * *

N. V. P. (Dover).—Is there any rule whereby I can work out the correct values of grid leak and condenser to use in any circuit?

It has been proved by experiment that quality of speech received is impaired if the product of the capacity of the grid condenser in micromicrofarads, and the resistance of the grid leak in millions of ohms exceeds 200. Generally speaking, the higher resistance and less capacity factor is advisable. Owing to the different qualities of apparatus it is always advisable to experiment in the values of these two items if optimum efficiency is desired. For instance, the grid "leg" or wiring insulation, or the grid condenser may be "leaky," in which cases it may be advantageous to dispense with the leak altogether.

* * *

A. D. (Lincoln).—On an ordinary single-layer coil is it right for the slider to be in contact with several turns of wire?

No, that is the great disadvantage of that method of tuning. When the slider is in contact with two turns of wire or more, a turn is short-circuited, and the current induced in it will be large and will oppose that existing in the remainder of the coil.

* * *

W. M. D. (Southend).—The Hague is East and London West to me, and I desire to hear broadcasting from both on a single valve. I know that is expecting a lot, but in the circumstances could I hope to hear Marconi House at all if my aerial was absolutely directional to the Hague?

You should be able to bring Marconi House in, but the strength of signals would not be conducive to comfortable reception. The best plan would be to erect, if it is possible, a "T" aerial, taking the down lead from the centre of the horizontal wire or wires, the free ends of these pointing East and West.

* * *

K. B. (Tooting).—Is it usual to insulate the supporting guys of aerial masts?

Yes, the guys of large masts are broken up into sections by means of "egg" insulators. In the case of smaller masts insulators at the top of bottom only are employed.

* * *

"AERBEAM" (Ashby-de-la-Zouch).—After reading the article on "Beam" aerials in POPULAR WIRELESS, I should like to ask a few questions on that subject. (1) Is it possible to use the beam aerial with a crystal set? (2) Would you require a licence for this type of aerial? (3) How does it compare with the ordinary P.M.G. aerial?

(1) We hardly think this method of reception is worth attempting with a crystal set. (2) Though we know of no regulations regarding this type of reception, it is only reasonable to suppose that a

(*Continued on page* 588.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 586.)

licence would be required. (3) As regards efficiency it has hardly had enough testing to compare it with ordinary aerials. With regard to "upkeep," it is obviously a more expensive method of reception, and would entail far more manipulation than the P.M.G. aerial.

* * *

"ANXIOUS" (Belfast).—I have had the offer of a crystal and valve set from a friend in England; will it be possible for me to get a licence over here?

We believe you can obtain a licence. Owing to an error it was stated that licences were not being issued in Ulster, but we now believe that if you apply to the "Ministry for Home Affairs for Northern Ireland" your application will be considered, and, if suitable, it will be forwarded to the P.M.G. for formal consideration as in England.

* * *

U. A. Z. (Moretonhampstead).—I have several zinc plates that I should like to use in a Daniell cell. I have tried to amalgamate them by rubbing mercury on, but it does not seem to work. Can you help me in this matter? Why should it be amalgamated?

The reason the zinc is given a coating of mercury is to protect it against the action of the sulphuric acid solution when the cell is not in use. If amalgamation is carried out, the zinc is attacked only when the current is passing. To amalgamate a zinc plate, its surface should be cleaned with dilute acid, and then, while still wet, mercury should be poured on to it, drop by drop. The mercury will spread out over the plate, and form a coating over the zinc. You will find it practically impossible to amalgamate dry zinc.

* * *

"MYRA" (Rangoon).—In your issue No. 17 you state in reply to "Amplifier" (Tooting) that the direction of the induced current will be in the same direction on breaking the circuit. With your permission, may I say this is incorrect?

We regret we do not see your difficulty, as we believe you will see after consideration that the statement *is* correct. When a current has been flowing in a circuit and the circuit is broken, the magnetic field round the conductor collapses. The collapse of this field will induce a voltage into the conductor in the *same* direction. For instance, take the induction coil primary—leaving out the secondary altogether—the base condenser is placed across the make-and-break to prevent sparking. That sparking is due to the voltage induced by the collapse of the primary magnetic field when the circuit is broken. We think you will remember that any "variation of a current in a circuit varies the number of linkages of lines of force, and induces an E.M.F. tending to *oppose* the charge of current." Therefore this means that if the circuit is broken—current stopped—the effect of the inductance will be to oppose this cessation of current flow, *i.e.*, to prolong the life of the current *in the same direction*. Thus, the spark at the contacts upon breaking a circuit carrying a current is due to the self-induced "E.M.F. having a tendency to continue the current across the contacts." Hansel states that "on breaking the circuit there is a momentary E.M.F. in the same direction as the disappearing E.M.F."

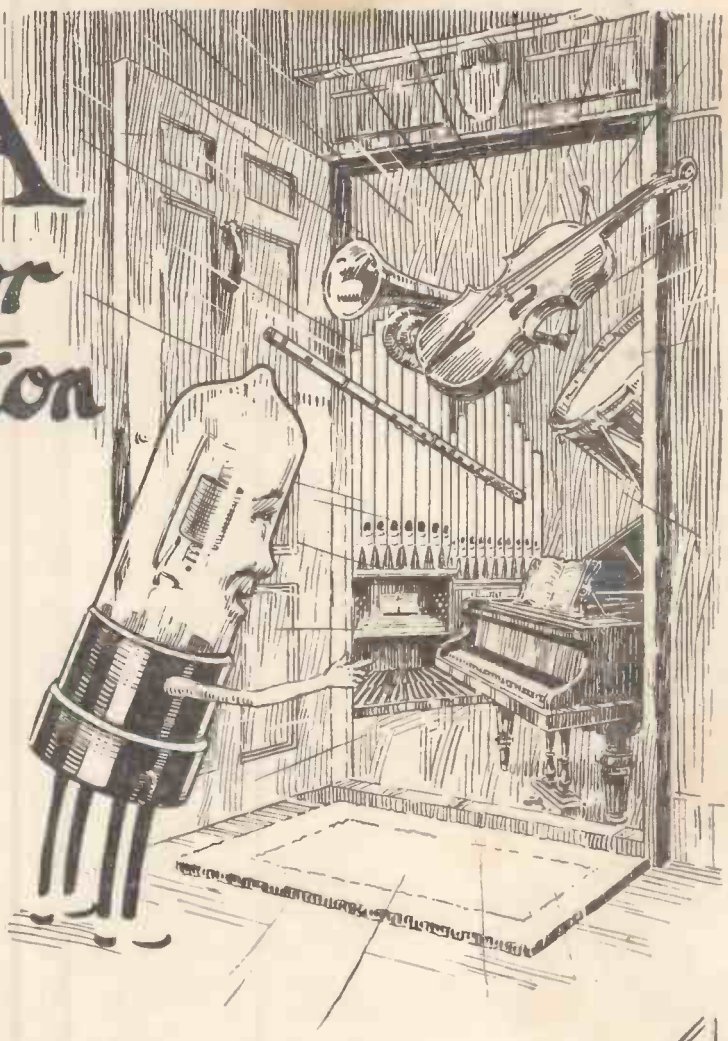
* * *

L. H. N. (Newport, Mon.).—I have been informed that stranded wires where each strand is insulated are not efficient for aerials or set wiring, owing to the fact that there is a capacity effect between the strands and also loss caused by the difference in potential that must exist between the strands. On the other hand, you mention that there may be a loss of 20% in efficiency by surface deterioration owing to corrosion, and the resultant increase of "skin" resistance offered to the high-frequency currents. What, therefore, should be the wire used?

Taking every point into consideration, we are of the opinion that for aerials the single strand of 16 or so gauge copper enamelled is as efficient as the more popular stranded electrically, if not mechanically. For set wiring a single strand of 22 run through systoflex insulating tubing should be employed. Surface corrosion of bare wires is much more noticeable in town areas than in more open surroundings.

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, War Office, Royal Air Force & Post Office.

Telephone: Battersea 1068 Codes: ABC (5 Ed) Bentley's Telegrams: Radiovalve Hammer Lond.

Trade Mark: Radio Mullard Valve

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
.....	BA Condensers, '0003 mfd...	2/6 each
.....	Combined Resistance and Condenser...	7/6 each
.....	Valve Bases with Terminals... ...	5/- each
.....	Valve Sockets ...	1/3 each
.....	Terminal Clips ...	9d. per pair

Name of usual Wireless Dealer

Name and Address

I enclose (Cheque Money Order, P.O.) value ..... to cover the cost.

To the MULLARD RADIO VALVE CO., LTD., 45, Nightingale Lane, Balham, S.W.12.

SEND THIS TO-DAY.

Printed and published every Friday by the proprietors, The Amalgamated Press (1922), Ltd., The Fleetway House, Farringdon Street, London, E.C.4. Advertisement Offices: Messrs. J. H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates: Inland and Abroad, 17/4 per annum, 8/8 for six months. Sole agents for South Africa: The Central News Agency, Ltd. Sole agents for Australia and New Zealand: Messrs. Gordon & Gotch, Ltd.; and for Canada: The Imperial News Co., Ltd. Saturday, November 25, 1922.
Y/Y