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Popular Wireless

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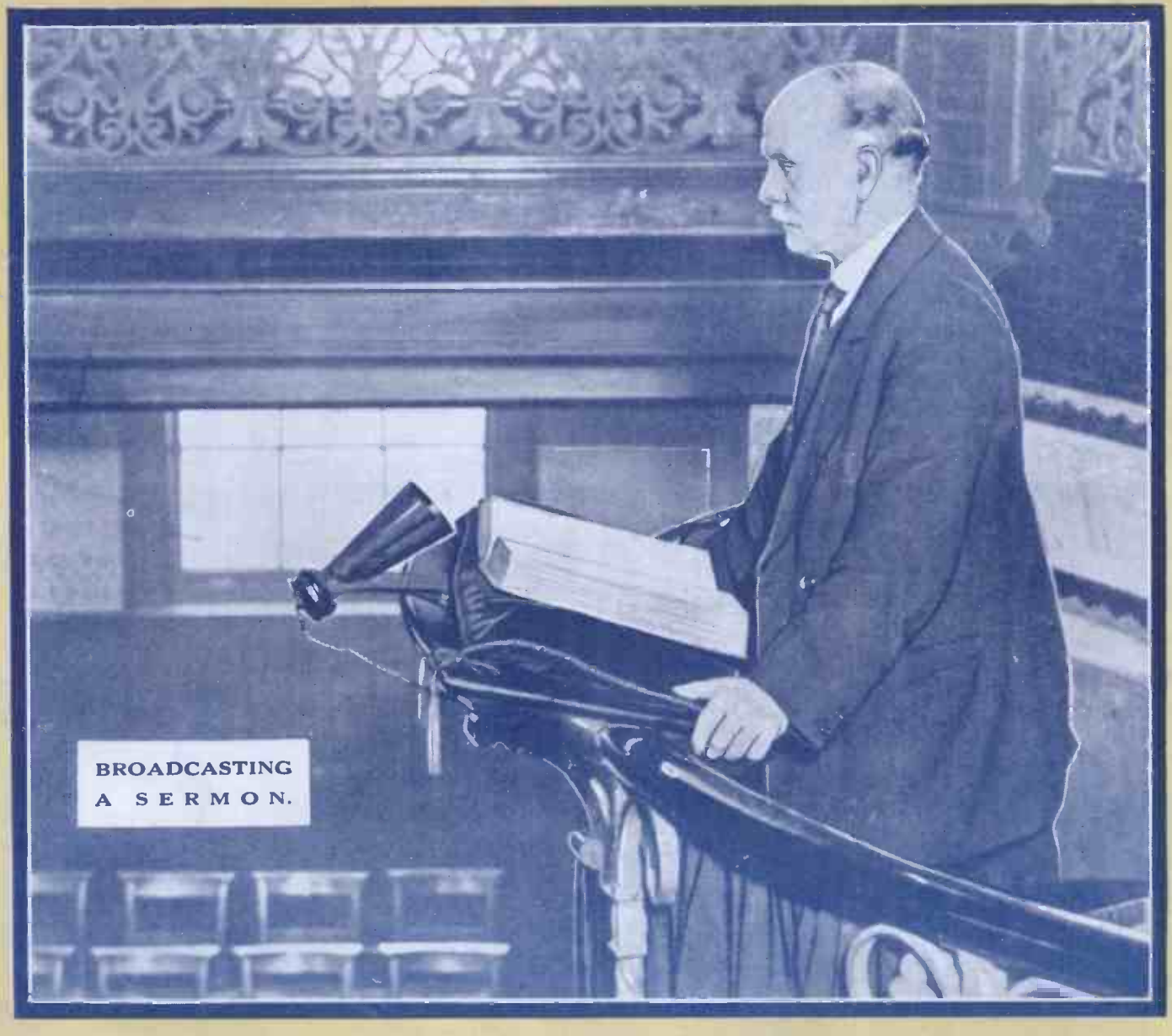


BROADCASTING A SERMON.

FEATURES IN THIS ISSUE.

The Wireless Section at Olympia.
A Special Review of the Exhibits.
Advantages of a High Aerial.
The Cardiff Broadcasting Station.
Another Four-Page Beginners' Supplement.
Part II of the Valve for Beginners.
A Tuned Anode Coupler.
A Page of Ideas for Amateurs.

THE FIRST OF A SERIES OF ARTICLES BY SIR OLIVER LODGE.

POPULAR WIRELESS

March 3rd, 1923.] SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S., D.Sc. [Every Friday.

TOPICAL NOTES AND NEWS.

Our New Cover.

HOW do you like our new cover scheme? The Editor tells me that a good many readers seem disappointed in the old cover, and, to tell you the honest truth, I did not care very much for it myself. After all, POPULAR WIRELESS has the largest circulation of any wireless paper in the country, and it is only right that its cover should be a little more dignified.

This number is rather a special effort, as I think you will agree when you glance through the pages. For one thing, it carries the announcement that Sir Oliver Lodge has accepted the appointment of scientific adviser to POPULAR WIRELESS, and the first of a series of articles by him appears on page 3.

Altogether a "bumper" number.

* * *

Northern Ireland Licences.

IT has been arranged with the Government of Northern Ireland that licences for wireless stations for the reception of music and other matter broadcast by wireless telephony shall be issued at the Belfast Head Post Office in approved areas to persons in Northern Ireland. Forms of application for such licences will be stocked at all head and branch Post Offices, but not at sub-Post Offices. No broadcast receiving licence will be issued except where the Ministry of Home Affairs has approved the application. Licences for the reception of broadcast matter are confined to apparatus which is manufactured by members of the British Broadcasting Company, and which bears the registered trade mark of that company, indicating that the apparatus is of a type approved by the Postmaster-General.

* * *

Glasgow Broadcasting Station.

THE Glasgow broadcasting station at Port Dundas will open in the first week of March. Mr. J. C. W. Reith, general manager, and Captain P. P. Eckersley, chief engineer of the British Broadcasting Company, have selected a site for the studio and office, the equipment of which will be carried out without delay.

* * *

Wireless in the "House."

WHETHER the Post Office will introduce a new measure to regularise the new position created by the advent of broadcasting is not yet decided. It may be recalled that the late Postmaster-General, Mr. Kellaway, introduced the Wireless Telegraphs and Signalling Bill on June 13 of last year "to make further provision with respect to the regulation of wireless telegraphy and visual and sound signals." The change of Government, however, held up the measure, and the point now is, whether it would be advisable to reintroduce it as it stands or scrap it, and bring forward an entirely new Bill.

Higher Education Broadcast.

IT is reported that lectures given at the Sorbonne, the College de France, and other seats of higher education in Paris are to be broadcast by wireless. At first lectures will be confined to topics of general interest, but if the experiment succeeds, it is hoped to send out courses on specialised and technical subjects.

* * *

An Up-to-date "Charabanc."

A MOTOR coach was seen recently in Birmingham fitted with a wireless installation. An overhead aerial enabled the passengers to hear all the broadcasting programme by means of a four-valve set and loud speaker.

* * *

The Radio Association.

IT is announced that Sir Arthur Stanley, C.B.E., C.B., M.V.O., has accepted the Presidency of the Radio Association.

* * *

Wireless in Warfare.

AN informative lecture on the subject of the development of radio signalling was delivered recently by Major Rupert Stanley, LL.D., M.I.E.E., principal Municipal College of Technology, Belfast, to the members of the Belfast Transport Officials' Club, at their rooms, Queen's Square.

The lecturer gave a vivid description of the use of wireless telegraphy during the war. He explained how the movements of batteries were detected, and, in consequence, how the British became informed as to where the "push" was about to take place. By means of listening-in, too, they knew the movements of Zeppelins, and were able to send accurate information, regarding them to the proper sources.

* * *

Wireless on Lifeboats.

AN order for 14 lifeboats for some of the leading steamship companies has just been completed by Messrs. Harland & Wolff, Ltd. The first to be delivered includes a wireless installation in the forecastle, and it is a good indication of the value placed on wireless in this capacity when it is noted that the seating accommodation is reduced from 40 to 36 in order to make room for it.

* * *

An "Aerial Hunt."

THE Norwich and District Radio Society recently conducted, under the auspices of a special committee, an "aerial hunt" to locate and endeavour to "round up" local amateurs not yet members of the society. I cannot help wondering how many "licence dodgers" were startled by these worthy "investigators" during the above proceedings.

* * *

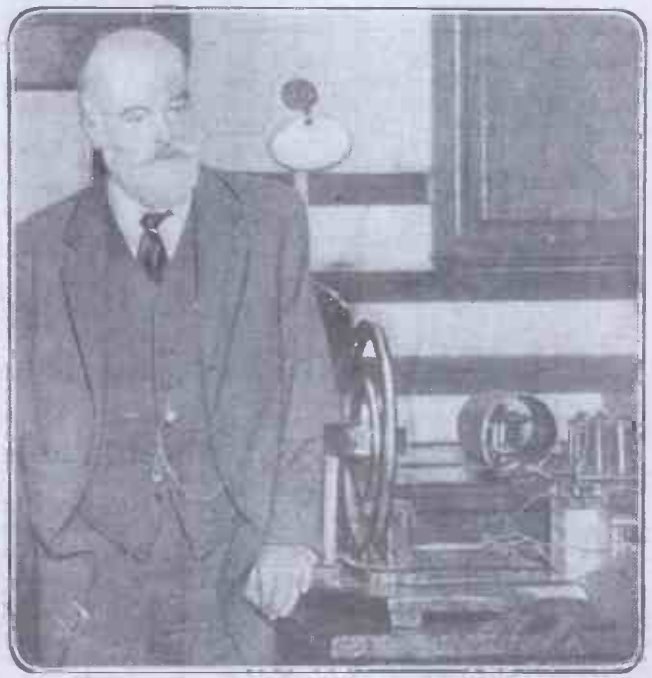
A Reduced Wave-length.

THE Cardiff Broadcasting Station had not been in operation for many days before it became apparent that 395 metres was much too near the 385 of

(Continued on next page.)

OUR SCIENTIFIC ADVISER.

It gives me great pleasure to announce that Sir Oliver Lodge, F.R.S., D.Sc., M.I.E.E., has accepted the post of scientific adviser to "Popular Wireless." The contributions made to science—and especially Radio science—by Sir Oliver Lodge are too well known to need recapitulation here; but I feel sure that readers of this journal will keenly appreciate the acquisition of the services of such a well-known scientist as Sir Oliver Lodge in the capacity of scientific adviser to "Popular Wireless."—The Editor.



One of the latest photographs of Sir Oliver Lodge.

NOTES AND NEWS.

(Continued from previous page.)

Manchester and that listeners-in situated in midway districts were having a pretty "thin" time. Therefore Cardiff was dropped to 353 metres and this will be its permanent wave-length. There are still a few grumblers in Wales who complain that the five-valve sets installed especially for 2 L O will now be rendered useless by jamming from Cardiff. However, if the intentions of the B.B.C. are carried, as they will be if the public support them, there will be no cause to grumble as to the quality of the Cardiff transmissions. Anyway, five valves will bring in some excellent French broadcasting on very dissimilar wave-lengths.

* * *

Still Increasing.

ACCORDING to the "Birmingham Post" there are now 10,000 wireless sets in use in Birmingham and districts. I wonder whether a margin is allowed in this estimate for the "Bilkers."

* * *

Novelty Wearing Off.

THE B.B.C. state that the cost of upkeep of their various stations is very considerably increasing. In the early days of broadcasting in this country people were inclined to give their services at a more or less nominal fee, but now that the first "edge" has worn off more normal figures are being charged. That is the reason for the increase in expenses put forward by the B.B.C. I cannot help thinking, however, that there will always be a very large number of artists willing to broadcast for not much more than a matter of "expenses" in order to obtain the publicity that broadcasting offers. It is about as good as the proverbial "stolen jewels."

THE IDEAL HOME EXHIBITION.

The Daily Mail Ideal Home Exhibition, at Olympia, should be visited by every reader of POPULAR WIRELESS. In the New Gallery Hall there is a special Radio Section. Some forty-two prominent wireless manufacturers have booked stalls, and some of them are reviewed in this number of POPULAR WIRELESS. The review will be concluded next week, and will be followed by a summary and criticism of the most original and useful features seen at the Radio Section of the Exhibition. Special photographs are being obtained for this critique. Readers in the provinces who are unable to attend the exhibition will find the completed review of the exhibits of great use, and as there is sure to be a big demand for future numbers of POPULAR WIRELESS it would be advisable to order a copy in advance.

THE EDITOR.

* * *

The B.B.C. Programmes.

A DEPUTATION from the Broadcasting Co., consisting of Sir William Noble and Mr. J. C. W. Reith, was recently received at a joint conference of the council of the Newspaper Proprietors Association. It was decided that newspapers might insert the B.B.C. programmes at their own discretion for a period of six months, when the matter will again come up for consideration.

* * *

The Ideal Home Exhibition.

ALL roads lead to Olympia, and all readers of POPULAR WIRELESS should do their best to pay a visit to the "Daily Mail" Ideal Home Exhibition. The wireless section is situated in the New Gallery Hall, and some 42 prominent firms are exhibiting there.

At POPULAR WIRELESS stall experts will be in constant attendance to answer queries, and a very special attraction will be a 24-page book—a complete "Outline of Wireless"—presented free to all who ask for it.

So roll up in your thousands!

* * *

A Talk for Scouts.

I HEAR the B.B.C. have arranged regular "Talks to Scouts" for a period of ten minutes every Thursday—from 6.50 to 7 p.m. This feature should be of considerable interest to the thousands of Scouts who are interested in wireless.

* * *

Various Items.

MESSRS. A. W. GAMAGE, Ltd., inform me that their stand number at Olympia will be 19, and not 26 as given in their report of their exhibits to the Editor.

* * *

Glasgow station is expected to commence with the opening of the Glasgow opera season, on March 19th.

* * *

I have just examined a very novel terminal produced by the Birmingham Products Co., which should have quite a vogue with experimenters. The Birmingham Products Co. will be pleased to give details to readers asking for particulars.

* * *

The Editor asks me to state that he has received several new catalogues from various firms which will be reviewed in a subsequent issue.

* * *

The Radio Waveora, Co. has removed to 1A, Garvan Road, Hammersmith, W. 6.

* * *

Messrs. Peto-Scott Co., Ltd., state that owing to an unfortunate mistake a number of "Turrode" plugs have been sold to customers incorrectly wired up. Will customers please return these plugs at once, when new ones will be supplied.

* * *

Messrs. Alfred Graham & Co. state that in a recent issue of this paper the Amplion Junior Loud Speaker was priced at 45*s.* instead of 50*s.*

* * *

Mr. Ben Tillett is to ask the Prime Minister whether he will consider the practicability of arranging for the proceedings of the House of Commons to be broadcast, in order that there may be closer touch between Parliament and the people.

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.
London Broadcasting Station, Strand ..	2 L O ..	369 ..	Usually every evening, 5 to 5.45 p.m.; 7 and 9.30 News; 7.15 Orchestra; 8.25 to 10.30 Music.
Newcastle Broadcasting Station	5 N O ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2 Z Y ..	385 ..	Every evening, usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5 I T ..	425 ..	Every evening, usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5 S C ..	415 ..	Commencing shortly.
Cardiff Broadcasting Station	5 W A ..	353 ..	5 to 10 p.m.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Paris	F L ..	2,600 ..	11.15 a.m. Weather report; 6.20-7 p.m. Weather report and Concert; 10.10 Concert.
Königswusterhausen ..	L P ..	2,800 ..	4 to 6.30 p.m.
The Hague	P C G G ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert.)
Haren	O P V H ..	1,100 ..	12 o'c. and 16.50 o'c. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m. News Items; 5.15 to 6.10 Concert; 8.45 p.m. News Items; 9 to 10 p.m. Concert.
School of Posts and Telegraphs, Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45-10 p.m. Saturdays, 4.30-7.30 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

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

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

All times given are G.M.T.

SOME WIRELESS OBSERVATIONS.

By SIR OLIVER LODGE, F.R.S., D.Sc., M.I.E.E. (Scientific Adviser to **POPULAR WIRELESS.**)

Sir Oliver Lodge has written a series of articles for POPULAR WIRELESS, the first of which is given in this issue. This series is primarily intended for the experimenter, and constitutes the commencement of a regular weekly feature for the advanced amateur. The Beginner is catered for in another special supplement. Readers will be glad to learn that Sir Oliver Lodge has also accepted the appointment of Scientific Adviser to this journal.—THE EDITOR.

AT the outset I want to acknowledge the help of my assistant, Mr. Edward E. Robinson, whose practical experience and instinctive recognition of the kind of problems which occur in connection with the winding of coils and other arrangements for wireless telegraphy has been of great assistance; and to him some of the incipient ideas here worked out are due.

The main essentials of a wireless installation are capacity and self-induction; introduced, for a receiving station, into a collector and a detector; and, for an emitting station, into a generator and an emitter. The emitter and the collector are one and the same. Transfer from generator to detector is effected by a switch. Capacity and self-induction are the essential ingredients of an aerial, and it is on them that the wave-length depends. But it is a question what value the capacity and self-induction shall have, and how they shall be arranged.

Confine Capacity to Aerial.

It is obvious that the more open the capacity, the better will it serve as emitter or collector; hence, whatever capacity is used, it should mainly be in the aerial, for highest efficiency. Any defect of capacity in the aerial can be supplemented by a closed adjustable capacity, which, of course, is very convenient, and will always be subordinately required for tuning.

If the aerial could be arranged so as to extend to a great vertical height, its capacity would be as open as possible, and its efficiency as emitter or absorber would be correspondingly high; for both the radiating and the absorbing power is proportional to the square of the height.

But there are practical limitations to the height convenient, so that when the greatest available height is attained, any bulk of the aerial beyond that is naturally horizontal.

In every ordinary case, however, the figure expressing the electrostatic capacity of an aerial in metres is small. It depends on the length of wire used, but is always incomparably smaller than the length of that wire. Expressed in electrostatic measure, we shall find that for an open vertical wire the capacity is about one-twentieth the length of the wire, and that the capacity of an aerial is seldom more than one-fifteenth of the wire used in its construction. Often it is much less.

The wave-length, however, depends on the capacity and the self-induction, being indeed six times the geometric mean of these two lengths. So, for any considerable wave-length, the length representing electric capacity being small, the length representing magnetic induction must be great.

Hence, to get any reasonable wave-length, the capacity of the aerial must be supplemented or reinforced and made effective by a considerable amount of self-induction. But whereas the capacity area may with advantage be as extensive as possible, there is no advantage in extending the self-induction; on the contrary, there is an advantage in compressing it into small compass, so that quite a minute coil will serve for a great wave-length.

Why should there be this advantage in constricting the self-induction coil? Because any capacity which it possesses is useless and, to some extent, deleterious. There is no gain in mixing up capacity and self-induction. They should be kept distinct and separate. The upper part of the aerial, combined with the earth below it, should have all the capacity; and the self-induction coil should have as little as possible. Then the wave-length has a chance of being clear and definite.

Whatever capacity exists between the turns of the coil has the effect of shunting some of the oscillation, and making it useless. The shunted portions would have any number of indefinite frequencies, and would not contribute to the main wave-length.

Use of Stranded Wires.

This has become known to practical men, and, as a result, what is called *basket* winding has often been adopted, in order that the turns of wire may have some intervening space between them, and so not lie too close together. Of course, this has some effect in diminishing self-induction as well as capacity, since the magnetic influence of the turns of wire on each other is diminished. But the reduction in capacity is found to more than compensate this disadvantage, and it is easy enough to get sufficient self-induction by making the coil bigger.

Only, of course, then more wire has to be used for the coil; and the more wire it contains, the more capacity it has. So it is evidently a question of compromise, and the best result has to be found by practice. Some capacity between the turns is inevitable; and, apart from basket winding, we may consider how best to secure a minimum of it.

First of all, then, thin wire is indicated. From the capacity point of view, the thinner the better. The only disadvantage of thin wire is that its resistance is high. But resistance only affects the damping of the vibrations; and the vibrations are usually sufficiently persistent to cause damping to have no great importance, unless it be excessive. Damping by radiation of energy is inevitable, and moreover useful. Other damping is of no use, but it is usually small in comparison. Of course, the wire must be of the highest conductivity. But, given that, there is a gain in keeping its thickness very small, say No. 40 S.W.G., or even thinner.

If in any case so much wire has to be used that its resistance does become excessive, then instead of making the wire thicker it would be better to have several wires in parallel, the said wires being very thinly insulated from each other, and then stranded or laid together.

A strand of this kind forms a very perfect conductor for high-frequency oscillations, inasmuch as every part of a thin wire helps to carry the current; whereas only the outside of a thick wire is effectively conductive for an extremely high frequency of oscillation, so that the effective resistance of a thick wire is considerably greater than it would appear to be when measured in the ordinary way with steady currents and a Wheatstone bridge. Such considerations do not apply to a strand of fine wires, however thinly insulated from each other they are.

Advantage of Cotton Covering.

It may be said—why insulate the parallel wires from each other at all? But it is clear that if they are in metallic communication, all along their length, they virtually constitute a thick wire. The ether waves cannot then gain access to more than the combined periphery. The inner wires will be screened by the outer ones, just as the interior of a thick conductor is screened. Whereas if there is any insulating material between them, however thin, the ether waves can, as it were, soak in and utilise the conducting power of all the wires. (It must be remembered that it is the ether, and not the copper, which really transmits the energy; the function of the insulating material is vital.)

Given then as thin a conductor as suffices for the quantity of electricity to be conveyed, the expression for the capacity of such a wire shows that in order to keep it small the turns of wire in a coil had better not lie close together. They can be separated by an air space, or they might be separated by a thick cotton covering outside the real insulation—a covering as airy and uncompact as it can conveniently be made.

However that may be, and however the distance between the wires is secured, it can be allowed for in the calculation; and the best method of obtaining the separation can be left to instrument makers.

The main consideration is to use as little wire as possible in the self-induction part of an aerial; or, in other words, to wind the coil so as to get the maximum self-induction out of a given length of wire. This will have a double advantage. It will keep down the resistance, and it will keep down the capacity—both of which must obviously depend on the length of wire used.

As far as I know, insufficient attention has hitherto been paid to this important consideration, and I doubt if coils are often wound so as to obtain the maximum self-induction. I regard this as important, and propose to take it fully into consideration.

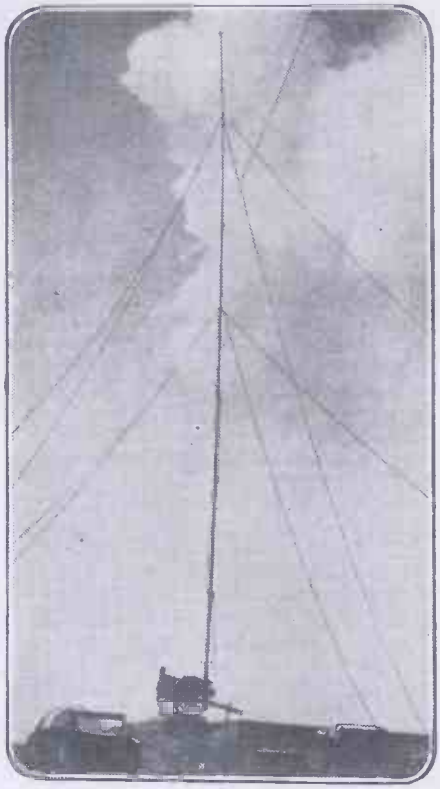
(*Another article by Sir Oliver Lodge next week.*)

THE ADVANTAGE OF A HIGH AERIAL.

By "NORAB."

MOSUL, that "bone of contention" of the Eastern dispute, looms very much to the fore in public discussions to-day. The writer was fortunate in being one of the first to enter the town in November, 1918, when our troops occupied it, and, as a wireless enthusiast, was delighted when we discovered that the German wireless station had fallen into our hands, intact.

The first point of interest and surprise was the very high aerial that the station possessed. It stood out defiantly against



Portable Mast used at Mosul by our troops during the War.

a background of beautiful blue sky, relieved only by small "cotton-wool" clouds. I had been engaged on war-time stations in that vicinity since 1914, and had many times cause to swear at the Mosul radio, because he worked incessantly and "jammed" our reception unmercifully.

Every Possible Foot.

The installation was of the usual mobile Telefunken 1½-kw. pattern, with a normal range of 250 miles, but I have reason to be certain that a much greater distance was spanned when it was so desired. The Telefunken apparatus has always proved itself remarkably efficient in regard to transmission over great distances, and "out East," where very strong "static" interference was present, the advantage of the "quenched" spark, employed by that system, was amply demonstrated.

In addition to the benefit obtained from using such a discharger, I was convinced, from the many captured enemy stations I saw, that advantage was always taken of every foot of mast that could possibly be erected, and this factor very materially assisted both the transmitting and reception distances covered by the stations.

The photograph of the mast at Mosul reminds me of the height question. Experiments have proved that up to a distance of about 200 miles reception varies directly as height of aerial. This is very remarkably demonstrated when working over deserts. I have known instances where the hoisting of an aerial 10 ft. more has made all the difference in "good" and "bad" signals, and has made regular communication possible, where otherwise it would have been useless to have attempted to carry on.

Many persons will not, of course, be able to erect an aerial as high as they may wish, owing to local conditions, or lack of space for masts, but I would advise all who can possibly increase their aerial height at all to do so. We have only to consider the aerial systems of the navies of the world, and also land stations, to realise what a definite factor height plays in efficiency of radio.

So pull in that "slack" and aim high!

"HARASSED HUMOUR."

An Impression of F. W. Thomas Broadcasting at 2 L O.

By K. D. R.

THERE is a peculiar, weird, and almost paralysing atmosphere about a broadcasting studio, with its horrible silence and heavy draperies. I have watched many vocalists and entertainers go cheerfully up to that seventh floor of Marconi House, bound for the studio of the London Broadcasting Station for the first time, chatting gaily, as if speaking into a microphone was the easiest thing in the world; but the moment that they enter the room itself a great change comes over them. The gay manner and flippant air have gone, and as you look round you are inclined to wonder whether you have not stepped into the waiting-room of some dentist, while instinctively you listen for the dread "Next, please!"

Mr. F. W. Thomas, the well-known humorous writer of "The Star," was no less perturbed than the rest by the uncanny stillness that pervaded everything when he went to 2 L O to read one or two of his stories the other evening.

Not at All Funny!

Laughing and chatting cheerfully as he went up the long corridor to the "torture chamber," he came to a sudden stop when he saw the forbidding looking instrument into which he had to speak. He glanced behind him as if seeking escape, but the door had swung quietly to, and there was nothing for it but to go on and hope for the best.

"Whatever did I come here for?" he groaned.

We explained that he was going to read one or two of his stories, and that he had come to be funny.

"Funny?" he gasped. "I am not a funny man, and even if I were I couldn't be funny down a thing like that."

He pointed to the awe-inspiring pile of sugar boxes and wire and cylinders into which he had to speak.

He was further assured that it was quite an easy thing to talk into the microphones, and at last he cautiously advanced towards the monster.

Quite Harmless.

Upon closer examination, Mr. Thomas saw that it was apparently "harmless," and he was shown how and where to stand while he delivered his speech. Then "time" was called and, pulling himself together, the humorist launched forth into one of his funniest stories. And the funniest thing about it was the fact that his story really *was* funny.

At the end of the first tale he decided he had had quite enough, but after a little persuasion consented to read another.

"Well, what did you feel like?" I asked, when he had finished.

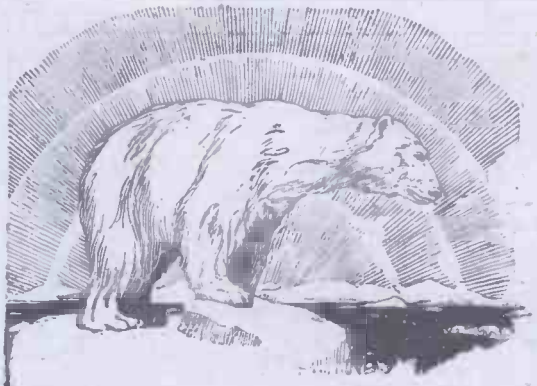
"Feel like?" he said; "like nothing on earth! It is about the worst evening that I have ever gone through. Ugh!"

"I am sure it went off quite all right," I remarked.

"I hope it did. All the afternoon my friends have been pulling my leg about it, and I know that several of them intended to listen in while I was speaking. Just to be able to congratulate me, as they said, when they see me to-morrow.

"Worst of all," he went on, "my family, including the children, have been listening also, and I sha'n't half know about it when I get home. I think that there ought to be some arrangement here so that the speaker can hear what it sounds like while he is speaking. I suppose it is rather a difficult business, though. I wish I could have heard what sort of an idiot I was making of myself. Still, I shall soon know when I get home."

Once more he was assured that he really had not made "an idiot of himself," that his stories had been heard quite distinctly, and that everything had gone off as it should, but he was not satisfied, and went home, as he remarked, "to hear the worst."



"POLAR"

SETS SERVICE SIGNALS

CONCENTRATED EFFICIENCY

—the Condenser Condensed.

The new "Polar" Variable Condenser embodies maximum efficiency with minimum dimensions at minimum cost.

Made in three ranges:

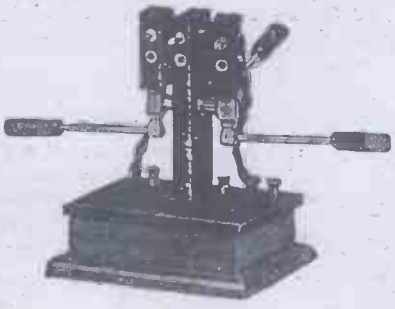
.0001 to .001 mfd.
.00005 to .0005 mfd.
.00005 to .0003 mfd.

All types are of the same dimensions—3 ins. by 3½ ins. by 1 in.—and sold at the same price:—

14/9 for panel mounting. Post free.

20/9 mounted in polished wood case. Post free.

"POLAR" THREE-COIL TUNING-STAND.



Of sound design, good workmanship, and fine finish.

The centre coil is rigid, while the outer ones can be rotated independently about their axes of support, or swung both together in planes parallel to that of the fixed coil. The former movement is controlled by two independent handles, one at each side, the latter by a single handle at the rear. The length of the handles is such as to prevent the hands of the operator from adding temporarily to the capacity while making the adjustments.

The coil-holders are of ebonite arranged for standard coil-plugs. They are carried on solid brass swivels. The whole is mounted on an ebonite panel supported by a polished wood base. All brass parts are highly lacquered, and the complete instrument is finished in a first-class manner.

Price 31/- *Post free.*

THE

RADIO COMMUNICATION CO. LTD

35, NORFOLK STREET, LONDON, W.C.2.

BRANCHES.

NEWCASTLE: 117 Sandhill. SOUTHAMPTON: 19 Queen's Terrace. CARDIFF: Atlas Chambers, James Street. LIVERPOOL: 67 Dale Street. GLASGOW: 116 Hope Street.
WARRINGTON—37 Bridge Street. ABERDEEN—9 Hadden Street.

IDEAL HOME EXHIBITION—Stand 40, New Hall Gallery.

THE CARDIFF BROADCASTING STATION

(By Our Representative in Cardiff.)

5 W A on the waves at last! And be it placed on record that the launching ceremony was both sparkling and impressive. Well, "South Walians" have waited long and impatiently. Many receiving instruments were ready before last Christmas, by which time the station was expected to be ready. January passed; hope was deferred. At last February 13th proved to be the date, and the success achieved has compensated for the delay.

Distinguished Visitors.

Through the great courtesy of the station director, Mr. Fred Roberts, our special representative was enabled to witness the inauguration in the company of Lord Gainford (Chairman of the B.B.C.), the Lord Mayor of Cardiff (Alderman Dr. J. J. E. Biggs), Sir William Noble, Sir W. R. Smith, Mr. John Duncan, Mr. J. C. W. Reith (General Manager of the B.B.C.), Mr. John Cory, Capt. Crompton, O.B.E. (Supt. Engineer of the Cardiff G.P.O.), and Mr. Arthur R. Burrows (director of programmes for the B.B.C.).

Speaking into the microphone, Mr. Reith introduced Lord Gainford to listeners-in, and referred to a new microphone to be installed shortly, which would do the work of the eight phones now in use, with expected improvement in transmission.

The King's Speech.

Lord Gainford opened his speech with the appended message from Mr. Lloyd George:

"It is with great satisfaction that I learn of the opening of a wireless station in Cardiff. I am following with the greatest interest the developments of this marvellous discovery, and am glad that Wales is taking part in, and benefiting by, the progress which is being made in this direction."

In the course of his address, his lordship mentioned that the Broadcasting Company had endeavoured to secure permission for the King's Speech to be conveyed directly from the House of Lords to all broadcasting stations. Unfortunately, and without apparent reason, the suggestion had been turned down.

Dealing with Possibilities.

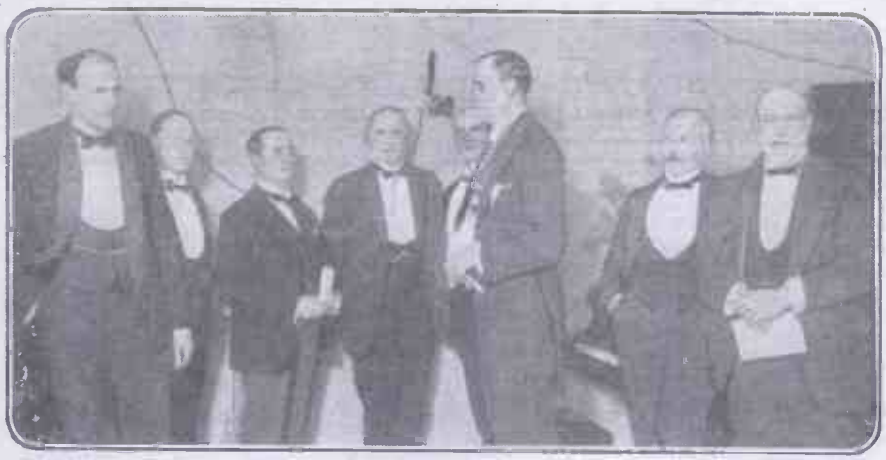
Sir William Noble, a director of the company, then addressed the unseen audience, concluding with the hope that the great musical festivals of Wales would be broadcast, "so that many thousands sitting by their own fireside would agree with the poet who wrote:

"And the night was filled with music,
For the cares that infest the day
Fold up their tents like the Arab
And as silently steal away."

The Lord Mayor very gratefully voiced the gratitude of all listeners-in for the nightly service of wireless telephony. "The standard of intellectual and artistic life," he said, "will be raised." He concluded with the moving words:

"We have begun to recognise that there

(Continued on next page.)



The Lord Mayor of Cardiff Opening the Station. Left to Right:— Mr. Reith, Mr. Burrows, Mr. Fred Roberts, Lord Gainford, Capt. Crompton, O.B.E., the Lord Mayor of Cardiff (at the Phone), Sir Wm. Noble, Mr. John Cory.

Listening-in with the presentation set in the Mayor's Parlour at the City Hall, Mrs. Coope and the Lady Mayoress are seated in the front row.

Left to Right—Front Row:—Mr. Mostyn Thomas (at the Phone), Miss Gladys Palmer, Mr. W. E Carston, Madame Fairburn, Madame Dilys Jones-Thomas.
Back Row—(standing) Mr. John Hill, Mrs. John Hill, Mr. Ronald Chivers, and Mr. Fred Roberts.

THE CARDIFF BROADCASTING STATION.

(*Continued from previous page.*)

are around us in the ether activities, powers, and if an appropriate transformation of electrical energy can enable the waves of sound to be projected to an almost indefinite distance, what further effects may not be produced in the ether by some similar transformation? This is a dream, of course; but may not, for example, the vibrations of light be projected in a comparable manner, and may it not become possible actually to see in this country the scenery, the architecture, the statuary, and the paintings of Italy, Greece, and Egypt?"

The "Music Room."

The station was then formally declared to be open. Undoubtedly Dr. Biggs carried out his part in a manner right worthy of the official head of a great city. A more impressive and appropriate ending to a speech on such an occasion can hardly be conceived.

Meanwhile another ceremony was taking place in the Mayor's parlour at the City Hall, where Mr. Cooper, acting district manager of the Metropolitan-Vickers Company, presented a receiving instrument, on behalf of his firm, to the then head of the city and future Lord Mayors. The Lady Mayoress accepted the gift, and thanked the company for their generosity. The acceptance was supported by members of the City Council, and those present spent the evening listening-in to the proceedings recorded above and the subsequent programme of music.

It is necessary to state that the music room is installed above the premises of the Castle Street cinema, about three minutes walk from the City Hall, and one and a half miles from the transmitting instruments housed at the Canton Power Station. Owing to this latter, the transmission can be tested every few minutes on a receiving instrument placed in the ante-room to the music chamber. Transmission is thus found capable of improvement by the immediate adjustment of the position of the microphones.

During the evening frequent messages were received from all parts of the country giving evidence of satisfaction with reception.

Taking the Photographs.

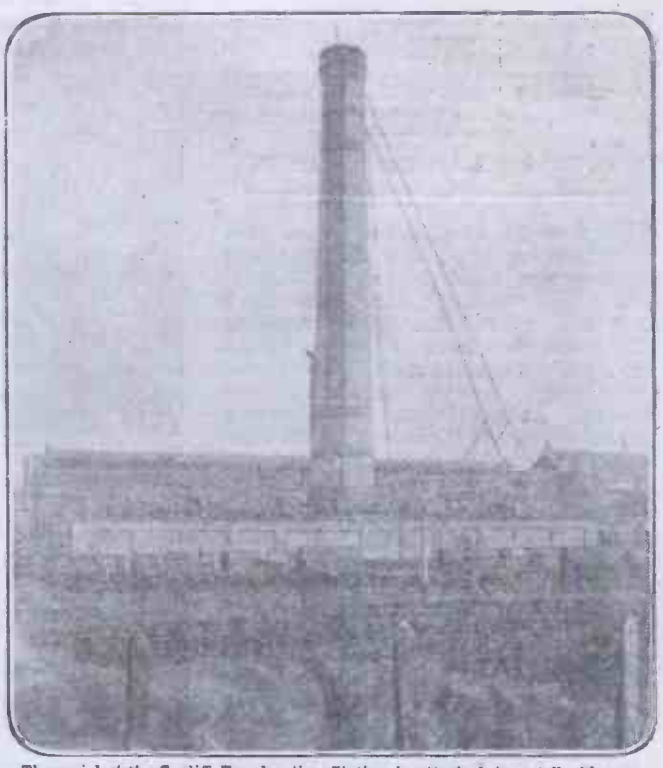
In the music room the scene at times was an animated one. Photographers were admitted in small groups, and occasionally opened fire from the doorway, for the room would not comfortably hold more than the officials, the musicians, and two or three guests. Pleasure was manifest on all faces, success being assured. On two occasions the listeners-in were asked to "stand by" while special photographs were taken. This was for the benefit of the readers of POPULAR WIRELESS. Unfortunately one of the negatives, that of the Lord Mayor speaking, was spoiled owing to the crush in the doorway. The one shown herewith takes its place. The second special photograph is that of the artistes, with Mr. Mostyn Thomas singing, and with our special representative standing at the back.

A Telegram Arrives.

Our heartiest congratulations to Mr. Fred Roberts on his successful debut as director of music. His programme was both high class and extremely pleasurable. High praise, too, has been earned by the Marconi engineers for their most efficient work. The engineer-in-chief, Mr. H. McCulloch, has been ably seconded by his colleagues, Messrs. Chesterfield and Boxer.

It remains to mention that during the evening a telegram was handed in to Lord Gainford, from Swale, Richmond, Yorkshire. It was from his son, Lieut. the Hon. Joseph Pease, conveying congratulations on his lordship's speech, and which had been clearly heard by Mr. and Mrs. Pease.

Illustrated descriptive articles of the Broadcasting stations are welcomed. Copy should not exceed 1,000 words in length. Photos should be very clear and "sharp."



The aerial at the Cardiff Broadcasting Station is attached to a tall chimney and has proved extraordinarily effective.

The valve-transmitting apparatus at the Cardiff Station of the British Broadcasting Co. These photos were specially taken for "Popular Wireless" by Mr. G. E. Thompson, of Cardiff.

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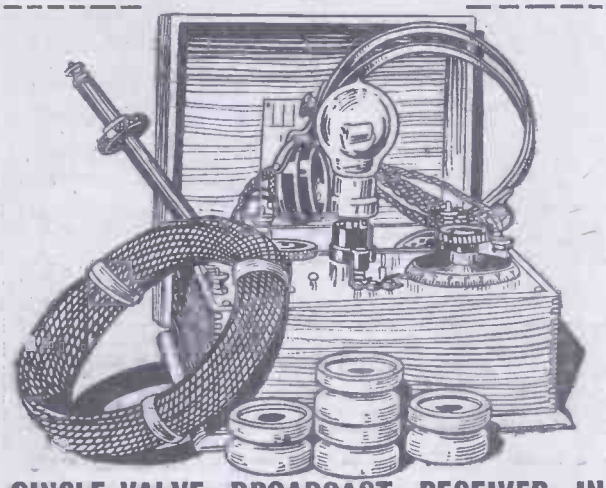

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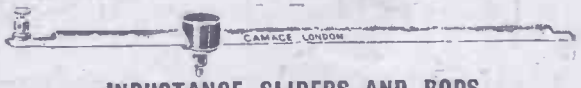

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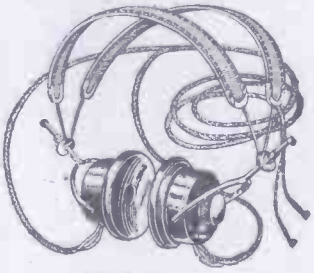

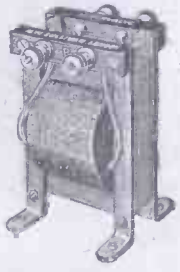

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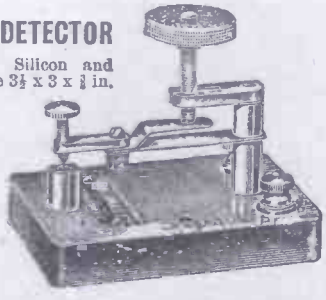

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LESS RANDOM REMARKS.

The second of two special articles of interest to amateurs

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

IN writing my article last week I took the liberty of soaring beyond my usual sober text-book style and subject, but there was method in my madness, inasmuch as I wished to direct the reader's attention to universal principles preparatory to the following attempt to show how wireless is simply a special department of one great fundamental organisation which is at work in Nature.

A working universe, like a great business, must be ruled by the execution of a certain number of basic principles, which the presiding genius adopts, specialises, or develops to meet various needs and contingencies. One of the great ruling ideas in the universe is called gravitation.

Matter in atomic or greater dimensions *attracts* similar masses, in direct proportion to the product of the masses and in inverse proportion to the square of the distance between the masses. Matter in *electronic* dimensions *repels* matter of similar dimensions; hence, as matter is composed of electrons, this simple law in uncontrolled operation would resolve the universe into electrons separated each from each infinitely. But that would bring to naught the idea of the universe as we perceive it, and so a by-law is enacted which forbids electrons to fly apart.

Harmonic Motion.

That by-law we conceive as a thing and name it "positive electricity," a stuff we imagine to be endowed with the power to attract electrons. Theory places a quantity of positive electricity at the core of every atom, its function being to hold or tend to hold the other components of the atoms (electrons) in position, like a sun with its attendant planets or a girl and her galaxy of mesmerised male admirers.

Another master idea is evolution, which also has its by-laws, all working towards that "one far off, divine event" towards which moves the one stuff, be it in the form of inorganic matter, living matter, or the mental and psychic bodies associated with these and manifested as Society. I apprehend that my readers will not welcome, at the moment and in these pages, an expansion of this particular idea, even though wireless has played and will play no small part in social evolution. Therefore we will pass on to yet another master idea, to which I referred last week, namely, motion.

Everything is in motion. Brought to absolute zero temperature particles of matter might cease their eternal dance, but in the aggregate they would still revolve with the earth around its axis and around the sun, and move with the rest of the solar system through space. If eternal vigilance is the price of security, eternal movement is the price of existence. Forms die and crumble to dust; the heart and brain of man become dust, but that dust is for ever unwearying in movement. The atoms which once composed the earliest living forms are still dancing; Plato's brain, Michael Angelo's hand, Buddha's heart, still move as to their ultimate particles.

Perhaps the most widely distributed form of motion observable in natural phenomena is harmonic motion, the recurrence of similar events. Periodicity runs like a refrain throughout the play of creation. "Consider the lilies;" first the seed, then the plant, and the flower, and thereafter again the seed. Consider those vital functions breathing and blood-circulation, how rhythmic the movement of the intercostal muscles and the rise and fall of the thorax, how regular the systole and diastole of the heart, the tick of the pulse.

Science is Measurement.

Think of the ebb and flow of tides, the regular succession of the seasons, and the recurrence of day and night, the swiftly spinning earth with its magnificent swoop round the sun, itself a revolving body. Wrench the mind from astronomical magnitudes to dwell upon the vibrations of sounding bodies, the incredibly rapid oscillations of electrons, and the infinitesimal and eternal ripples in the ether. You cannot entertain any doubt but that one of the by-laws is periodicity. It rules the life of the individual, the community, and the race. It enters so deeply into those causes which shape our being that one may say without exaggeration that periodicity has made us what we are.

A simple case of harmonic motion is that of a point moving uniformly round the circumference of a circle; another example is the motion of a piston in a cylinder, the piston-rod being imagined infinite in length. The particles of water move up and down in harmonic motion during wave-propagation, and so also do electrons in alternating or oscillating currents.

The outstanding characteristic of simple harmonic motion is that it follows a *sine law*—that is to say, it may be represented by a sine curve. I am warned off mathematics by a discriminating Editor, but I will permit myself to remark that amateurs interested in wireless theory must learn about sine curves or they will not progress very far. To have drawn a series of sine and cosine curves and to have digested their significance and uses is the beginning of a liberal education in wireless theory, and as some grasp of theory is equivalent to "knowing what you are doing"—well, a nod is as good as a wink to a keen fellow.

By means of these sine curves we can represent electrical oscillations and calculate the frequency and wave-length concerned and the amplitude of the current or E.M.F. at any moment of the cycle; we can show differences in phase by means of a plurality of curves plotted on a common base line, we can show how "beats" are set up, and what are their frequency and amplitude, and from the areas of curves we can calculate the power in a circuit.

Tackle this subject, and you will find keener delight in your hobby by being able to draw curves from figures taken from your own apparatus in operation. In this connection I will repeat once more the words of the sage, "When you can measure a thing you know something about it." Science is measurement.

THE P.M.G. AND HOME-MADE SETS.

INTERVIEWED at Birmingham by a representative of POPULAR WIRELESS on the vexed questions of wireless amateurs with home-made sets, the Postmaster General, Mr. Neville Chamberlain, remarked that it was evident that the position in regard to broadcasting is unsatisfactory from the point of view, both of the people who cannot afford to pay high prices for their sets, and that of the British Broadcasting Company and the Post Office.

"What the Government tried to do was to secure a sufficient revenue to enable those who erect the broadcasting stations and provide the programmes to maintain a high standard of quality, and on the other hand to avoid doing anything which would hamper the progress of experiment and invention.

"My predecessor seems to have thought that the man who made his own set could fairly be reckoned to be a genuine experimenter, but he did not give sufficient credit to the ingenuity of the manufacturer who supplies all the parts of a set, with a diagram enabling anyone to assemble them.

"This is simply evading the just and proper obligations of those who get the benefit of the broadcasting programmes.

"I recognise, however, that the majority of those who, having a little knowledge of electrical engineering, have been making their own sets, are now finding themselves in a difficult position.

"I do not want to check in any way the development of the present desire to share in the benefits of a very remarkable invention. The only difficulty is to find the most practical method of combining this with a due regard to the interests of all the parties concerned.

"I hope, before very long, to announce modifications in the regulations which will surmount the present difficulties."

THE KALLIROTRON.

An interesting article describing a wonderful valve combination.

TO obtain a two-thousandfold amplification of signal energy by the use of only two valves appears an incredible result, yet that is what has been accomplished by the circuit illustrated in Fig. 1. This powerful combination is due to Mr. L. B. Turner, who has named it the Kallirotron, from the Greek word *Kalliroos*, meaning "easy flowing."

As will be seen, the valves are connected together so that the plate of one is joined to the grid of the other, and vice versa, somewhat after the fashion of the mythical serpents who each seized and swallowed the other's tail until they both deteriorated into a spot of grease.

The analogy is not unapt, because the retroaction effects set up by the energy

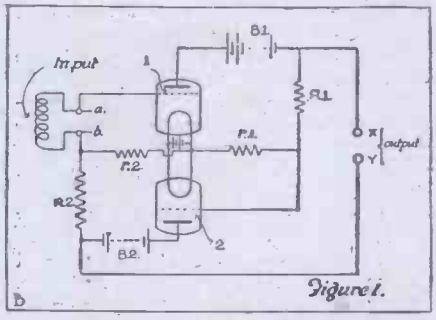


Figure 1.

flow through such a system create an increasing "negative resistance," which diminishes or destroys the ordinary ohmic resistance until the application of a minute electromotive force at the input is sufficient to give rise to an extremely large current flow through the device; in actual fact, it results in a voltage variation at the output end corresponding to such a current.

In other words, the device approximates as closely to an infinitely sensitive relay as appears to be possible within the limits of actual practice.

Regarding the circuits more closely it will be seen that the plate of valve 1 is supplied with a high tension voltage from a battery B 1, and that it is connected in the first place to its own filament through two high resistances, R 1 and r 1, and in the second place it is joined to the grid of the valve 2.

A Cumulative Action.

Similarly the plate of the valve 2 is fed by the voltage from a battery, B 2, and is likewise connected to its own filament through resistances R 2, r 2, and also to the grid of the first valve.

The input or signal energy is applied across the terminals *a*, *b*, between the grid and filament of the first valve. In order to keep the grids of both valves at a suitable negative potential small auxiliary batteries should be inserted in both grid circuits, but these have been omitted from the drawing for the sake of clearness.

Suppose, for example, that the applied signal causes an initial rise in the potential of the grid of valve 1, then a larger current will flow in the plate circuit of that valve. The potential drop across the resistances r 1 and R 1 increases accordingly, the voltage fall across any resistance being equal to the product of the resistance and the current flowing through it.

In other words, the potential gradient between the positive end of the battery through the valve and the two external resistances R 1 and r 1 becomes steeper, so that the voltage on the grid of the valve 2 (which is the same as that of the adjacent ends of the resistances r 1, R 1) is lowered. It follows that the current flowing through the plate circuit of that valve and across the resistances R 2, r 2 is diminished accordingly.

This fall in current in turn lessens the voltage drop across the resistances R 2 and r 2, because the whole potential gradient of the system is flattened out. The potential of the junction between the resistances R 2, r 2 will accordingly rise and increase the positive potential initially applied by the incoming signal. And so the process goes on.

Results on Test.

In a given test of the apparatus, using a high-tension of 95 volts on each plate, with an applied negative charge of 4 volts on the grids, an impulse of 5 millivolts across the input gave an output pressure of 8 volts, or an amplification ratio of 1,600. In this experiment the value of both the resistances marked R 1 and R 2 was 55,000 ohms, r 1 was 9,500 ohms, and r 2 13,600 ohms. Ordinary French or R valves were employed.

The actual degree of amplification obtained is, in fact, a function of the product of the two resistances r 1 and r 2.

As an example of its efficiency when used as an amplifier for ordinary line telephony it is sufficient for a person to speak in a conversational tone twenty feet from a pair of high-resistance telephones lying on a table, and connected to the input terminals of a Kallirotron in another room, for loud speech to be heard in a second pair of phones connected across the output terminals.

As the circuits are aperiodic (*i.e.*, contain practically no inductance or capacity) the device gives substantially equal amplification over wide ranges of frequency, a feature which is of great importance, as it avoids distortion effects when used for amplifying speech currents.

By removing both resistances R 1 and R 2 from the circuits, the output amplification of the Kallirotron may be made to

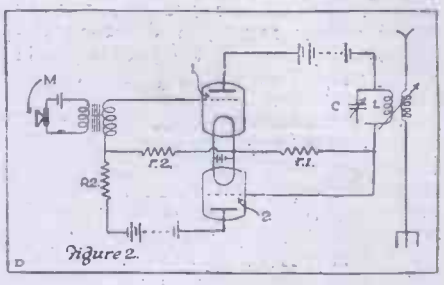
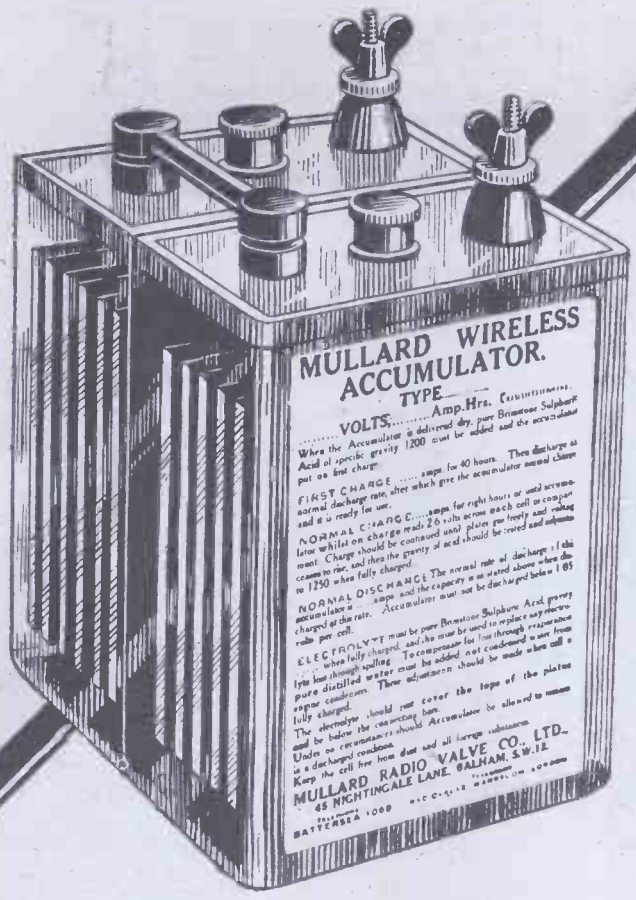


Figure 2.

reach a maximum value for a given small input, and thereafter to diminish, so that it can be usefully employed as a limiting device for minimising the effect of strays and other atmospheric disturbances, or for selecting a given note in preference to undesired jamming signals.

Fig. 2 shows the device in operation as a generator of high-frequency oscillations for the transmission of wireless telephony. The frequency of the carrier wave is determined by the tuned circuit L C, which replaces the resistance R 1 in the plate path of the first valve. Speech variations are applied to the grid circuit through the microphone M.

The King of Spain visiting a wireless instrument factory near Madrid.



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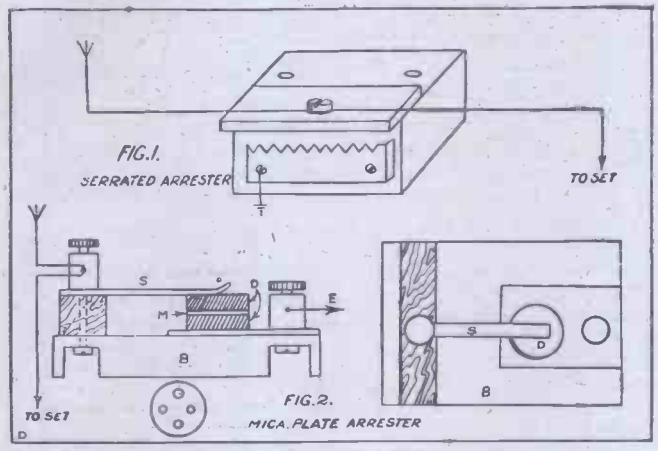
THE CONSTRUCTION OF EARTH ARRESTERS.

By H. E. HAYES.

MOST amateurs, taking up an unfamiliar subject, are at first unduly anxious as to what is going to happen: (*a*) If I do a certain thing, and (*b*) If I do not do it. Fortunately, even the worst accident in most hobbies only affects one's pocket; but in certain subjects—steam, electricity, and chemistry, for examples—certain precautions are very necessary. Now, at the present time a large number of aerials are erected, or in course of erection, and many ill-informed people talk freely concerning lightning discharges and the consequent danger to life and property.

When the dimensions and height of the regulation aerial are considered, this alarm is, to anyone with even a slight knowledge of the subject, quite unfounded. In a town or city, with its numerous high buildings, nearly all well-protected against lightning discharges, an aerial conforming to the regulations would scarcely receive the first attention from a discharge, unless by some freak cause, improbable but not impossible. The chances are 10 to the *n*th power that the aerial will never be damaged by lightning; yet, just to make it absolutely safe, an arrester can be made and fitted at an expenditure of a shilling or two, and isolated country houses with high aerials are recommended to do so.



The Straightest Path.

Investigation has proved that a lightning discharge to the earth's surface (an infrequent occurrence in our climate) can be safely conducted there by an elevated system of earthed points; and, further, that the existence of such points acts as a conductor and leakage arrangement for the charged cloud, or clouds, and consequently is a preventive of the discharge occurring.

It is also known that given a comparatively easy path to earth, any high pressure discharge will take this in preference to traversing even a single turn of a winding, such as a tuning coil. In fact, it will not turn a sharp angle on the copper tape of the lightning conductor wiring system, and for this reason such runs are wired as straight and direct as possible. Most readers have seen an electric spark jump from one point to another, for instance, across the minute gap of a sparking-plug, or the 6 to 10 inch discharging points of a powerful X-ray induction coil.

Damage May Result.

Now, a cloud is a mass of minute water globules, and, as such, can acquire a very high potential—much more than if it was a solid body of water. Many factors contribute to the charging of a cloud, such as evaporation, friction, rotation of the earth, etc. A second charged cloud may join the first one, and, assuming they are of equal mass and equally charged, the resultant potential on the combined cloud is, for reasons which will not be considered now, greater than that possessed by either before contact.

When this electrical pressure (or voltage) reaches a certain value, a discharge will occur from the cloud to the earth's surface, or vice-versa. A discharge may also occur from one cloud to another, but oppositely-charged, cloud. Roughly, a voltage of 50,000 is required to overcome the resistance offered by one inch of dry air. The enormous pressure or voltage of a lightning flash which will jump several miles can scarcely be realised.

The discharge, when it does take place, travels the path of least resistance to earth, and if this is provided by a tall, unprotected building or *isolated* tree, considerable damage may result. Many years ago it was observed that a charged, pointed conductor rapidly lost its charge, and that by providing elevated, pointed conductors, efficiently earthed, not only did they provide a path to earth if a discharge occurred, but by steadily neutralising and keeping in check the potential of the storm clouds actually prevented such discharge.

A large wood or forest would act in a similar way, as it presents a multitude of earthed points in the form of leaves. In large cities the amateur's aerial is by no means the most elevated point (he heartily wishes it was!). But just as a matter of precaution, one of the following simple lightning arresters should be made and fitted as near as possible to the point where the aerial is brought in.

Fig. 1 is called the "serrated" lightning arrester. It consists of a block of ebonite, or other insulator, on which are fixed two plates, one having saw teeth cut as shown. The distance between those teeth and the fixed plate should be as small as possible. The fixing holes on the serrated plate may be filed out to an oval shape, to allow of a close adjustment.

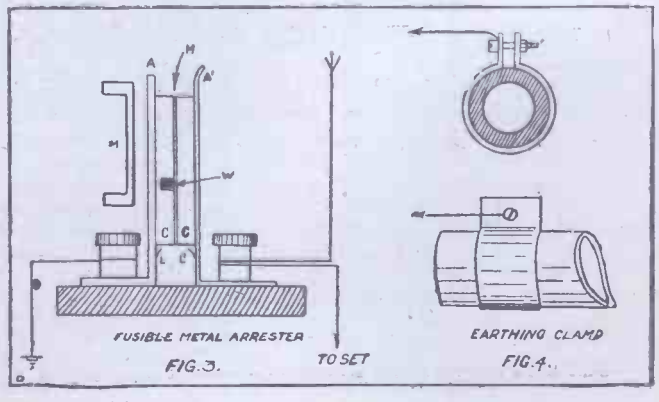
The "Earth" Arrangements.

Fig. 2 shows a better type of arrester—the "mica plate" arrester. Its construction will be evident from the plan and side elevation. D are two heavy brass washers separated by a piece of mica of similar diameter. Four holes should be made in the mica, as shown in separate sketch. S is a piece of springy brass or steel, and should bear tightly on the top washer. The usual ebonite base is provided.

Fig. 3 is an improvement on the two foregoing types. This arrester, known as the "carbon" arrester, automatically earths the aerial in the event of a discharge, but may be set clear again without trouble. A, A¹ are two brass angle-pieces, shown approximately full size. A¹ should be of a springy nature, to hold the carbon blocks (C C) tightly together, but separated by a piece of mica, shaped like a broad U and shown separately in Fig. 3.

Two small leaves are cut in the upright brass contacts, and pushed inwards to help keep the carbon blocks in position, as indicated by L, L¹. A small hole is drilled (about ⅛ in.) in one of the carbon blocks, and filled up flush with the face of the carbon with Wood's metal, as used for fixing crystals. The effect of any sparking or discharge taking place is to cause the metal to melt and make contact with the second carbon block, thus directly earthing the aerial.

A substantial earth connection should be made to the nearest water-pipe; if any other piping is passed on the route it is advisable to connect to that also. Failing soldering the wire on the water-pipe (this cannot be done while water is in the pipe), a collar should be made from sheet brass slightly smaller than the pipe, and clamped on the pipe by means of a small nut and bolt, under which the wire should be secured. Fig. 4 shows this arrangement.



CORRESPONDENCE.

The Editor, POPULAR WIRELESS.

Dear Sir,—It appears to me that with the progression of the amateur wireless movement in the direction that it is taking, a great deal of what one can only term "unfairness" is going to result owing to the present licensing conditions. It is easy to make destructive criticisms. I have therefore outlined a suggested plan for levelling up matters a little.

At the present time a person desiring to receive the extremely fine broadcasting programmes that are being sent out can obtain either an experimental or a broadcasting licence, either of which is going to cost him the same. With a broadcasting licence he buys a receiving set and, in doing so, pays a considerable fee to the Broadcasting Co., to pay for the excellent entertainment he is receiving. No reasonably minded person can possibly object to pay £3 or £4 for what amounts to years of first class nightly entertainments. In no other way than the reception of broadcasting can an individual obtain such cheap amusement, and even education.

Avoiding the Tax.

On the other hand, there are a tremendous number of people who, in order to avoid payment for their share of the entertainments, apply for and obtain an experimental licence under the pretext that they are desirous of carrying out wireless experiments. I am afraid that in many cases this is also encouraged by the trade.

I, personally, have been carrying out experimental work in wireless telegraphy and telephony since 1912. I am also a member of the Radio Association, and therefore nobody can accuse me of being an ardent and biassed supporter of the Broadcasting Co. I venture to say that at one time when I saw my liberty being considerably interfered with, I was one of the first to criticise the Broadcasting organisation, and I am afraid I have at times, like many other people, groused about the monopolies of the other, etc., but after three months sampling of broadcasting transmissions and a very careful searching into the intricacies of the trade and the difficulties with which the Broadcasting Co. are confronted, I think we owe them our thanks and congratulations for having so successfully carried through the difficult task.

A Suggested Solution.

The point remains, however, that there are a very large number of people who have only become interested in wireless because of the broadcasting, who are paying nothing whatever other than a licence fee for the very wonderful entertainments they are nightly receiving. This spells either of two things—the cessation of broadcasting owing to its failure to pay for itself, or else the man with the broadcasting licence paying for the entertainment of the man with the experimental licence.

The number of people desirous of really carrying out serious research work in matters connected with wireless are very few. It is one thing building up a set and adding valves to it in order to try and improve the reception of broadcasting, and it is another thing delving into the scientific depths of wireless reception. The man who is doing this latter work necessarily requires fairly expensive instruments of equipment, and broadcasting will only appeal to him from the point of view of being a fairly continuous supply of radio transmissions on which to test apparatus. If he wishes to listen to broadcasting, as a rule he will be the first to be willing to pay for his entertainment.

A Third Licence.

It appears, therefore, that instead of two different types of licences, three should be issued, the first the ordinary broadcasting licence, *and it would be just as well if the Post Office were to send an inspector round to examine the apparatus held by people with this licence.* It is a most extraordinary thing how many people with broadcasting licences seem to be able to get their sets to oscillate.

The second licence should be an experimental and broadcasting licence. This licence, given to people who desire to make their own sets and who wish to try the effects of different circuits on the reception of broadcasting, should include in its cost payment to the Broadcasting Co. on the same scale as that paid by people who are buying broadcasting receivers, *i.e.*, for a crystal set a man would pay a royalty on a crystal set, etc. If a person had a licence to receive on a two-valve set desired to use a third valve, he should be able to obtain permission by paying the difference in the royalties to the Post Office. After the issue of the first licence it could, of course, be renewed at the ordinary licence fee.

Something for Nothing!

The third licence, which should be very sparingly issued, should be issued only to serious research workers with considerable experience. This purely research licence, as it might be called, should enable the holder to receive or transmit with certain restrictions, such as are already in force.

If some such licensing arrangement were in operation, the success of the Broadcasting Co. would be more probable, and everyone would be paying their fair share for the entertainment received. I think nobody would grumble at the serious research worker being exempt from the broadcasting fees, as they would to a certain extent compensate him for the expense and time he was putting in to further radio interest.

It would be extremely interesting if others of your readers, holders of broadcasting and experimental licences, would put forward their views, more especially if, before doing so, they would endeavour to look into the matter in as broad-minded a way as possible, realising that in this world it is impossible to obtain something for nothing, and that there is no more reason why they should expect certain sections of the community to pay for their amusement than for entirely unknown people to regularly present them with free tickets for the theatre.

Yours faithfully,

"EXPERIMENTER WHO ENJOYS BROADCASTING RECEPTION."

The Editor, POPULAR WIRELESS.

Sir,—In view of the reports appearing from time to time in the daily Press of so-called "Diddlers" who are listening-in without Licences, I should be glad if you could definitely solve this problem for me.

The question is, are *all* the unlicensed listeners-in "diddlers," or is it not a question for the Post Office authorities to answer, inasmuch as no licences are issued even when applied for.

Take my own case, for instance (and I know of several others): I made my own 1-valve set about a month or six weeks ago, and at once applied to the P.M.G. for an experimenter's licence. I received the necessary form of application, and returned it duly completed, *without delay*; since then I have had no further word from them.

What then is the position? I certainly have no intention of evading the licence fee, and should be only too glad to have this matter settled.

Scrap the Set?

This, no doubt, is the experience of scores of other amateurs. Therefore, I repeat, whose fault is it that there are *so-called* "diddlers," when the P.M.G. might surely adjust matters, and issue licences more speedily, thereby adding to the Revenue and, incidentally, the B.B.C. receiving their just proportion.

Finally, does it seem feasible that, failing the issue of a licence by the P.M.G., an amateur is going to refrain from using his set or, "better" still, scrapping it?

I should be obliged if you could settle this point by an answer in your valuable paper.

Thanking you in anticipation,

I am, sir, yours faithfully,

CHARLES A. SHELDRICK.

13, Cromford Road,
West Hill,
London, S.W.18

The Editor, POPULAR WIRELESS.

Sir,—My client, Alfred Dinsley, Ph.D., of Great Crosby (call sign 5 I L), has requested me to write to you with reference to the recent abuse of his call sign.

Dr. Dinsley is at present using his station solely for research purposes, and it is regretted that some person or persons, at present unknown, have been using and abusing his call sign for the purposes of transmission.

If this practice does not immediately cease, strictest investigation will be made, and the facts reported to the Postmaster-General.

As this practice is not only unfair, but is also calculated to hinder and retard research work, I should be glad if you would insert this letter in your next issue.

Yours faithfully,

FRANK H. HENRI,
Solicitor, Liverpool.

HAVE YOU IDEAS?

The Editor welcomes short contributions from readers of "Popular Wireless." If published, they will be paid for at our usual rates.

POPULAR WIRELESS EXHIBITION REVIEW.

A Concise Summary of the Wireless Exhibits at the "Daily Mail" Ideal Home Exhibition, Olympia.

RADIO INSTRUMENTS, LTD.

Our stand contains one of the most representative displays of wireless apparatus, both instruments and components, made in this country. Everybody interested in wireless should not fail to inspect the magnificent collection of instruments and accessories displayed here.

Twenty-four different types of broadcasting instruments are shown, including sets fitted with 1, 2, 3, 4. 5, and 7 valves. There are also a number of our well-known artistic "Lyrian" cabinet sets fitted with and without frame aerials; those fitted with frame aerials can be used in any place without wires or connections of any sort, the instrument being completely self-contained. All "Lyrian" sets are fitted with loud speakers. Two new fine cabinet models are shown in Chippendale and Jacobean styles.

The famous R.I.L. Low-frequency transformers and a wide range of high-frequency transformers suitable for wave-lengths of from 150 to 30,000 metres in one unit are also shown at our stand. All the R.I. components used in wireless and made in our own works can be seen. Experimenters will be well repaid by inspecting these components.

A large range of our improved crystal sets are also shown. These are fitted with the R.I.L. Micrometer Adjustment, which considerably increases the sensitivity.

* * *

A. W. GAMAGE, LTD.

Once again the well-known firm of A. W. Gamage, Ltd., are offering to the public the right apparatus at the right price, so that one and all may enjoy these nightly concerts transmitted by the British Broadcasting Company.

At the Ideal Home Exhibition they will have on show a complete range of their apparatus capable of filling everybody's requirements from crystal sets to multi-valve sets. In particular every one should examine their Ideal Crystal set, which is constructed on sound lines, every detail being carefully considered, so that consistent maximum efficiency may be obtained. They have only been selling these sets for a short period, and the reports of concerts enjoyed are continually arriving, which proves that there is nothing complicated in these sets.

Everyone is also interested in amplifiers for Crystal sets for the purpose of working either several pairs of telephones, or a loud speaker; this has also received their attention, and their single stage amplifiers are all that may be desired for this purpose. They easily claim to have in their stock the finest single-valve receiver yet offered to the public, and this will be on show at this exhibition. The workmanship is perfect throughout, and the guaranteed receiving range is 40 miles for telephony.

They will also be putting before the public a range of new cabinet sets consisting of 3, 4, 5, and 6 valves constructed to give the maximum efficiency with the minimum of trouble at prices which will be worth considering.

There will be several unique features, particulars of which will be found in the circular obtained at their stand. There will be an efficient technical staff to answer your questions and to give you every possible advice as to the purchase of your wireless set. A large range of useful accessories will also be displayed.

* * *

L. McMICHAEL, LTD.

We shall be showing a complete range of our receiving sets, among which we should like to draw attention specially to our M.H.3 3 valve receiving set which consists of one high frequency valve, 1 detector valve, and 1 low frequency valve complete in polished mahogany cabinet. This set has been consistently receiving the American broadcast concerts from different parts of the country and may be purchased, complete with all accessories, for £27 10s., this making a complete station.

Our M.H.4R. set, which has 1 valve high frequency, 1 detector and 2 valves note magnifier, a high frequency being obtained by tuned anode. We have the M.H. Loose Coupler, which we recommend to go with this set, both being mounted in desk shaped mahogany cabinets, making a very handsome pair of instruments. The total cost of such a station would be in the neighbourhood of £40 complete with all accessories. With such a set as this the London broadcast stations have been heard as far away as the north of Scotland, South of France, and indeed so far distant as Norway.

We are also showing the very last word in broadcast sets, our M.H.B.R.2 being a highly efficient set and stamped B.B.C., complying with all regulations. The cost of complete station, embodying this 2 valve receiving set, is about £23, and a further 2 valve of amplification for those desiring to use loud speaker can be added at an extra cost of 9 guineas.

In addition to the sets mentioned there will be a good selection of ex-Government apparatus reconditioned, and in some cases reconstructed for present day use as broadcast receiving sets, these of course being highly efficient, as everyone realises the very good workmanship which was put into Government apparatus, regardless of expense.

Another interesting feature on our stand will be our radio blocks or unit system, each unit being in specially fine machined aluminium case. Thus a good screening effect is obtained, and it is possible at comparatively little expense to build up a 4 or 5 valve set with these units. High frequency is arranged for either by the transformer plug-in method or by reactance capacity.

* * *

TINGEY WIRELESS, LTD.

Messrs. Tingey will be exhibiting:

SINGLE-VALVE BROADCAST SET.—Stamped B.B.C. Entirely self-contained with exception of batteries. Wave-length 300–3,000 metres. Broadcast reception up to 50 miles for speech; also Paris time signals.

TWO-VALVE BROADCAST SET (Type A).—Stamped B.B.C. Entirely self-contained with exception of batteries. Wave-length 300–3,000 metres. Broadcast reception up to 50 miles for speech; also Paris time signals. Same as Single-Valve set, but added Low Frequency Magnifying Unit.

TWO-VALVE BROADCAST SET (Type B).—Stamped B.B.C. Entirely self contained with exception of batteries. Wave-length 300-3,000 metres. One H.F. and 1 Detector. Broadcast reception on headphones 100 miles. Also possible to hear Paris speech and Hague.

THREE-VALVE BROADCAST SET.—Stamped B.B.C. Entirely self-contained with exception of batteries. Wave-length 300–3,000 metres. One H.F., 1 Detector, and 1 L.F. valve. Broadcast reception on headphones up to 300 miles. Capable of Low Frequency extension.

FOUR-VALVE BROADCAST SET.—Stamped B.B.C. Entirely self-contained with exception of batteries. Wave-length 300–3,000 metres. One H.F., 1 Detector, and 2 L.F. valves. Broadcast reception on headphones up to 300 miles.

FIVE-VALVE BROADCAST SET (Type A).—Stamped B.B.C. Entirely self-contained with the exception of batteries. Wave-length 300-3,000 metres. Two H.F., 1 Detector, and 2 L.F. valves. By means of switches any combinations of two or more valves may be used. Capable of receiving broadcasting from all British and Continental broadcasting stations.

FIVE-VALVE BROADCAST SET (Type B).—Stamped B.B.C. Entirely self-contained with exception of batteries. Wave-length 175–28,000 metres. Two H.F., Detector, and 2 L.F. valves. Three or five valves can be used by means of a switch. Separate inductances for each range of wave-lengths.

TINGEY UNIT SYSTEM.—For holders of experimental licences only. The most effective type of apparatus produced. Any combination of valves may be built up by the purchaser to suit his individual needs. American speech has been successfully received on numerous occasions with these units. Special patent coils with exceptionally low self capacity are sold for use with this instrument.

TWO-STAGE POWER AMPLIFIER UNITS.—For addition to any of our sets when exceptionally loud signals are required.

* * *

THE IGRANIC ELECTRIC CO., LTD.

The Igranic Electric Co., Ltd., say their exhibit will consist of a collection of modern wireless units, as manufactured in their factories, featuring their:

Filament Rheostats, Plain and Vernier types. Intervalve Transformers. Honeycomb Inductance Coils, Plug and Gimbal mounted. "Triplug" Coil Holder, for table and panel mounting of plug type Honeycomb Coils. "Micro Adjusta" Coil Holder for plug type Honeycomb Coil. "Gimbolder" Coil Stand for Gimbal mounted Honeycomb and Slab Inductance Coils. Variometers of the Ball and Socket type. Vario-coupler of the Ball and Tube

(Continued on next page.)

POPULAR WIRELESS EXHIBITION SUPPLEMENT

(Continued from previous page.)

type. Tapped Inductances of the Honeycomb Coil type.

Special attention is drawn to the Gimbal Mounted Honeycomb Coils and "Gimholder" stands, which represent the latest development in the art of wireless telephone and telegraph signal reception. The use of gimbal mounted coils on the "Gimbolder" stand entirely obviates the need for aerial tuning and results in much sharper tuning and consequently less damping of the received signals.

The damping of the received signal is further decreased by the use of the honeycomb form of winding, owing to the fact that the high frequency resistance is thereby reduced to a minimum.

The combination of the "Gimbolder" stand and Gimbal mounted Coil actually provides a variometer and coupler of very low distributed self-capacity. When arranged in this way the Gimbolder system has considerable advantage over the standard variometer, which is limited in wave-length.

Other interesting items on view will be Coil Winding Machines in operation, one winding the famous Honeycomb Coils, and the other winding the noted Cotton Interwoven Intervalve Transformer coils. This latter winding is used on all Igranic Intervalve transformers and ensures maximum efficiency and silent working.

* * *

ELECTRIC APPLIANCES, LTD.

The Electric Appliances Co., Ltd., are showing a complete range of instruments for the reception of Broadcasting. This range includes:

1. *Eureka Loose-coupled Crystal Set.*—This set is capable of giving very selective tuning (in cases of serious jamming) owing to the "coupled circuits," while, by means of the "tune and stand-bi" switch, a single circuit may be used. No batteries or valves are required. The set is complete for reception of broadcasting and has a range of 25 miles. For telegraphy and time signals 300 miles or more. Wave-lengths 300 to 600 metres.

2. *Eureka 2-Valve Broadcast Receiver.*—This set is specially designed for the reception of Broadcasting within a radius of 50 to 80 miles. In the construction of this set simplicity has been the keynote. A child can "tune-in" a Eureka Valve Receiving Set at the first trial. Only two adjustments are necessary: (1) Rough tuning; (2) fine tuning. Valves are enclosed—very accessible—and a vent over each serves the double purpose of ventilation and examination. The panels are mounted at a convenient angle, which is much better than if horizontal or vertical.

3. *Eureka 3-Valve Broadcast Receiver.*—This set is built on similar lines to the 2-Valve Set previously described. Its range for Broadcasting is from 80 to 120 miles—thus a number of transmitting stations can be heard. With this set a Loud Speaker may be used. The tuning is extremely simple, and the set can be operated by a child or anyone without the slightest technical knowledge.

4. *Eureka 4-Valve Broadcast Receiver.*—This is the most powerful instrument of its kind on the market, and there is no finer Broadcast Receiver manufactured. Its manipulation is extremely simple, being precisely the same as for the 2 and 3-valve sets. The range is considerably increased, and Broadcasting can be received from all stations in the British Isles and from the principal Continental stations as well. This set will operate with or without a Loud Speaker.

All Eureka Valve Receivers can be supplied to work on either outdoor or indoor aerial, as required, and absolute satisfaction is guaranteed with every set, whether used with outside or inside aerial.

* * *

RADIO PRESS, LTD.

"Modern Wireless" the largest British Wireless Monthly, and a full range of wireless books are amongst the publications of the Radio Press, Limited. The beginner will find in "Wireless for All" and "Simplified Wireless" a non-technical explanation of the fundamental principles of wireless telephony and telegraphy. "How to Make Your Own Broadcast Receiver," and "The Construction of Wireless Receiving Apparatus" are two little books which will be found invaluable for constructional information. "Wireless Valves Simply Explained," and "Practical Wireless Valve Circuits" are two excellent books suitable for those who already have some slight knowledge of the subject, while "Elementary Text-book on Wireless Vacuum Tubes" is suitable for the more advanced student. "How to Erect Your Aerial," and the Radio Press "Wireless Directory" of commercial and amateur call signs are two indispensable books.

* * *

S. G. BROWN, LTD.

The Type A Telephone Head Receiver (Adjustable reed).—These phones represent the highest development in the production of a super-sensitive receiver. For the detection of weak signals, and for all cases where the greatest efficiency is demanded they are without equal. By their use the range of a given receiving set is much increased.

The Type D Head Receiver.—This is of the flat diaphragm design, and, while not so efficient as the Type A, is, nevertheless, a thoroughly efficient instrument for all-round use. It is particularly good for telephony (speech and music). In fact, it differs from the Type A only in price, and is lacking the ultra-sensitiveness of the dearer instrument.

The Type F Featherweight Phones.—These have been produced in response to the demand for a phone that shall be almost as good as the Type D, but lower in price. They have the added merit of extreme lightness. The workmanship is quite up to our usual standard, and this receiver constitutes the best possible value for money. They are wound either to 120 or 4,000 ohms; the price, 30s., being the same for both.

The H1 Loud Speaker.—This is the premier loud speaker, both in respect of volume of sound and clearness. It has a scientifically designed horn, free from all distortion.

The H2 Small Loud Speaker.—Where so large an instrument as the H1 is not called for, or where price is a consideration, this receiver, which is practically a miniature edition of the famous H1 loud speaker, affords the amateur the best possible way of allowing a number of people to listen-in simultaneously. In common with the H1 instrument, it operates on the adjustable reed principle, and it has, likewise, our patent logarithmically-expanding horn.

The Microphone Amplifier.—This instrument constitutes a robust and efficient device for amplifying wireless telegraphy and telephonic currents. It is simple and cheap; very reliable, and its upkeep cost is negligible. It gives amplification greater than that obtained from the use of two valves. Speech of a given loudness in a pair of head phones will, by the use of the microphone amplifier, be of the equivalent loudness from a loud speaker.

* * *

ROGERS, FOSTER AND HOWELL, LTD.

On Stand No. 13, in the new Hall Gallery, Rogers, Foster & Howell, Ltd., radio engineers, of Edward Road, Birmingham, have a comprehensive exhibit of their well-known wireless receiving sets. As is to be expected, great importance is given to their New Reaction Sets for use under the ordinary broadcasting licence. The great advantage of these new sets is their great selectivity, which enables them to cut out any local broadcasting station at will, even if this is only a mile or two from where the instrument is installed. Such sets also eliminate risk of interference from spark transmitting stations which in certain parts of the country give so much trouble to wireless users. The effective range of the instruments with the new circuit is also greatly increased; to take only one instance, the 2-valve instrument when used in Birmingham will receive telephony from Paris, the Hague, London, Manchester, Newcastle, Cardiff, etc. The instruments exhibited of this new type comprise 2-valve, 3-valve, and 4-valve sets.

Of the non-reaction type there are on exhibition specimens of the 1-valve, 2-valve, and 3-valve sets. In the way of crystal sets there are on view a number of the firm's Model O Class "A," an extremely attractive and well-finished crystal receiving set. There are also various receiving sets shown in different styles of pedestal cabinets in various "period" designs, especially suitable for the lounge or drawing-room, and forming attractive pieces of furniture. Various 2-valve and 3-valve amplifiers, and a number of special 7-valve sets are on view, together with a varied stock of wireless components and parts.

* * *

RADIOPHONES, LTD.

The wireless enthusiast who wishes to go in for a large set, but does not want a lot of panels, wires, and batteries all over his room, will find the stand of Messrs. Radiophones, Ltd., very interesting and helpful.

The chief exhibit, besides the standard 2 and 3 valves sets, will be a large 4 valve cabinet set. It is completely enclosed in polished mahogany of artistic design, and embodies the whole equipment except the aerial. A loud speaker is contained at the top of the cabinet, and this can be used if desired, or can be switched off and telephones attached to the terminals provided. Batteries are included and the valves are coloured red to prevent glare. The whole set is completely encased when not in use, two swing doors hiding the whole apparatus. The range of wave-lengths is very large, being from 250 to 3,000 metres, thus including all the British broadcasting, the French telephony, the Hague, and also the Paris time signals from the Eiffel Tower.

(To be continued next week.)

It speaks for itself in a loud, clear and perfectly natural tone

With the highest amplification of all Wireless reception, and particularly of Vocal and Instrumental music, the clarity and tonal purity of the AMPLION is unapproached in any other form of loud speaker. The adjustment is simplicity itself, and "volume" may be regulated to a nicety.

THE

AMPLION

LOUD SPEAKERS

The World's Standard

are supplied in a series of 10 models, suited to every service—the Home, Laboratory and Concert Hall—and the prices range from fifty shillings to fifteen guineas.

The registered Trade Mark AMPLION on a Loud Speaker is a guarantee of efficiency and reliability, and an assurance of Improved and Perfected Reception.

Ask for Folder "P.W."

Type A.R. 15.
Table Type with "Music Master" style horn, 14-inch bell mouth.
2,000 ohms £6:2:6
Other resistances supplied.

Type A.R. 19.
Table Type with independent receiver.
2,000 ohms £5:5:0
Other resistances supplied

Type A.R. 17
Concert Grand Model with 23-inch bell mouth.
2,000 ohms £15 : 15 : 0
Other resistances supplied.

Ideal Home Exhibition
STAND 24
Gallery —— New Hall

ALFRED GRAHAM & CO.,
St. Andrew's Works, Crofton Park, London, S.E. 4.

'Phone: Sydenham 252 & 1700.
'Grams: "Navalhada, Brock, London."

SHOWROOMS: The Algraphone Saloon, 25/6, Savile Row, Regent Street. 'Phone: Regent 1075

SCOTLAND: Mr. F. M. Milligan, 25, Renfrew St., GLASGOW.

IRELAND: Mr. Alex. R. Munday, 41, Chichester St., BELFAST.

The above are three of the ten models which will be on exhibition at our stand

A NOVEL CRYSTAL SET.

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

THE set made and designed by the writer and fitted into a cigar box 1 in. deep is in no wise a "freak," but a highly efficient receiver put up in a rather novel form. The set was made as an attempt to get away from the more or less stereotyped form of apparatus, but the necessity of high-class workmanship and good insulation was kept in mind throughout in view of the limited accommodation available for the various units.

The set is a "made" one, as distinct from an assembled proposition, the whole of the apparatus being constructed from the raw material, nothing having been purchased but the ebonite, wire, and terminals.

In view of the limited amount of room available the spider-web type of coil was adopted for the tuner, two of these coils being made up and connected in series; tuning being accomplished by mounting the top coil upon a hinged ebonite panel so as to vary the coupling between the two coils.

The accompanying photograph gives a good indication of the lay-out of the set.

Space Economy.

The lower ebonite panel measures $3\frac{3}{4}$ in. by $4\frac{9}{16}$ in. bare, being eased down to a snug fit and screwed down to the bottom of box. The upper panel measures $4\frac{1}{8}$ in. by $4\frac{9}{16}$ in. bare, and just works freely into the sides of the box, and, being screwed flush with the right-hand edge of the pivoted member, which is $\frac{5}{8}$ in. square, is capable of easy adjustment in relation to the fixed coil, as the square piece—of wood—is pivoted at either end by screws as shown.

An ebonite knob is shown for tuning, but this is not really necessary, as a tab of leather can be screwed to the upper panel and the necessary adjustment made with the fingers.

All contacts are mounted on ebonite, and to save room the blocking condenser has telephone pattern terminals screwed directly into it to accommodate the tag ends of the headphones.

The detector is the author's own pattern, and is fully described in a former article dealing with the construction of a broadcasting set. The crystal is hertzite, which leaves little to be desired; half a "specimen" of this crystal is ample.

Mr. W. S. Sholl.

The formers for the coils are cut out of Bristol board, which on account of its comparative stoutness and rigidity is very suitable for the purpose. Nine slots are provided and the winding consists of 44 turns—22 a side—of 28 S.W.G. D.C.C. wire treated with shellac and thoroughly dried.

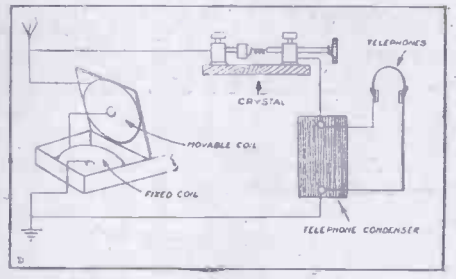
The inside of the fixed coil goes to earth, the lower terminal, the outside end, is connected to the inside end of moving coil, and the outside end goes to aerial by means of an inch or so of electric lighting flexible to allow free movement.

The coils are secured to their respective panels by 4 B.A. screws tapped into the ebonite, which is $\frac{3}{16}$ in. thick throughout, except in the detector base, which is $\frac{5}{8}$ in. thickness.

The condenser is ·003 mfd. capacity, having 11 copper foils $\frac{1}{2}$ in. wide by 2 in. long, the active portion of the foils being $1\frac{5}{8}$ in. with a $\frac{3}{8}$ in. lug.

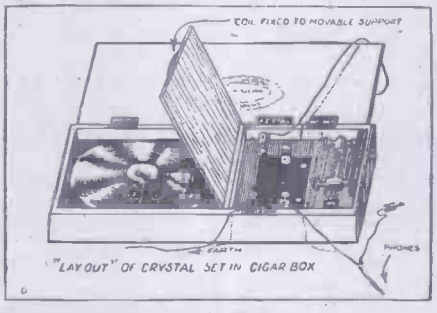
Thirty Shillings Complete.

The small amount of wiring is effected by 20 S.W.G. tinned copper wire encased in sleeving. For the encouragement of those unblest with workshop facilities it may be stated that the whole of the work was carried out on a table in a *bedroom* with the most limited equipment of tools.

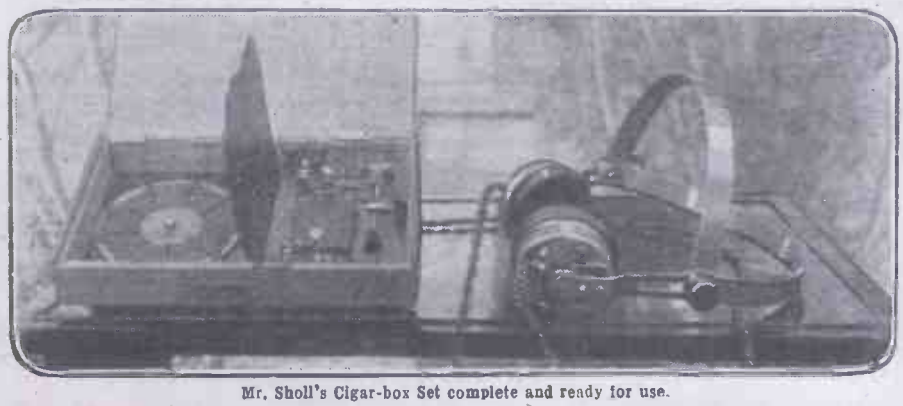


Perhaps the Editor will pronounce on the quality of the workmanship? The whole receiver cost just under seven shillings, the phones—British made, 4,000 ohms—£1, and the aerial 8d. The results on broadcasting, eight or ten miles radius, are all that could be desired.

When closed, the tuning set—if knob is omitted—betrays no evidence of its actual nature. The box being very nicely made, and fitted with hinges and a clasp to the lid, makes the set very easy to take about without fear of damage.



"LAY OUT" OF CRYSTAL SET IN CIGAR BOX



Mr. Sholl's Cigar-box Set complete and ready for use.

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POPULAR WIRELESS Beginners' Supplement

PART VII.—CAPACITY AND INDUCTANCE EXPLAINED.

By MICHAEL EGAN.

THE function of a receiving aerial is to provide some means of reproducing the electrical vibrations which occur in the aerial of the transmitting station from which it is desired to receive. As previously explained in these articles, the vibrations that are produced in a transmitting aerial give rise to waves of energy which move out in all directions through the surrounding space. These waves are capable of vibrating any suitable object that may be placed in their path, and the most suitable object for this purpose is a length of wire.

An Important Factor.

Except for their reduced strength, the vibrations set up in the receiving wire will be exactly similar to those which gave rise to the emission of wireless waves, in the first instance, from the transmitting station. Owing to the distance which the waves have travelled, however, the vibrations set up in the receiving aerial will be considerably weaker than the original vibrations in the transmitting aerial. It is, therefore, advisable to make your receiving aerial very sensitive in order to enable the weakened waves to produce as strong vibrations as possible in it. The distance is only one factor; the sensitivity of your receiving aerial will also play an important part in affecting the loudness of signals.

Maximum sensitivity is obtained by "tuning" your aerial—as a violinist "tunes" the strings of his instrument. There are two ways of tuning a violin string, and they are analogous to the two ways in which a receiving aerial is tuned. When a violinist wishes to produce a particular note from a string, he alters either the *tension* or the *length* of that string. Similarly, when you want to listen to signals which are sent out on a particular wave-length, you must alter either the (electrical) tension or the length of your receiving aerial.

Effect of Inductance.

You have, no doubt, often seen a violinist "tuning up." He turns a little black knob in the handle of his violin, thereby adjusting the tension of the string until it is capable of vibrating at a certain rate, *i.e*, until it can emit whatever note he wishes it to emit. You may not be so familiar, however, with the idea of altering the length of the string to produce the same effect. Yet, he does this also.

The four strings of a violin are, normally, only capable of emitting four different notes—or four notes of different pitch—whereas an ordinary violin selection may contain some dozens of different notes. And the player certainly couldn't alter the tension of the strings to produce these different notes in the course of his performance! He can, however, alter the length of the strings.

This is what he does when he slides his hand up and down the handle of the violin, pressing the tips of his fingers on the strings at different points. When he presses the tip of one finger half-way down one of the strings, he is, in effect, halving the length of the string. The only part of the string that vibrates is the half that extends from the tip of his finger to the "bridge" of the violin. The other half is "dead." By altering the effective length of the strings in this way, he can produce any desired note within the range of his instrument.

A wireless receiving aerial is tuned in a similar manner. In order to receive waves of a definite length, it should be tuned to whatever pitch of sensitivity will make it most susceptible to being vibrated by these waves. This is done by altering its length and its (electrical) tension. The former can be effected by means of a coil of wire—usually referred to as an "aerial tuning inductance." This coil is connected to the down lead of the aerial inside the operating room, and, instead of lengthening the outdoor part of the aerial, you can lengthen it by adding any desired amount of the wire on the coil.

What a Condenser Does

The (electrical) tension of the aerial is adjusted by means of a "condenser." A condenser is an instrument for containing electricity. When it becomes filled it overflows, and the current that formerly filled it surges backwards and forwards in the circuit. The smaller the condenser, the shorter will be the time taken for it to fill and overflow, and the more rapid will be the resulting vibrations.

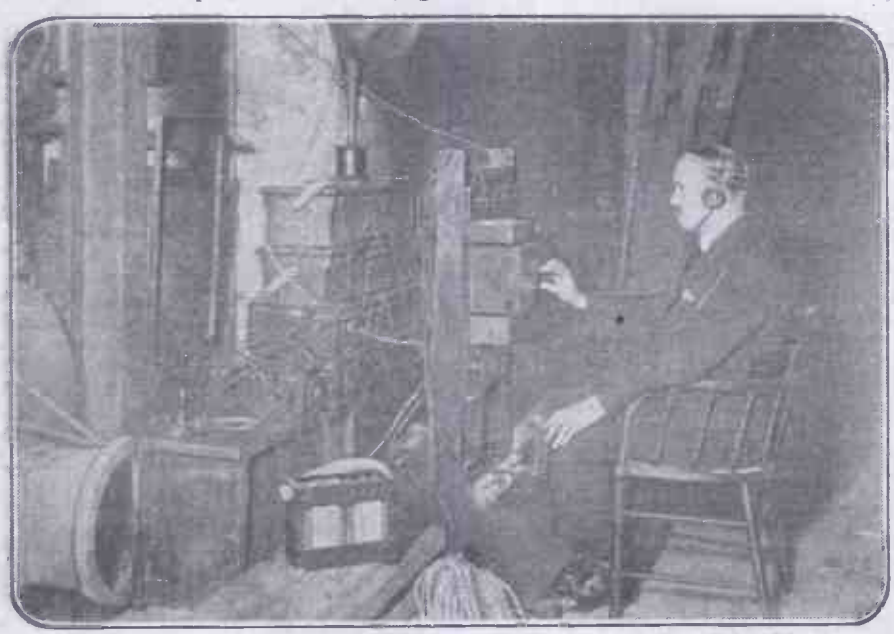
Condensers are, therefore, variable, as a rule. That is, they are so made that their capacity can be altered at will. This is done by turning a knob at the top of the instrument, just as the violinist alters the tension of his strings by turning a knob at the top of his violin. In practice, therefore, you can tune to a particular transmitting station by adjusting either the "aerial tuning inductance" or the "tuning condenser."

The whole object of tuning, of course, is to *prepare* your aerial to vibrate at a particular rate. For a given length and a given tension, an aerial tends, "naturally," to vibrate at a definite rate. If this natural rate is the same as the rate at which the transmitting aerial is vibrated it will make it all the easier for the wireless waves to set it vibrating. On the other hand, if this natural rate differs from that of the transmitting station, it will offer a certain amount of resistance to being vibrated at the same frequency.

To Obtain Loud Signals.

A certain portion of the energy of the received waves will therefore be consumed in overcoming this resistance, and the remaining energy available for producing signals in the telephones will be small, with the result that signals will be weak. If the difference is very big, moreover, all the energy of the received waves may be consumed in overcoming it, with the result that no signals will be heard at all. The more "closely" tuned you are, therefore, the louder will be the resulting signals.

"Sharp" tuning will sometimes render audible signals that are quite inaudible when the adjustments of a set are run over quickly. Therefore, when tuning-in, turn all the various adjusting knobs slowly and carefully. Remember, too, that the close proximity of your hand may slightly increase the capacity of the set, and, therefore, allow just a little over the adjustment required to compensate for the slight "drop" when you remove your hand.



The amplifying apparatus under the stage at the Hippodrome. Land-line wires to 2 L O carry the strains of the familiar panto.

THE VALVE FOR BEGINNERS

By SEXTON O'CONNOR.

PART II.

IT was stated in the last article that there is an almost perfect vacuum inside the valve. The result is that, of the myriads of electrons which together make up the electric current passing through the filament, some thousands "boil off" or evaporate from the red-hot wire directly they enter the region of reduced pressure within the valve.

We can imagine, therefore, the interior of the glass bulb to be filled with an immense number of free electrons so long as the filament is kept heated.

A glance at the diagram given in Fig. 1 shows, however, that the plate is joined up to the positive pole of the high-tension battery (which is built up from a number

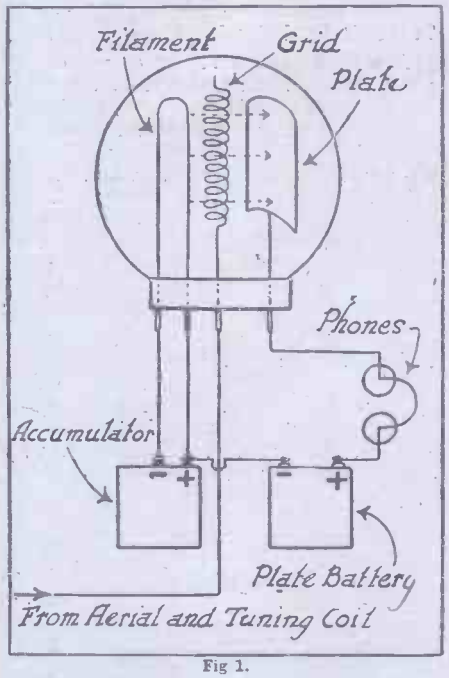


Fig 1.

of ordinary dry cells). There is, therefore, a "positively charged" body (the plate) in the close neighbourhood of the cloud of free negative electrons given off by the glowing filament.

In other words, the plate is thirsting for negative or neutralising electrons, whilst the inside of the bulb is full of unattached electrons continually "boiling-off" from the glowing filament and flying around in all directions with tremendous speed, vainly endeavouring to get outside the closed walls of the bulb. Only one possible thing can happen. The plate swallows up as many of these negative particles of electricity as it can attract or draw within range.

What the Grid Does.

The plate carries a positive charge of some 50 volts or so, according to the size of the large dry battery used, and is able, in ordinary circumstances, to absorb all the electrons that the filament can give off, providing that the latter is not "boiling" too hard, *i.e.*, is not carrying too much filament current from the accumulator.

Therefore, as the other and negative terminal of the H.T. battery is connected to the filament of the valve through the telephone receivers it stands to reason that it will endeavour to complete its circuit from the plate across the path formed by the electron stream in the opposite direction to this latter. This it does in the form of a steady current of a strength proportional to the conductivity of the electron stream which, under normal conditions, is constant.

Such a steady current will not, however, give rise to any audible note. Before broadcast music can be heard, the incoming "signal waves" or energy picked up by the receiving aerial must first be transferred from the aerial to the grid.

The grid interposes the electron stream in accordance with the charge formed on it by the incoming signal current. If this latter is negative it will not permit the passage of negative electrons through it, because all like charges tend to oppose each other, unless the power of the negative charge on the grid is less than that of the electron stream. Therefore, the nature and strength of this charge on the grid will increase or decrease the electron flow from the filament to the plate, and, therefore, its conductivity and finally the current flow of the H.T. battery from the plate to the filament. That is quite clear, isn't it?

Valve as a Detector.

The form or structure of the electric energy radiated from a broadcast station consists of a stream of ether waves or "oscillations," which have been "moulded" into an irregular shape or outline by the effect of the voice or musical sounds applied at the transmitting end.

If they could be made visible the moulded waves might be represented somewhat as shown in Fig. 2.

The first action of the valve on such waves is, in effect, to cut them in half through the line X Y. One half is then "suppressed" altogether, or, rather, not used, whilst the other half tends to alter the H.T. current flow through to the phones by means of its action on the grid. Thus this H.T. current consists of a number of "pulses" all in the same direction, which is from the plate to the filament.

In this form they are able to "push," and so "vibrate" the telephone diaphragms or earpieces, whereas if *both* half-waves could actuate the H.T. current so that it would flow in both directions each half would cause a "pull" in opposite directions at the same time, and the net result would be nothing, even if the diaphragms of the 'phones could vibrate in

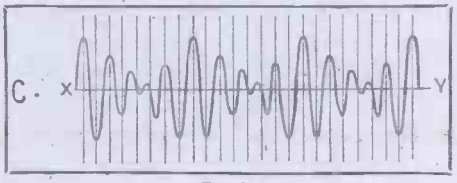


Fig. 2.

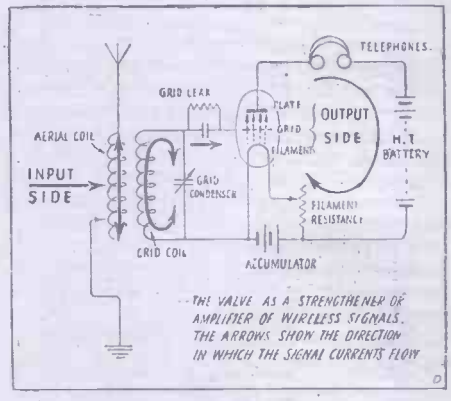


Fig. 3.

time with such alternations—but, of course, they couldn't.

This process of cutting the waves in half is called "rectification," and the valve when so used is acting as a "rectifier" or "detector."

The next point to be considered is the amount of energy that is available for reception, *i.e.*, the actual power transferred through space from the transmitter to the receiving aerial.

In the London Broadcasting Station (2 L O) a considerable amount of electrical power (1½ kilowatts) is applied to the radiating aerial. The ether waves so created spread outwards in all directions, and in so doing naturally fall off in strength very rapidly.

It has been estimated that at a distance of 15 miles a receiving aerial 100 feet long will only tap the one-billionth part (the millionth of a millionth) of the energy poured into the ether at the transmitting station. This is just sufficient to give good signals on a crystal set, *i.e.*, without using any means of amplifying or strengthening the received energy.

Amplifying Signals.

By the use of what is called "reaction" (which will be explained later), a single valve can be used to receive over a distance of about 50 miles, or more than double as far as a crystal, whilst with two or more valves in series, musical signals can be heard over a range of several hundred miles.

The second purpose, then, of the valve is to "amplify" or strengthen the extremely small amounts of energy picked up by the receiving aerial until they become sufficiently strong to operate the phones or a "loud speaker."

This "boosting" or amplifying action constitutes the really remarkable and unique feature of the valve as a receiver. There are many other types of useful rectifiers or detectors (for example, crystal, coherer or magnetic detector), but none of them amplify or strengthen the signals in the way a valve does.

When acting as an amplifier the valve is best regarded as a simple "relay" having certain special features. A relay, it should

(*Continued on page* 1011.)

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or seriously injured.

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	1	1	0
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	1	16	0
	2	14	0
35	1	0	0
	2	0	0
	3	0	0
40	1	4	0
	2	8	0
	3	12	0
55	1	7	6
	2	15	0
	4	2	6
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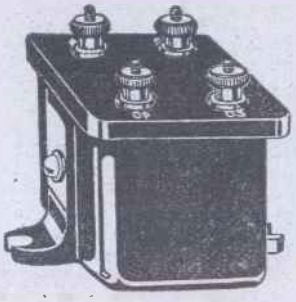

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GETTING AT THE "WORKS."

WHEN you hear someone say, "I wonder what's inside?" and no satisfactory answer is forthcoming, or even if it is, you can bet your last cent that the "lid" of the innocent wireless set will eventually be unscrewed in order to satisfy that curiosity bequeathed to man since Adam. Then, again, that "*I'll* make it work" remark directed to an erring set will certainly have the same result.

What it is expected that there will be seen when the interior is revealed, depends upon the extent and vividness of the imagination of the amateur "surgeon"; certainly wheels of various sizes and numbers are expected to figure largely in the construction of anything that looks and acts mysteriously. In the case of wireless sets, however, the first glimpses of the "innards" are apt to be disconcerting to the uninitiated, owing to just what isn't inside. Take, for instance, those handsome-looking "Desk" type sloping panel wireless receiving sets.

Differences In Sizes.

There is room enough inside one of these for the "works" of half a dozen alarm clocks, and yet, upon removing the ebonite panel, it is seen that all the "underworkings" could be comfortably stowed away in a cigar-box. Moreover, they are all neatly fixed on to the back of the panel, and come away with it, leaving a huge vacant wooden cavity.

Perhaps you are shown two complete one-valve sets, one the size of a coal-scuttle, and the other little larger than a cigar-box; this will make you ask yourself the question, "Why the bulk?" or "Why the stunted growth?" as the case may be. The answer is that it is not so much a matter of the size of the component parts—"works"—as the design or "lay out" of the wiring.

Whilst very small sets look neat and take up less room, "crowding," especially in the case of multi-valve sets, does not lend itself to efficiency. Take, for example, the well-known type of single-valve amplifying panel that has a small black box neatly mounted on the top of the ebonite panel; apart from this, which is what is known as a low-frequency transformer, there is nothing absolutely essential in the whole box of tricks. Underneath will be found nothing but the small coil and moving contact of the filament resistance, which is really but a refinement, although a very useful refinement, and the wires connecting up the terminals, valve-holder, and transformer mounted on the outside of the ebonite panel. I say "nothing," but there may happen to be a small fixed condenser in shape similar to a small block of chocolate neatly screwed to the underside of the ebonite.

Identifying the "Parts."

In the case of the tuning and detecting cabinet there will be either inside or outside, attached to the ebonite panel, a tuning coil or coils, variable condenser, and filament resistances, the shapes and appearances of which will be familiar to most people. Then there is what is known as the "grid leak," similar in appearance to a couple of inches of slate pencil, held by clips and mounted above, or rather under, what is known as the "grid condenser." This latter is a fixed condenser of a suitable value, the appearance of which may vary slightly with different makes, but can easily be recognised by its close proximity and connection to the grid leak. In addition there may be another small fixed condenser known as the "bypass" condenser or "phone" condenser." All the various component parts are mounted upon the ebonite panel and are removed as a whole when this latter is raised, the wooden cabinet merely acting as a protective case.

Someone may venture the question, "What is inside a crystal set?" and the answer is, in most cases—nothing at all. In fact, 50 per cent. have no "insides," unless the inside of the inductance coil is included in the question, and there is nothing inside that. Anyway, have a look at some of those crystal sets mounted on just plain, flat bases. The various instruments that appear on this will be duplicated in various different shapes and forms in the interior of the "cabinet" type of crystal set.

Finally, so long as your set is working efficiently don't worry about its "innards," and even if it isn't, leave them alone until you have acquired that little knowledge on the subject that will prevent you following the example of the man who tried to repair a German alarm clock and found that the works, like Shakespeare's "brief candle," once out, stayed out.

THE VALVE FOR BEGINNERS.

(*Continued from page* 1006.)

be explained, is any device wherein a small applied or "input" force releases or controls a large "output" of force. As a simple instance, a slight pressure with the finger is sufficient to close an electric circuit, which may release sufficient power, say, to start a train.

Looking at the simple valve circuit shown in Fig. 3, from this point of view the control or "input" circuit is that connecting the grid and filament. It contains a coil of wire called an "inductance coil," which is coupled or linked with a similar coil in the aerial A; there is, also, a condenser for "tuning" the circuit. (The grid condenser and leak will be referred to later.)

Across the "Bridge."

The "output" or controlled circuit is that containing the plate and the filament. It comprises the high-tension battery (which is the source of the released or "controlled" power) and the telephones.

The "connecting link" between the "input" and "output" parts of the valve is formed by the continuous stream of electrons. These, as we have seen, are emitted or thrown off by the red-hot filament, and are then caught up by the plate and thus form a "bridge," which completes the circuit consisting of the telephones and the high-tension or "power" battery. Some confusion may arise owing to the fact that the H.T. current and the filament electron stream flow in opposite directions, but when it is remembered that this latter consists of purely negative electrons the charge they convey, as, of course, they form an electrical current, is negative, and therefore the direction of the current is opposite to that in which the particles or electrons are moving. Sounds complicated, but think of the electron stream as a bridge across which the current from the H.T. battery can pass.

On its way to the plate the stream passes through the spiral grid or "input" electrode, which "controls" it in the manner described previously.

Commencing with the aerial we will assume that wireless waves from a certain station are being received upon it. When the aerial is "tuned" to the same wavelength as these waves, the impact of each wave creates the largest possible effect—just as in the case of properly timed pushes applied to a swinging pendulum.

From the aerial the waves are transferred to the grid circuit, and there set up a swinging electric current which charges each plate of the grid condenser, first negative and then positive in rapid succession.

It will be seen that the upper plate of the condenser is connected to the grid and therefore shares this charge, rhythmically changing from positive to negative in sympathy with it.

Glancing again at Figs. 1 and 3, it will be seen that the grid stands immediately in the path of the electrons coming from the filament, and striving to reach the plate.

When the grid is thrown positive by the incoming signal waves it will obviously assist the attractive action of the plate on the electrons, as both will be pulling them in the same direction. The grid does not physically obstruct the path of the electrons, as it is in the form of an open spiral of wire, through which they can readily pass.

But it adds to the general effect or "pull" of the plate, and as it is situated quite close to the filament, this action of the grid is sufficient to increase the total number of electrons reaching the plate, increasing, as it were, the size of the "bridge" which, of course, allows an increased value of current to pass across from the H.T. battery through the plate and through the phones.

When, however, the grid is thrown negative (in sympathy with the upper plate of the condenser) its effect is far more pronounced. Instead of *attracting* the electrons, it repels them, and crowds them back towards the filament and away from the plate, causing a very decided *decrease* in the current passing from the H.T. battery through the phones.

So sensitive is this action that an extremely small amount of energy transferred from the aerial to the grid is sufficient to "control" the relatively large current passing across the bridge formed by the electron stream from the H.T. battery through the phones.

This is the explanation of the amplifying or strengthening action of the valve.

(*To be concluded next week.*)

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

Q. How brightly should a valve glow ?

A. This should be regulated so that the valve is just bright enough to give the best results. If it is allowed to glow more brightly than is necessary, you will find that instead of an increase in signal strength you have possibly a decrease.

* * *

Q. It has been said that reaction is not allowed on B.B.C. stampedsets. Is this right ?

A. To a certain extent. You are not allowed to have reaction capable of energising the aerial and thus probably causing interference. This, of course, forbids reaction on a one-valve set. There is, however, a method of employing this in a way that will prevent interference. This is possible on two or more valve sets provided one of the valves is actingas an H.F. amplifier.

* * *

Q. What is the cause of crackling noises in a valve set ?

A. Probably a loose connection somewhere, or it may be due to atmospherics. A very frequent cause of crackling is a loose filament resistance. If the crackling continues steadily it may be due to a faulty cell in the high-tension battery. In this case the noise frequently resembles the spluttering of frying bacon and is therefore often referred to as a "frying" sound.

* * *

Q. How can the "frying" noises be cured ?

A. This may sometimes be done by connecting a large condenser of about ·02 mfd. across the high-tension battery. If this has no effect, the only thing is to search for the faulty cell and short circuit it. A voltmeter will come in useful here. The cells, if possible, should be tested in groups of about three, and if their voltage has dropped below 75 per cent. they are probably causing the noise. The voltmeter is not an infallible test, but it will be found very useful.

* * *

Q. What is the "grid" of a valve ?

A. It is the spiral of wire which can be seen between the filament and the plate—a metal sheet usually in the form of a cylinder. The grid controls the stream of electrons across from the filament to the plate, and, indirectly, the current through the telephones. The grid is connected to the aerial and thus the incoming oscillations are acting on the grid automatically and controlling the action of the valve.

* * *

Q. What is meant by the natural wavelength of an aerial ?

A. It is the wave-length the aerial has when connected directly to earth, there being no coils or condensers connected to it. It is not necessarily the same as the fundamental wave-lengths of an aerial, as this is the wave-length to which the aerial is tuned by the addition of coils and condensers. It will respond most readily to signals of that wave-length, though it may also respond slightly to impulses whose wave-lengths are harmonics of that fundamental.

* * *

Q. Must I have a grid leak ?

A. For efficient working a grid leak is necessary to allow the electrons that have collected on the grid of the valve to "leak" away to earth. If the leak was not there these electrons would render the valve far less sensitive to the incoming oscillations, or impulses. Another thing, one leak, which is of high resistance, may suit one type of valve, while it does not at all suit another. For this reason various leaks should be used until one is found that will work efficiently with the valve you intend to use. In connection with this, a variable grid leak is a useful piece of apparatus to have.

* * *

Q. Why does carborundum need a battery ?

A. Because with this type of crystal a peculiar thing happens. If a voltage is applied across the mineral the resistance of the crystal gradually decreases. At a certain voltage the resistance decreases very suddenly, and then goes on slowly decreasing. Thus, if an incoming signal current is passed through the crystal when it is so adjusted that the slightest extra voltage will cause a large increase in current, as it will if the voltage across the crystal is properly adjusted, then, on the addition of that tiny impulse from the aerial, a tremendous drop in the resistance of the mineral takes place.

Thus a large amount of the current from a battery which is always connected, flows through and a loud signal in the phones is heard. When no signals are coming in, the resistance of the crystal is high, and very little current is flowing, the incoming signal just upsets the balance, as it were, and a large rush of current takes place at each incoming signal.

Q. Why is it dangerous to use a gaspipe for an earth ?

A. Because, although it is not a very great possibility, a very heavy lightning discharge might cause an ignition of the gas, especially in cases where leaks exist. Apart from this, a gaspipe makes a poor earth, owing to the fact that the materials used for the joints are not at all conductive.

* * *

Q. What is meant by characteristic curve as included in so many articles about valves ?

A. Just curved lines on graph paper to indicate, by comparing different positions on the curve against divisions along the sides and the bottom of the paper, various effects caused when various adjustments are made. Thus a simple example is the characteristic curve for plate current variations caused by altering the current of the L.T. or filament flow by means of the variable filament resistance.

P.-c. Wooding, of the Metropolitan Police Force, and his fine set. P.-c. Wooding hears American amateurs regularly.

* * *

Q. Why has a crystal set such a short-range for telephony ?

A. Because the impulses received by the aerial from telephony waves are fairly weak, and a crystal set requires quite a considerable amount of energy to operate it. Thus, unless it is fairly near a transmitting station, the comparatively weak impulses due to the telephony waves are not powerful enough to operate the crystal satisfactorily. Spark stations send out much more energy, and so, of course, you can hear them on a crystal set from much farther away than you can hear telephony on the same set.

* * *

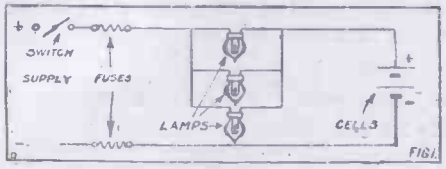
Q. What is a choke coil ?

A. A highly inductive coil employed to choke back high-frequency currents or to smooth out irregularities in the current received from a generator supply.

THE CHARGING OF ACCUMULATORS

By R. G. De WARDT, M.I.R.E., A.M.I.E.E.

THE problem of the supply of heating current to the filaments of valve sets is one which, until such time as the low temperature emitters now on the market are retailed at a reasonable figure, can only be solved by the use of accumulators. When such accumulators become discharged (a habit which they have of doing just when they are particularly wanted), it is necessary to take them to a garage or other charging station, except in those cases where plant exists for charging at home.



Where an electric supply is available in a house, comparatively simple arrangements can be made by which the necessary charging can be undertaken at home. The cost will in some cases be higher than the cost of charging at a garage and in some cases lower, depending on the type of the supply, *i.e*, whether continuous or alternating current and the price per unit.

An accumulator may be regarded as a primary cell, the elements of which are renewed at each charge. Its efficiency in ampere hours under the conditions appertaining to valve reception will be about 80 per cent., that is to obtain a discharge of 80 ampere hours necessitates a charge of approximately 100 ampere hours. Ampere hours are the product of the current flowing and the time it is flowing, and are the measure of the quantity of electricity carried in a circuit.

Cost of Charging

A current of two amperes flowing for two hours from an accumulator represents an output of four ampere hours, six amperes for half an hour represents three ampere hours, etc.

Consequently, if we have an accumulator with a rated output of 30 ampere hours, it will be necessary to supply it with $\frac{100 \times 30}{80}$ = 37·5 ampere hours to enable it to discharge its rated capacity. The current flowing during the charge should be such that this input should be given to the cell in nine hours, and it may be here remarked that the charging rate in amperes of any cell should be such that the normal charge is given in nine hours.

In this case the required charging current from our definition of ampere hours is equal to $\frac{37·5}{9}$ which equals approximately 4·2 amperes.

To obtain this current where the supply is continuous current, it is necessary to insert resistance in series with the accumulators and the supply. The cost of this method of charging depends on the voltage of the supply, and the price per unit.

For instance with a 100-volt supply at fourpence per unit or kw.h. (1,000 watt hours), the consumption of energy is equal to 100 multiplied by 4·2 or 420 watts, and the consumption of energy per hour being 420 watt hours or ·42 kw.h. The watt being the unit of power and equal to the product of the pressure in volts and the current in amperes, the watt hour being the product of volts, amperes, and time in hours the current is flowing, the kw.h. (kilowatt hour), or Board of Trade unit, being 1,000 watt hours.

For a nine hours' charge the energy consumed would be ·42 multiplied by 9, or 3·78 units, which, at 4d. per unit, would cost 15·12 pence. When the supply voltage is 200 and the price per unit the same, the cost would be exactly double this figure. It is usually possible, however, to arrange with the supply authorities for a supply for such a purpose to be given at the "power" rates, which range from one penny per unit upwards, at which price such arrangements become an economical proposition.

By applying the foregoing calculations to each individual case the amateur will be able to determine whether it will pay him to charge his own cells.

The most convenient form of resistance to use is the carbon filament lamp. These lamps consume approximately 4 watts per candle-power, and if 32-candle-power lamps are used, each lamp takes 128 watts. Having determined the total watts required, as previously shown, the number of lamps necessary can be easily calculated.

Batten lampholders should be obtained, and mounted on a board connected as shown in Fig. 1, the supply leads being connected to the charging boards through a suitable switch and fuse. The positive plate of the battery being connected to the positive terminal of the charging board, and the negative plate to the negative terminal.

Various Methods

Where the supply is on the alternating current system, much more economical arrangements can be made by taking advantage of the fact that current at a much lower voltage than the supply can be obtained without practically any loss by means of transformers. In principle the transformer consists of two separate coils wound on an iron core, and if an alternating current be supplied to one winding a similar current will be induced in the second winding, and the voltages in each winding will be in proportion to their number of turns of wire.

For example, assume a transformer with 1,000 turns on one winding (the primary) connected to a supply at 100 volts, then, if the second winding (the secondary) has 100 turns, an alternating current with a voltage of 10 will be induced in it.

The power in watts given out by the secondary will be the same as that supplied to the primary except for the slight loss due to heating of the windings and in the core, losses which may be ignored for the present purpose. If, therefore, a current of 5 amperes is taken from the secondary of the transformer under consideration, the power taken from the mains by the primary will be approximately equal to 50 watts.

Of course, alternating currents cannot be used for charging accumulators, as such currents reverse their direction of flow once during each cycle, and a supply given at say 50 cycles per second means that there are 50 pulsations of current in the positive direction and 50 in the opposite or negative direction each second. If we can arrange to reverse direction of the current flowing during the negative periods, we shall have one hundred pulsations per second, a state of affairs which is quite suitable for battery charging.

There are several methods by which these reversals may be effected, the simplest for the case under review being dependent on the fact that plates of aluminium and lead when immersed in a solution of ammonium phosphate have the peculiar property of permitting the current to flow only from the lead to the aluminium and not in the contrary direction.

Advice to Amateurs

By making four of such cells or "Nodon Valves" as they are called, and connecting them as shown in Fig. 2, it will be seen that when the current is flowing from the transformer in the direction A to B it passes through cell 4 of the battery under charge, cell 2 to B. When it reverses, and flows from B to A, it passes through cell 3, the battery *in the same direction as before*, cell 1 back to A.

The power consumed by using such an arrangement and a suitable transformer, in the case of the 30-ampere-hour cell used in the previous example, assuming a secondary voltage of 10, would be 10 x 4·25 watts per

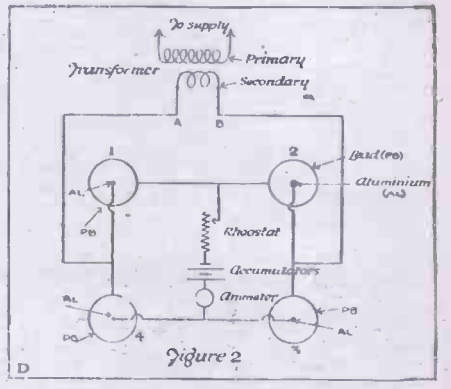


Figure 2

hour, that is, 382·5 watt hours or ·328 units in the nine hours which at fourpence per unit would cost only 1·5 pence.

Transformers of this type can be purchased at a reasonable price, and the Nodon Valve can be made up quite cheaply by using stoneware jam jars as containers, the ammonium phosphate being obtained of any chemist. An ammeter should be fitted as shown in Fig. 2, together with an adjustable rheostat to regulate the current as required.

The amateur who proposes to charge cells at home would be well advised, however, to consult the local electrician, to ensure that anything that is done is carried out in accordance with the Local Supply Authorities Regulations.

A SIMPLE WIRELESS RECORDER.

By Prof. M. DAISOMONT.

THE essential feature of the recorder is as follows. A thin blade of soft iron-plate hangs in the strong magnetic field of a polarised electro-magnet, and vibrates synchronously with the variations of the current circulating in bobbins of the electro-magnet. As the vibrations of the small iron blade have a certain amplitude, a contact existing on it can be modified by the vibrations, and a strong relay of any type, or the recorder directly, can be operated by the current of a distinct electric circuit interrupted or established by the vibrating blade. As now the variations of the first current in the bobbins of the electro-magnet are determined by the Morse signals, the vibrations of the blade will follow the same vibratory motion, and, as a natural consequence, the stronger relay, or the writing stylo or pen, will directly transfer the signals on to the paper.

The stronger relay and the writing device are by no means a special feature of our recorder. Any strong and rapid relay and any writing device both moved by an electro-magnet of the "electric bell" type will do. The paper can be in the shape of a long tape moved by a clockwork or a small electro-motor, or a sheet of paper on a cylinder, turning with a helicoidal movement.

Suspended Vibrator.

It was comparatively easy to find a polarised electro-magnet. We took a heavy German trench telephone, and, removing the magnet, we wound it to 1,000 ohms instead of 200, and fixed it on a board. Flexible wire, taken to a plug, was fixed to the terminals of the bobbins, to lead in the varying current coming from the receiving set (Fig. 1).

The more delicate piece was *the vibrating*

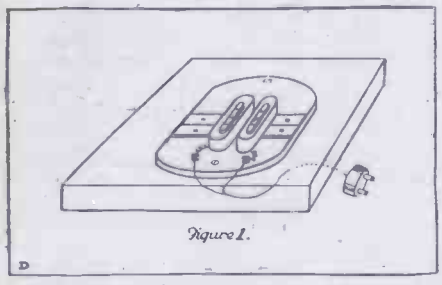


Figure 1.

blade and its suspension. This was the manner of its construction. Out of a tin box that had contained a typewriter ribbon we cut a square piece just the size of the two poles of the electro-magnet. Just in the centre of the blade a very small piece of platinum (found in a German trench microphone set) was soldered; then two 10-in. copper wires were soldered to the blade, and running parallel to each other, were fixed with eyelets for the suspension (Fig. 2).

The vibrating system was suspended in such a way that, on the left, the wires could be tightened by means of a nut and a screw; on the right were arranged two screws to lower the whole as near as possible to the electro-magnet, but without touching it. A copper wire, soldered to the metal part on the right, made electric connection with the vibrating blade possible (Fig. 3).

Above this vibrating blade a micrometric screw with a platinum point was fixed to enable very fine contact to be obtained. Another wire fixed to the metal support of this screw made it possible to have an electric current circulating from the screw to the blade, and to interrupt it when the latter was vibrating.

High Speed Work.

When the electro-magnet is connected in the right way to the receiving set, and when the current in the bobbins is varied by the strong Morse signals, the vibrating blade makes or interrupts the contact to the micrometer screw. The recorder being directly in circuit, or by means of a stronger relay, will bring the signals on to the paper, if it is so constructed that it can mechanically follow the speed of the transmission. If well

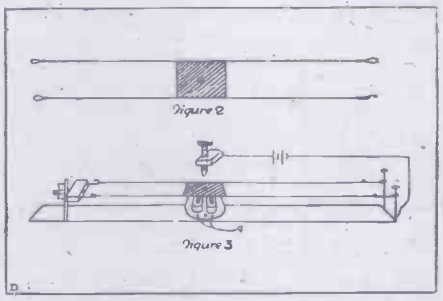


Figure 2

Figure 3

made, the recording system just described can record up to 100 words per minute.

Four small rubber heels should be placed under the corners of the board bearing the vibrating system to prevent trouble from mechanical vibrations. Further, trouble due to sparking in the relays can be avoided by the choice of just the necessary current to actuate the mechanism and by connecting fixed condensers across the contacts. These condensers are easily made of tinfoil and waxed paper, and should have a capacity of about 2 mfds.

TESTING H.T. BATTERIES.

THE following piece of apparatus will be found very useful for testing H.T. batteries of the 15-volt type, now so much in use. In fact, similar apparatus may be made for testing any voltage.

The necessary articles are four "flash-lamp" bulbs, a piece of wood 4½ in. by 1½ in. by ⅜ in., a piece of tinned copper wire, and two small terminals.

Take the piece of wood and draw a line down the centre as in Fig. 1, and drill four ⅜ in. holes 1 in. from each end and ¾ in. apart. Between each of these holes drill a small one, about ⅛ in. or so, also a hole at each end to take the terminals.

Next, fasten a piece of wire to each lamp just below the bulb and around the brass by passing it around and twisting it; or, if preferred, this may be soldered. Now press each lamp into the ⅜ in. holes.

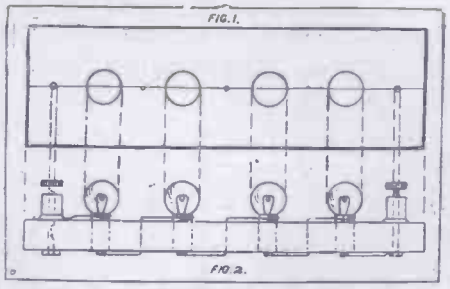


FIG. 1.

FIG. 2.

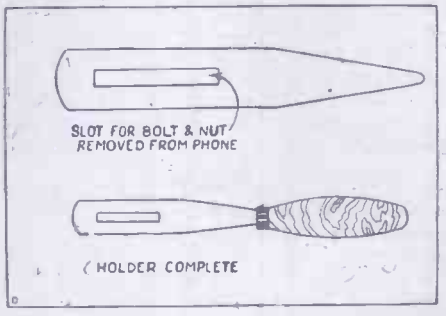
The wire from the first lamp should be passed under the nearest terminal, the wire from the second lamp through the small hole and soldered to the base of the first lamp. Fix the third and fourth lamps, pass the wire through their respective holes, and solder to the second and third lamp respectively. A short wire must also be soldered to the bottom of the fourth lamp and taken under the screw or nut of the other terminal (see Fig. 2).

The bulbs are now connected in series. By connecting two leads to the terminals, and touching them for a second on each of the lugs of the 15-volt unit, each lamp should light up brilliantly if the battery is in good condition.

A PHONE HOLDER.

IF your set is sufficiently near a broadcasting station to obtain a good volume of sound, the usual pair of phones may be split up, making one pair do for two people. As something is required to hold each earpiece comfortably, the following can be easily made up.

Purchase an ordinary boxwood chisel-handle from the local ironmonger's (cost, about 4½d.), and then cut a piece of brass (about ⅛ in. thick) ¾ in. wide and 3 in. long. Cut a slot in the centre and shape the bottom half so that it can be easily driven into the handle. The bolt and nut taken from the phones will be used to fasten the holder to the earpiece.



TO AMATEURS

If you have made an original or particularly useful piece of apparatus, send a short descriptive article to "P.W." If accepted, it will be paid for at our usual rates.

A "PHASE" OF WIRELESS.

By Sir K. D. MACKENZIE, Bt.

"WHAT'S the least I need spend on this blessed wireless? I've no spare cash to chuck away on such foolishness. How far will five bob go?" Thus my old friend Samkins a few months ago.

"Not far, I'm afraid. It hasn't quite come to that yet," I replied laughingly. "But if you're game to spring a tenner or so, I'll take you where you'll get good value for your money, and something worth having; but nothing very elaborate, of course. How'll that do?"

"What! A tenner? Good heavens! Can't I get anything for less than that?"

"Of course you can, but you'd better come along and see and hear for yourself. It'll interest you, anyway, to have a look at the things, and you can see, then, what you care to spend on them."

"All right," he answered grudgingly, "I suppose I'd better, or I'll never get any peace from the family. But I'm not going to spend a penny more than I can help, anyway."

I know Samkins of old. He's like that. A very good fellow at heart, and really generous, but queer-tempered at times and rather easily upset. "Liver," perhaps, I suppose, like many of us. Anyway, I took him along to a firm I deal with, knowing he would be safe enough with them, and get his money's worth for whatever he bought.

When Samkins saw all the beautifully got up apparatus and instruments of all kinds, both crystal and valve receiving sets, in their highly polished mahogany cases and ebonite panels, with all the brightly burnished and lacquered brass fittings, he got quite excited and eager, especially when the assistant, who explained things to him, switched on a loud speaker, and we heard a band playing at the broadcasting station, the music being so distinct and clear that one would almost have thought it was in the same room.

Spick and Span.

I had at last to actually curb his eagerness to buy the things I knew would be quite beyond him, and a sheer waste of money to start with, knowing, as he did, nothing of radio. So I only let Samkins get what he and his boy would be able to manage easily, and a book on wireless called "How to Become a Wireless Wizard in a Week," and we left the shop, he as pleased as Punch, and in a very different frame of mind from that in which I had met him. I thought to myself as we parted, with many grateful thanks on his part, that precious little amusement would his *boy* get from handling that set so long as his father was about.

"You'll have to get a licence, you know," I reminded him, on parting, "and by the time you've got it your aerial will be fixed up. Good luck, old man; I'll look in in a day or so to see how you are getting along."

. . . . . .

It was not till about a month later that I was able to call and see Samkins to find out how he was getting on with his new toy and I often wondered how he had taken to it, and whether his opinion of broadcasting had changed.

When I reached his house one Saturday afternoon I noticed a fine aerial stretched from a pole fixed to the side of his house, the other end being supported by a beautiful seventy-foot iron mast standing in the corner of the grounds at the back; everything very spick and span.

Catching the "Fever."

"Hallo! He's been going it!" I thought to myself. "He didn't buy that when we were together that day, I'm sure." It was quite another Samkins who greeted me at the front door, a very much more cheery body.

"My dear fellow, I *am* glad to see you!" he exclaimed, as we shook hands. "I've been wondering ever so long when you'd come. I've got such a lot to show you now. By Jove! You are a *converter*, you've been a complete *transformer* of all of us here!

The operator is tuning in on a typical Telefunken Receiver. A change over switch at the back connects the aerial to the transmitter.

I thought I had some *capacity* for *permeability*, but *jam* me if your *power* for overcoming my *specific resistance* hasn't completely taken away all the *impedance* and *reluctance* I had when I met you that day! Gad! I'm a *coherer* to radio now, and no mistake! I feel sure that all the *resistance* I showed that day when I met you was only a *loose coupler* after all, entirely due to the *frequency* of my general worries and bothers."

"I say, old man," I cried out, "by gad, you've caught it badly. A regular attack of 'radioitis,' it seems to me. Has the boy got the fever, too?"

"Oh, Henry! Yes, he's as keen as I am, and, what's more, the first *skin effect* has entirely gone from all of us, so that the *tuning* between us all here now is perfect. A regular case of *induction*, I assure you. Let's *switch over* to the library, where all the things are. I'll *lead in*," and I followed him into what used to be his old sanctum, but now was evidently the haunt of the whole household.

"Yes, as I was saying," he continued, "Henry, as the unit of *inductance*, naturally infected me; I gave it to the wife, and her mother evidently caught it from her, owing to the *audible frequency* of her expressions of delight. By Jove! By now its *quantity* is quite beyond the *power* of any *rectifier* to act as a *choking coil* on any of us! Even the cook has got a *phase* of it, and calls flour a gravy *condenser* when she uses it as a *thickener*, and told the wife her wages must be raised owing to her increased *capacity* as a cook!"

Quite a Brainwave.

What a change had come over dear old Samkins! I found he had got a very much more elaborate set than what he had bought that day with me; evidently his "tenner" had been multiplied several times to satisfy his keenness for wireless, a matter he had looked upon then with contempt and disdain. His son Henry was busily engaged listening to some ships signalling from somewhere, and told me he had quite got a grip of Morse by now, and could read fifteen words a minute easily; a sharp boy, I could not help thinking.

"Sit down, old fellow, and light up," said Samkins, as he offered me a cigar. "Henry and I have been puzzling how on earth the name 'Henry' should have been given to a unit. Who was that particular 'Henry,' what was his surname? I'm *jammed* if I know! If the unit of *inductance* is called a 'Henry,' why shouldn't that of 'allowance' or '*impedance*' be called a 'Bob'? I allow Henry so many 'bob' a week, and he is often *impeded* from getting what he wants because he hasn't enough of them.

"It strikes me, too, that 'Harry' would be a very appropriate name for the unit of '*interference*'; we're all 'harried' more or less by someone's silly *interference!* And 'Dickey' as the unit for *oscillation* or *stability*; what's wrong with that? The financial situation in Europe is decidedly 'megadickey' at present. What? How does it strike you?"

"Quite a brain-wave, old boy," I replied. "I don't see why your idea shouldn't be extended, though I wouldn't keep to male names only, as some qualities are decidedly feminine in nature. 'High frequency resistance,' for instance. You might call that a 'Polly,' that word having something to do with "many,' and a parrot generally resists when you want to stroke it! Any female name would do for the unit of 'group frequency,' as at mothers' meetings women with all names attend.

"Your idea seems worth thinking out. However, you might add 'Bill' to your list as the unit for '*reluctance*,' for the man who pays his bills with 'microbill' celerity is indeed a 'rara avis.' But, my dear old fellow, don't let this new phase get too big a hold of you; be an *alternator* now and then for a change, and restrain the *natural frequency* of your thoughts from running in one direction only.

"Let me ask you something—a silly riddle: Who was Ma Coney? Give it up? Why, Ole Brer Rabbit's wife, of course! See? Now I must really be off, or '*shunt*,' as you would say. I'll look in again soon, and see how you are getting on."

WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

The Tottenham Wireless Society.

The chief feature of this meeting was a very excellent lecture by the chairman, Mr. F. A. Bourne, on the subject of "Crystal Detectors."

Mr. Bourne not only fully explained the theoretical side of the question, but also fully explained the construction of a crystal set that everyone could make for themselves.

Presentations were made to the society of a crystal set, set of coils and coil holder, and a battery of accumulators. It is hoped shortly to give a demonstration on wireless subjects for the benefit of the local public.

Prospective members should apply to the hon. sec. Mr. R. A. Barker, No. 22, Broadwater Road, Tottenham, N.17, for full particulars.

Swansea and District Radio Experimental Society.

A very successful meeting of the above society was held at their headquarters, the Y.M.C.A., recently, when a very interesting lecture and demonstration was given by D. W. Walters, Esq., of Gowerton.

Having had permission from the Postmaster-General, an aerial was erected, and a wireless receiving set was installed, which was used by the lecturer to demonstrate his lecture, entitled "Hints on Tuning," a very appropriate lecture at a time when Swansea is experiencing a considerable amount of interferences from local amateurs.

The president of the society, Capt. Hugh Vivian, occupied the chair, and gave a very encouraging address as to the prospects of a very bright future for the society.

Later in the evening, Continental telephony was listened to on a loud speaker.

The society has a very interesting programme for the season, and all interested in wireless are invited to join.

Hon. sec., Herbert T. Morgan, 218, Oxford Street.

The Ilford and District Radio Society.

A meeting was held recently at headquarters, St. Mary's Hall, Ilford. Mr. J. E. Nickless, A.M., I.E.E., was in the chair.

Mr. F. C. Grover gave a very interesting lecture on "Elementary Electro-Statics." The characteristic curves of two valves were also plotted and Mr. Grover explained the practical uses to which such data could be put.

Hon. sec., A. E. Gregory, 77, Khedive Road, Forest Gate, E.7.

Sutton and District Wireless Society.*

Meetings are held on the second and fourth Wednesdays in the month at 8 p.m., at the Adult School, Benhill Avenue, Sutton (near tram terminus). All those interested in radio work in the district are invited to join. Every effort is made to ensure that the society will be a real benefit to its members. There are now about forty members, but there is plenty of room for more, so please come along and help make the society a complete success.

At the meeting held on Wednesday, February 14th, a lecture was given by Mr. Bentley, of Messrs. Dickie & Co., on the care of accumulators. Some of the latest types of accumulators were exhibited, together with sections of plates, and a very interesting discussion followed. The important question of charging was dealt with, and Messrs. Dickie & Co. have a system of collecting, charging, and delivering which should go a long way towards solving the problem of valve current supply. The lecturer was accorded a hearty vote of thanks, and the meeting closed at 10.15 p.m.

Hon. sec., E. A. Pywell, Stanley Lodge, Rosebery Road, Cheam, Surrey.

The Streatham Radio Society.*

The first annual dinner and wireless concert of the above society took place at the Telegraph Hotel, Brixton Hill, on the 14th inst.

Over fifty members and visitors were present, including a large number of ladies. A large amount of work had been put in prior to the meeting by the committee in the erection of a set for the evening, but owing to the short time at their disposal, and the fact that an indoor aerial under a metal roof had to be used, the results obtained left much to be desired. However, plenty of local talent was available, and the evening proceeded merrily enough.

The dinner came to a close, after a very interesting evening, at 11.15 p.m.

The next general meeting of the above society will be held at the headquarters, 35, Streatham Hill, on March 14th, when Mr. A. G. King will give a lantern lecture.

Intending members (both sexes) are invited to ask for particulars from the hon. sec., Mr. S. C. Newton, 5, Pendennis Road, S.W. 16; or, in his absence, the assistant sec., Mr. A. G. Wood, 93, Upper Tulse Hill, S.W.2.

The Stratford-on-Avon and District Radio Society.

The fourteenth general meeting of the above society was held on Monday, February 12th, at headquarters, with Mr. F. A. Sleath occupying the chair. After the business arising from the previous meeting had been dealt with, it was announced that the president, Capt. H. C. J. A. R. West, R.N., invited members to visit his residence at Alscot Park to inspect the experimental station there. The next item on the agenda was a talk by Mr. Sleath on the Single Valve Rectifying Panel, and the lecturer dealt in a simple and concise manner with the parts required and their function. Keen interest was shown when the matter of reactance was brought up, and the cause of re-radiation was explained. A very successful evening was concluded by switching on the club set and listening to the close of 5 I T's Concert.

Hon. sec., E. W. Knight, 17, Park Road, Stratford-upon-Avon.

Ilkley and District Wireless Society.*

A general meeting of the society was held on Monday, January 14th, at which Dr. J. B. Whitfield presided. Following the meeting, Mr. J. C. Croysdale, of the Leeds and District Amateur Wireless Society, was called upon to give his lecture on the "Armstrong Super-Regenerative Circuit." The lecturer described the action of the ordinary regenerative circuit, and showed how Major Armstrong had succeeded in utilising the maximum amplification of the valve by means of his new circuit. Mr. Croysdale then gave some useful values for the components utilised in this circuit, which he had found from experience to give the best results. The lecturer then gave a demonstration of the circuit on a three-valve set of his own construction. After a little patient tuning, Manchester was received strong enough to operate a loud speaker, with neither aerial nor earth connected, nor even the orthodox frame.

On Monday, February 5th, an enjoyable evening was spent listening to the broadcasting programmes on a Gecophone receiver and loud speaker kindly lent by Messrs. Francis Law, Ltd. The demonstration was undertaken by Mr. Francis Law and Mr. Lynn, of the General Electric Co., Ltd., of Leeds.

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

The Forest Gate Y.M.C.A. Amateur Radio Society.

The above society has been formed, with headquarters at the Y.M.C.A., Woodgrange Road, Forest Gate, E.7. Meeting nights—Tuesdays, Wednesdays, and Thursdays.

Intending members are invited to any of the above meetings.

Full particulars can be obtained of the hon. sec., T. W. Moore, 90, Claremont Road, E. 7.

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RADIOTORIAL

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

Questions Answered

I think most of my readers will agree that this week's POPULAR WIRELESS is well worth 3d. Thousands of amateurs who will not be able to visit the "Daily Mail" Exhibition at Olympia will find in this number the first instalment of a special review of the exhibits shown by Wireless Manufacturers. For the experimenter and student there is the first of a series of articles by Sir Oliver Lodge which, I am sure, will cause considerable interest.

I must say a word here concerning our new Scientific Adviser. I am sure all my readers will be glad to hear that Sir Oliver Lodge has accepted this appointment. As one of the most brilliant scientists of the day, and one of the most advanced pioneers in radio work, Sir Oliver Lodge has certainly honoured POPULAR WIRELESS in accepting this appointment.

This week's number also sees the commencement of a new cover scheme. I feel perfectly sure that 99 per cent of my readers will prefer this new cover to the old one. I should like to hear from readers on this point, as I am always doing my best to improve the appearance of the paper.

THE EDITOR.

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, The Fleetway House, Farringdon Street, London, E.C.4. Readers are requested to send the necessary postage for reply.

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

A. T. I. (Bedford).—I have a two-valve set and cannot tune in London at all; but a friend of mine tried it the other day and got it at once. I use a three-coil holder. Why cannot I get London?

Your tuning is probably at fault. If you have no switch for "stand-by" and "tune," try the following. Disconnect the secondary from the set, and connect up the set to the primary coil, aerial, and earth, and tune in. When you have got the station tuned in properly, note the position on your condenser dial, and replace the secondary and old connections. Then tune in the secondary coil, leaving the primary as it was. When you hear faint signals, vary both the condensers and the coupling between the coils until you obtain maximum strength. A "stand-by" switch merely obviates the necessity of changing the connections.

* * *

P. D. M. (London).—I have a hertzite crystal set, and would like to improve it. Will a battery help? If so, can I use a filament resistance as a potentiometer?

No, a battery will not noticeably assist you with that type of crystal. In any case if a battery is used, and this should be with carborundum, not hertzite, a filament resistance is far too small a resistance. You need about 200-300 ohms for the potentiometer, whereas a filament resistance has only about 5 to 7 ohms.

* * *

"EVLAV" (Plymouth).—Why do soft valves usually have a shorter life than hard ones?

The reason why very soft valves have a short life compared with the harder type is this. When a soft valve is in action, the electrons flying off the filament keep on colliding with the residual gas atoms, and of course the softer the valve the more atoms there are, and more chances of collision are obtained. When, however, the electron has collided with the atom, the atom is to a certain extent burst. It loses electrons which go on with the main electron stream, and thus help to increase the flow of plate current, which of course gives us a sensitive detector. But the rest of the atom, having lost some of its negative electrons, becomes positively charged. Thus it is naturally repelled by the positive anode, and attracted by the negative filament. This atom residue, or positive "ion," rushes off to the filament. Therefore, in a soft valve the filament is always being bombarded by a stream of positive "ions," and it is this steady and violent bombardment which eventually breaks the filament down. In a hard valve the number of collisions with gas atoms is very much less, and therefore the bombardment of the filament by positive "ions" is decreased, and the filament has a longer life.

"FRED" (Tottenham).—My neighbour told me laughingly this morning that I "howled" a lot the previous night, and as I do not use reaction, although I have an experimental licence, I thought it safe to bet him that I could not cause interference. Am I right?

Although in the circumstances we are inclined to think that you were not guilty of the interference, such would be quite possible, even although you possessed no reaction coil or "artificial" arrangements for regeneration in your circuit. Mr. Shaughnessy, O.B.E., detailed in an article that appeared in a recent number of POPULAR WIRELESS the Post Office test for regeneration and self oscillation caused by a grid-plate capacity in quite simple valve circuits, and therefore it is quite possible that your set, if not of an approved B.B.C. type, is capable of the same action.

* * *

G. L. P. (Durham).—Why is it that in the case of a valve we are told that the current flows from a negative point always to a positive point, whereas in all other electrical and wireless practice we are told that a current always flows from a positive point to a negative. Also, why is it that in the case of valve work it is said that the negative point has the most electrons and therefore electricity and the positive is the undercharged point whilst in all other practice the positive point is said to hold the most electricity? Anyway, why is it that the signs plus and minus are still used when obviously the negative or minus point is a plus quantity if we are to believe in the electron theory?

To explain the phenomenon of the electron emission from a valve filament and the effects which are associated with it, it is necessary to accept the theory that electron flow takes place from a negative to a positive point, the former being that which holds the greater number of electrons, these being presumed to be negative particles of electricity. However, it need in no way confuse with former and other electrical practice if the view is taken that simply because an electron stream is passing from one point to another relatively there will be a current of electricity flowing in the opposite direction, *i.e.*, from positive to negative. Take as a simple analogy two trains that have stopped at a station and you are in one of them. It doesn't matter which of them moves first, but if you are looking at the other train it will momentarily appear as though both trains are moving, the one in the opposite direction to the other. Call the electron stream the moving train and say that to all intents and purposes the current of electricity appears to flow in the other direction. Ballantine makes it a definite statement that "The stream of electrons to the plate constitutes an electric current; and since the charge conveyed is negative, *the direction of the current* is opposite to that in which the particles are moving." The italics are his.

* * *

P. C. L. (St. Albans).—What coils do you advise for different purposes?

Single layer cylindrical type of the well-known

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 1022.)

solenoid pattern known as single and double slide, tapped cylinders, etc., for all crystal work and for short wave or small ranges of valve work, basket coils for short wave valve work and the several forms of duo-lateral or honeycomb lattice, etc., type of coil for long wave valve work. By short wave we mean up to, say, 800 or 900 metres.

* * *

D. D. (Hull).—Is reaction, regeneration, self-oscillation, heterodyning, howling, etc., all the same thing, or can a valve set do all sorts of different things in the way of interfering with other receivers?

Generally speaking, all those terms are used to denote the regenerative effects of a circuit that tend to cause self oscillation, although the terms vary in their strict application. In practical, as opposed to absolutely and strictly accurate theoretical practice, "howling" is the audible note produced in the phones by the heterodyning of two oscillating currents of different frequency, or the interaction between transformers or other components of a set, whilst regeneration causing self-oscillation only will not be audible in the phones unless the self oscillation is impressed or has impressed upon it other oscillations of dissimilar frequency.

* * *

F. B. (Leyton).—What is an amplification factor?

The ratio between the plate voltage and grid voltage for constant plate current.

* * *

What is plate resistance?

The rate at which the plate voltage changes with respect to the plate current.

* * *

E.D. (Bolton).—In experimenting could It vary the grid leak by drawing pencil lines along the top of the ebonite panel from the grid leg of the valve to the aerial terminal?

Yes, your idea is perfectly sound. You will find, however, that it is apt to cause future trouble unless you either shellac the line when the correct value has been determined or carefully erase it if not required.

* * *

P. F. H. (Plumstead).—I wish to build a three or four valve set, but do not want to build the whole thing at once. What sort of set shall I build?

We should advise you to build a set on the unit system, commencing with the detector panel, and then adding H.F. and L.F. as desired. You will find the set described in our issues of Nos. 26, 34, and 35 very useful.

* * *

P. P. T. (Birmingham).—I have a crystal set which tunes up to 2,000 metres. Can I increase this to 2,600 metres? What is a loading coil?

Yes, you can add another coil in series between your present tuner and the aerial. This coil will have the effect of increasing the inductance in the aerial circuit, and thereby increasing its wave-length. If you add a coil—basket type will do—of about 100 turns of 24 on a 1½ inch centre former, winding with about 11 spokes, it should bring your wave-length up to 2,600 metres easily. A loading coil is one which adds, or loads, inductance to any circuit.

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 1023.*)

F. H. T. (S.E.1).—I am about 2 miles from 2 L O, and wish to use a frame aerial with my crystal set. What size wire and how many turns should I use?

We do not advise the use of an aerial for that type of set, not if the transmitting station is more than a few hundred yards away. You would need a four or six foot frame, winding 5 or 3 turns of 22 D.C.C. wire respectively. Spacing would be about ¼ inch between each turn. Use ebonite strips at the corners where the wires will be in contact with the frame.

* * *

W. W. C. (Barry).—Could I hear Cardiff, 10 miles away, on a crystal set and outdoor aerial? Must the aerial be above the houses, or can it slope from a chimney to a post in the garden? Can a landlord forbid the erection of an aerial?

You should be able to hear Cardiff quite well. The aerial can be sloping, as you suggest. We believe that a landlord has a right to refuse to allow an aerial to be erected on his property. In any case, we would advise you to ask his permission before you go to the expense and trouble of setting up the station.

* * *

P. J. L. (Hendon).—I have a two-valve set, and want to increase my range. Will a crystal detector and two H.F. valves be quite efficient, or do you advise a valve detector?

You will find that the crystal rectifier will operate quite well, but the worst of crystals is that they are so unstable in their adjustments. You will find a valve detector easier to operate, but, of course, it will cost more in upkeep.

* * *

L. S. D. (Dundee).—Is it true that the Dull Emitter valves last longer than the ordinary type?

Yes, we think that you will find this type of valve, although it is so costly, will eventually be worth it in the end, especially if you have difficulty in having accumulators charged. As the filament of this type of valve only needs to be red hot, the low tension current can be obtained from a primary battery, a dry cell being quite suitable. Also the filament will be found to last much longer than that of the ordinary valve which takes about ·7 amp.

* * *

A. S. K. (no address) asks if the presence of large gasometers near his house will have any effect on the quality of his reception.

Yes, in all probability you will find that such large masses of iron in the near neighbourhood of your aerial will deflect the wireless waves to a certain extent. From certain directions we are afraid you will be badly screened if these gasometers are very near you. It should not prevent you obtaining results, however, though you may have to use an extra valve to counteract the effects of the iron screen.

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 1024.)

B. T. K. (Skipton).—I have a loose-coupled crystal set, and want to use an H.F. amplifier. What connections and alterations do I make ?

Disconnect your crystal and phones from the secondary circuit, leaving the primary coil as it is. The secondary is now connected, one terminal to the grid of your H.F. valve, and the other terminal to the low tension negative. The plate of the valve goes to a coil (preferably a plug-in type of size to suit the wave-length required) called the anode tuning coil. This coil is wound so as to cover the wave-lengths desired. It may be a large slider coil if you wish, but we prefer the smaller ranged plug-in type. The other end of this coil goes to the crystal detector and to the H.T. positive. From the detector the circuit is continued to the phones—usual blocking condenser across them—and back to the first terminal of the coil (terminal connected to the plate). Across the coil, in shunt, is connected a small variable condenser, about ·0002 for tuning. The further connections for the valve circuit are, of course, H.T. negative to L.T. positive, L.T. negative to the secondary of loose coupler as mentioned before. The filament of course goes to L.T. plus and L.T. minus.

* * *

C. I. L. (Doncaster).—I have a solenoid type tuner of about 150 to 200 turns on a 4 in. diameter former. I should like to use this coil on a valve set with reaction. If I use the solenoid type of reaction, how big should it be ?

You will need a reaction coil of about 75 turns of 28 D.C.C. on a 3 in. diameter former. For efficient working this should be tapped two or three times to allow you to cut out some of the turns when listening-in on low wave-lengths. The reaction coil tappings can be evenly spaced, say one at the 30th turn, one at the 45th, and the other at the 60th turn.

* * *

L. W. (Bushey).—I want to use honeycomb coils for low wave-lengths on a two-coil holder. How many do I need ? I shall not be using reaction.

Probably five or six coils will be best. Wind one of 35 turns, one of 50, then 75, 100, and 120 turns. This will give you four combinations, using two coils at a time, the smaller being used as the primary, while the next size is used as the secondary. You will of course need two variable condensers for tuning purposes, one for each coil.

* * *

F. V. T. (Brighton).—Is resistance coupling efficient for H.F. amplifiers ?

We do not advise its use for wave-lengths under about 1,000 metres. Above that it may be used quite successfully. You will have to use more H.T. voltage on the plates of your H.F. valves when you are using this type of coupling, than when you use the ordinary tuned anode or transformer. The resistance of the coupling should be about 80,000 ohms.

* * *

F. G. (Brussels).—What are the diameters in millimetres of the following wires ? S.W.G. Nos. 18, 20, 22, 24, 26, 28, 30, 34, 36, 40, 42, 44, 48 ?

The dimensions are as follows, measured in millimetres : 1·219, ·9144, ·7112, ·5588, ·4572, ·3759, ·3149, ·2337, ·1930, ·1219, ·1016, ·0813, ·04064 respectively.

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 1025.*)

"ENQUIRER" (Tooting).—Supposing I was to connect two accumulators together, each of exactly six volts, with their like terminals, would not the pressure in each direction cause no current to flow, or would they simply short each other because each has negligible internal resistance?

Owing to the opposition of current, or rather the potential at each end of the connecting wires being equal, no current flow would result. However, as exactly similar voltage seldom exists between different accumulators, it would not be wise to attempt an experiment of this nature without the insertion in the circuit of suitable fuses.

* * *

B. M. (Birmingham).—Two condensers in parallel, one ·001 mfd. capacity and the other ·0005 mfd. What is the total capacity?

Merely the sum of the individual capacities when condensers are placed in parallel, *i.e.*, ·0015 mfd.

* * *

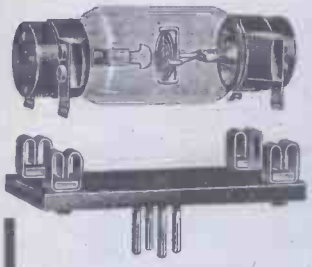
"EARTH" (Wolverhampton).—I am troubled by leaky electric cables and the electric railway. Can I avoid this?

You may be able to avoid the disturbance caused by the stray currents in your earth wire due to leaks in the electric cables, by having a capacity earth instead of the ordinary type. This earth is comprised of insulated wires, running parallel with and directly under the aerial. Three or four wires may be used, suspended by insulators about two or four feet above the ground. To this "earth" the set is connected in the ordinary way. It is essential that the capacity earth should be as well insulated from the real earth as is the aerial, so that the lead-in from the earth will have to be well insulated. Keep the aerial and earth leads as far away from one another as possible.

* * *

R. C. (Bolton).—How much wire should I need to wind a 5 inch by 5 inch former with 24 enamelled? What wave-length would I reach on it?

About 5 ounces of wire should suffice. The wave-length would be roughly 300 to 1,600 metres.



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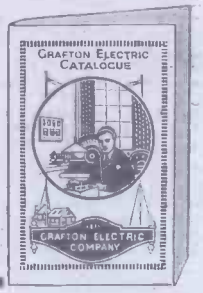

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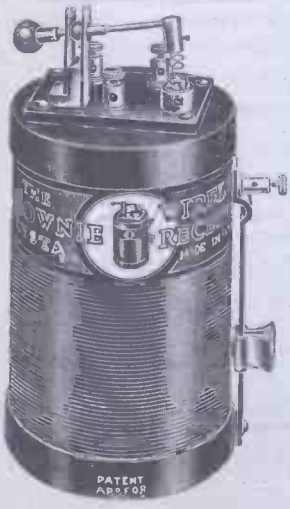

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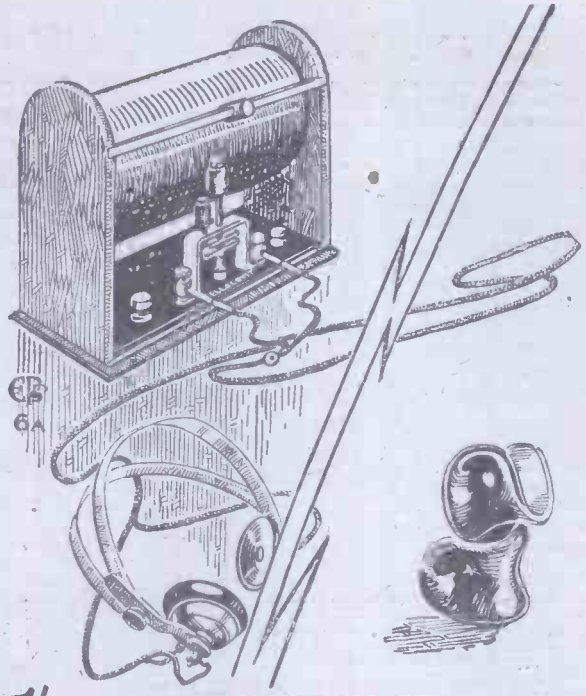

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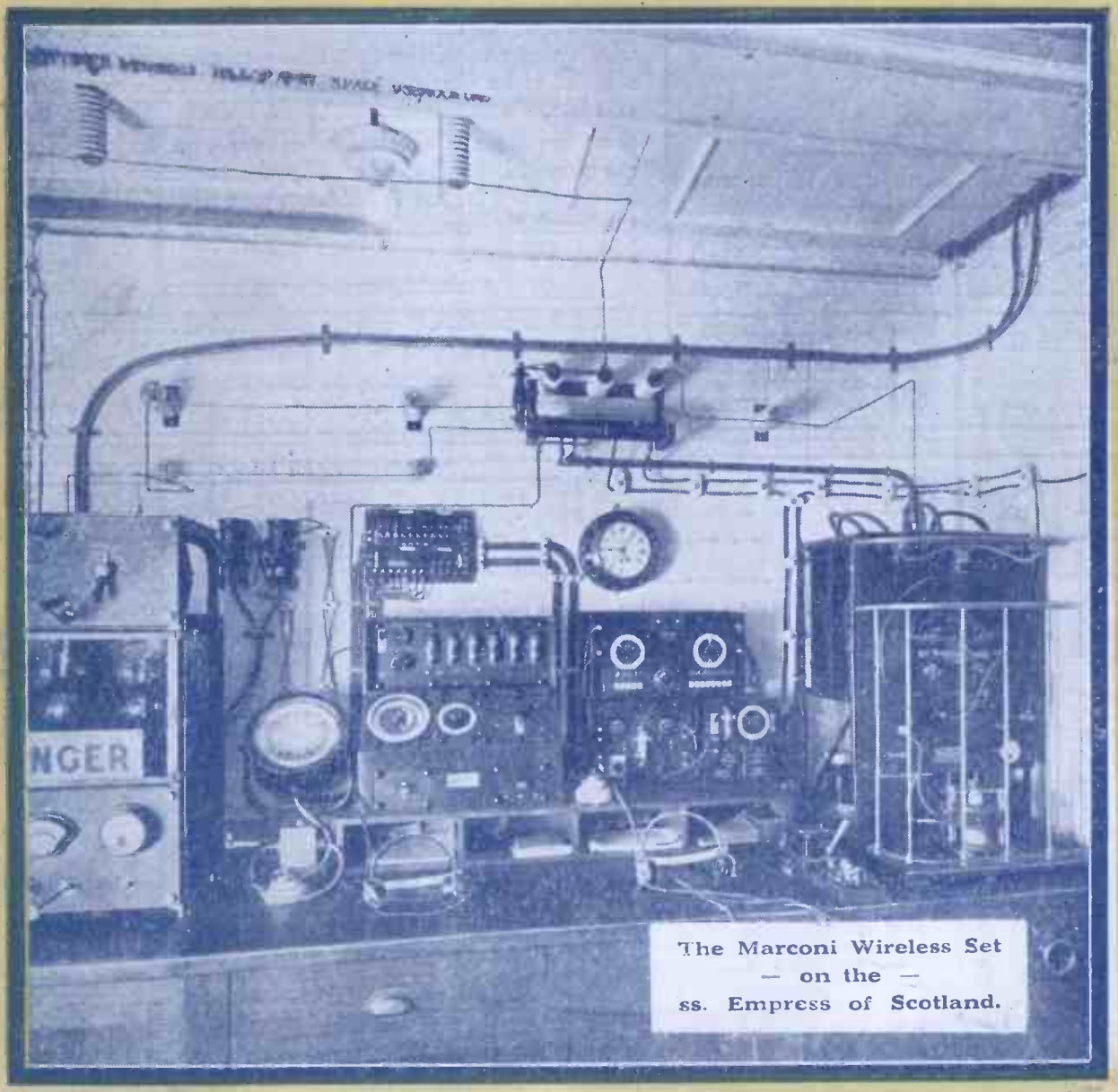
R/Y

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

WIRELESS AT THE EXHIBITION (THE REVIEW CONTINUED)

Popular Wireless

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



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

FEATURES IN THIS ISSUE.

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

POPULAR WIRELESS

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

TOPICAL NOTES AND NEWS.

The New G.E.C. Laboratories.

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

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

* * *

Sir Joseph Thompson.

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

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

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

* * *

5,000 Volts D.C.

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

* * *

Wireless and the Deaf.

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

* * *

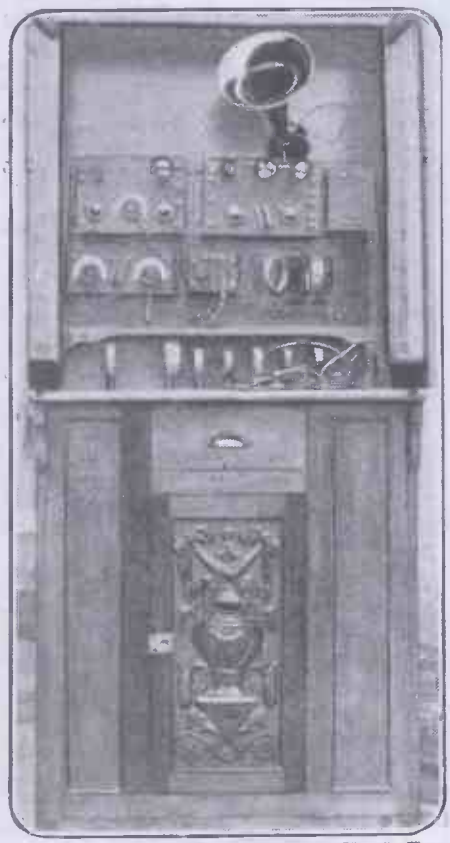
Radio for Miners.

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

* * *

A Wireless Dance.

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



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

* * *

Encouraging Wireless.

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

* * *

At the Exhibition.

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

* * *

The Wireless Concert.

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

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

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

* * *

"Popular Wireless" Stall.

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

* * *

A Correction.

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

* * *

Another Wireless Concert.

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

* * *

Dispensing with the Microphone.

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

* * *

Radio Association.

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

ARIEL.

The latest photograph of Professor A. M. Low.

Broadcasting Programmes

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

TELEPHONY AND MUSIC TRANSMISSIONS.

Station.	Call sign.	Wave-length in metres.	Remarks.
London Broadcasting Station, Strand ..	2LO ..	369 ..	Usually every evening, 5 to 5.45 p.m.; 7 and 9.30 News; 7.15 Orchestra; 8.25 to 10.30 Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5NO ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2ZY ..	385 ..	Every evening, usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5IT ..	425 ..	Every evening, usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5SC ..	415 ..	Commencing shortly.
Cardiff Broadcasting Station	5WA ..	353 ..	5 to 10 p.m.
Croydon	GED ..	900 ..	Throughout day to aeroplanes.
Paris	FL ..	2,600 ..	11.15 a.m. Weather report; 6.20-7 p.m. Weather report and Concert; 10.10 Concert.
Königswusterhausen ..	LP ..	2,800 ..	4 to 6.30 p.m.
The Hague	PCGG ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert.)
Haren	OPVH ..	1,100 ..	12 o'c. and 16.50 o'c. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m. News Items; 5.15 to 6.10 Concert; 8.45 p.m. News Items; 9 to 10 p.m. Concert.
School of Posts and Telegraphs, Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45-10 p.m. Saturdays, 4.30-7.30 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

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

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

All times given are G.M.T.

SOME WIRELESS OBSERVATIONS.

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

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

PART II.—CONDITIONS FOR MAXIMUM INDUCTANCE.

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

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

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

"Banked" Coil Arrangements.

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

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

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

Studying Length and Breadth.

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

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

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

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

(Another article by Sir Oliver Lodge next week.)

AN ACCUMULATOR TIP.

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

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

SOME PRACTICAL TIPS ON AERIAL CONSTRUCTION

By R. A. RICHARDS

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

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

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

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

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

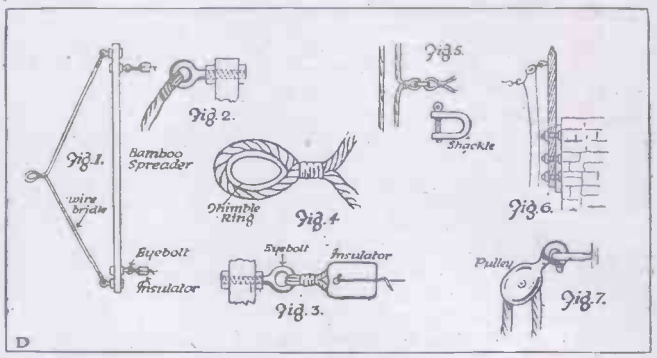
A length of the thicker wire was arranged to form the bridle to each spreader, the lengths being arranged so that the middle of each could be stretched out to a distance of a little over a foot from the spreader when about three inches was hooked through each further eyebolt (Fig. 1).

Useful Halyard Hints.

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

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

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



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

MAKING A FIXED CONDENSER.

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

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

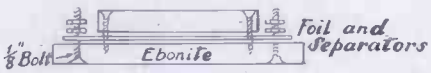


Fig 1.

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

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

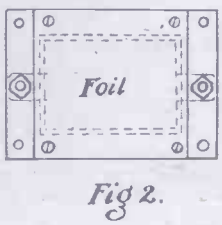


Fig 2.

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

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

Fig 3.

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

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

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

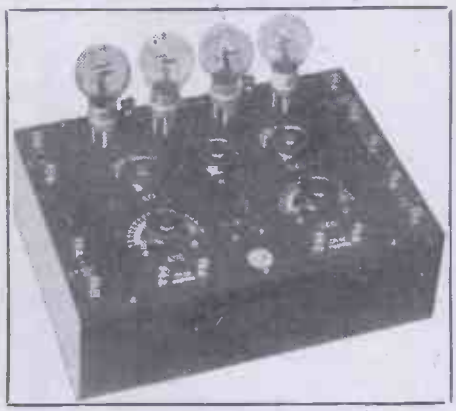
Now fasten the smaller block down with four screws that should have been arranged with regard to thickness, and holes made to receive them. When screwed down fairly tight, warm the whole by holding it near a gas flame or any form of heat that will allow the whole plates and separators to squeeze very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

POPULAR WIRELESS EXHIBITION REVIEW.

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

GENERAL RADIO CO.

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



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

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

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

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

A One-valve Tingey Broadcast Receiver.

* * *

RADIO COMMUNICATION CO.

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

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

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

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

* * *

METROPOLITAN-VICKERS CO., LTD.

The Metropolitan-Vickers Electrical Co., Ltd., are exhibiting the Cosmos Radiophones, which are specially designed for reception from the British broadcasting stations. The outstanding feature of these sets is simplicity, without sacrifice of efficiency. All unnecessary complications are avoided, and the sets are therefore eminently adapted for the non-technical user, and can be operated without difficulty by anyone without special knowledge or skill. All the sets, Valve as well as Crystal, are entirely self-contained, the only wires that have to be connected up by the user being the aerial and earth leads. All the sets have been approved by the Postmaster-General, and may be used under ordinary broadcasting licences.

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

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

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

(*Continued on next page.*)

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

POPULAR WIRELESS EXHIBITION SUPPLEMENT

(Continued from previous page.)

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

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

STERLING TELEPHONE & ELECTRIC CO., LTD.

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

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

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

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

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

* * *

A. GRAHAM & CO.

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

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

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

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

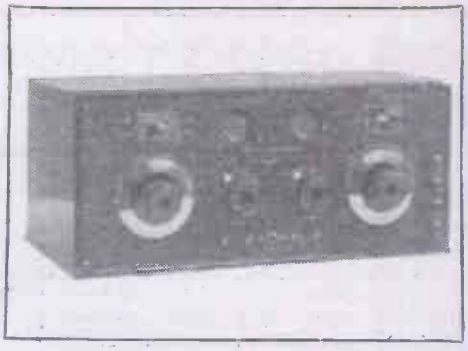
* * *

C. F. ELWELL, LTD.

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

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

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



A Two-Valve Set by the General Radio Co.

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

* * *

THE DUBILIER CONDENSER CO. (1921), LTD.

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

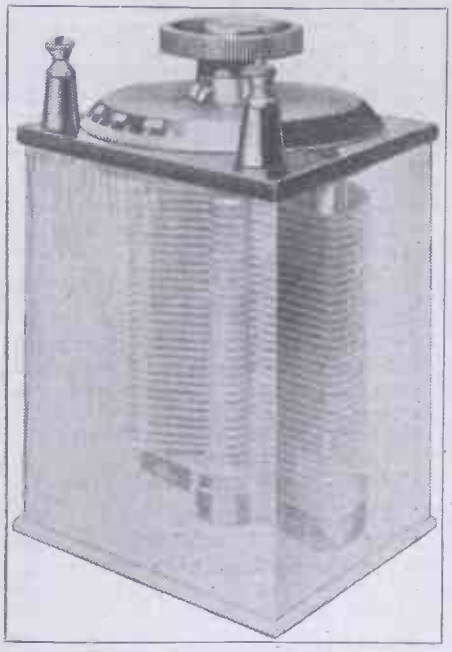
For use with wireless receiving apparatus, four patterns of fixed condensers are shown, known respectively as the Type 600, with and without grid-leak attachment; the Type 600A and the Type 577 condensers. These condensers are all constructed with carefully selected mica dielectric, and are built up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

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

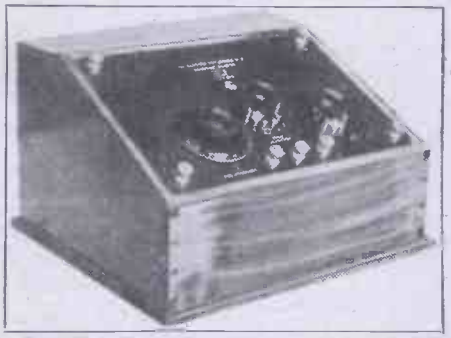
(*To be continued next week.*)

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

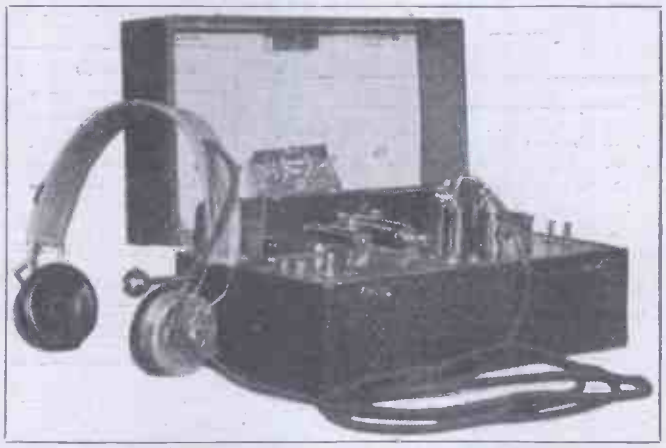
SEEN AT THE EXHIBITION.

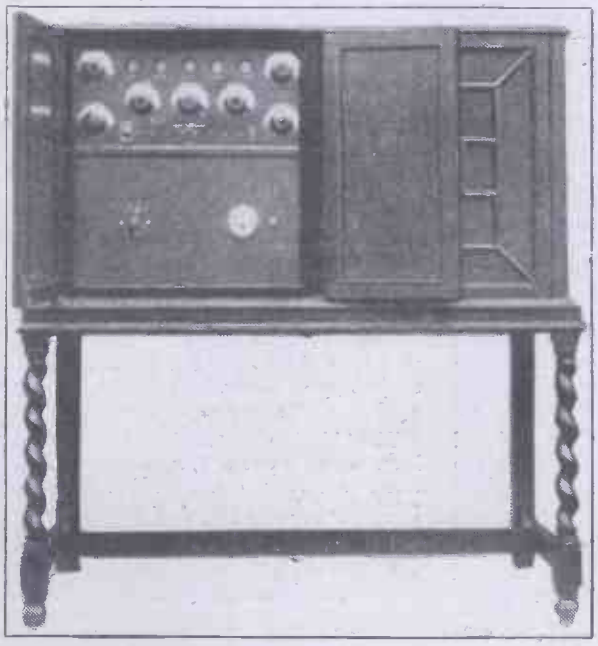


A VARIABLE CONDENSER, BY DUBILIER CO.; A "CONCERT GRAND" AMPLION LOUD SPEAKER, BY A. GRAHAM & CO.; AND A TWO-VALVE BROADCAST RECEIVER, BY METROPOLITAN VICKERS, LTD.



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





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

A TUNED ANODE COUPLING

By T. Mc. L. GALLOWAY.

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

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

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

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

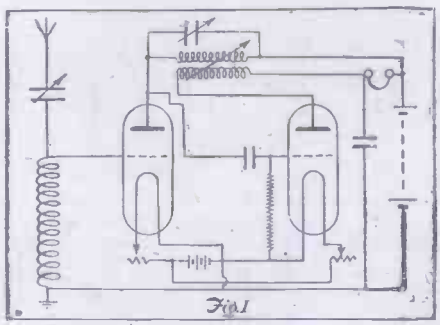


Fig. 1

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

Permissible Reaction

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

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

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

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

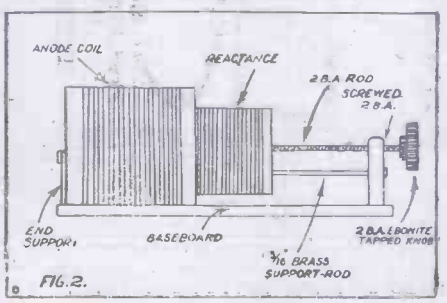


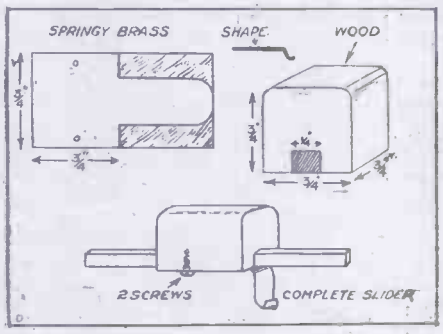
FIG. 2.

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

A NEAT SLIDER

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

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



CATALOGUES

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

* * *

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

* * *

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

SERIES AND PARALLEL

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

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

"Cascade" and "Shunt"

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

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

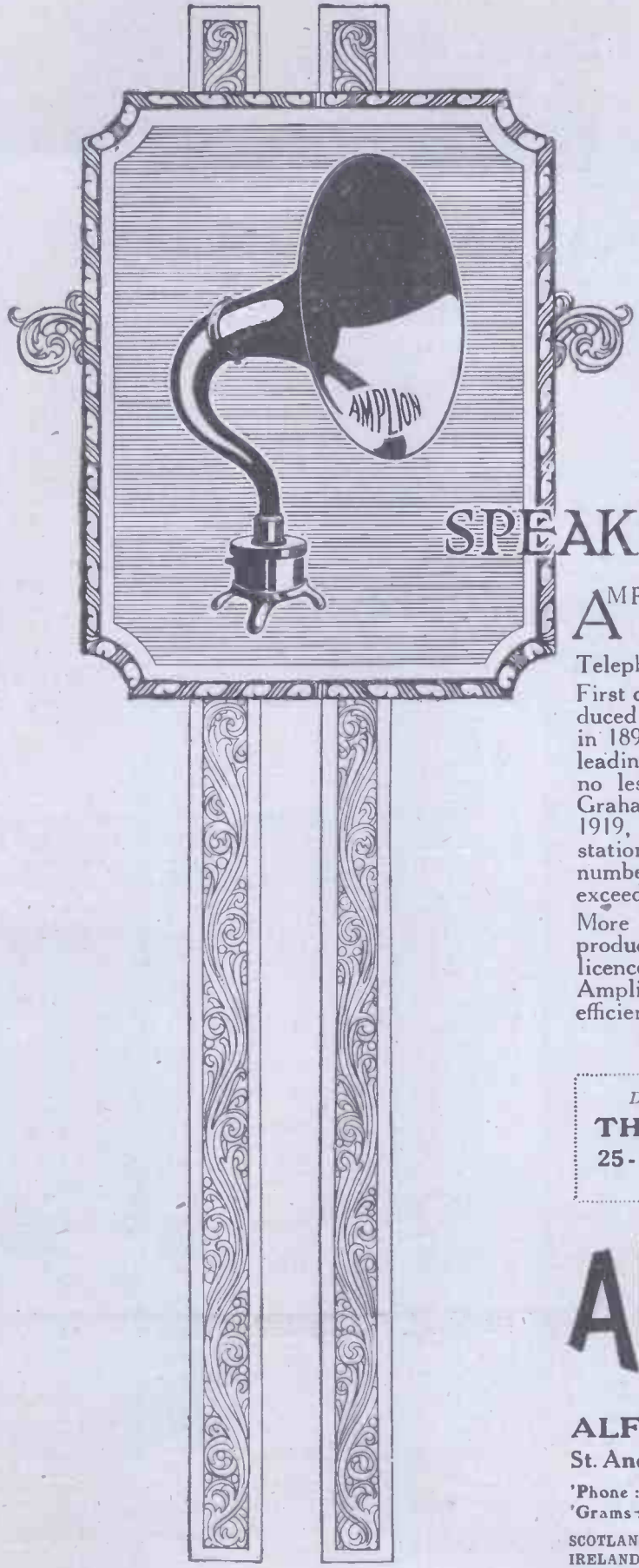
To reduce wave-length range a condenser can be connected in *series* with the aerial or earth lead.

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

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

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

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



SPEAKS FOR ITSELF

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

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

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

Ask for Folder "P.W."

Daily Demonstrations at the Graham Showrooms:

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AMPLION

ALFRED GRAHAM & CO.,
St. Andrew's Works, Crofton Park, London, S.E.4

'Phone: Sydenham 952 & 1700.
'Grams: Navalhada, Brock, London.

SCOTLAND—Mr. F. M. Milligan, 25, Renfrew Street, Glasgow.
IRELAND—Mr. Alex. R. Munday, 41, Chichester Street, Belfast.

A VISIT TO THE BIRMINGHAM BROADCASTING STATION.

(By our Representative in Birmingham.)

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

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

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

Quite a Sufficient Introduction.

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

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

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

An Interesting Record.

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

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

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

"What does this mean?" I asked.

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

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

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

The Rated Range.

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

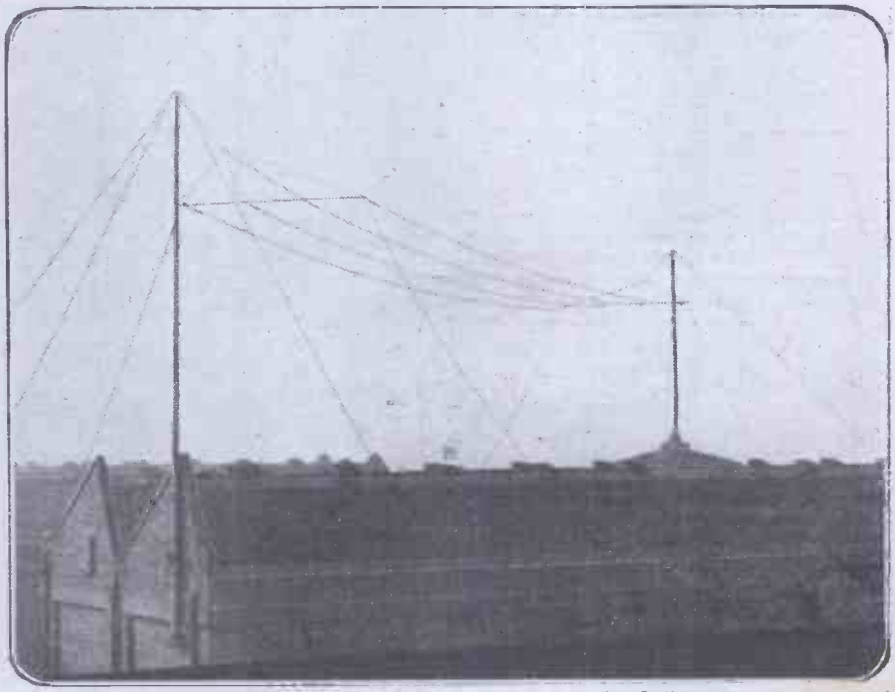
The rated range of the station is 100 miles, and the wave-length used is 425 metres.

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

Describing the Generators.

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

(*Continued on next page.*)



The Aerial System at the Birmingham Broadcasting Station.

A VISIT TO THE BIRMINGHAM BROADCASTING STATION.

(*Continued from previous page.*)

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

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

Controlling the Wave-length.

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

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

The Microphone Circuit.

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

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

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

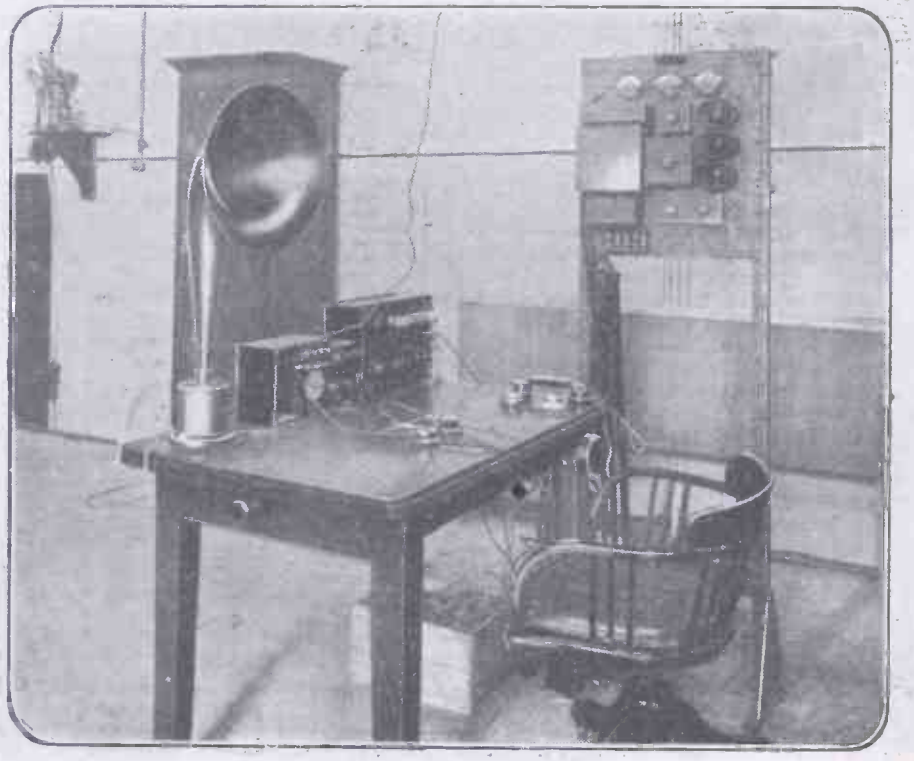
The Concert Studio at the Birmingham Station.

Three Small Rooms.

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

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

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



The Test and Control Room at 5 I T.

HOW TO MAKE A VARIABLE CONDENSER

By A. W. DRANSFIELD.

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

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

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

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

Method of Assembling.

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

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

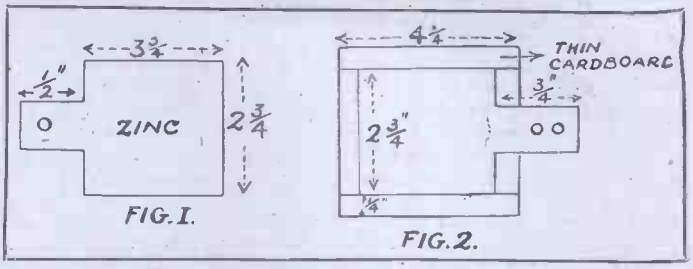
The neatest way, of course, will be to put a long bolt through the lot, but it will be sufficient to tightly wire them together.

Straightening Kinked Plates.

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

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

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



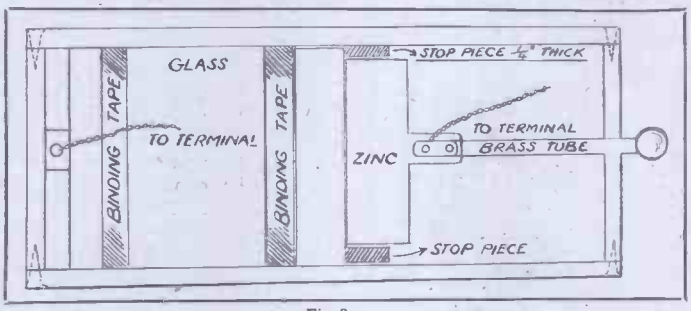


Fig 3.

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

ADDITIONS TO "POPULAR WIRELESS" DIRECTORY OF AMATEUR TRANSMITTERS.

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

THE HEAVISIDE LAYER AND THE "GLIDING WAVE."

By A. H. DALY

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

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

No Earth Connection.

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

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

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

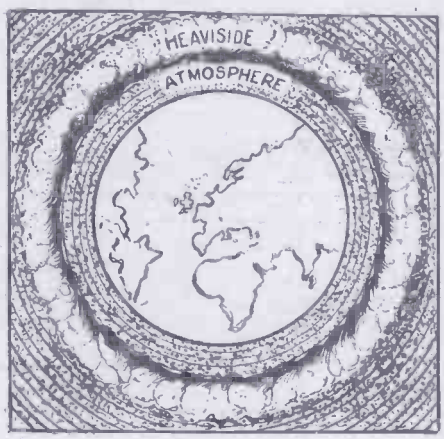
In order to get at the root of the argument it is necessary to go back to the early days of wireless. The discovery of wireless or electro-magnetic waves was made by Hertz about 1888. His transmitting apparatus consisted of two metal plates—each plate being connected to the spark gap of an induction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

Only "Half" Waves.

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

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

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



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

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

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

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

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

Dust from the Sun.

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

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

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

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

Sabang is a wireless station in Sumatra with a range during the day of 150 miles. On some nights this station can be picked up at Osaka, a Japanese wireless station 3,726 miles away from Sabang. At a point between Sabang and Osaka 2,484 miles from the former and 1,242 miles from the latter—Sabang can never be heard.

112 Miles Above the Earth.

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

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

POPULAR WIRELESS Beginners' Supplement

PART VIII.—WAVE-LENGTH AND FREQUENCY.

By MICHAEL EGAN.

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

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

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

Rate per Second.

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

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

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

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

A Fixed Law.

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

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

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

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

An Analogy.

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

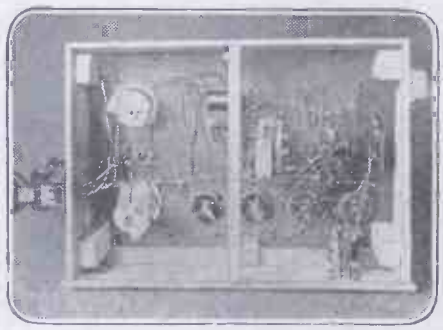
Now, owing to the difference in size, or length, between a train and a motor-car, several motor-cars will arrive in the time taken for a complete train to arrive. Whilst one long train is drawing into the station a whole group of motor-cars will have arrived at the garage. If the lengths of a train and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

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

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

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

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



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

THE VALVE FOR BEGINNERS.

By SEXTON O'CONNOR.

PART III. (Conclusion.)

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

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

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

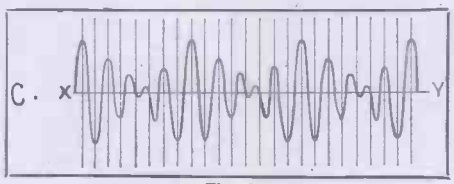


Fig. 1

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

Nothing would be Heard.

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

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

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

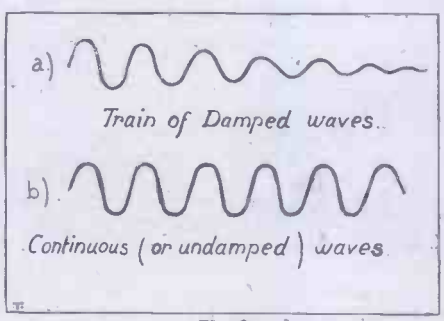


Fig. 2

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

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

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

"Carrying" the Music.

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

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

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

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

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

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

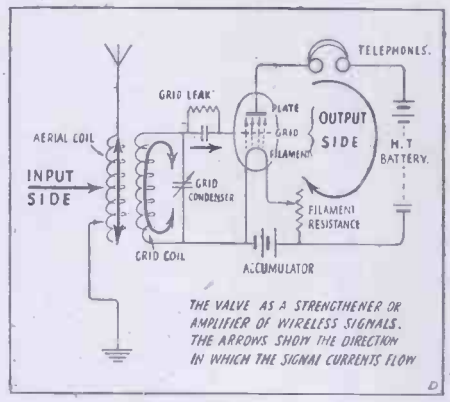


Fig. 3

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

The Grid Leak.

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

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

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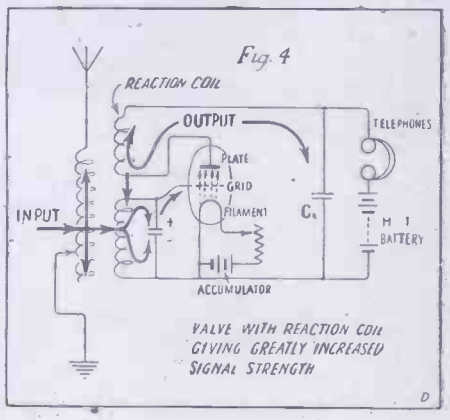


THE VALVE FOR BEGINNERS.

(*Continued from previous page.*)

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

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

Briefly Dealing with Reaction.

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

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

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

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

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

Final Remarks.

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

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

HOW TO DEAL WITH A FAULTY CRYSTAL SET.

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

The Worst Offenders.

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

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

Three Important Points.

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

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

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

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

After All That.

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

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

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

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

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

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

* * *

Q. What does "in series" mean?

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

* * *

Q. What is a primary battery?

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

* * *

Q. What is a "carrier" wave?

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

* * *

Q. What is meant by so many watts?

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

* * *

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

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

* * *

Q. What is a loose coupler?

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

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

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

* * *

Q. Can burnt-out valves be repaired?

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

Q. What causes atmospherics?

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

The Countess of Westmorland broadcasting from the Manchester station.
[Photo, Metropolitan, Vickers.

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

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

* * *

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

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

Q. How do I obtain an experimental licence?

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

* * *

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

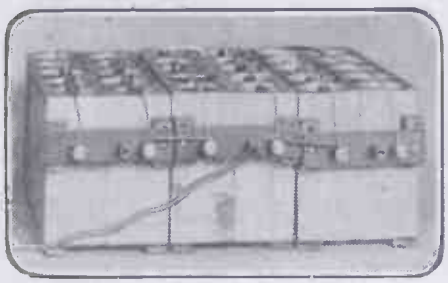
A. You will find that a small condenser in series with your aerial will enable you to tune down to about 190 metres. If you are using a variable condenser for tuning, connect it between the aerial lead-in and the aerial terminal on the set. A ·0005 mfd. condenser will do quite well, if you do not already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

A UNIT H.T. BATTERY.

THERE have been many articles published dealing with H.T. batteries reconstructed from disused dry cells, but very little has been said about the containers, which is an important and difficult part, especially when forty or fifty are required, and after many failures I have made them up in the form shown in the photograph. As will be seen, they are made up of ten cells each, with an ebonite strip in the front to carry negative and positive terminals with a valve leg in the middle drilled out to $\frac{5}{16}$ in. and a spring fitted in the side to ensure good contact: $\frac{3}{4}$ in. of $\frac{5}{16}$ in. brass rod is next drilled $\frac{1}{8}$ in., $\frac{1}{4}$ in. deep, and then $\frac{1}{8}$ in. through to solder a flexible lead; the wire, of course, being taken right through and soldered from the top, ensuring a neat finish and reliable plug.

In Blocks of Ten.

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



An H.T. Battery unit.

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

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

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

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

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

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

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

AN INDUCTANCE COIL FOR BROADCASTING RECEPTION.

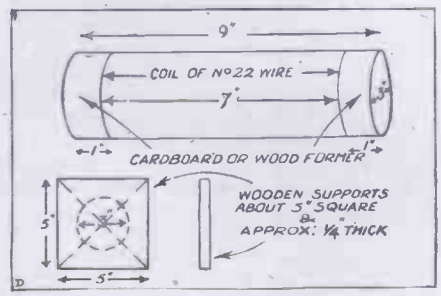
IT is a common saying that one must walk before one can run, and as this article is intended for the beginner it is presumed that a crystal detector is to be used in conjunction with the coil about to be described. For the benefit of those readers who wish to make the piece of apparatus in question,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

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

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

Winding on the Wire.

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



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

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

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

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

BOOK REVIEW.

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

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

CATALOGUES.

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

A VERNIER CONDENSER FOR PANEL MOUNTING

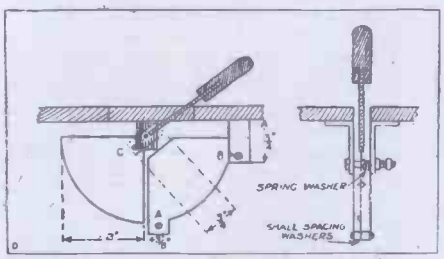
MOST circuits employing a valve are very critical, and a Vernier condenser is practically a necessity. With many amateurs space is a great consideration when constructing a panel. The following is a very effective and compact Vernier condenser for panel mounting.

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

Method of Adjustment.

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

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



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

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

Assembling the Parts.

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

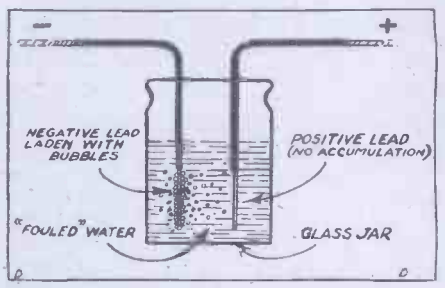
The two larger brackets are screwed to the panel directly in a straight line with the others and $1\frac{3}{4}$ in. from them. It is very important to have them in the same straight line, or great difficulty will be experienced in preventing the plates from touching. The plates are fixed to these brackets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

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

SIMPLE POLARITY INDICATOR

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

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



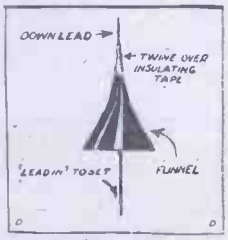
positive lead remains to all intents and purposes free from any such accumulation.

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

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

HOME-MADE CONE INSULATOR

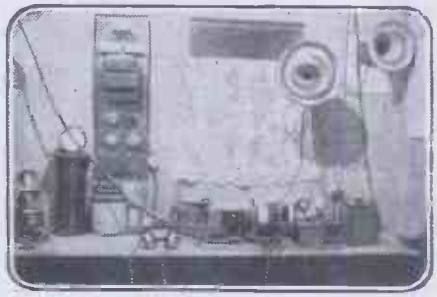
THE expression "cone insulator" will be familiar to all professional wireless operators, and also to a good many advanced amateurs. This type of insulator does not appear to be so well known to the beginner, however, as it is the writer's experience that such insulators are only conspicuous by their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



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

To Prevent Corrosion.

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



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

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

TO READERS.

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

GEARY GOES IN FOR WIRELESS.

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

By HIGHAM BURLAC.

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

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

Mining Operations.

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

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

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

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

wireless station decreased as the hole got deeper.

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

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

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

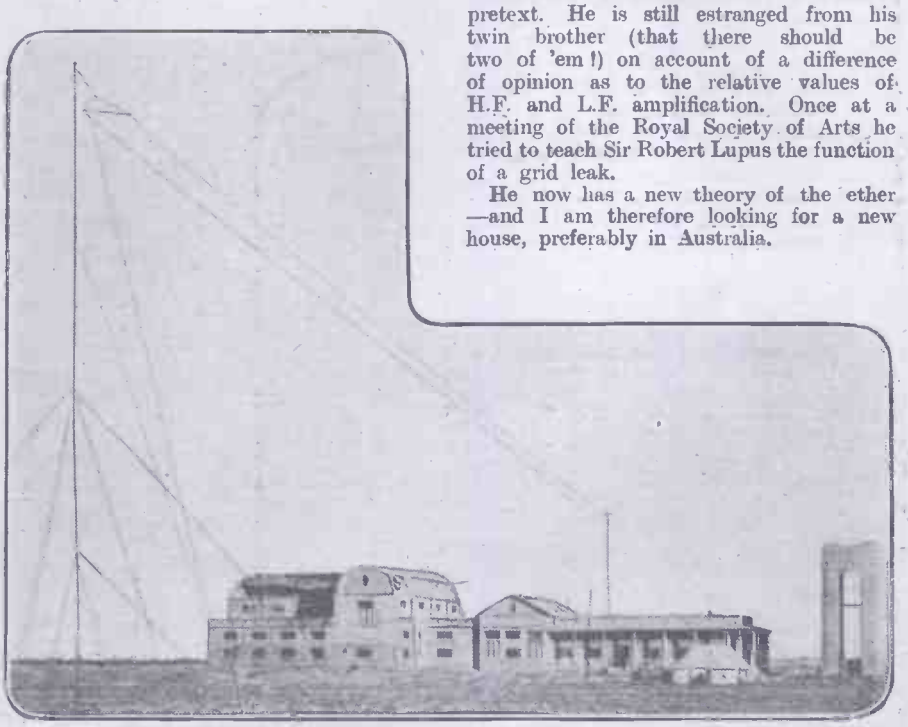
The elephant is a noble beast, but when enraged he will not do so.

Well and Truly "Bitten."

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

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

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



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

THE RADIO ASSOCIATION

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

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

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

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

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

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

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

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

PROVINCIAL HON. DISTRICT SECRETARIES.

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

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

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

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

Bristol.—V. W. Russell, 14, Park Row.

Bognor.—Wm. H. Sinnott.

Bloxwich.—A. V. Perry, 66, Park Road.

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

Chatham.—A. E. Ryeland, 381, High St.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Welshpool.—A. E. Bond, Havelock Ter.

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

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

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

METROPOLITAN.

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

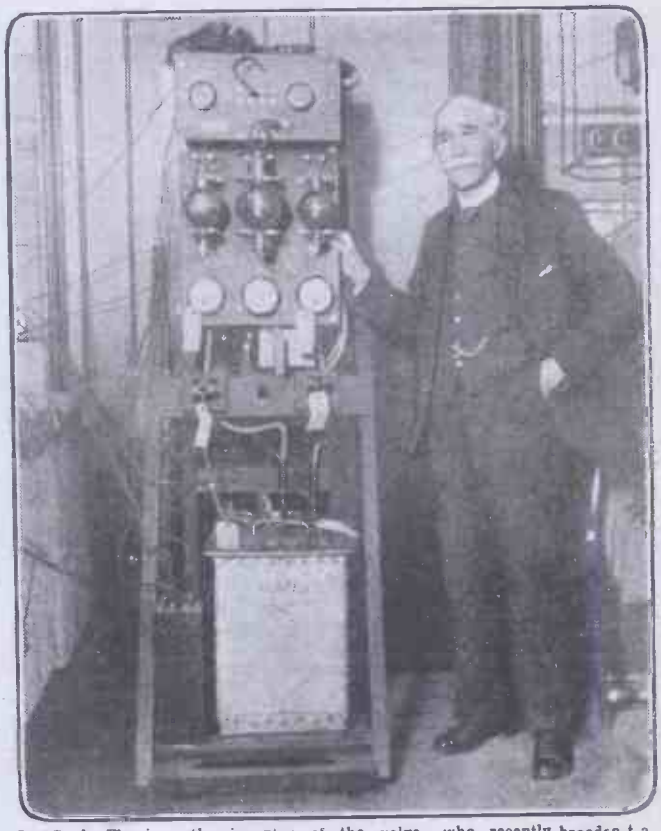
Brockley.—C. R. Rice, 111, Upper Brockley Road, S.E.

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

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

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

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



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

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

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

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

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

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

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

WRITE to the nearest branch secretary or head office.

SUBSCRIPTION FORM.

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

Date.....192....

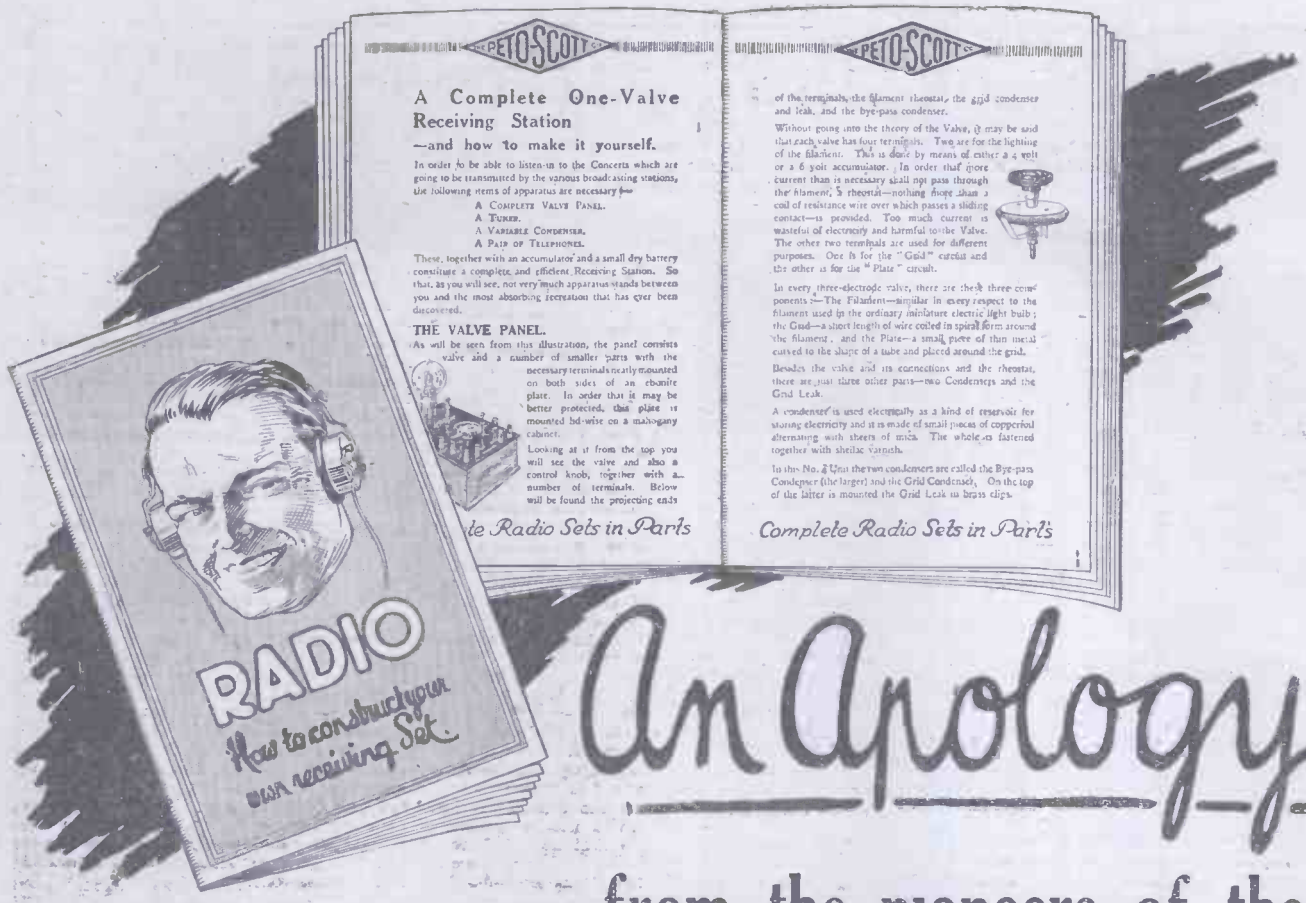
Dear Sir,

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

Name in full .....
(with Titles)
Occupation .....
Address .....
.....

Are you a Member of any Local Wireless Club or Societies? If so, state names and addresses

.....
.....



An Apology

from the pioneers of the Standardised Unit System

THE ever-increasing popularity of the Peto-Scott Standardised Radio Unit System among experimenters has caused us no little embarrassment. In spite of having placed huge orders for raw material long before Broadcasting started, we have found it very difficult to keep pace with the demand.

However, by making very considerable additions to our factory accommodation, and by taking over the lease of a large building in Holborn, we hope now to be in the position to handle expeditiously the manufacture of still greater quantities of these Units and also of our Broadcast Receiving Instruments.

The Booklet "Radio," giving full particulars of the Peto-Scott Unit System, has now run to its 3rd Edition, and copies are again available at 6d. each, post free. It contains a full description of the elementary principles of Wireless Telephony, and is an excellent guide to those about to take up Wireless.

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No. 1. Tuner Unit ...	... 27/6
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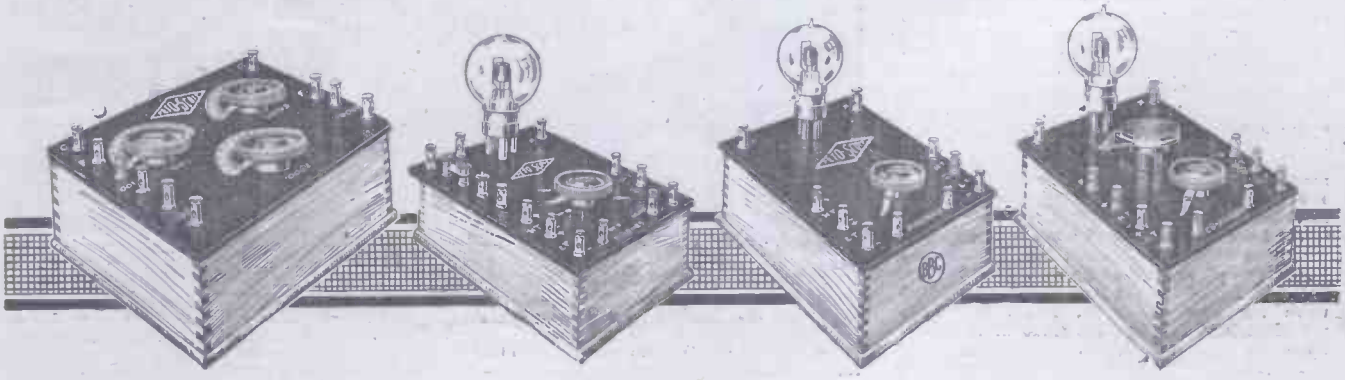


WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

The Portsmouth and District Wireless Association.*

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

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

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

The Wireless and Scientific Society of Bridlington.

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

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

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

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

Acton and District Radio Society.

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

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

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

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

Wireless and Experimental Association.*

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

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

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

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

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

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

Grays and District Radio Society.

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

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

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

Birmingham Experimental Wireless Club.

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

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

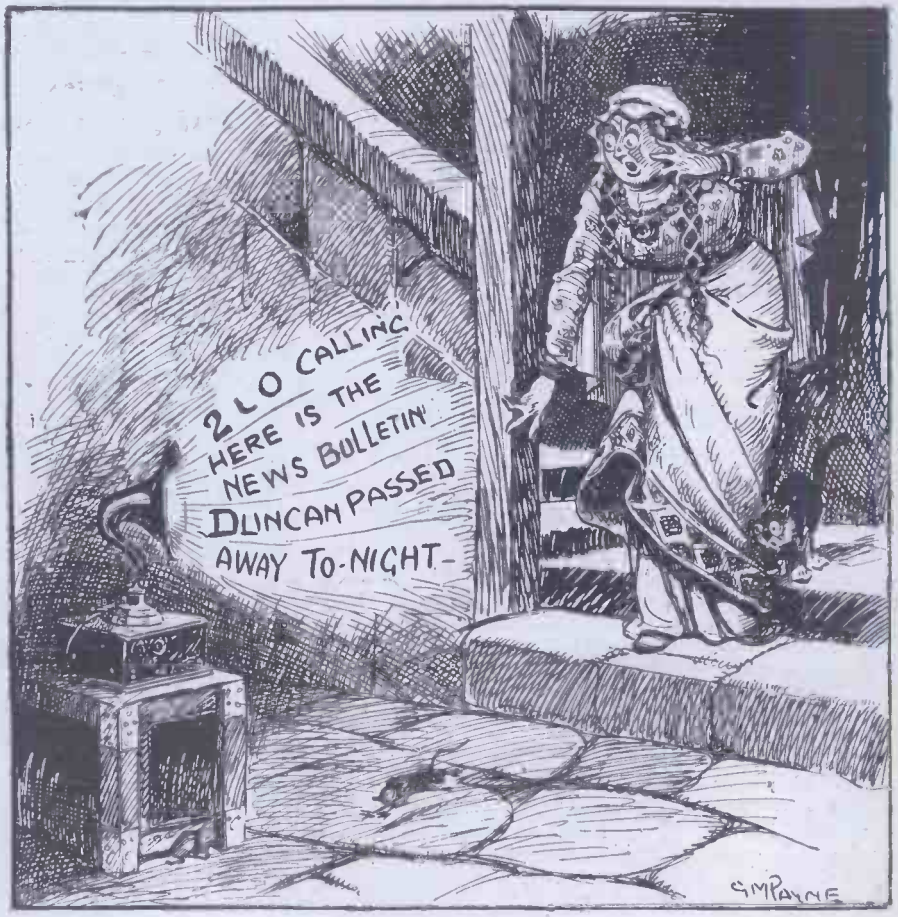
Other members contributed to the discussion. We find these meetings very helpful to members, as we encourage our members to bring any difficulties they may have forward for general debate.

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

The Wireless Society of Hull and District.

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

LADY MACBETH HEARS THE SAD NEWS.



RADIOTORIAL

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

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

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

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

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

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

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, The Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send the necessary postage for reply..

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

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

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

* * *

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

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

* * *

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

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

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

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

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

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

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from previous page.)

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

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

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

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

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

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

* * *

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

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

* * *

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

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

* * *

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

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

(Continued on page 92.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 90.)

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

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

* * *

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

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

* * *

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

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

* * *

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

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

* * *

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

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

(Continued on page 94.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 92.)

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

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

* * *

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

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

* * *

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

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

* * *

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

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

(Continued on page 93.)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 94.)

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

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

* * *

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

Yes, you are quite correct on all those points.

* * *

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

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

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

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

* * *

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

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

* * *

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

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

* * *

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

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

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Ewell. ***J. L. S.***
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POPULAR WIRELESS WEEKLY, MARCH 17, 1923. REGISTERED AT THE G.P.O AS A NEWSPAPER

HAVE YOU BEEN TO THE WIRELESS SECTION AT OLYMPIA?

Popular Wireless

No. 42, Vol. III. PRICE THREEPENCE WEEKLY. March 17th, 1923.

A Wireless Concert in the Birmingham Town Hall.

FEATURES IN THIS ISSUE.

A Gramophone Loud Speaker.
Wave-Length and Interference.
The Licence Question.
A Wireless "Piano" Tuner.
The New Radio Danger.
Four Pages for Beginners.

Another Article by Sir Oliver Lodge, and a further Review of the Wireless Section at Olympia.

POPULAR WIRELESS

March 17th, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S., D.Sc. [Every Friday.

TOPICAL NOTES AND NEWS.

Those "Experts."

I DON'T expect that I am the only one who has noticed it, but what a lot of "wireless experts" there are about nowadays. I was helping in the erection of a friend's aerial the other day, and no less than three friendly neighbouring "experts" supplied a continuously running stream of varying advice during the operations. These latter concluded, I retired, leaving them heatedly arguing among themselves as to the "pros and cons" of various crystals.

* * *

Proofs of Identity.

TALKING about "experts" reminds me of two very funny incidents. In the Tube one day last week I heard a man solemnly declare to an interested companion that it was possible to identify a receiving set by its aerial! During the same evening I was quietly enjoying a piano solo from the London Broadcasting Station through a friend's loud speaker when I was interrupted by a loquacious acquaintance who would insist upon enlightening me in various minor matters radio. While he was telling me how to identify a Brown loud speaker by its shape, pointing to the one in operation as a good example, how to locate the three L.F. valves by the size and shape of their bulbs, etc., my host strolled over and exclaimed, "How do you like my new Amplion loud speaker? It is working well on one L.F., isn't it?"

* * *

Not Deliberate.

I DO not believe for one moment that there was any deliberate interference during the broadcasting of Lord Robert Cecil's radio speech recently. In my opinion the rather severe heterodyning was caused by listeners-in unintentionally. This particular transmission, as observed in some districts, was not quite so good as usual, and, in any case, reaction is always more used, and also more greatly misused, during the transmission of speech, owing to the endeavour of everybody to bring it in as loudly and clearly as possible.

* * *

The Duke of York's Wedding.

THERE is a rumour floating about that the marriage service at the Duke of York's wedding is to be broadcast. Most rumours die a natural death—but I have hopes that this one will flower into actual fact.

* * *

The House and Broadcasting.

MR. BONAR LAW cast cold water on Mr. Ben Tillet's suggestion that debates in the House be broadcast from 2 L O. I can't help thinking that if Mr. Lloyd George had been Premier the suggestion would, at least, have received a little more sympathy. But readers may rest assured that Mr. Law's dislike of the suggestion will not prevent the ultimate realisation of the scheme. "This 'ere progress—it goes on" as Mr. Wells once remarked in one of his books.

* * *

The "Spouter."

"MR. G. W. REED, Cromwell Road, and Messrs. H. E. Daft and E. J. R. Cowles, Eastfield Road, received a concert from the broadcasting station at Newark, New Jersey, U.S.A. Except for some jamming by a spout station——" (From the "Peterboro' Advertiser.")

Yes, we all know that "spout" station, only "spark" is more polite.

* * *

A Link With Home.

VOYAGING to Australia via Cape Town recently, the Aberdeen liner Themistocles—fitted with the latest Marconi wireless apparatus—was in touch with land stations in Great Britain the whole time, and was able to receive 65,000 words of news, representing 738 words per day, throughout the voyage.

* * *

Some Diaphragm.

AN enterprising firm in Mark Lane has introduced a very ingenious contrivance which converts their large plate-glass window into a diaphragm. A small instrument imparts the audio-frequency vibrations to the window, and one is able to hear the broadcast concert items quite clearly by pressing one's ear against it. That, at least, is what I have been told; when I wandered down Mark Lane the other day to investigate, I discovered such a crowd assembled that I decided I would not endanger this enterprising firm's freedom from police intervention by adding to its number.

* * *

Direction-Finding and the S O S.

AFTER a strenuous battle with Atlantic storms during a tow of 750 miles, the Furness liner Sachem brought the Norwegian ore-carrying steamer Capto safely to harbour at St. John's, Newfoundland. The Capto's wireless distress call, reporting the loss of a rudder and asking for assistance, was picked up by the Sachem when the vessels were about 100 miles apart, and the Sachem immediately steered in the direction given. A heavy gale was raging, and although the Sachem searched thoroughly, she could not locate the disabled ship. The Canadian Pacific liner Montclare, equipped with Marconi direction-finding apparatus, plotted the exact position of the two ships from the signals they were sending out, and communicated the information to the Sachem, which then soon came up with the Capto.

* * *

Imperial Wireless Chain.

THE Government have decided to issue licences for the erection of wireless stations in this country for communi-

(Continued on next page.)

Sir Gerald Du Maurier, the popular actor, and his fine Cabinet Set.

NOTES AND NEWS.

(*Continued from previous page.*)

cation with the Dominions, Colonies, and foreign countries, subject to the conditions necessary to secure British control and suitable arrangements for the working of the traffic. At the same time the Government have decided that it is necessary, in the interests of national security, that there should be a wireless station in this country capable of communicating with the Dominions, and owned and operated by the State. A station of this kind will therefore be erected as early as possible, and it will be available for commercial traffic as well as for service messages. Formerly it had not been intended that private companies should be allowed to participate in the State-operated wireless chain of communications, but such a restriction has now been abandoned.

* * *

THE Glasgow station commenced operations last week.

The first speaker to address a Scottish audience through the medium of the new station was Lord Gainford, chairman of the British Broadcasting Company, who was followed a few minutes later by the Lord Provost of Glasgow.

Immediately afterwards the programme of the first concert was opened with an orchestral selection, which, as was fitting, was of Scottish music.

In the course of the evening five-minute addresses were delivered by Principal Sir Donald MacAlister and Sir William Noble, and a news bulletin was given.

Speech and music alike were heard clearly and loudly throughout Glasgow and the neighbourhood.

The results achieved show that the Glasgow station will give a satisfactory service over a very large area.

* * *

"The Wireless Trader."

IN bringing forward their new publication, "The Wireless Trader," The Trader Publishing Company, Ltd., 139-140, Fleet Street, London, E.C.4, are only extending their field, which already covers the motor, motor-cycle, and cycle trades.

The new journal, which appears monthly, will, like the other organs of the house, be issued by subscription, to the trade only. There is no doubt that such a periodical will find favour with the trade.

The first issue maintains the high reputation of its issuing house, and if this quality is maintained I have no doubts whatever as to the immediate and well-deserved success of "The Wireless Trader."

* * *

A New Firm.

MR. ALFRED W. KNIGHT, late of Mitchells' Electrical & Wireless, is promoting his own wireless company in conjunction with Mr. H. J. Bywaters, the proprietor of Eiffel Tower Crystals. They have secured premises at 167, Rye Lane, and by this time will have their specialities ready for the market.

* * *

The Alfred Graham Cabinet Set.

ON page 61 in last week's issue of POPULAR WIRELESS, owing to an unfortunate error, a handsome cabinet type receiver, manufactured by Messrs. Alfred Graham & Co., was credited to another firm.

Daytime Concerts.

THE morning and afternoon concerts broadcast by the London Broadcasting Station for the "Daily Mail" Ideal Home Exhibition have been very fully appreciated in many other quarters, and it is to be hoped that during the summer we will be able to enjoy broadcast items in summer circumstances. Some of the "air liners" on the Croydon-Paris route have fitted up receivers in order that passengers can listen-in during these hours.

* * *

The Broadcasting of "Polly."

"POLLY" is not a play that lends itself to broadcasting; there is too much going on on the stage that is impossible to visualise unless one has actually seen it. Although the relaying and transmission from 2 L O was, as usual, excellent, I am afraid few listeners-in were able to hear it without developing that exasperating feeling of wondering exactly what all those crashes and bangs were. In fact, although it was an advertisement for the theatre proprietor it was rather a failure from the point of view of the listener-in, from what I can hear.

The New Game.

NOW that the Beaver craze has died a natural death, it looks as if an even worse craze is to take its place.

Little boys have now picked on the interesting pastime of "spotting" aerials.

Every time they see one of these gadgets in a back garden they scream out "HAERIAL!" I am not sure whether the "H" is part of the game or part of their accent. Anyway, owners of aerials are getting annoyed. "Frames" should enjoy a boom if this goes on.

* * *

A New B.B.C. Appointment.

MAJOR ARTHUR CORBETT-SMITH has been appointed Director of the Cardiff Station of The British Broadcasting Company, Limited. Amongst other things, Major Corbett-Smith is M.A., Oxon., F.R.G.S., barrister-at-law, major, R.F.A., officer de l'instruction publique, hon. secretary-general the Naval and Military Musical Union, editor The Journal of State Medicine, etc. Major Corbett-Smith is an accomplished musician, and has several operas and other compositions to his credit.

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.
London Broadcasting Station, Strand ..	2 L O ..	369 ..	Usually every evening, 5 to 5.45 p.m.; 7 and 9.30 News; 7.15 Orchestra: 8.25 to 10.30 Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5 N O ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2 Z Y ..	385 ..	Every evening, usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5 I T ..	425 ..	Every evening, usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5 S C ..	415 ..	——
Cardiff Broadcasting Station	5 W A ..	353 ..	5 to 10 p.m.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Paris	F L ..	2,600 ..	11.15 a.m. Weather report; 6.20-7 p.m. Weather report and Concert; 10.10 Concert.
Königswusterhausen ..	L P ..	2,800 ..	4 to 6.30 p.m.
The Hague	P C G G ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert.)
Haron	O P V H ..	1,100 ..	12 o'c. and 16.50 o'c. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m. News Items; 5.15 to 6.10 Concert; 8.45 p.m. News Items; 9 to 10 p.m. Concert.
School of Posts and Telegraphs, Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45-10 p.m. Saturdays, 4.30-7.30 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

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

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

All times given are G.M.T.

THE NEW RADIO DANGER.

By ALEXANDER W. SHARMAN.

IT is well known that new conditions call for new regulations if they are to be used to the fullest advantage and prevented from becoming a danger to the art which has called them into being. We have a new condition in radio and already much restrictive legislation, but a further trouble has arisen which was not foreseen, and the present regulations do not provide the remedy.

The chimney pots of Suburbia are becoming fairly festooned with aerial contraptions, good, bad and indifferent, but all aerials within the definition, "Insulated, elevated conductors," and it is obvious that if you increase the number of aerials within a given area the average distance between them will become less and less.

Already we have met a case of two "flat dwellers," one on the ground floor and one on the floor above. The male pillar of the house in each case is addicted to wireless amongst other domestic bad habits, and their activities have resulted in the erection of two aerials within about 18 feet of each other. Both of these gentlemen are suffering from radio disease in its acute form and both are in the second or crystal scratching stage of the malady.

Which became the host for the radio germ first and subsequently infected the other does not appear, but it is fair to assume that they mutually reinfected each other and will both become permanent chronics.

On the "Fading" Trail.

What brought me on the scene was a report from one of the victims concerned that the signals from 2 L O were showing unmistakable symptoms of rhythmic "fading." Now really genuine "Fading," the sort we spell with a well-merited capital F, has no excuse for its presence in London as far as signals from 2 L O are concerned. The genuine "Fading" is a mysterious variation in intensity or reduction in strength of signals from a distant station, and is thought to be due to clouds of misguided electrons which maliciously oppose the harmless and inoffensive ether ripples so melodiously and continuously produced (for financial consideration) by the British Broadcasting Company.

Now the presence of real "Fading" in London would be about as exciting as an authentic account of the presence of a super Usapia Palademo in the same locality; in either case I should forsake all and follow the trail. Armed, therefore, with my own pre-war crystal set and supported by a portable wave-meter, I sallied forth at the darkening hour to the wilds of Upper Tooting to hear this marvel. It is very dark in Tooting in the absence of light, and so I could not see the aerial, but I was given the terminal extremity of a piece of wire with the assurance that it was the aerial, and subsequent events entirely justified the statement.

I hooked up my set and in came 2 L O with normal clarity and volume. Triumphantly I passed the phones to my host, and was about to expound upon the greater pleasure derived from a home-made set as opposed to the commercial indiscretion of buying one, when suddenly the signals dropped down in strength and finally vanished utterly, in spite of switching in a second detector and going over all adjustments.

Stealing Another's Energy.

Now, my own little portable set has an unblemished character for reliability and this result was astonishing, but facts are stubborn things and do not happen without a cause. I naturally asked rude questions concerning the earth, not the oblate spheroid on which we dwell, but the connection to my host's water-pipe. Was it possible that he had connected his earth wire, not in the rising main which must go to earth, but to a service pipe only connected to the metallic lining of the cistern, a mistake often made by the novice? In this case the only real earth is of course through the high resistance water level, the ball-cock, and thence to the rising main, and if the water level drops and the main supply happens to be shut off the water fails to make contact with the ball-cock and the earth connection is a thing of the past.

This, however, was not so in the present instance. The earth connection was good and of the earth, earthy. We then paid a visit to the radio enthusiast residing in the flat immediately below and discovered, by comparing notes, that the moment our signals faded away was coincident with the moment that our competitor was tuning his adjacent aerial to the wave-length of 2 L O. Several experiments were made, and it was found that we could not both get good signals with our respective crystal sets at the same time.

We had hoped that readjustment of tuning would enable us to pull in 2 L O in spite of the activities of the adjacent set, but no success was obtained. When the second aerial is either put direct to ground or left on open circuit all is well, but if one of the two aerials is left without sufficient inductance to ground to tune it to 2 L O there is nothing left for the second aerial to get. That was the explanation of the apparent "fading." It was simply due to the activities of the other flat dweller. The more signal energy he captured by readjusting his tuner, the less was available for ourselves.

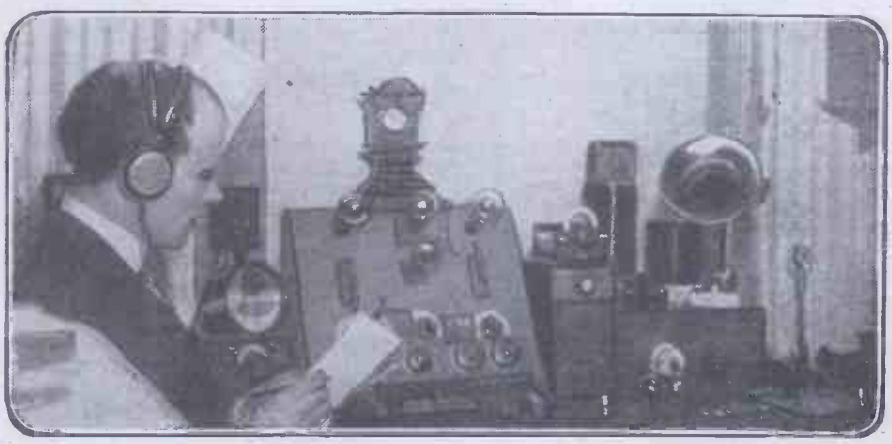
This fact is of course not so noticeable when the aerials are further apart, but aerials are cropping up in such close proximity that the danger of interference with reception from this cause is imminent. Each aerial seems to integrate the energy for some little distance round it, and the effect is certainly not limited to conditions as described above, although this is an extreme case.

Radio Eleventh Commandment.

At home I am using the standard Post Office twin-wire aerial and operate a loud speaker with a 2-valve set and occasionally a third note-magnifying valve is used. Next door but one another aerial has made its appearance, and although I have not paid a visit there I am certain that a crystal set has been installed, for since its appearance I received (unthankfully) on my loud speaker certain new and strange scratching, clicking and spluttering noises which are both new and nasty. These noises occur in spasms, two or three per session, due to the aforesaid crystal set being tickled up and readjusted.

What we really want is a new law, saying, "Thou shalt not readjust thy crystal contacts during the precious musical moments of 2 L O, neither shalt thou shove thy sliding contact violently along the turns of the inductance, lest horrible noises be produced in the ears of others and they become rampant."

The explanation is evident that in London the tuned aerial is energised by the carrier wave from 2 L O and re-radiation takes place. The aerial, in fact, acts as a very small power transmitter, and when the continuity of the circuit is interrupted or varied, noises are produced which seriously interfere with reception at adjacent stations. A limit range over which this effect is noticeable is now being investigated experimentally.



Mr. H. Cheesman's home constructed set, 11, Bushey Lane, Sutton

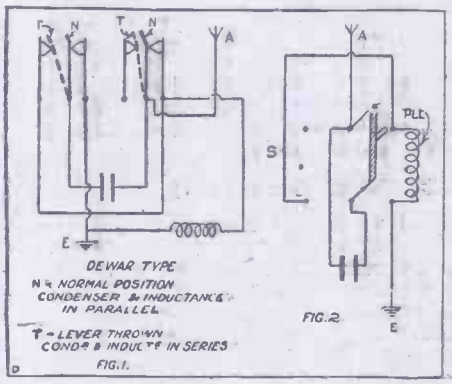
A FEW HINTS ON SWITCHING.

By ALBERT BULL.

LET us take the series-parallel arrangement as used in connection with the aerial tuning condenser and inductance. (See Fig. 1.)

A similar arrangement stands for the ordinary D.P. change-over switch. No explanation will be necessary *re* Fig. 2.

Whilst dealing with series-parallel arrangements, the following may interest the experimenter. We may save a few shillings



in arranging, say, grid leaks. (See Fig. 3.) It will be seen at a glance that two 2-megohm grid leaks joined in parallel equals 1 megohm, and when in series 4 megohms. The reverse applies to condensers. (See Fig. 4.)

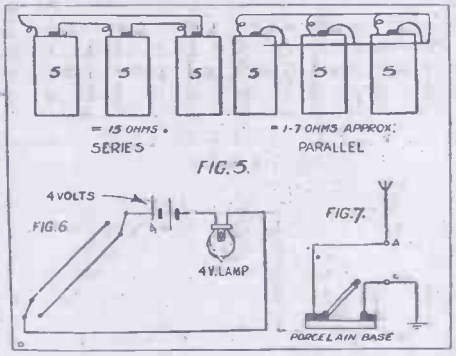
Cells in Parallel.

By a very simple application of Ohm's Law the amateur can utilise his primary cells so that the maximum current may be obtained; the reason why certain series-parallel arrangements are necessary is due to the internal resistance of the cells. This resistance definitely limits the amount of current. The same applies to the secondary cell or "accumulator," but in the latter the internal resistance is in the order of ·001 ohms.

We may very suitably apply the term "self-control" to the internal resistance of any cell or battery. Ohm's Law states the $C=\frac{E}{R}$, a "dry" cell of, say, 1·5 volts, with 4 ohms internal resistance or self-control, has a piece of thick wire connected to its terminals. This wire is of negligible resistance. At the most we can only get $\frac{1{\cdot}5}{4}=0{\cdot}38$ approx. amperes flowing, so that we see that the dry cell has a very appreciable amount of "self-control." But in the case of the secondary cell or accumulator of, say, 4 volts, the result is vastly different. Let us prove it. $\frac{4}{{\cdot}001}=4{,}000$ amperes, or a short circuit, as it is generally called. Of course, the current stated is far above that given from the ordinary 4-volt accumulator, which, as a rule, is of 20—100 ampere hour capacity; but "self-control" is nil.

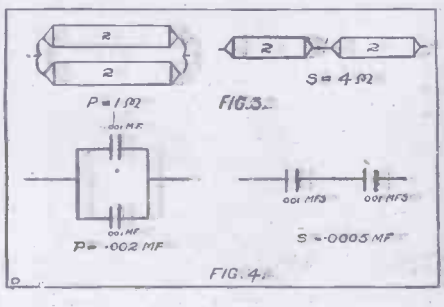
It will be clearly gathered from the above that in cases where comparatively heavy currents are required from primary cells it will be advantageous to join them up in parallel, so that we may reduce the internal resistance of the total battery in a similar manner to that applied to the grid leaks. (See Fig. 5.)

A most useful method of two point remote control up to the "laboratory," sometimes called the attic, may be adopted from the sketch shown in Fig. 6.



This combination enables one to switch "on" or "off" from top or bottom of staircase.

You can protect your aerial or apparatus when not in use by using a S.P.S.T. (single pole single throw) switch, as shown in Fig. 7.

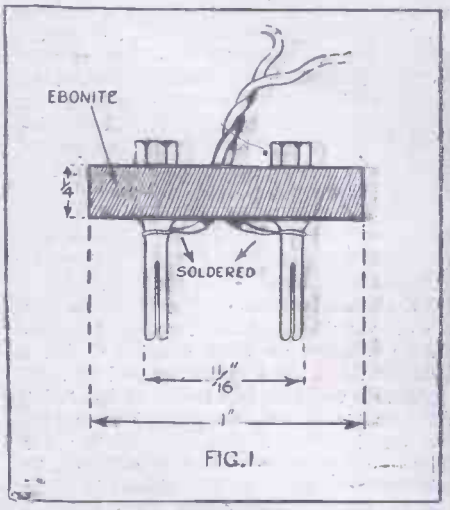


THE USE OF PLUGS.

By T. Mc.L. GALLOWAY.

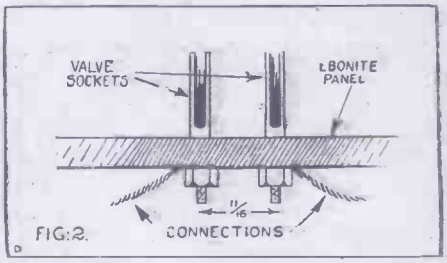
THE plugs and sockets which are about to be described are cheap (a two-pin plug and socket on ebonite costs about sixpence), easy to make, and have negligible self-capacity. They may be used to plug in and out H.F. or L.F. valves, for switching on filaments, for varying the high-tension voltage, for putting condensers in series or parallel, or out altogether, and for a thousand other purposes which the reader may think of.

The "plug" part consists of a small piece of ebonite, one inch in length and ¼ in. wide, with a thickness of ⅛ in. to ¼ in. Through this, two holes are bored $\frac{11}{16}$ in. apart, which is the approximate distance between the grid and plate legs of a valve, and of slightly larger diameter than the end of a valve pin. Next, two valve pins are placed through the holes, and the nuts screwed down. Connection may then be made by soldering "flex" to each pin.

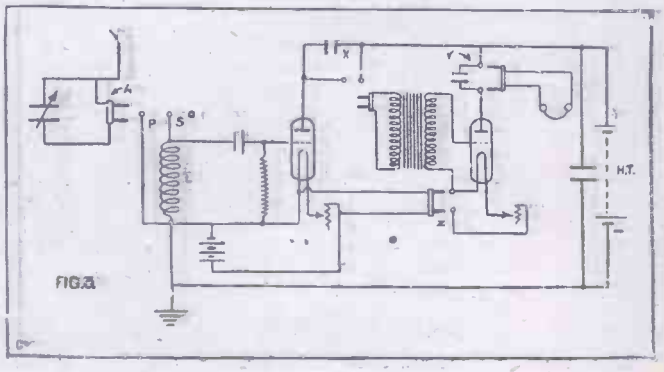


If a central hole be bored in the ebonite, the "flex" may be inserted, and the ends soldered to the pins on the opposite side of the ebonite from the nuts. The resulting plug will appear as in Fig. 1.

A suitable socket consists of two valve sockets mounted on the ebonite panel of the set on which the plugs are to be used at, of course, a distance of $\frac{11}{16}$ in. apart. A complete socket is shown in Fig. 2.



In Fig. 3 is shown the method of connecting in or out a low-frequency valve, with a means of having the valve completely out of use, also showing how to use the plug to put a condenser in series or parallel, or earth the aerial. Care should be taken that the plugs are not left hanging loosely about the apparatus, otherwise there is always a risk of "shorts" causing irreparable damage.



We are exhibiting at the IDEAL HOME EXHIBITION **Stand 38** Gallery NEW HALL

Broadcast Reception without Complications

The above illustrations depict the series of " COSMOS " RADIOPHONES as manufactured by the Metropolitan - Vickers Electrical Co., Ltd., of Trafford Park, Manchester. They have been specially designed for reception from the British broadcasting stations. The outstanding feature of these sets is simplicity, without sacrifice of efficiency; all unnecessary complications are avoided, and the sets are, therefore, eminently adapted for the non-technical user, and can be operated without difficulty by anyone without special knowledge or skill. All the sets, Valve as well as Crystal, are entirely self-contained, the only wires that have to be connected up by the user being the aerial and earth leads.

" COSMOS " RADIOPHONE Crystal Set	" COSMOS " RADIOPHONE 2-Valve Cabinet Set	" COSMOS " RADIOPHONE 4-Valve Cabinet Set *(not illus. above)*
£4 : 17 : 6	**£28 : 5 : 0**	**£41 : 15 : 0**
complete ready for use.	complete ready for use.	complete ready for use.

"Cosmos" Radiophones are obtainable from all Electrical Contractors, Retailers, Opticians, Stores, etc.

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BE SURE YOU GET A "COSMOS" SET

R 213

SOME WIRELESS OBSERVATIONS.

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

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

PART 3.—COMPARISON OF THE ABSOLUTE MAGNITUDES OF CAPACITY AND SELF-INDUCTION.

I PROPOSE here to interpolate, among calculated and practical considerations, a little theoretical point of some interest. For wireless workers and amateurs surely like to think occasionally of the ether whose properties they are utilising.

In electro-magnetic waves the electric energy and the magnetic energy are equal; or, in more general terms, in every wave, or system of waves, the kinetic and the potential energies are equal. This is obvious, because (at any given spot) the energy alternates from one form to the other. At one instant it is static; at the next it is kinetic. Hence the two energies must be equal.

So it is, also, with the discharge of a Leyden jar, or any other capacity area. At one instant it is charged electrically, and at the next (that is, after a quarter swing) it is momentarily discharged, and all the energy is contained in the rushing current. Then, once more, the energy piles itself up statically in the opposite direction, and then swings back again. So it is even in a swinging pendulum: the potential energy at the end of the swing is equal to the kinetic energy in the middle. So it is, also, in a vibrating spring.

Controllable Electrical "Inertia."

Consider, then, a spring with a load on it which you can set vibrating. At the extremity of the swing the energy can be called elastic energy, or the energy of recoil. It is static. It depends on the elasticity of the spring; it does not depend on the inertia of the load. It does not depend on inertia at all; it would be the same if the spring was bent an equal amount and not loaded.

But now let the spring go, and consider what happens as the load is rushing past the middle position. The whole energy is now the energy of movement. It depends wholly on inertia—that is, on the massiveness of the load—it does not depend on the elasticity of the spring at all. It would be just the same for the same moving load if the spring were instantaneously abolished.

This energy may be called inertia energy, or the energy of current or movement. The elastic and the inertia energies must be equal. The spring adapts itself to them. Its rate of vibration is thereby determined. If it is a very stiff spring with a small load, it will vibrate with extreme rapidity. It must, in order that the motion energy can equal the elastic energy. If, on the other hand, it is a weak spring heavily loaded, it will vibrate very slowly; because, since the energy is small, the motion of a massive body must be slow.

All this is very elementary and simple mechanics, but now apply it to the electrical analogy. Are we to regard a Hertz vibrator or a wireless sending station as represented by a stiff spring and a light load, or a feeble spring and a heavy load? Or, again, should we not rather try to arrange it so that the spring is moderately stiff and the load moderately massive, the one being adapted to the requirements of the other, and neither being overbalanced by the other?

Now, in the electrical case, the oscillating thing is a group of electrons. They are very highly charged, but they are certainly not massive. They possess a kind of inertia due to the magnetic field which surrounds them when they are in motion. But the magnetic field due to a moving charge is but feeble, unless the charge is great and the motion exceedingly fast.

Now, the electrons, though not massive, are highly charged, and they are presumably moving very quickly. Hence their current or magnetic energy is by no means negligible. But to bring it up to the required amount we must magnify it by coiling up the path of the electrons into a close spiral, so that all the magnetic fields reinforce each other and give a large, combined result. In that way, by the use of a sufficient coil, we may make the inertia what we please, and obtain the required amount of kinetic energy.

Now, what about the static energy? Here we must regard the ether as strained, probably sheared, so as to call out what is analogous to rigidity. And the ether's rigidity is excessively high. We know that, because of the rate at which light travels. Its elasticity, compared with its density, is accurately determined as equal to the square of the velocity of light; that is to say, the ratio of the two is excessively great.

A Margin of Variation.

A very small amount of distortion will account for a great amount of energy. But, to make room for all the electrons which are to take part in the discharge, an extensive area is required. If we use only a small area, we can hardly get any charge in it. It is like trying to bend a very stiff spring.

A tuning-fork, for instance, can be excited by a blow, or by a succession of timed impulses in synchronism with its natural period, which is practically what a violin bow does. Such a bow grips and releases a string or a spring in a synchronous, and therefore effective, manner. But a tuning-fork hardly yields to a steady pull. The amount a small force can thus bend the prong of a stiff fork is insignificant. To be able to bend it sufficiently the spring must be long, and the greater the rigidity of the material the longer it must be. That means that, to get an effective capacity area, it must be of large extent.

It must be the most visible and conspicuous item in a telegraph station. On the other hand, the coil responsible for the magnetic energy may be quite small; we might even say the smaller the better, within certain limits. The capacity area should be quite big; we might almost say the bigger the better, again within certain limits.

There is no doubt a best relation between the size of the capacity area and the size of the inductance coil, and this relation is determined by the fact that the electric and magnetic energies must be equal. A great margin of variation is permissible, just as is the case in musical instruments, which may vary from the stiffness of a tuning-fork to the laxness of the column of air in a flute, with all manner of strings and reeds as intermediaries.

The Practical Considerations.

So it is with a telegraph station. One person may be working with a small capacity and a big self-induction, while another one may be working with a great capacity and a small self-induction; and yet both may have the same period of vibration—and will have, if the product of capacity and inductance is the same for both. But there is sure to be a best relation between the two things which, however overridden in practice, it may be instructive to consider.

And it is specially instructive to realise that the great size of the aerial, as compared with the small size of the coil which is in circuit with it, is an immediate consequence of the relation which exists between the two properties of the ether, its elasticity and its density. One is incomparably bigger than the other. The ratio, in c.g.s. measure, is 10^{21}. Hence we may say that the ratio between the size of an aerial—which depends on the ether's elasticity—and the size of the little coil—which depends on the ether's density—is also of something like the order 10^{21}.

No; it can hardly be as big as that, even with the best possible arrangement. But it is legitimate to regard that as a sort of ideal, and to emphasise the importance of a big as well as of a high aerial, and of a small, compact coil.

The size of the aerial has to be fixed by practical and often financial considerations. The size of the coil is at our disposal, and must be determined by the rapidity of vibration—that is, the wave-length that we want. And it must be adjusted so as to give this wave-length when worked in combination with the given aerial.

That, then, is the problem before us. Given an aerial of definite capacity, and required a certain wave-length, whether for receiving or for emitting—but especially we will consider receiving—what sized coil shall we use, and what wire shall we wind it with?

THE GRAMOPHONE AS A LOUD SPEAKER.

By B. H. J. KYNASTON.

IF we examine the grooves in a gramophone record in which the needle rests, we will notice that they are not straight lines but that they are in the form of waves, so that when the record revolves, and the needle lies in these grooves, it has to vibrate from side to side in order to follow the wavy grooves. This is what reproduces the speech, music, etc., in a gramophone. If we examine a wireless telephone, we shall see that the reed or diaphragm, according to the type of phone being used, also vibrates when music, speech, signals, etc., are being received. If

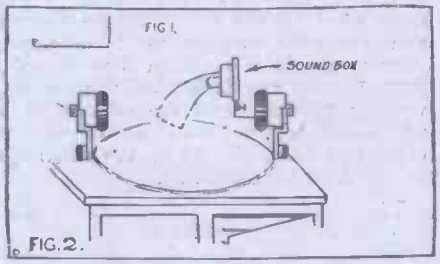


FIG. 2.

we can connect the telephones to the gramophone sound-box in such a manner that the vibrations of the diaphragm or reed cause vibrations of the gramophone needle in the same way or direction that the record goes, then the wireless signals will be reproduced by the gramophone.

The Adjustable Reed Type.

There are two types of wireless headphones in general use, the one being the adjustable reed type, and the other the ordinary flat diaphragm type. Methods of connecting the telephones to the gramophone sound-box are as follows.

The first method described is for the adjustable reed type of phone. If the ebonite cap of one of these phones is unscrewed a thin metal cone will be seen, in the centre of which is a small brass screw. This screw should be carefully removed. Next take a piece of stiff wire about two inches in length, and bend a very small loop in the end, just large enough to take the small screw. This piece of wire is now bent in the middle so that it is in the shape of a letter L (see Fig. 1), and the screw passed through the loop, and the whole screwed back into the centre of the cone. The two terminals on the earpiece not being used are now short-circuited with a piece of wire, so that the signals will pass through the one earpiece only.

The head bands should be opened out flat, so that the telephones will stand upright as shown in Fig. 2. The end portion of the wire L is now perpendicular, or, if not, it should be adjusted until it is. This piece of wire is placed in the sound-box in place of the gramophone needle and the screw tightened, and the instrument is then ready to receive signals.

Excellent Results.

The author used a bent pin with the head cut off for the wire L, and signals from a ship 50 miles away were readable 120 feet from the gramophone. The Eiffel Tower Station, 250 miles away, could be heard 80 feet away. The receiver consisted of two V24 valves, and the gramophone used was a small portable one. Some very slight adjustments in the position and angle of the sound-box and telephone are usually necessary before the best results can be obtained.

If the ordinary flat diaphragm type of head telephones are used, a separate instrument must be constructed. This instrument is contained in a small wooden box 9 inches long. The box and interior are shown in Fig. 3.

The distance between ordinary head telephones is about 8 to 8½ inches, so that on slipping the telephones over the box it will be found that they hold in place owing to the metal head band acting as a spring.

In Fig. 3 the centre rod A, which is perpendicular, is pivoted at B, and the two connecting rods C connect the two rods D. All these rods are made from wood, and hinged at the places marked E by means of pins passed through them, small glass beads being used as washers. A small hole is drilled through each rod D in the centre, and a thin piece of elastic passed through, as shown by the dotted line in Fig. 3. These pieces of elastic act as springs and tend to pull the rods D apart, and therefore move the centre rod A in a clockwise direction.

Flat Diaphragm Device.

This instrument should be so constructed that, when the centre rod A is perpendicular, the ends of the rods D project about ¼ inch through each end of the box. The top of the rod A projects about one inch through a slit in the top of the box. Before putting the headphones upon the box it is necessary to move the top of the rod A to the left, so that the ends of D become level with the ends of the box.

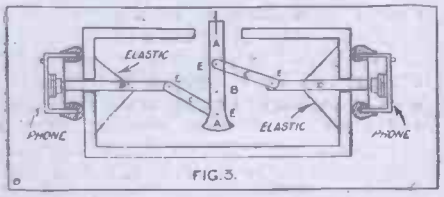


FIG. 3.

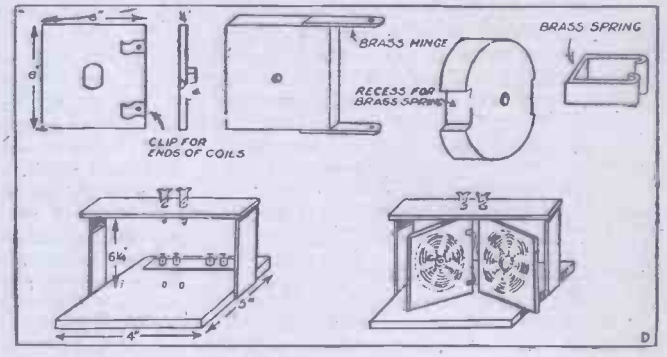
The telephones are now slipped on and the rod A released. The elastic springs will now pull D outwards until the ends of these rods rest lightly upon the telephone diaphragms. Now, when signals come through and the telephone diaphragms vibrate, these vibrations are transmitted to the top of the rod A and through D and C. If a wire nail about the same thickness as a gramophone needle is obtained, and the head cut off and the nail fixed firmly in the top of the rod A as shown in the diagram, this nail will vibrate with the incoming signals. This nail then takes the place of the gramophone needle, and is connected to the sound-box in the usual manner.

This type of instrument does not give quite such good results as the one first described, but the author has received signals over 60 feet from the gramophone on this type, using only two valves in the receiver.

A SIMPLE BASKET COIL HOLDER.

EXPERIMENTING with basket coils becomes a troublesome matter if it is necessary to keep making two pin plug portions to attach to each coil. The following holder will allow of all sorts of experiments without the necessity of making such plugs at all.

The coils are mounted on two ebonite



blocks on hinges so that they open and close book fashion. Only one need have the hinge, and the writer, although showing two holders, suggests that a fixed one between the two will be found useful.

These dimensions need not be strictly adhered to, but a 6-in. carrier will permit of pretty long range coils being tested; broadcasting coils would have ample room on a 4-in. carrier.

The Coil Clips.

The carrying portion consists of a piece of square ebonite in the centre of which should be fastened a piece of round ebonite the size of the former on which the coil has been wound. This core should have two grooves filed as shown, to take the spring that grips the centre of the coil. This latter should have a piece of thin cardboard tube shellacked to its centre. On the back two small copper or brass clips will have to be screwed to take the ends of the coils and also to take the flex-leads to the terminals. On the ends of the coils fasten a short piece of wire that will slip into the clips tightly. On the top and bottom supports two hinge portions are screwed for the ebonite to pivot on.

The baseboard to carry these holders is a very simple matter and the drawing shows all details.

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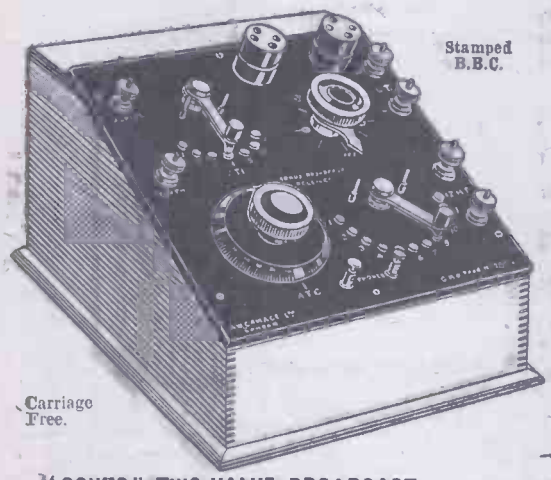

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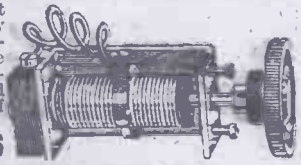
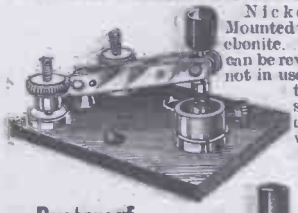


IMPROVED CRYSTAL DETECTOR



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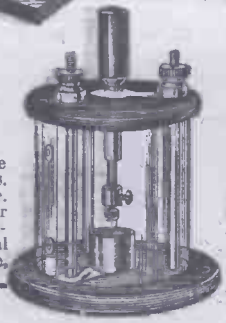

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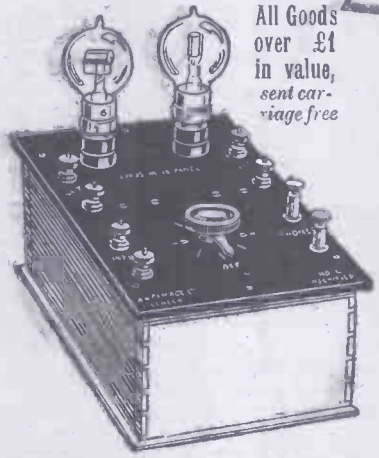

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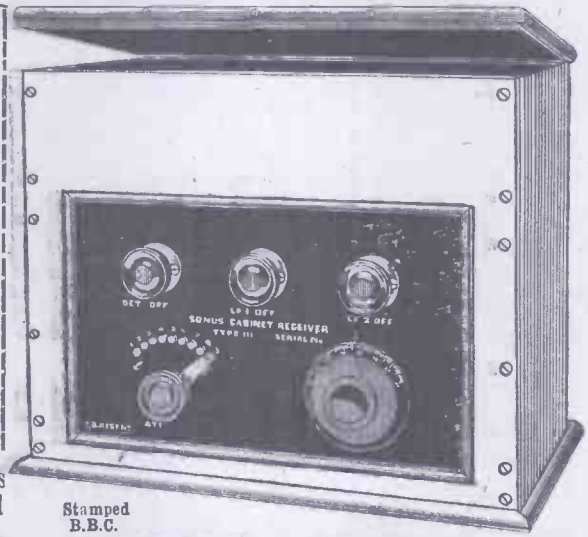

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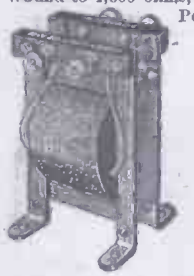

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BROADCASTING & THE THEATRES.

AN INTERVIEW WITH MISS PHYLLIS NEILSON-TERRY.
By "ARIEL."

I WAS fortunate enough last week to be able to introduce the delights of "listening-in"—by means of a six-valve Marconi portable receiver—to Miss Phyllis Neilson-Terry, the distinguished actress now appearing in Mr. Temple Thurston's play, "A Roof and Four Walls."

Miss Neilson-Terry was both astonished and delighted with the novel experience of hearing a first-class concert arranged by the B.B.C., and, as she aptly put it, "all within a roof and four walls!"

Miss NEILSON-TERRY.

I was anxious to hear Miss Neilson-Terry's views on what effect she considered broadcasting would have on theatres generally, and whether, as the number of "listeners-in" increases, material damage would be done to the box-office receipts. It appears that Miss Neilson-Terry's attention had been drawn to a pessimistic feeling expressed in theatreland that the enormous and ever-increasing interest in wireless existing in this country would eventually lead to the definite discomfort of theatres and other places of amusement.

Just the Difference.

"Frankly," said Miss Terry, "I do not agree. Without wishing in any way to belittle what is probably the most marvellous achievement of modern brains and science, I cannot think that even the magic fascination of 'listening-in' will alter the fundamental fact that humanity, gregarious by nature, will ever lose the desire to use the most precious of God-given senses. To capture to the full the rich glory of magnificent music, the true beauty of the spoken word, the average human being must thrill with the multitude of fellow-enthusiasts and *see* the accompanying scene enacted before his very eyes."

"Then you consider," I asked, "that wireless as a means of supplying an entertainment heard from the depths of an armchair, by a cosy fire and minus the fatiguing journey to and from the theatre, will not in any way diminish the popularity of the existing public amusements?"

The Real Thing.

"As a home entertainment, probably relegating the once-beloved gramophone into a very back seat, the wireless installation is a boon. But, after all, what human imagination could be miraculous enough to visualise a scene from, say, 'Tristan and Isolde,' with the aid of a pair of headphones, an armchair, and a cosy fire? The *wildest* of applause helps the illusion not a whit," said Miss Terry.

"But it is a glorious thing to realise that, during the past few months, tens of thousands of all classes have been privileged to hear Melba," she went on, "the majority for the first time in their lives, easily, inexpensively, and in comfort; and *yet* I seem to remember reading of enormous queues of Londoners willing to endure the chill and discomfort of an all-night wait in the open street in order to get a few hours of the 'real thing.'

Not Competitive Rivals.

"Nevertheless, the broadcasting system is an epoch-making innovation—to country people an incalculable blessing; to the bedridden and sightless, a godsend. There is room in this world for everything new, beneficial, and splendid, without the slightest fear of shaking the foundations of existing things; and so, with wireless, the mighty millions of London absorb it into their daily life, and carry on as usual.

"Aerials may rise from every roof and gable in the metropolis, but, in my opinion, the world of entertainment need scent no hated rival in the now ubiquitous wireless-set."

And then the call-boy was heard announcing that the curtain would shortly be going up, and so I had to put away my portable box of magic lamps and depart, more than interested in Miss Terry's views on Broadcasting v. The Theatres.

HOLES IN WOOD.

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

HOW very often has the sharp sound of cracking wood been accompanied by a noise somewhat more vocal but equally expressive; as one has driven a bradawl into the edge of the boxwork of the newly constructed set, to make a hole for the brass screw which was to hold on the ebonite top.

And yet a little forethought would have avoided the catastrophe. Fig. 1 shows a bradawl, and if its chisel point is driven into the wood in such a manner as to sever the fibres—that is, to cut across the grain and not along it—there is little danger of splitting the work.

The "Wedge" Principle.

Fig. 2.—A and B shows the wrong as well as the right way. If driven in as at B, the fibres are cut and telescoped up endways, thus compacting the wood into a better hold for the screw. If driven in as at A, the wedge-shaped point can hardly fail to have a splitting action as illustrated.

Londoners will often have seen the principle used by the roadmakers, driving in wedges to displace the granite "sets" in the street, and all country people will have seen wedges driven into a tree-log to split it up into smaller pieces. Yet we go thoughtlessly and merrily away, and do not apply the lesson of what we have seen, till the ruined piece of wood enforces consideration.

Another point is to use a bradawl a little smaller than the size of the screw, so as not to make too big a hole, and make the hole rather deeper than the screw is long, so

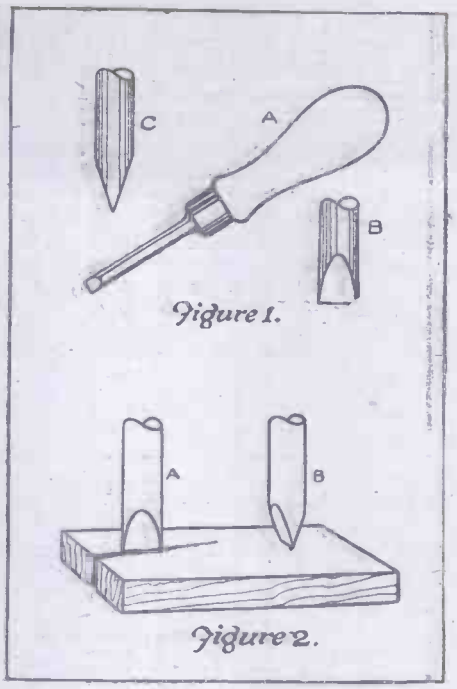


Figure 1.

Figure 2.

that the screw, if of brass, shall not jam in the bottom of the hole, and, in trying to drive it home, break off in the hole.

This latter accident is worse in a hard wood than it is in metal; for a metal screw broken in metal can generally be drilled out, but a metal screw broken off in wood is much more difficult to deal with.

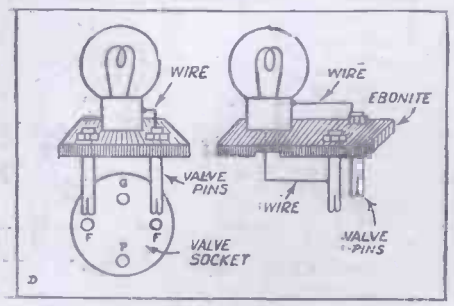
Better than Drills.

A small twist-drill might be used for making your holes, but it needs more care and skill than the bradawl, and the writer recommends the latter tool in preference, on account of the greater command that a grasped awl-handle gives, and the blunting and risk of breaking a small twist-drill used in a brace. It is also much more liable to wander from the exact spot where the hole is wanted.

A SAFETY DEVICE.

THE diagram illustrates a simple device for testing the filament connections of a valve set.

Two valve legs are screwed to a small base of ebonite to which also is attached a small



4 volt pocket-lamp globe. Thus when testing connections this small "gadget" can be plugged into the filament sockets, and the effect of varying the rheostats noted. It is better to risk burning out a cheap bulb than an expensive valve.

A "PIANO" TUNER FOR WIRELESS.

THE types of tuner used by most wireless amateurs either consist of large coils with sliders or tappings taken to studs, or else a set of honeycomb or slab coils.

These methods of making tuners do not give the best results. This can be easily proved by using a coil with tappings, and when signals are heard, cutting off the part of the coil not used. It will then be noticed that the signals increase greatly in strength. This is known as the "dead end" effect of the coil.

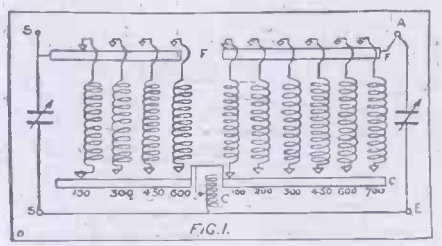


FIG. 1.

The second method of making a tuner, by using separate coils and tuning with a condenser, does not give the best results, although it gives better results than the coils with tappings or sliders do.

The reason these coils do not give the best results is because for certain wavelengths a large condenser capacity is necessary, and, as valves and crystals are potential operated devices, it is necessary to keep all capacities as small as possible.

General Principles.

The "piano" tuner was designed and brought into use by the Marconi Co., and is known as the tuner "Type 127." It is practically beyond the power of any amateur to make an exact copy of one of these instruments, so an instrument working on the same principles will be described.

This tuner contains two sets of keys—one for aerial tuning and one for secondary circuit tuning. Each key controls a coil, so that one or more coils can be used in parallel if desired. The final tuning is done by means of the two condensers. Fig. 1 shows how the coils are connected, the first coils being shown in circuit. In the instrument made by the author there were 10 coils, 6 for aerial tuning and 4 for secondary tuning. These coils were wound on wooden formers, and mounted on the back of the box, as shown in Fig. 2. The diameter of these coils was 2 inches, and the wire No. 30 d.c.c.; the number of turns used are shown in Fig. 1 in figures under each coil. The method of coupling, it will be noticed, is different from the usual method. The coupling coil C consists of a coil 2 inches in diameter, of 200 turns, with tappings off each 20 turns.

Constructing the Keyboard.

The two condensers used are rather large, having each a capacity of ·001 mfd. It will be found that 57 plates of standard dimensions are necessary in each condenser to obtain this capacity, 29 fixed plates and 28 moving.

The one condenser is placed directly between the aerial and earth terminal, and the other between the terminals marked secondary.

These secondary terminals go direct to the valves or crystal detector. The keyboard is the most difficult part to make; this is shown in Fig. 3. The keys are made from ½ inch square wood about 4 inches long. A hole is drilled through them at A, and a metal rod passed through them all. Three strips of $\frac{1}{32}$ inch brass are screwed to the bottom of the key, as shown in the diagram; these are marked C, D, and E.

The two ends of the coils come to C and D, and these make contact with the two strips of brass, F and G. These strips run the length of each keyboard, the two sets of keys being separated by a dummy key. Fig. 4 shows the key pressed, and it can be seen how the catch K holds the key down. When another key is pressed, the catch is pushed back by E, and thus releases the key previously held down. The bottom of the catch K is weighted so that it returns to its original position after being pushed back by E, and thus holds down the key, whilst the spring H forces any key that had been previously held down to return to its normal position.

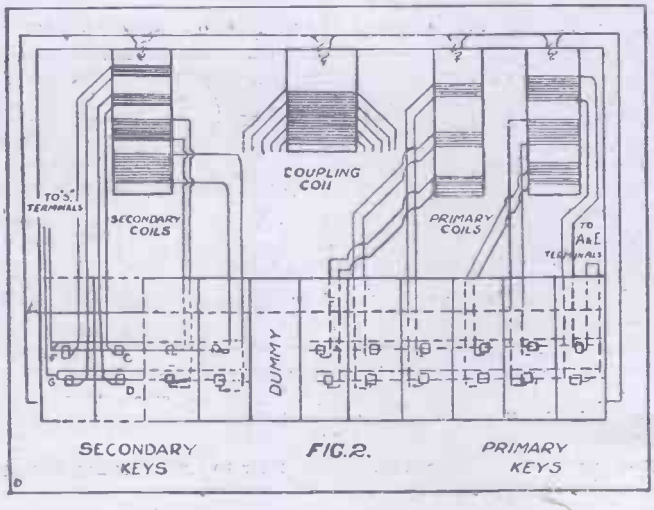


FIG. 2.

It will be noticed that two holes are drilled through the keys to allow the wire from the coils to be connected to C and D. F and G are connected to the aerial and earth terminals on the aerial side of the tuner, and to the two secondary terminals on the tuned side of the instrument.

When C and D are in contact with F and G the coil connected to C and D is actually connected to either the aerial and earth or the secondary terminals, depending, of course, on which set of keys are pressed. It will be noticed that when a coil is in circuit the condenser in that circuit is in parallel with the coil.

In the instrument made by the author, the keys are marked with the wave-lengths they cover, so that the instrument could be used by anyone, whether they had a knowledge of wireless or not. Using a hundred-foot single-wire aerial, and condensers of ·001 mfd., the range of the tuner made was from 200 to 20,000 metres. The keys were worked as follows: Commencing from the left of the instrument

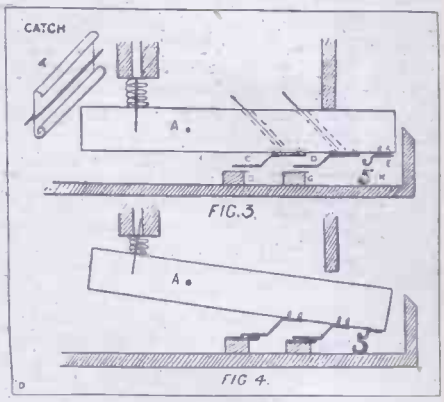


FIG. 3.

FIG 4.

—this is the tuned circuit—the first key gave 200 to 2,500 metres, the second 2,200 to 6,500, the third 5,500 to 12,000 metres, and the fourth 11,000 to 20,000 metres. The fifth key is a dummy key, and only used to separate the two sides of the tuner.

The sixth key is the first key on the aerial side of the tuner, and has a range from 200 to 2,000 metres. The range of the seventh key is 1,800 to 4,000 metres, the eighth 3,500 to 9,000 metres, the ninth key gives from about 8,500 to 13,000, the tenth from 12,000 to 16,000, and the last from 15,000 to 20,000. This range of wavelengths was obtained using the number of turns given in Fig. 1 in the coils.

How to Apply Reaction.

The range of the aerial circuit will probably vary slightly with different aerials. The condensers, keys, and coils were all enclosed in a box or cabinet, so that when the instrument was finished it appeared as shown in Fig. 5. The centre knob on the front of the instrument controls the coupling coil, and the other two knobs are the aerial and secondary condensers. The two terminals on the right-hand side are the aerial and earth terminals, while the two on the left are the secondary terminals to which the valve or crystal are connected.

For C.W. reception, when using this tuner it is necessary to either use a separate

(*Continued on page* 111.)

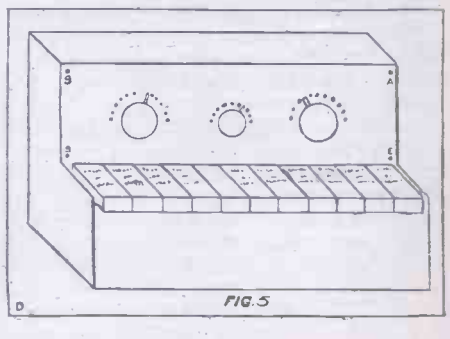
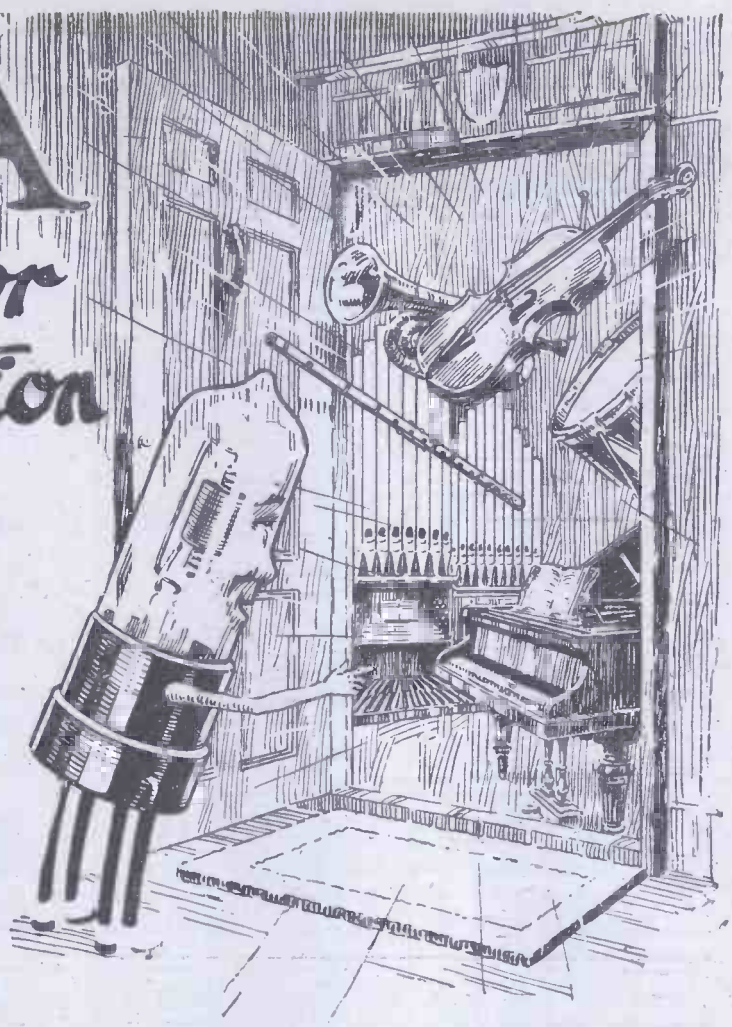


FIG. 5

ORA

The Valve for perfect reception



A CONVINCING STATEMENT.

The International Meteorological Expedition operating in North West Perth, W. Australia, and using a portable wireless equipment, consisting of a 3-valve receiver with small portable aerial, received quite easily the time signals from all the high power stations in the world.

They reported very satisfactory results despite the fact that conditions were very unfavourable indeed.

Needless to say, Mullard "ORA" valves were used.

The admirable manner in which these valves sustained several trans-shipments, submersion in water during landing, and severe rough handling generally, is the subject of a very interesting letter sent to us recently by Mr. John Wishaw of Mount Lawley, Western Australia.

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.

Standard Price 15/- each.

THE MULLARD "R" VALVE is now Reduced in price from 22s. 6d., to **17**s. 6d.

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WAVE-LENGTH AND INTERFERENCE.

By B. R. CUMMINGS (Radio Engineer, General Electric Co.)

IN the adjustment of radio receivers, we know that we can "tune-in" different stations which are transmitting on different wave-lengths by an adjustment of the control or controls provided in the receiver for this purpose. We know that, even though a number of stations are transmitting simultaneously, if their wave-lengths are sufficiently different we can tune one station out and another in.

In order that the term "wave-length" may have somewhat more meaning than that of an arbitrary term, it may be explained that the energy which actuates a radio receiver, and which is transmitted through space from the transmitting station, is transmitted in a series of pulses. These pulses are so frequent that they cannot be individually detected by the ear, and they generate an electric current in the receiving antenna, their nature being such that each pulse generates a current in the opposite direction from that generated by the preceding pulse.

If we can mentally picture these pulses in space at a given instant, between the transmitting and the receiving station, the distance in metres between one pulse and the second pulse ahead of or behind it is known as the wave-length of the transmitted signal. The majority of broadcasting stations are operating on wave-lengths between 350 and 450 metres, which is very nearly one quarter of a mile. For long distance commercial radio work, the wave-length is frequently as long as 20,000 metres or approximately 12½ miles. The speed of transmission is so great, however, that, even at this wave-length, approximately 30,000 pulses are picked up at the receiving station each second.

Simple Explanation of Tuning.

For an analogy of what takes place in a radio receiver when it is tuned to a particular wave-length, let us picture a swing suspended from a branch of a tree, say, and that two people, one at each end of the swing's travel, are alternately pushing the swing and keeping it in motion. Their pushes are timed to the natural period of the swing, so that each push is delivered at a time when it will add to the motion of the swing.

In this case, the energy given to the swing by the two people alternately pushing it is analogous to the energy put into the radio receiver by an incoming signal, and the motion of the swing is analogous to the current flowing in the receiver, flowing first in one direction and then in the other. If, however, the people pushing the swing do not time their push so that it coincides with the natural period of the swing, the amplitude of the swing will decrease more and more as the pushes become more and more out of step.

We know that the shorter the length of the swing, the quicker it will swing back and forth, and that as it is made longer, the time required for it to travel back and forth is increased. In the case of a radio signal we have no control at the receiving station over the frequency of the pushes or pulses of energy, the frequency being established at the transmitting station; but we must tune our receiver so that the flow of current in the receiver will be a maximum. When we tune the receiver, it is analogous to shortening or lengthening the swing so that it will have a natural period which will coincide with the frequency of the pulses transferred to it, under which conditions the travel of the swing and likewise the current in the radio receiver will be at a maximum. Since all radio signals, regardless of their wave-length, travel through space at the same speed, the shorter the wave-length the greater will be the number of pulses received per second.

The fact that a great number of transmitting stations can transmit simultaneously on different wave-lengths, and that any one of these stations can be received without interference from the others, providing the wave-lengths are sufficiently separated, is one of the most interesting phenomena encountered in radio. The signals from all of these stations exist in space simultaneously, but none of them is effected by the others, each communication retaining its individual characteristics.

Congestion in the Ether.

Although very incomplete, a simple analogy to this condition can be made by dropping two stones simultaneously in a still body of water, at a separation of several feet. Waves in concentric circles will emanate from both points at which the stones enter the water. These waves will increase in diameter, and the waves set up by one stone will cross those set up by the other, but after they have crossed they will emerge intact, and neither one will be distorted or changed in form by having come in contact with the other.

In the foregoing it has been carefully stated that stations can be received without interference from other stations, "providing there is a sufficient difference in wave-length between the station received and other stations."

A study of this condition has recently been made, and in one town, which is typical of a great number of the small towns in the eastern part of the United States, a total of thirty-nine broadcasting stations were picked up, in one evening, all operating on wave-lengths between 350 and 400 metres. In many cases, two stations were found to be working on exactly the same wave length, so that, even with the most refined receiving equipment, it was not possible to differentiate between them.

An Unavoidable Evil.

Super-imposed upon this condition is interference caused by static disturbances, and by receiving equipment in the hands of people not cautious in its manipulation. It should be remembered that, whenever a vacuum-tube receiver is allowed to oscillate, it itself becomes a low-power radio transmitter, and causes interference with reception being carried on in the immediate vicinity. In receiving telephone signals, it is not necessary to have the receiver oscillate at any time, and any operator who carelessly permits his receiver to oscillate is increasing the difficulty of obtaining satisfactory broadcasting reception.

The elimination of static interference is, at the present stage of radio development, beyond the hope of the average receiving station, and must, therefore, be accepted as an unavoidable evil. More refined receiving equipment can be built which will increase considerably the selectivity of radio receiving equipment, but such equipment is comparatively expensive, and requires more technique in its operation than the receiving equipment now being built for radio broadcasting reception.

This condition will doubtless be remedied in the near future, and any apparent delay in accomplishing such improvement is merely an indication of the difficulties which are being met in making it.

A "PIANO" TUNER FOR WIRELESS.

(*Continued from page* 108.)

oscillator or to employ capacity reaction between the valves if an amplifier is used, although a separate oscillator will usually be found to give much better results. It is necessary to use these methods for C.W. reception because reaction cannot be obtained without altering the tuner, and if this is done so that the tune slide coils act as a reaction coil, it will be found that when the circuits are oscillating the set will be radiating a certain amount of energy into the ether, which may cause interference with other stations, trying to receive on that wave-length, which are somewhere in the vicinity.

"Tuning" the "Piano."

When the instrument is finished it is only necessary to press the two keys marked for the wave-length required and to vary the condensers until signals are heard. The catch K, which is shown in Fig. 3, can be made from tin, the one end rolled up to act as a weight. One catch sufficiently long to reach from end to end of the keyboard is all that is necessary, but two can be made instead if desired, so that there is one for each set of keys.

If only one catch is made, it will be necessary to press the aerial side and tune side keys together, otherwise the first key pressed will be released on pressing down the second. This will not happen, however, if two catches are made, as each catch then controls the keys for its respective side, viz., aerial or tune circuit.

A steel wire, such as a steel knitting-needle, is soldered to the centre of the catch, as shown in Fig. 3. This forms a hinge for the catch. Care must be taken to make the bottom portion of the catch considerably heavier than the top, so that it will always hang perpendicularly, as shown in the diagrams.

A TELEPHONE PANEL.

By W. G. RICKETT.

I NOTE with great interest Mr. F. B. Lidstone's letter published in the current issue of POPULAR WIRELESS, and would like to add that I have for some time used with great success a telephone panel as per enclosed diagrams. I also find that I can successfully take it to any part of the house, and, in addition, the signals received in this way have often proved stronger than when the telephones were placed directly on to the set. Its advantages are at once obvious. Besides being of service for taking the phones to a room other than that in which

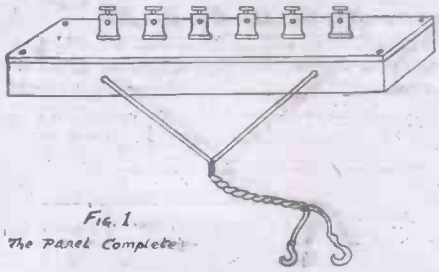


Fig. 1. The Panel Complete.

the set is working, I find that it is a great convenience in the same room, insomuch that three listeners-in can sit in any position they choose, instead of being "chained" to the set.

Connected in Series.

Fig. 1 on the enclosed diagram shows the panel complete for use. The twisted flex (which is shown very short for the sake of illustration) is connected to the phone terminals of the set by two brass lugs as shown, these being soldered on to the flex to secure a good joint.

Fig. 2 shows the ebonite panel drilled ready for the mounting of terminals, and it is secured to the wooden base by a brass screw at each corner. For three pairs of 'phones I find that a convenient size of this panel is 6-in. by 2-in. by ¼-in.

Fig. 3 shows the under-side of the panel, the terminals being connected in series.

Fig. 4 shows the wooden base, 6-in. by 2-in. by 1-in. This should be of fairly heavy wood, to ensure it standing firmly. The middle portion is cut away as shown to provide a clearance for the terminals also; two holes are drilled through the side as represented by the dotted lines, through which the flex passes to connect with the two end terminals. The outside of the wood is afterwards stained black, and the whole assembled.

Fig. 2. Ebonite Panel as drilled.

Fig. 3. Underside of Panel Showing Connection in Series.

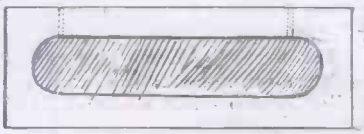


Fig. 4. Wooden Base (Shaded portion cut away). Dotted lines show passage of flex through wood.

HOW TO MAKE A GRID LEAK AND CONDENSER.

THE amateur who has a valve set may greatly improve it, and at the same time amuse himself, by making up a grid leak and condenser. It is a very simple matter and not at all beyond the ordinary amateur. The following can be made out of a few odds and ends.

All that is required is a few bits of tin or copper foil, ditto mica, and a couple of pieces of ebonite. The ebonite should be 2 ins. square. Clamp them together in the centre, one and a half inches apart, as in Fig. 1.

The ebonite will be ¼ in. thick and the top 3-16 in. Next drill with a larger drill a recess that will allow the head of the ⅛ in. bolts to go in flush.

The next process will be cutting the plates of the foil. Fig. 2 shows all sizes and does not need further explaining. The same applies to the mica.

Shellac the mica and stick a foil to each of the 4 in. pieces of mica; then place the first plate on the ebonite base so that the lug will lay over the ⅛ in. hole. The next plate goes on top, but the lug in this case goes *over the other hole*. The following plate has its lug over the first one, and the last over No. 2.

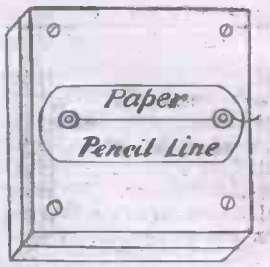
Ready for Use.

A little shellac will help to keep them from slipping. Lay a piece of mica on the last plate and then screw on the top plate.

Next, push the ⅛ in. bolts right through the foil and the bolt will make contact as it goes through. Before putting on the nuts get a piece of soft paper and make two holes one and a half inches apart and place it over the bolts. Two small washers will be required to drop on first, but before doing so, scrape some lead from a soft black lead pencil, and rub it well round the bolts so that the washers will make good contact with it.

After this the nuts may be screwed down tightly. Another extra nut will be wanted on each bolt to act as terminals.

Wax the heads of the bolts in the bottom plate and the instrument is now ready. All that has to be done is to



connect it up to your set, and with a soft pencil draw a line between the terminals.

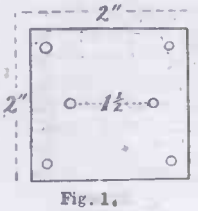


Fig. 1.

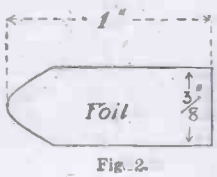


Fig. 2.

THOSE TWO VOLTS.

THE ordinary or normal thermionic valve requires, in order to light up its filament to the proper state of incandescence to emit a copious stream of electrons, a current of about ·75 of an ampere.

Now it does not matter where that ampere comes from, or what its quality. If it has to be slowed down to turgidity through the resistance of the filament rheostat, or flows pure and free from the bright terminals of a new celluloid-cased, four-volt accumulator. An ampere is an ampere for all that.

Now, one amateur constructor of apparatus will have in his home-made set short, thick, straight-run wiring for his low-tension current circuit, and will find that he can apply from his four-volt battery sufficient voltage at the terminals of his valves to ensure that they get the necessary ·75 of an ampere right up to the time that his battery voltage drops to 2·9 per cell, below which figure it should never be allowed to go.

A Comfortable Reserve.

Another experimenter, with a wealth of fine, rubber-covered or systoflex-tubed wires festooning the inside of his set, positively must have six volts or his valves refuse to glow any brighter than the end of a blown-out match.

We need not now explain why, but any battery delivering current loses some of its terminal voltage in proportion to the current taken from the battery.

If the battery is a new one, or in good working condition, and has large plates, it will have a smaller fall of voltage at its terminals while delivering any current than will an old, badly used, or smaller-plated battery. This will probably account, in the great majority of cases, for much which at first would seem obscure. A good big four-volt battery ought, with skilful use, to be ample for the filaments; but it is extremely useful to have a "bit up one's sleeve." To have to increase from four to six volts, or a fifty per cent. increase, seems wasteful.

A five-volt accumulator would be ideal, but the ordinary lead plate battery advances by two volts for each added unit, and as five is not a "gozinter" for two, most people go for six volts, and waste the surplus in heating up the rheostats or overrunning the filaments of their valves.

Reg. Design No. 594025.

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"By far the neatest, simplest and best I have yet seen at the price . . . ."

"Have had perfect results and must congratulate you also on its handsome and artistic design."

"Am delighted with the clearness and volume of tone with which we hear concerts, speeches, etc."

"DESKOPHONE" users are welcome to our expert advice and assistance free of charge. This ensures the best results and will avoid the disappointments that come to so many amateurs through insufficient experience.

The DESKOPHONE which is built by us to our own registered design, is manufactured under Marconi patents, is authorised by the British Broadcasting Co., and has been tested and passed by the P.M.G.

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POPULAR WIRELESS EXHIBITION REVIEW.

A further summary of the wireless exhibits at the Ideal Home Exhibition, Olympia.

WATES BROTHERS.

Beginners who are taking up wireless will find many interesting and useful articles displayed by Messrs. Wates Brothers.

One of this firm's specialities is an accumulator constructed for wireless purposes, and designed to give about 25 hours of actual lighting on one valve. It is sold in two sizes, a 4-volt and a 6-volt, complete with a wooden case. The cells are claimed to be practically immune from sulphating, the great bugbear of all who use accumulators.

Several types of crystal and valve sets are also on view, and a large number of accessories, for all kinds of wireless sets.

A neat high-tension battery case is being introduced, which will hold a 60-volt battery, with a Wanda plug on the lid whereby the potential across the valves may be varied at will. The whole outfit forms a very compact and neat accessory, and vastly improves the usual untidy appearance due to H.T. batteries and their connections.

* * *

J. A. COOMES & CO., LTD.

Exhibits at Stand 25 include a complete range of our famous Ionophone Variometer Tuned Broadcasting Sets.

Five-valve set, consisting of 2 H.F. valves, 1 detector, 2 L.F. valves.

Three-valve set, consisting of 1 H.F., 1 detector, 1 L.F.

Two-valve set, consisting of 1 H.F. and 1 detector.

(All above sets have a wave-length range from 300—3,000 metres.)

Two-valve Amplifier for either two or three-valve sets.

Valve and Crystal Set.

Crystal Set.

Loud-speaker Adaptor, consisting of ebonite horn with phone attachment.

A.C. Battery Charger. A new device enabling small batteries to be charged direct from A.C. mains of ordinary voltages and any frequency up to currents of 2 amps., especially suited for L.T. wireless batteries.

* * *

MARCONI'S WIRELESS TELEGRAPH COMPANY, LIMITED.

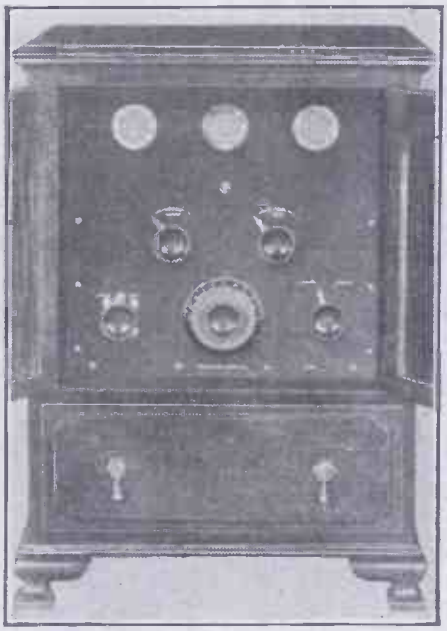
This company is showing a full range of Marconiphone wireless receiving models and loud-speaking equipment at Stand No. 37, Gallery (New Hall).

The special details are as follows:

Marconiphone Valve-Crystal.—A unique model. A new and improved receiver employing a crystal detector and a special low current valve as amplifier. This combination gives an increase in range to at least 50 miles, without sacrificing any of the clearness of speech and simplicity of the crystal models.

Marconiphone V.2.—A new and improved type of this popular receiver which incorporates special features, increasing its range up to 100 miles and over.

Marconiphone Multivalve. Type R.B. 7.—A long-range receiver designed primarily



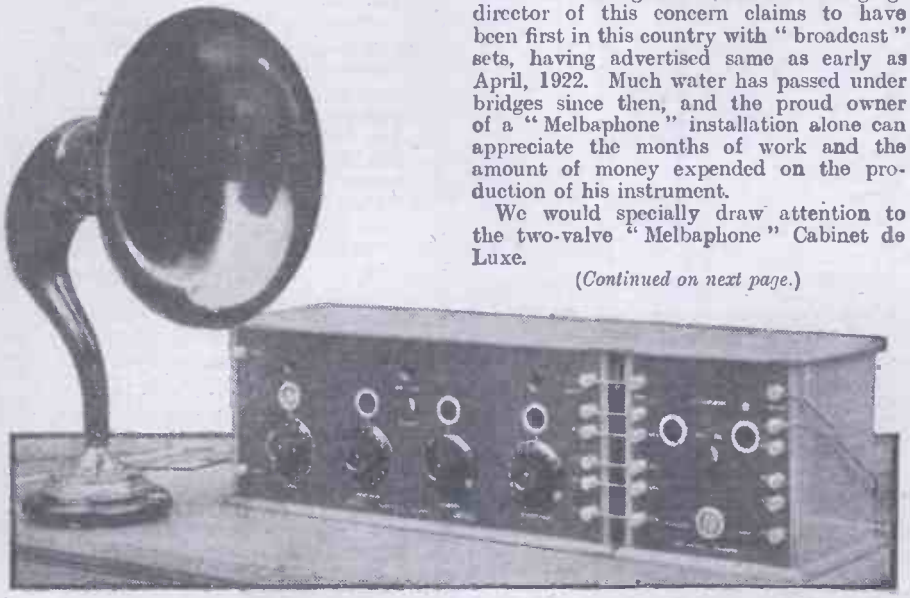
Three-valve cabinet set, by Gambrell Bros.

for use with an outside aerial. Range 200 miles and upwards.

Also suitable for use with frame aerial. Approximate range 40 miles.

Marconiphone Multivalve. Type R.B. 8.—Specially designed for use with frame aerial. Used with Marconiphone table aerial, gives ideal combination for short-range reception. Approximate range 40 miles.

Marconiphone Voice Amplifier (2 Stage).—Expressly designed for use in moderate sized rooms, entire elimination of distortion having been the chief aim rather than production of great volume of sound. An amplifier unrivalled for purity of tone and clearness of reproduction.



Complete receiver and loud speaker set, by the Automatic Telephone Manufacturing Co., Ltd.

Cabinet Models.—Self-contained models fitted with the Multivalve types and incorporating all batteries, amplifiers, etc., both with and without Amplion loud speaker.

* * *

THE WIRELESS PRESS, LTD.

A complete range of over seventy books on Wireless Telegraphy and Telephony will be open to the inspection of all visitors to our Stand, No. 7. For the beginner desirous of making his own apparatus, for the experimenter who wants a reliable guide, for those anxious to study the subject thoroughly from a theoretical standpoint—in fact, for all interested in wireless, elementary or advanced—we have just the books required. For ten years we have been publishing wireless literature, and have no hesitation in stating that any book bearing the name of the Wireless Press, Ltd.—the pioneer house for wireless publications—can be relied upon.

* * *

AERADIO, LTD.

The name of this firm, although now well known to the trade, is perhaps new to the public, but their trade-mark, "Melbaphones," strikes a familiar chord.

An interesting selection of "Melbaphones" is shown, ranging from one-valve receivers to three-valve power amplifiers. In each case the manufacturers have avoided "freak circuits" when designing, and have constructed their instruments upon conventional, thoroughly tested and proved lines. It is claimed, however, that "Melbaphones"

"Are as good as the best
And better than the rest,"

and for the reason that the manufacturers have adopted the policy of using only the best materials, expert labour, and simplicity in design of control, together with a first-class finish.

It is interesting to note that the managing-director of this concern claims to have been first in this country with "broadcast" sets, having advertised same as early as April, 1922. Much water has passed under bridges since then, and the proud owner of a "Melbaphone" installation alone can appreciate the months of work and the amount of money expended on the production of his instrument.

We would specially draw attention to the two-valve "Melbaphone" Cabinet de Luxe.

(*Continued on next page.*)

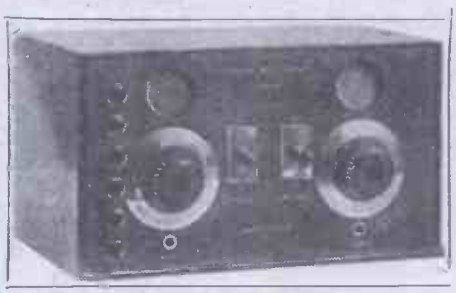
POPULAR WIRELESS EXHIBITION REVIEW.

(*Continued from previous page.*)

This cabinet is completely self-contained, with 6-volt 40-amp. accumulator, 60-volt H.T. battery, valves, and two pairs of headphones, and is dispatched complete with aerial equipment. The price is only £20.

To the best of our knowledge, it is the only completely self-contained two-valve cabinet on the market.

Other valve panels are on sale from £5 10s. The excellent "Melbaphone" one, two, and three-valve amplifiers (note magnifiers) must not be missed.



General Radio Company's Two-Valve Set.

AUTOMATIC TELEPHONE MANUFACTURING COMPANY, LIMITED.

At this stand will be found the joint exhibit of Messrs. Automatic Telephone Manufacturing Co., Ltd., Milton Road, Edge Lane, Liverpool, and their sole distributing agents, Messrs. Ashley Wireless Telephone Co., Ltd., 69, Renshaw Street, Liverpool.

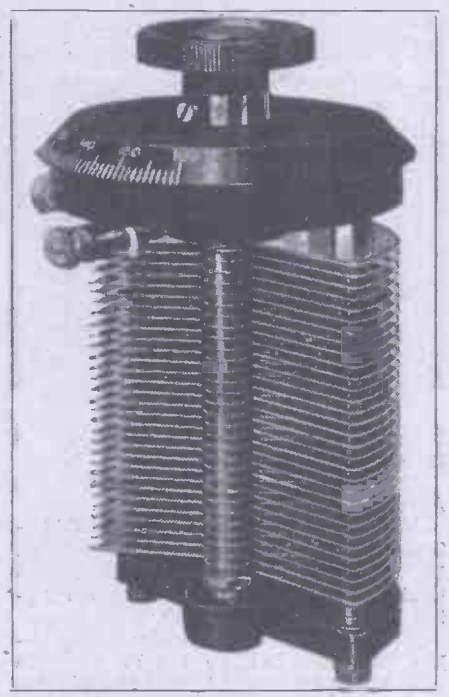
Outstanding features of the exhibit are the Ashley 2 and 3 Valve Receiving Sets and the Ashley 2-Stage Low-Frequency Amplifier, together with combinations of the two first-named sets with the Ashley 2-Stage Amplifier, representing 4 and 5 valve installations respectively.

The "Graham" Electravox.

These Ashley Valve Receiving Sets are designed for reception on unlimited wavelengths up to 3,000 metres. They embody approved adjustable reaction, and are furnished complete with sets of interchangeable aerial tuning coils and H.F. Transformers to vary the wave-length in conformity with the station it is desired to pick up.

There is also exhibited an Ashley 3-Valve Broadcast Receiving Set of special interest.

In crystal sets, the Automatic Telephone Manufacturing Co. are showing their well-tried popular model which has established an enviable record of receiving clearly at 32 miles radius from the broadcasting centres. It is equipped with specially selected Perikon detector, tuning inductance, with single slider and fixed condenser.



Dubilier "Vanicon" Condenser for Panel Mounting.

Each set includes A.T.M. 2,000-ohm long-distance radio headphones.

An outstanding exhibit at this stand is the now famous A.T.M. "Claritone" Loud Speaker, literally "the best-spoken fellow in the radio world." Moreover, experts are agreed, and the manufacturers hold testimonials confirming this view, that the A.T.M. "Claritone" Loud Speaker is the best yet placed on the market for clearness, combined with volume and musical tone.

The Automatic Telephone Manufacturing Co. also make an effective display of their well-known Long Distance Radio Headphones, which are of light weight, comfortable in prolonged wear, have a high effective impedance, and are generally recognised as among the most efficient headphones now being offered.

(*Conclusion of Exhibition Review.*)

THE EXHIBITION.

Don't fail to visit Olympia and see for yourself the attractive Wireless Exhibits in the Wireless Section.

A CRITIQUE OF THE WIRELESS SECTION.

By the TECHNICAL STAFF of POPULAR WIRELESS.

Peto & Radford, Ltd., are exhibiting a large assortment of accumulators specially constructed for wireless purposes. A point worth noticing with regard to these accumulators is that they are all marked with the actual capacity instead of the more usual ignition capacity. This feature will appeal to the wireless amateur, as the ignition rating of batteries has been a stumbling block to a great many beginners in wireless. Among the many accumulators is shown a type embodying a hydrometer in the battery itself. Each cell contains three "gravity floats" coloured white, blue, and red. These floats are calibrated to sink as the gravity of the acid falls. At 50 per cent. discharge the white one sinks, at 75 per cent. the blue follows suit, and at 95 per cent. discharge the red one sinks. At this point the cell is not quite empty, but another hour or two will see the end of that charge. Thus the amateur can see at a glance how much longer his "juice" will last, and need never be let down by a run-down accumulator.

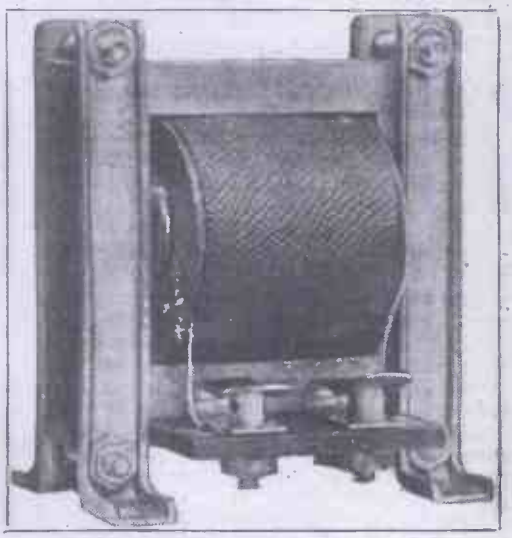
An Interesting Exhibit.

The Sterling Telephone and Electric Co., Ltd., has a goodly array of valve unit panels and power amplifiers. The unit sets are very neatly encased in black metal, and are so arranged that the separate panels can be plugged together instead of being strapped in the usual way.

A combined valve and crystal set is also manufactured by this company, and is said to give dual amplification so that the one valve plays the part of H.F. and L.F. amplifier. The range for broadcasting is about 150 miles. Dull Emitter valves are used, so that an accumulator is not needed.

The most remarkable exhibit on the stall of Abbey Industries, Ltd., is a tiny crystal set which will easily go on the palm of your hand; in fact, two or more would find room there.

(*To be continued next week.*)



Inter-Valve Transformer, by the Igranic Electric Co.

RELIANCE ONE VALVE SETS
RELIANCE TWO VALVE SETS
RELIANCE THREE VALVE SETS

HERE'S YOUR OPPORTUNITY

FOR A LIMITED PERIOD ONLY WE ARE PREPARED TO SUPPLY DIRECT OUR CELEBRATED RELIANCE BROADCAST RECEIVERS AT

VIRTUALLY HALF STANDARD PRICES.

Our only stipulation being that we reserve the right of delivery, which must be strictly in rotation. It is only feasible that many would-be "listeners-in" will take advantage of this unique offer to obtain a First Class Wireless Receiver, and we have therefore made arrangements for dealing with orders first received by return.

RELIANCE ONE VALVE

Mahogany Upright Slope Cabinet panel, 9 in. x 6 in. Variometer Tuning covering Broadcast wave-lengths. Equipment: 1 pr. H.R. Headphones, 4 V. 40 Accum., 36 V. Battery, Ediswan Valve, 100 ft. Aerial Wire.

Price: £6 6 0
Standard Price: £10 10 0
Plus Taxes, £1 12 6

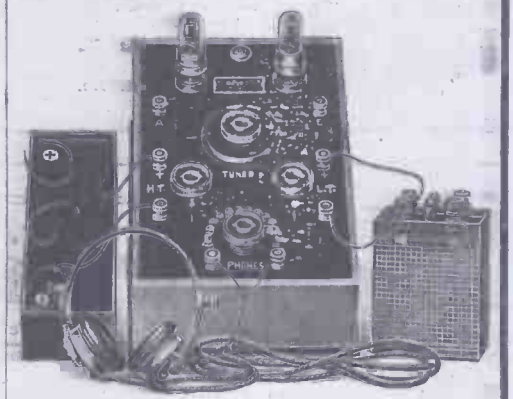
One-Valve Note Magnifier, in Cabinet to attach to One-Valve Reliance.

Price (includes Valve): **£4 5 0**

Two-Valve Amplifier.

Price (includes Valves): **£7 15 0**

RELIANCE TWO VALVE



Mahogany polished Cabinet, 12 in. x 8 in., 1 Detector, 1 L.F. Valve, Studs Switch Inductance, Tuning Condenser, etc. Equipment: 1 pr. H.R. Headphones, 4 V. 40 Accum., 36 V. H.T. Battery, Ediswan Valves, 100 ft. Aerial Wire.

Price: £8 8 0 Standard Price £15 0 0
Plus Taxes, £3 0 0

RELIANCE THREE VALVE

Superior Upright Mahogany Slope Cabinet, panel 14 in. x 12 in. 1 H.F., 1 Detector, 1 L.F. Valves, Separate Controls. Stud Switch Inductance with additional holder for Loading Coils to obtain all wave-lengths.

Equipment: 1 pr. H.R. Headphones, 6 V. 60 amp. Accumulator, 63 V. H.T. Battery, Set of Loading Coils, 3 H.F. Transformers, Ediswan Valves, 100 ft. Aerial Wire.

Price: £12 10 0
Standard Price: £22 10 0
Plus Taxes, £4 2 6

TERMS

Nett Cash with Order. Delivery Free London Radius Packages & Packing, 2s. 6d.

A FEW TESTIMONIALS

Birmingham.
"We have tried Two Valve Set and reception of Broadcasting was excellent, in fact with filaments fairly well over is too loud."

Maidenhead.
"Re Two Valve Set supplied, I am getting magnificent reception of Operas, etc., and have also picked up Birmingham, Manchester, Writtle, The Hague, and Eiffel Tower."

Nelson.
"Reference Valve Set supplied, it is giving every satisfaction, Manchester comes in loud and clear."

Dowlais.
"I have great pleasure in advising you that I heard Cardiff last Tuesday very well, speech and music quite clear."

NOTE

These Sets do not differ from our Standard products in any way; our Guarantee is behind each and every one, all of which undergo strict test to give clear, strong Telephony Reception.

Letters containing cash should be registered

ORDER FORM.

To Henry J. Brewster & Co. Please forward per ..... one Reliance.... Valve Set, for which I enclose cheque money order value £...., on condition that this Set will give me efficient reception of speech when installed.

Name .....
Address .....
.....
Date .....

HENRY J. BREWSTER & CO.,

Proprietors of the well-known Aerowave Crystal Receiver.

II, QUEEN VICTORIA STREET, LONDON, E.C. 4.

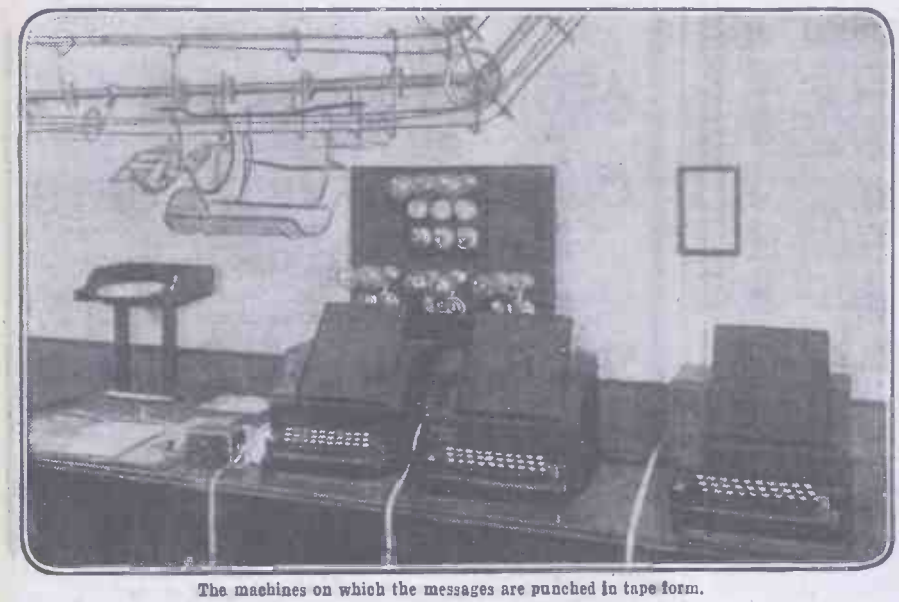
'Phone: **CITY 768.**

Telegrams: **AEROWAVA, PHONE, LONDON.**

RADIO HOUSE.

THE NEW CITY PREMISES OF THE MARCONI COMPANY. A FLYING SURVEY.

FROM time to time reference has been made in these columns to the new City quarters of the Marconi Company, in Radio House, Wilson Street, E.C., where every modern convenience has been installed for the rapid transmission and reception of wireless messages to and from many parts of the world.



The machines on which the messages are punched in tape form.

Those who, like the writer, have had the privilege of visiting both the old offices in Fenchurch Street and those now under review could not fail to be impressed with the immense improvements that have been effected. There is now almost complete automatic control of all distant wireless stations, and facilities for reducing to a minimum the time lost after a message is handed in and before it is dispatched, and also after receipt of a message and before it is delivered at its destination.

The Automatic Carrier.

In addition to a receiving depot, there is a private telephone exchange at Radio House, for the convenience of any client—and there are many such—who makes use of wireless to such an extent as to warrant being connected up by a private wire. By this means he is enabled to phone his instructions, and conversely, to receive messages within two minutes of their reception by the company. Connecting up the various rooms on different floors is a system of automatic dispatch carriers, by means of which messages are conveyed from one department to another. The carriers are attached to continuously running cords, and are so designed as to pick up and grip sheets of paper laid in trays, as they pass.

They also drop messages at the same point at which they pick messages up. The carriers possess the gift of discrimination; in other words, each individual carrier ignores every tray on its circuit except one at which it makes a dive, picking up any sheet that an operator may have placed there. If there is none, it passes on, empty. Similarly it is arranged so that it drops the sheet into another tray at a pre-determined point. Other carriers deal with other points on the circuit.

Incoming messages for wireless dispatch are passed into the hands of an officer on one side of a frame, on the other side of which are clerks waiting to receive them.

They are then delivered to an operator who transcribes them into morse code on a paper tape, perforated in a keyboard perforator, which is passed through a Wheatstone transmitter in the usual manner.

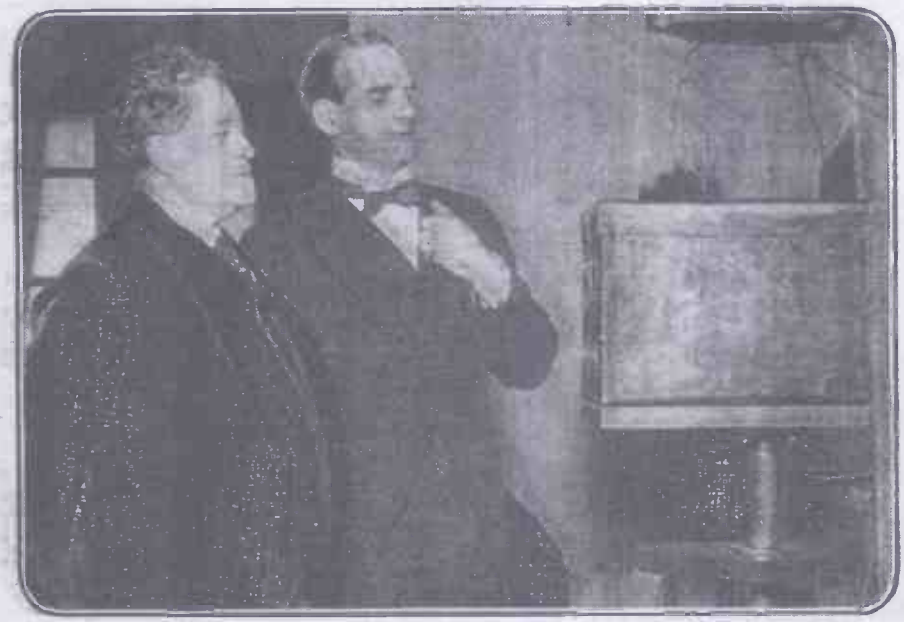
Conversely, messages received and printed in English letters and figures by the automatic high-speed printer are delivered by automatic carriers to the telephone department, or to the messenger-room for dispatch to their destination.

Distant Control.

Between Radio House and certain other stations, the duplex system of operation is in use. Since there is quite a common misconception as to what is meant by duplex working, it is as well, perhaps, to explain that this does not imply transmission and reception of wireless on the same aerial.

It is said that this has been done experimentally, but on a commercial scale over appreciable distances, hitherto it has not proved practicable. What can be and is done, however, is to transmit simultaneously from the same aerial, messages to different stations on different wave-lengths. Thus from the same antenna at Ongar transmission is effected to France and Switzerland simultaneously.

The transmitting stations in Essex, for the Continental Services, are already controlled direct from Radio House, so that no transcription of messages takes place, the transmitting telegraphists automatically governing operations at the wireless stations. Arrangements are now almost completed for including Carnarvon transmitting station under the same central control, and it is anticipated that, in a few months, that great station will present the same apparently lifeless and uncanny appearance as the others.



Mr. Shayle Gardener and Mr. Hubert Carter broadcasting the quarrel scene from Julius Cæsar at 2 LO.

POPULAR WIRELESS Beginners' Supplement

PART IX.—RECTIFICATION AND AMPLIFICATION.

By MICHAEL EGAN.

THE two important looking words which swell the title of this article need not frighten the beginner unduly. It seems inevitable that many of the names adopted by science should convey the least possible amount of information concerning the things, or processes, for which they stand. These particular words, however, are not nearly so bad as they might be. The root meaning of the verb "to rectify" is "to make right," *i.e.*, "to correct." And the root meaning of the verb "to amplify" is "to make large," *i.e.*, "to increase." Let us see what it is we have to *correct*, and what it is we have to *increase* in connection with the reception of wireless signals.

Two Difficulties.

When wireless waves flow past a receiving aerial, small electric currents are set up in that aerial. These currents flow alternately in opposite directions, up and down the aerial wire, at exactly the same rate as the currents in the transmitting aerial which sends out the waves. Now, this rate is very high, though it varies in the case of different transmitting stations, of course.

The currents set up in the aerial of a broadcasting station, for instance, occur at the rate of nearly 1,000,000 per second, the actual number being slightly different for each broadcasting station. The currents set up in a receiving aerial must therefore flow up and down the latter at the same stupendous rate. How are these high rate, or "high frequency," currents to be converted into sound in the telephones?

Two important difficulties present themselves at once. In the first place, the diaphragms of the telephone are incapable of being vibrated at this stupendous frequency. Secondly, even if they could be vibrated at this rate, we should not be able to hear any "sound." The human ear is incapable of sensing air vibrations of more than a certain frequency—and this maximum frequency is considerably lower than that at which currents usually flow up and down a wireless aerial.

"Group" Frequency.

The first thing to be done, therefore, is to (figuratively speaking) *slow up* the currents that flow from the receiving aerial into the telephones. The frequency at which they occur in the aerial is too high for the purpose of actuating the telephones; they must therefore be *corrected*, or *rectified*, to a suitable frequency before being applied to the task of vibrating the diaphragms of the latter.

The main difficulty involved in carrying out this rectifying process is due to the fact that the currents in the aerial flow alternately *in opposite directions*. It is this *changing of direction* that causes the trouble. If there were 1,000,000 small currents flowing *in the same direction*, the matter would be quite simple. They could be collected together in *groups*, and each group, acting collectively in the same direction, could be made to effect one pull on the telephone diaphragms.

So far as reception is concerned, there is only one process involved here, *i.e.*, that of preventing the currents from flowing in opposite directions. *The grouping effect takes place at the transmitting station.* Each sound wave that strikes the transmitting microphone gives rise to a *group* of vibrations (or currents) in the transmitting aerial, and, hence, in the receiving aerial. The frequency at which these *groups* occur is therefore the same as the frequency of the sound waves addressed to the transmitting microphone, which, of course, corresponds to the pitch of the speaker's, or singer's, voice.

The Crystal's Action.

If each *group* of currents set up in the receiving aerial could be made to produce *one* vibration of the telephone diaphragms, the latter would, of course, vibrate at a rate corresponding to the pitch of the voice at the transmitting station. The problem of rectifying these currents still remains to be solved, however. How is it actually solved in practice?

One way of solving it is by means of a piece of crystal. Some American scientists discovered that certain kinds of crystal allowed electricity to flow through them *in one direction only*. When such a crystal is placed between the aerial and the telephones, therefore, it acts as a buffer to one set of currents from the aerial, whilst allowing the others to flow through the telephones.

That is to say, it prevents the aerial currents from surging *backwards and forwards* in the telephones. All the currents that flow in one direction will pass through it, and all those that flow in the opposite direction will be stopped. For each group of electrical vibrations (or currents) that occurs in the aerial, therefore, what is virtually one large current flows through the telephones. This single large current is composed of a number of small currents, *all of which flow in one direction.*

What a Valve Can Do.

This is the only function performed by a crystal. It is a rectifier "pure and simple." A valve can only rectify, though its action is not so simple as that of a crystal. If the currents set up in a receiving aerial are weak, a crystal will be powerless to strengthen them. A valve, however, can only perform the important job of *strengthening* received signals. That is, it can increase, or amplify, their strength. There are ways of amplifying signals other than by means of a valve, but the valve is at once the most popular and the most efficient of all amplifiers.

A valve can be made to amplify signals either before or after they have been rectified. That is, it can amplify the "high-frequency" currents the moment they arrive from the aerial, as it were, or it can amplify the uni-directional currents that flow from the crystal before they enter the telephones. The wonder of the valve is that it acts either as a rectifier, as an amplifier of "high-frequency" currents, or as an amplifier of "rectified" currents.

The frame aerial receiving set used at the big public wireless concert given at Birmingham recently

EXTENDING THE WAVE-LENGTH RANGE OF YOUR SET.

By G. V. DOWDING, Grad.I.E.E.

THERE are doubtless many people who, having purchased a broadcasting receiver with a limited range of wave-length adjustments, are desirous of extending it in order to enable them to listen-in to aircraft and amateur telephony, Paris time signals, or even Continental broadcasting where the set is considered sufficiently sensitive to do so.

In the first place, it may be mentioned that there is no official objection to the extending of the wave-length range of a B.B.C. set, although additional apparatus such as variable condensers, etc., should bear the B.B.C. stamp. The adjustments of the majority of B.B.C. sets are limited to a range between 300 and 500 metres, and as it is essential that both those figures should be covered on any aerial between 30 and 100 ft. long before the P.M.G. will license them, it can safely be depended upon that 100 metres margin at least either way is allowed in most cases.

Down to Amateur Wave-lengths.

The only transmissions taking place below 300 metres are those of the amateur stations whose wave-lengths may vary from 150 to 200 metres. To get down to there, it will be necessary to introduce a variable condenser in series with the aerial. You will know by now that wave-length directly depends upon capacity and inductance; increase either and the resultant wave-length is increased, or reduce either and the wave-length is reduced.

Now we must have a certain amount of inductance in the set across which to connect our detector, otherwise it would not be possible to "tap" off energy from the aerial circuit for the purpose of diverting it through the telephones, and we do not want to shorten the length of the aerial every time we desire to go down to the lower wave-lengths, so, therefore, we must attack the capacity factor and endeavour to reduce that.

When condensers are placed in parallel, the resultant total capacity will be merely the sum of the individual capacities; thus, if we placed a ·0005 mfd. variable condenser in parallel with one of ·001 mfd. capacity, the total capacity will be ·0015 mfd. On the other hand, when condensers are placed in series, the resultant capacity will be smaller than the smallest individual capacity. There is no need to detail the mathematics involved in this latter case, however, as it is rather tricky and apt more to confuse than assist the beginner.

An Adjustable Coil.

However, if we place a variable condenser in series with the earth lead and the earth terminal of the set, we shall be able to control the capacity value of the whole circuit, but only from somewhere near normal downwards. We cannot increase the capacity, because however much we place in series, the resultant total will always be less than the smaller capacity, which would in that case be that of the aerial and the set.

By decreasing the value of the variable condenser placed in series, we can bring the total capacity down, and, therefore, reduce the wave-length tuning of the set. A ·001 or ·0005 mfd. variable condenser would be the most suitable value to employ for the purpose.

Now we come to the more difficult question—that of increasing the wave-length range. For this we must rely solely upon the other wave-length factor—inductance—because the capacity must always be kept at its minimum value if efficient reception is desired. Quite a number of the sets being sold for broadcast purposes have two small terminals or plugs on the panel marked "extra induct" or "long wave." To these two points can be connected extra inductance coils in order to increase the wave-length range. Should such terminals not be in evidence upon your particular set, then the extra coil or coils must be placed in series with the aerial lead and the aerial terminal of the set.

An adjustable coil is an advantage, otherwise it is obvious that to cover very dissimilar ranges several different coils will be required. For instance, Paris transmits on a 2,600-metre wave-length, and to get up to that on a set normally tuning but to 500 metres would require an inductance coil of some considerable value, which would obviously be far too large for the aerodrome telephony 900-metre adjustment.

How to Get Paris.

As a matter of fact, the most suitable form of loading coil for ranges from, say, 900 to 2,600 metres will be an ordinary single layer single-slide coil of about nine inches in length by five in diameter, wound with some 350 turns of what is known as gauge 24 wire. In the case of the plug or two-terminal connections provided on a panel, one lead would go from the slider bar to one of these terminals, and one end of the winding itself to the other. Or it can be placed in series with the aerial lead by taking the aerial lead straight to the slider bar of the coil, and a lead from the end of the winding to the aerial terminals on the set.

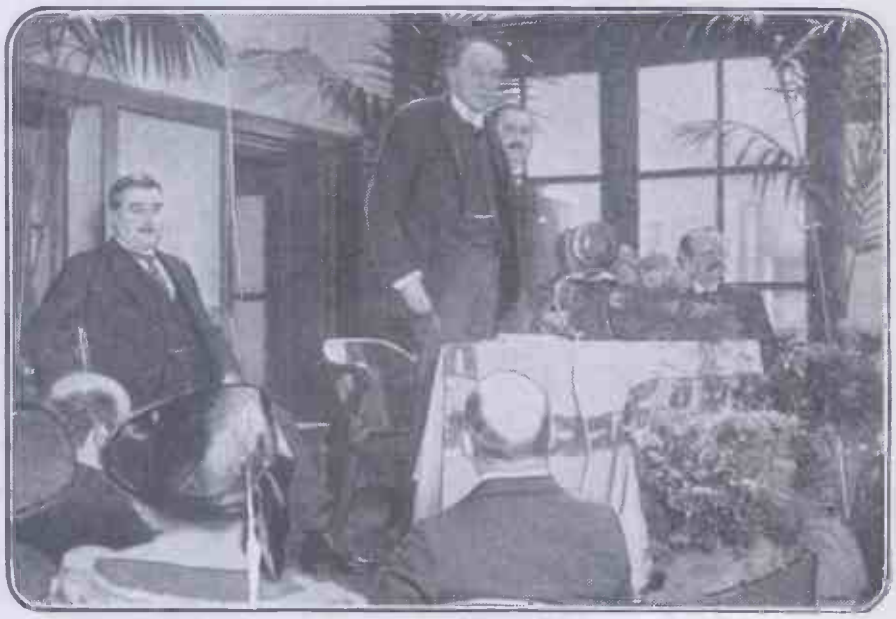
Where the increased wave-length range desired is from, say, a maximum of 550 metres or so to only 1,100 metres to cover shipping, the aerodromes, 'planes, and the Hague, etc., a small single-slide coil of some seven inches in length and three in diameter wound with 150 turns of 22-gauge wire would suffice. Although these single layer coils are the more efficient for the purpose, it stands to reason that a fixed coil of the well-known honeycomb type or even basket type could be used for useful extensions of wave-length ranges.

A More Efficient Method.

For instance, if your set has a minimum adjustment of 300 metres, and will range up to 550 or so, it is very easy to see that a fixed coil placed in series to bring the minimum adjustment up to 550 metres would allow the set to be adjusted to seven or eight hundred metres. For efficient reception on long wave-lengths, however, it is advisable to have the set at its maximum adjustment, and do the tuning with the loading coil, unless this latter is inserted right into the circuit of the set in the way that they are in the case of those sets that have terminals provided for extra coils.

To insert a coil into the circuit in this way, it is necessary to slightly modify the wiring, in order that the additional coil can be placed in series with the original coil of the set, so that to all intents and purposes the arrangement results in one continuous coil, with the detector circuit tapped across the whole lot.

As a matter of fact, this last arrangement is so much more efficient than directly loading the coil on to the aerial, that I would advise you to have a shot at doing it in that way when you have acquired a little more knowledge on the subject of a set's "innards."



Lord Robert Cecil speaking into the microphone at the opening of the new G.E.C. Laboratories.

GETTING THE MOST OUT OF A VALVE SET.

WE will put aside the question of tuning because by this time you will be able to realise the necessity of bringing this to the sharpest point possible, and that whilst it is advantageous to employ a variable condenser to enable you to do so, this, the capacity value, should be kept as low as possible, and the more considerable variations of wave-length obtained by varying or changing the inductance coil. Also, it might be added, that if you are employing one of these very popular coil-holders, or a "loose coupler," always work with the loosest possible coupling consistent with good signals. This is obtained by keeping the coils as far apart as possible.

Until you have "experimented" a little with your set, you should not take it for granted that you are receiving the best possible signals. At the same time, limit the extent of your "experimenting" to those things that you know you can do with safety—burnt-out valves or short-circuited accumulators are expensive items to replace.

Efficiency and Economy.

With a one-valve set there is little that you can do towards this "experimenting," except in the way of careful high and low tension current regulation. The high tension—that large dry battery—should be variable, and the type that is fitted with a small plug and tapping sockets is highly to be recommended. With the filament resistance regulated so that the dullest light is emitted from the filament while signals are still audible, vary the high tension until the loudest signals result, and then gradually increase the filament brightness until, with the lowest possible variation of both, you are satisfied that the best possible signals are coming in.

Having accomplished this, you will have effected both efficiency and economy. Lighting the valve filament at its lowest temperature increases the life of the valve and saves accumulator "juice," while obviously there will be a saving of H.T. pressure, thus allowing plenty of "margin" against the time when the H.T. battery begins to drop in voltage. Regarding this latter, when to all intents and purposes, judging by results, its active days are over, by all means purchase a new battery and use it, but don't throw the old one away. A rest of one or two weeks will prove that it is still capable of recuperation, and it will provide a very useful "standby."

A Wise Precaution.

Should you be the possessor of a two or three or more valve set, there are several little "tips" worth noting. In the first place some valves will function better when used on the amplifying side than on the detecting side although they are of the same type and make. No two valves are alike in individual characteristics. Therefore, it is always a good plan to change the valves about until the best positions have been discovered. Should you have a separate L.F. amplifying unit connected to your detector panel, changing over the "line" or "input" leads on the amplifying panel sometimes results in an extraordinary increase in efficiency. On some "hook-ups" these terminals will be the "'phone" terminals on the receiver or detector panel. Owing to the fact that in some cases the L.T. positive is taken to earth, and in others the L.T. minus, it is a good plan to observe the effect of changing over the accumulator leads. Very little alteration in the circuit results, and there is no danger in doing it, but sometimes it causes signals to be very much improved.

Finally, although if you leave the H.T. terminals alone, and the H.T. battery isolated and carefully connected to those terminals, it is hardly likely that a blown-out valve will result; it is always as well, apart from this, to take other precautions. The investment of a shilling or so for one of those small "pea" lamps and holder to place in direct circuit (series) with one of the H.T. leads, to act as a fuse, is a wise one. In the event of the H.T. battery becoming by some means connected to the filament of the valve or valves, the small "pea" lamp will burn out, break the circuit, and save the more expensive "lamps."

DULL-EMITTING VALVES.

By an Expert of the General Electric Co.'s Research Laboratory.

THE electron-emitting properties of thoriated tungsten filaments were studied by Dr. Langmuir in America as long ago as 1914, and American patents covering the use of these filaments were taken out by him shortly afterwards.

When a thoriated tungsten filament has received no special treatment, the electron emission obtained from it is approximately the same as that obtained from a filament of pure tungsten. At a very high temperature (about 2,600° C.) in thoriated tungsten a chemical reaction occurs between the tungsten and thorium oxide, resulting in the formation of a small amount of the element *thorium*, some of which remains in solution in the tungsten. Then, when the filament temperature is lowered to about 2,000° C., thorium atoms diffuse outwards from the interior of the filament and gradually form a film or coating on the surface of the filament.

What Actually Happens.

Now, when an electron escapes through the surface of a hot filament it has to do work against the electric field at that surface, and the amount of work which it has to do is different for different substances. This amount of work happens to be less for thorium than for tungsten, so that with the same filament temperature many more electrons are able to escape from a filament covered with thorium than from one having a tungsten surface. The actual ratio of the number escaping from these two surfaces at the same temperature is about 100,000 to 1.

When employing these filaments in valves, what we do is to reduce the filament temperature until we get the same electron emission as we normally use from a tungsten filament. We therefore save very much in the current used for heating the filament.

Much Longer Life.

For example, the tungsten filament in an ordinary receiving valve requires a voltage of 4 and a current of 0·7 amp., the power being 2·8 watts; while a dull-emitting filament of the same dimensions requires a voltage of 1·6 and a current of 0·36 amp., the power being only 0·58 watt, or less than a quarter of that for tungsten.

Owing to its electro-positive character and consequent great affinity for electro-negative gases, the thorium film is very soon oxidised in a poor vacuum, so that special precautions have to be taken in manufacture in order to obtain a very high degree of vacuum in these valves. However, it has proved to be possible to obtain the necessary degree of vacuum under manufacturing conditions, so that numerous types of receiving valves are being turned out which give very long working lives—sometimes as much as 5,000 hours.

BOOK REVIEW.

Radio Telephony for Amateurs. By STUART BALLANTYNE. (London: Chapman & Hall, Ltd., 7s. 6d.)

From the point of view of the real wireless amateur who wants to know the values and constructional details of receiving and transmitting apparatus, this book will prove invaluable.

In the introduction the writer comments on the fact that in his earlier experiences of amateur experimental wireless he had searched in vain for a book that would provide more practical data and less formulæ than the average wireless handbook, and determined to write one himself when his knowledge and experience warranted him taking that step. The result we have before us as we write, and it proves that Mr. Ballantyne has completed his task in an exceedingly commendable manner. Being an American his wire gauges are B and S, and some of the apparatus is little known on this side, but, on the whole, those minor points detract little from the value of his book.

Beginners are reminded that P.W. will answer all questions free by post. Address your queries to Room 138, "Popular Wireless," The Fleetway House, Farringdon St., London, E.C.

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

Q. Is there any limit to the distance that you can tune downwards towards the lower wave-lengths ?

A. Yes; you will find that to tune below 200 metres is a difficult undertaking even with condensers in series with the aerial. If you shorten your aerial, you can tune still further down; but for effective reception of telephony, it is not usually possible to get below 150 metres. Below this a smaller aerial has to be employed, and a system of condensers, all of which tend to reduce the signal strength. For amateur work 180 metres is a good minimum, as the natural wave-length of most aerials is about 130—150 metres, and to get below this natural wave-length will result in a great loss of efficiency.

* * *

Q. What is meant by heterodyning ?

A. When one station's continuous wave gets mixed up with that of another station, and these waves keep on getting in and out of step, or phase, with one another. This produces a series of notes in the telephones of receiving stations within range. It usually occurs when near-by stations have nearly the same wave-length, or wave-lengths that have common harmonics. One method of receiving C.W. depends upon heterodyne reception. The receiving aerial is made to oscillate at a given rate or frequency, and the incoming C.W. signals get mixed up with these oscillations, and the result is a beat giving audible signals in the phones.

* * *

Q. What is the cause of crackling in the phones when using a valve set ?

A. This may be the result of several causes. It may be due to atmospherics; disconnect the aerial and see if it ceases. It may be due to a faulty high-tension battery, in which case it will probably be continuous. See if it ceases when you change the battery. If you have a loose connection anywhere, it will cause noises in the phones. A loose filament resistance, loose valve, or an insecure lead from the L.T. battery will also cause a great deal of disturbance, and possibly the valve will flicker. Lastly, you may have a broken wire, probably in the phone leads, or even a burnt out, or breakdown of insulation somewhere in the telephone windings.

* * *

Q. Do all crystals have sensitive points ?

A. Presuming that crystals such as are used in wireless reception are being considered, you will find quite a number that do not have sensitive points. The mineral may be quite right, but the structure may not be suited for the rectification of high-frequency currents. For instance, carborundum is a very uncertain mineral. It is quite a frequent occurrence to have to try several crystals before you find one that will operate at all efficiently. Different crystals, even of the same type, vary considerably in sensitivity, and often such sensitive crystals as galena and hertzite appear to have no sensitive spot on them anywhere. If you cannot find a spot, and scraping the surface with a penknife does not uncover one, you should try a new crystal.

* * *

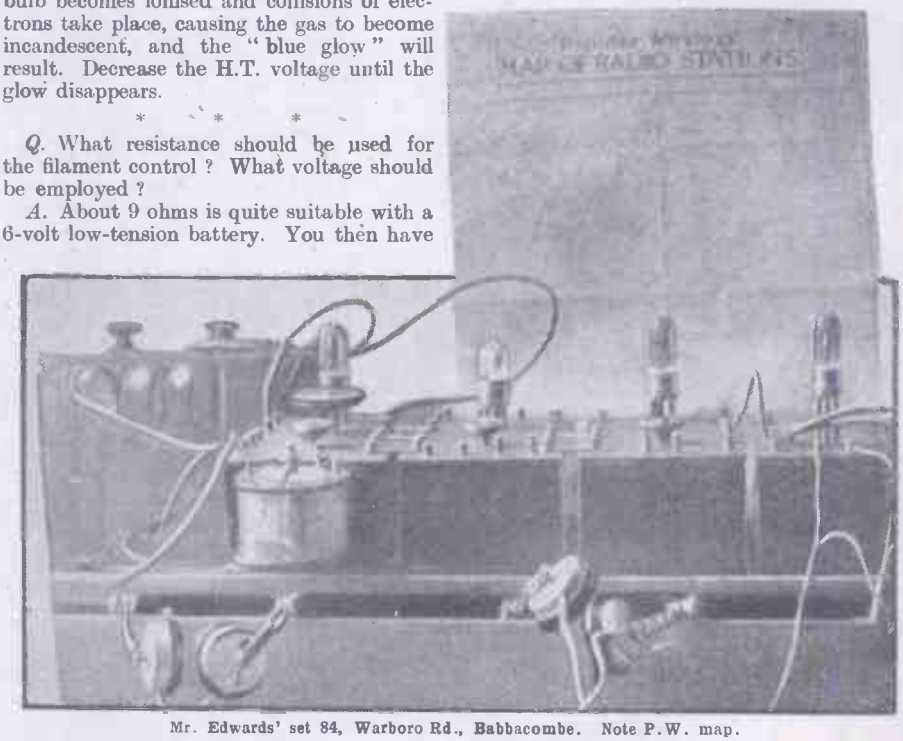
Q. What is the cause of a valve filling with a blue light ?

A. Too much H.T. potential. If you have a fairly soft valve, such as the Dutch valves sometimes used, the remaining gas in the bulb becomes ionised and collisions of electrons take place, causing the gas to become incandescent, and the "blue glow" will result. Decrease the H.T. voltage until the glow disappears.

* * *

Q. What resistance should be used for the filament control ? What voltage should be employed ?

A. About 9 ohms is quite suitable with a 6-volt low-tension battery. You then have a wide range of control over the filament current. This means of varying the current should not be neglected as, to get the best out of a valve, the filament current should constantly be adjusted, as the amount of current has a great effect upon the results achieved. Similarly the high-tension voltage should be adjustable by means of switches or wander plugs, as a matter of a few volts more or less will often make all the difference between good and poor reception. Especially is this the case with soft detector valves.



Mr. Edwards' set 84, Warboro Rd., Babbacombe. Note P.W. map.

* * *

Q. Is a variable grid leak an advantage ?

A. Yes, we would advise the experimenter to fit a variable grid leak to his set. For those who are using broadcast sets, and always the same make of valve, this is not so important, but those who wish to experiment with various valves and various circuits will find a variable grid leak of great assistance, as practically every valve, even of the same make, will need a slight adjustment of the leak value if best results are to be obtained.

Q. Can slate be used as a panel instead of ebonite ?

A. Yes; but you may find it is not quite so efficient. The surface of the slate should be thinly coated with shellac to break up any film of moisture that is likely to form on the panel.

* * *

Q. What is ebonite ?

A. A specially prepared black substance that has very good insulating properties. It is a preparation of sulphur and rubber. It is one of the best-known insulators that can be successfully worked for the making of instruments.

* * *

Q. Can valves be repaired ?

A. Yes, we believe that one or two firms are now in existence which undertake the repair of valves. The price is usually about 7s. 6d. or 8s. 6d. The G.W.I., Ltd., Imperial Works, Shanklin Road, Crouch End, carry out these repairs at about the above charges.

* * *

Q. How long should a valve last ?

A. This, of course, depends upon the way in which it is handled. Properly treated, it should give about 1,000 hours' of light, though this is sometimes exceeded. A "soft" valve will not last quite so long as a "hard" one, owing to the bombardment of the filament by gas ions which have been liberated by the collision of the gas atoms with the electrons emitted from the filament.

CORRESPONDENCE.

To the Editor, POPULAR WIRELESS.

THE LICENCE DODGER.

Dear Sir,—I have read your somewhat severe strictures on the "licence dodger," and, whilst agreeing with you that this practice is not playing the game and is dishonest, I would ask you what one is to do. What would you yourself do were you in the position of thousands like myself ?

To illustrate. If you will turn to page 967 of POPULAR WIRELESS, you will find these words, "The first diagram A . . . could be aptly named the beginner's circuit, being a hot favourite amongst those amateur mechanics who believe there is nothing like the home-made set." Now this—and dozens of other instances can be found in back numbers—is a direct incentive to one and all to make their own sets. Acting on your advice the set is made, then the poor devil prepares to purchase a Broadcaster's Licence, but learns that if he does so he will not be permitted to use the set. Now, sir, what is he to do ? What would *you* do ? Evade the case by declining to take out a licence, or take out a licence and straightway break your contract with the P.O. ? It is a simple issue. What *would* you do ? *Tell* us frankly.

That was my plight, for I knew nothing of that clause nor of the B.B.C. stamp until my set was completed—a two-valve set.

I had to do something, so took out a licence and broke my word. Nay, further, I have since purchased a set of 52s. 6d. headphones from the Sterling Company which does not bear the B.B.C. stamp, so again I break the contract.

I ask you, sir, who should be in the dock—who should be pilloried ? I, who acted in all good faith—up to that point—or the Press proprietors who advise us and the members of the B.B.C. who sell their stuff without the requisite stamp ? Anyhow, the B.B.C. stamp is but a transfer, and wears off in the course of a few weeks.

Having a conscience, however, and also a sense of decency, I sent to the B.B.C. a £1 postal-order made out to them and crossed "A/C payee."

Now, where do I come in in your strictures, and when I am before the magistrate? The P.O. officials have been round to see my set on three successive days, so what is going to happen I don't know. You can, however, appreciate what my defence will be—copies of POPULAR WIRELESS and other technical papers and the Sterling Company's 'phones.

It seems to me that the P.O. is missing its mark when it hits *us*, and I think that in common decency the Wireless Press should take up the case for us if we are prosecuted. Personally, I am very doubtful as to whether it is *law*, but I cannot afford to fight on those lines, I should have simply to state my case and accept the magistrate's verdict.—Yours faithfully,

A B.B.C., NOT A P.O., LICENCE DODGER.

NOTE.—The above letter is printed exactly as received. The case presented by the writer is a common one, and he has my sympathy. But sympathy is not much good, of course. That the writer has acted in good faith few can doubt, and I have no doubt there are many more in the same position as himself. The writer, however, is hardly fair when he blames POPULAR WIRELESS for publishing constructional articles. There are some thousands who hold experimental licences ; they must be catered for. The writer asks where he comes in for my strictures ; he does not come in at all, because he has acted in good faith. The point is—thousands are *not* acting in good faith. How many readers who have made their own sets have forwarded compensation to the B.B.C.? It is the deliberate "dodger," the man who avoids paying *any form of tax*, that is to be pilloried—if at all. When "home-made sets" licences are issued, even this concession will still leave the deliberate dodger, and I cannot imagine any reader of POPULAR WIRELESS disagreeing when I say such behaviour is grossly unfair.

THE EDITOR.

To the Editor, POPULAR WIRELESS.

Dear Sir,—I wish to notify you that I received the American station W G Y on a home-made *single-valve set* between the times of 3.21 a.m. and 3.51 a.m. this morning, February 20th, 1923. I am enclosing programme of items received. The words given are the exact words used by the announcer. I think that this constitutes a record, taking into consideration the material at my disposal. I think a short description of the components of my set will upset a few standard ideas.

My aerial is, approximately, 65 ft. long (single wire, 223 gauge, copper). The lead-in, after passing through the window-frame, runs along the wall of a bedroom, through the bedroom floor, down a wall downstairs, and through same to instruments in the kitchen, the length of lead being, approximately, 34 ft., a most inefficient arrangement. The phones I am using are a pair of watch type receivers taken from 2-in. "Sterling" intercommunication commercial desk telephone sets, the combined resistance being only 300 ohms. The only alteration I have made to same is the fitting of thinner diaphragms. I do *not* use a telephone transformer, the 'phones being placed directly in the plate circuit.

W G Y was tuned in with two basket coils made from descriptions given in POPULAR WIRELESS, the primary coil having 64 turns of 36 wire, the reactance having 102 turns of 36 wire coupling between the two coils 2 in.

A 39 plate standard variable condenser in series with the aerial. The earth connection was connected to gas-pipe near meter. This is the second time I have received the American stations, the previous occasion being last Friday, when I received W J Z.

I am making a few adjustments to my set, after which I will forward you a full night's programme from either W J Z or W G Y.

I should be pleased if you would publish this letter and programme, as I should like to know if any other amateur has received American broadcast using a ragtime set like mine.

Yours faithfully,

J. H. BRITTAIN.

5, Leighs Fold, Green Lane, Patricroft, Manchester.

(NOTE.—*As the programme given by Mr. Brittain is very long, it is not reproduced. It has been checked, however, and found correct.*—EDITOR.)

To the Editor, POPULAR WIRELESS.

Sir,—I have read with much interest your article on "Licence Dodgers." Will you allow me to state a few facts ? I have applied *eight weeks ago* for an experimental licence, so far with no reply. (I called for the form.) Since then I have built a crystal set. It being home-made, I cannot obtain a B.B.C. licence ; and, presumably, as I am not a true experimenter, I cannot obtain an experimental licence.

Here am I, ready and willing (as are many others whom I know) to pay the B.B.C. royalty and licence fee if they will only let me.

I do not want to dodge the licence, but it seems a pity to place the B.B.C. in peril for want of a satisfactory system of issuing licences.

Yours faithfully,

R. E. THOMAS.

318, Milkwood Road, S.E. 24.

To the Editor, POPULAR WIRELESS.

Dear Sir,—Having read your article on the "Licence Dodger," I would wish to say that I am one of your thousands of readers who have made their own sets, and am unable to use it owing to restrictions. Several of my school-mates are in the same position. I am quite willing to pay 10s. 6d., or even more, for a licence for my crystal set. I agree that to dodge the licence is rather mean.

Also, that there will soon be a licence to the advantage of the home-worker I do not doubt. Meanwhile, I would like to ask what I am to do, as I am unable to answer the necessary questions for an experimenter's licence ?

Yours truly,

WALTER J. GIBBS.

296, Lymington Avenue, Wood Green, N. 22.

To the Editor, POPULAR WIRELESS.

Sir,—Your article in POPULAR WIRELESS, February 24th issue, "The Licence Dodger," is decidedly interesting. I do not think there are *so many* who are desirous of dodging the licence fee as you may imagine. I have made a set (without any previous technical knowledge), but cannot really be called an experimenter ; at the same time I am only too willing to pay a reasonable licence fee, over and above the 10s. 6d., for a "home-made set licence." There is far too much red tape in connection with "experimental licences." Why not issue straight away a "home-made" licence, and let our boys then get on with experimenting, with the aid of information gleaned from your valuable weekly publication ?

Yours faithfully,

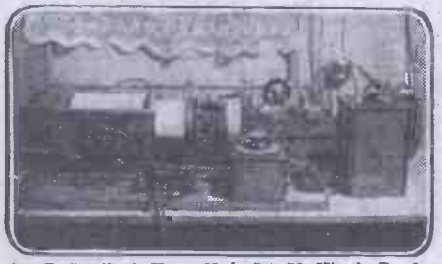
G. H. H.

148, Queen's Avenue, Watford.

A RADIO DINNER.

By P. E. HELYAR.

THE first annual dinner of the International Amalgamation of Wireless Societies was held on December 14th, 1932, at the principal hotel in every city of the world wherein the I.A.W.S. has a branch. The menu, which we reproduce, was broadcasted three days before the dinner from the society's head office in New York, thus ensuring that every member, be he in Paris or Patagonia, should partake of the same repast, and minute precautions were taken that the dinner should commence everywhere at the same time. It is whispered, however, in culinary circles that the interpretation of that menu by the cook of the Pig's Ear Hotel, Burnem-up-Creek, differed slightly from that of the Paris chefs.



Mr. F. G. Allen's Home Made Set, 58, King's Road, Wimbledon, S.W.19.

"The dinner-table of the New York branch of the I.A.W.S.," writes our special correspondent, "laid in the wireless room of the 'Wastorf-Aldoria,' was one of the wonders of the age."

Torturing America.

In reality a monster multi-valve panel, the sole illumination emanated from the valves, which ran down the centre, the table being laid in the usual manner, except that at every place, in lieu of the usual array of glasses, was placed a loud speaker, which, though in miniature, was none the less effective, and before each plate was a menu and a programme of speeches, each tastefully framed in ebonite.

Monsieur Dufile-Decuivre, the president of the Paris branch, who holds the honoured title of "Senior Radio Fan," opened the proceedings with an able speech in which he said that Esperanto had been adopted by the I.A.W.S. as the official language.

He had to congratulate the British Broadcasting Company on their enterprise in engaging the Spellmon Institute to teach Esperanto by wireless. At the conclusion of this speech dinner was served, and no event of importance was marked until during the second course the Abernethy branch reported interference from Berlin. Upon investigation this was found to be merely a member eating his soup. Apologies were tendered and accepted.

After the fish course a break was made for the speech of the "Assistant Senior Radio Fan," Mr. Cyrus Gurgleheimer, the president of the New York branch.

Mr. Gurgleheimer in his remarks asked that at future dinners of the I.A.W.S. his European confrères should fit silencers to their wine bottles, as the pop of drawing corks and the gurgle of poured wine was distinctly audible in New York. He was told that the American Press were suffering the torments of Tantalus.

During the rest of the evening speeches were made at intervals by the "Junior Radio Fan," president of the Melbourne branch, the "Senior Tuner In," secretary of the London (England) branch, "The High Transformer," president of the Cape Town branch, and the "Chief Micro-farad," the Begum of Dungarree, president of the Calcutta branch and the only woman official in the society.

Britain to the Fore.

During the whole of the meal, music was discoursed by the foremost orchestras of the world in turn. One item, the Black Rhubarb Jazz Band of San Francisco, was specially appreciated.

While the coffee was being taken, Mme. Screecher gave an exquisite rendering of that soul-stirring solo "The Lost Volt," from the Queen's Hall, London.

The evening was brought to a close by the whole of the diners singing in unison the anthem of the I.A.W.S., "A Life on the Hertzian Wave."

We gather from our London correspondent that the only fly in the ointment was that while New York sat down at 8 p.m., the corresponding time in Great Britain was about 2 a.m. But as a famous wireless expert remarked, "Britain has always been foremost in making sacrifices in the interests of Science."

MENU.

Sparks Variés.
Consommé Marconi.
Supremes de Soles à la Micro Henri.
Escalopes de Riz de Veau à la Morse.
Tournedos de Bœuf Cathode.
Selle d'agneau Tonello.
Pommes en Grid. Artichauts en High Frequency.
Spaghetti à la Hertzian Wave.
Poularde Farcie Potential.
Ohmlette à la Resistance.
Oscillations en Parmesan.

WIRELESS RECEPTION BY TASTE.

By A. H. DALY.

SOME time ago a paper was read before the American Institute of Radio Engineers dealing with the reception of wireless signals by means of taste. It was suggested at the meeting that taste reception might be used on aircraft where the noise of the engine makes wireless reception by sound difficult for signals of low audibility. At the time very little attention was paid to the idea—taste being a very inferior sense for receiving intelligence as compared with hearing. Now, however, the idea is again being revived with the object of enabling people whose senses of sight and hearing are impaired to receive by wireless.

The apparatus for tasting wireless consists of the usual type of wireless receiver minus the receiving telephones. In place of these are two flexible electrodes separated by a piece of ebonite. These electrodes, which are merely two short strips of silver three inches long, are constructed in the form of a clip which fits lightly over the tongue.

In the experiments with this apparatus the receiver was first excited by a buzzer, and it was found that by using two or three stages of amplification signals could be received by taste quite well, provided they were fairly strong. The apparatus was then connected to an aerial for actual reception of wireless signals, and provided at least four stages of amplification were used, all incoming signals from about medium strength upwards could be tasted distinctly.

A Good Effect.

The speed of reception was limited to a maximum of about ten or twelve words per minute by operators able to receive from twenty-five to thirty words per minute by sound. But although ten words a minute is comparatively slow, it is very useful to a person unable by an accident or otherwise to receive by sound or sight, and it is quite possible that with a certain amount of practice much higher speeds for taste reception might be attained.

The sensation of receiving wireless signals by taste is, of course, rather peculiar, and it is open to question whether it is good for the health of a person to receive by taste. The physiological effects of this method of receiving have been investigated already, and the general opinion appears to be that the electro-chemical action which takes place in taste reception will have a beneficial rather than bad effect upon the taste organs, as the electric current tends to stimulate the organs concerned.

It has been found that the intensity of the sensation of taste depends largely upon the area of the tongue stimulated, therefore the greater the surface of the tongue which comes in contact with the electrodes the more efficient and better is reception.

Try It.

Anyone who has the necessary valve amplification available can carry out tests with taste reception. It will be understood that a dash of the Morse code is a long taste and a dot is a short taste. Silver electrodes are preferable for the tongue clip, as copper and other metals tend to leave the taste in an unpleasant form in the mouth.

Apart from the actual experiment a fairly good idea of what wireless signals taste like can be gathered by placing the tongue between the positive and negative terminals of the dry battery of a small electric pocket torch. If the battery has any energy in it, a salty, rather acid taste is experienced, and this will give some impression of what wireless taste reception is like.

THE FUTURE OF WIRELESS

By SIR PHILIP GIBBS.

Sir Philip Gibbs is one of the most brilliant of living journalists, and readers of "Popular Wireless" who remember his vivid war articles, and the wide imaginative thought they displayed, will read the following article with more than usual interest.

THE first time I had a revelation of the new miracle of "wireless," and some idea of its future possibilities, was in the city of Detroit, in the United States. The editor of the "Detroit News," which gives a programme of music, lectures, stories, and news every night to something like two million people, listening-in from many towns, villages, and lonely homesteads, asked me to speak for ten minutes or so on any subject I liked to this invisible audience.

Sir Philip Gibbs.

I had lately come back from the famine area in Russia, and in that ten minutes I gave a concentrated description of the tragic pictures I had seen. It was a strange experience, speaking down a cardboard funnel in a big room littered with musical instruments belonging to an orchestra which had just been giving a selection from light operas, and with a few members of the newspaper staff standing about. But, somehow or other, I was conscious that great numbers of people in the outside world were listening to what I was saying, could hear the tones of my voice, and were receiving this message of mine.

A Strange Power.

It gave me a strange power. I might have written an article on the same subject for the "Detroit News," but it would not have had the same effect. People would have read the headlines and skipped it, or they would have read it without that sense of personal contact with a man who speaks as an eye-witness of the thing he tells. The human voice has an authority not belonging to the written word. It is also self-revealing, for a liar gives himself away and a truth-teller establishes his character by the tone in which he talks.

Anyhow, here was a new instrument by which the human brain could get closer into touch with the minds of his fellow men; and, in my opinion, that is the supreme value of this new discovery, and the secret of prodigious possibilities which lie in the future of wireless. It is a miraculous triumph over the material limitations of life which have hitherto hampered human society and confined the individual intelligence in a very small prison-house.

All the progress of civilisation has been in the breaking down of that prison-house dividing one brain from another. Language came first as a means of thought transmission after signs and gestures and inarticulate noises. Then came the hieroglyph, or written symbol, by which primitive man could inscribe some thought on a bit of clay or stone or leaf. Then writing was developed and manuscripts were circulated among the chosen few.

Then printing was invented, and books became more numerous and passed from one country to another. Then the telegraph and telephone enabled a thought from one brain to be transmitted rapidly to another brain, and news from one part of the world to be published in all other countries within a few hours. All this was the breaking down of the prison-house, until it seemed that man's mind was liberated utterly, and that human thought had no limitations, and that no further conquest were possible. We now see that we are only at the beginning of thought transmission.

Looking Ahead.

It will surely be possible in the future to talk with one's friends almost regardless of distance and without any complicated arrangements now required by long-distance telephones. It is even now possible for one man to make a speech in New York and to deliver his message direct to human brains in London, Paris, and many other cities on this side of the Atlantic. The present limitations of wireless, the first experimental adventures, will be followed by such improvements and facilities in common use that every little home will be a storehouse of vibrations linking up the individual mind with the great world intelligence.

That, anyhow, is how I see this thing, and I am inclined to believe, without scientific authority, that this is the beginning of an era when we shall not only be able to listen to people at great distances from our whereabouts, but shall be able to see them by vibrations of light as well as sound. In that case there will be no barriers in space, and distance will be annihilated.

But that is looking too far ahead! What of this wireless now? So far, it seems to me merely a scientific curiosity with very little practical use, and giving very little addition to the means of knowledge and enjoyment as at present developed in this country. That is partly due to the limitations imposed upon it by the Government and the wireless authorities.

Until there are great numbers of transmitting stations, and until the most important news, music, knowledge, and intellectual activity of the nation, and ultimately of the world, pass freely through the ether to the receiving sets of the listeners, there will not be much value in the invention. The weakness of the present state of wireless is in the poverty of the programme presented to the public.

It is interesting to listen to a bit of ragtime, a popular song, a violin solo, a bedtime story, an item of news that was in the evening papers—only as the first uncanny experience of picking up these things from a distance and realising its scientific marvel. But that is not satisfying after one evening at the game. It is not going to appeal to large numbers of people after the novelty has worn off. A rather third-class programme of musical selections and comic tales, with a dreary speech by some second-class celebrity or a mock debate put up for the purpose, is, to my mind, hopelessly unattractive, and bound to result in a general "slump" of interest. Far better to read a decent book, or listen to a gramophone, or pedal at a pianola, to say nothing of intelligent conversation.

I have had the advantage, thanks to the editor of POPULAR WIRELESS and other friends, of listening-in to the programmes of the British Broadcasting Company, and I have heard all I want to hear of that class of entertainment. I would not pay sixpence for it. Indeed, I should charge for my waste of time. But I quite realise that we are only at the beginning of things, and that public opinion is bound to exert sufficient pressure to obtain a very much better and wider service when the initial difficulties have been overcome. It is certain that before long this means of influencing national thought will be used by public men who have important things to say, and that it will be used largely for the transmission of news.

Newspapers Replaced?

It is said that the newspapers are nervous of its development, but in my judgment they have nothing whatever to fear, and will make use of wireless for their own prestige, just as in election times they flash the results to the public on the cinematograph screen.

For wireless will never replace the written word. It will only aid it by the spoken word. An important item of news told one night to millions of listeners at their receiving sets, will send them all to the papers next day to read the detailed story. The only way in which newspapers might suffer would be in losing the first publication of racing and football results, and the verdicts of great trials—which, I admit, would hit them hard. But they must make up their minds to that, for it is going to happen anyhow, as it is already happening in the United States. They must supplement their ordinary newspaper service by their own wireless news, as the "Detroit News" does, and compete in that way with their rivals, so increasing their popularity in millions of households.

Looking ahead, it is impossible to avoid the conviction that wireless is going to create a revolution in the means of transmitting news and views, and will be a powerful aid to the education of humanity. This country is going to be left behind if it allows official obstruction and narrow-minded policy to limit its opportunities in receiving and transmitting.

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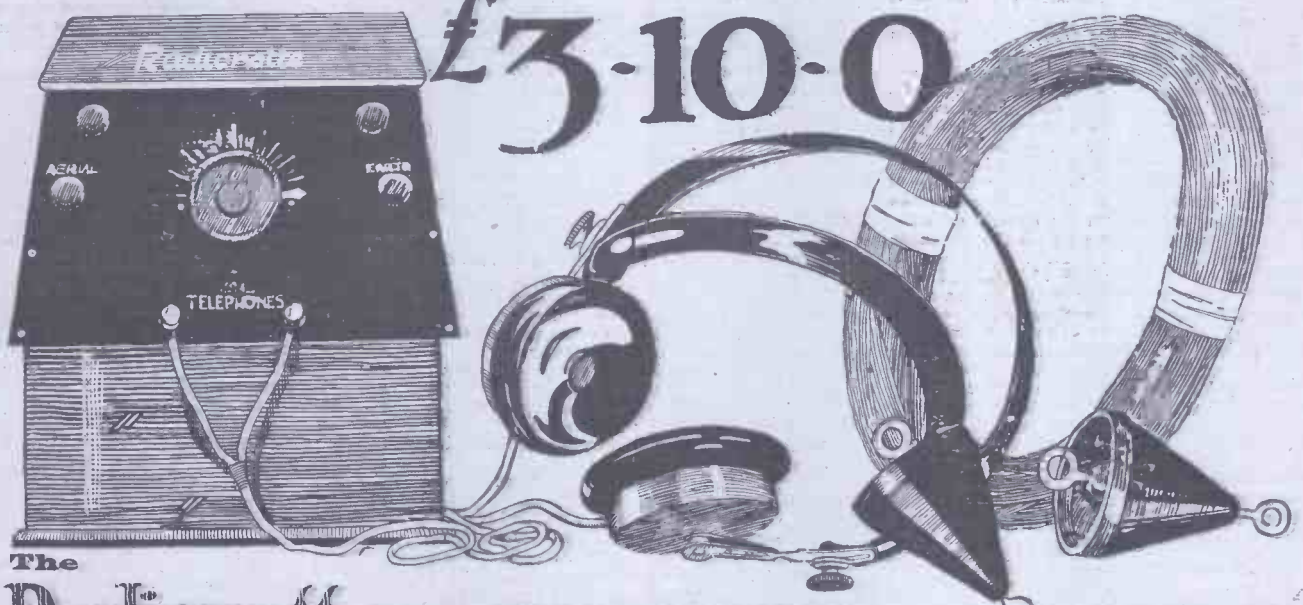

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Yours faithfully,

Name .....

Address .....

(Please write clearly.)

WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

Hackney and District Radio Society.*

The above society held its usual weekly meeting on Thursday, February 15th, at its premises at the Y.M.C.A., Mare Street, Hackney, the chairman, Mr. A. E. Epton, presiding.

After the formal business had been dealt with, when several new members were elected, three "waistcoat pocket" talks were given by members of the society on their experiences with radio. Mr. Kiernan gave details of interesting experiments he had carried out by the extension of telephone leads to distant rooms in his house, and their utilisation for both transmitting and receiving of telephony in the house. He demonstrated with a couple of ordinary watch earpieces connected together. One was taken out of a room, and a conversation was carried on by two members of the society by means of these earpieces.

Mr. Francis then gave a short talk on a simple plan for utilising D.C. mains for charging accumulators. His plan consisted in breaking one of the two main switches, and attaching thereto an ordinary d.p.d.t. knife switch, one end of same being shorted and the other connected by the two accumulator terminals. He was bombarded with quite a number of questions, and gave the usual warning of standing on a piece of wood or other non-conducting material when playing about with the electric mains.

Mr. Bell put a problem before the members. He stated that he had fixed a crystal set at home, using a short piece of insulated wire hung up in the room as an aerial, and an earth wire attached to the nearest gas pipe. Signals came in quite nicely. When the earth wire was detached, signals faded away, the same occurring when the aerial wire was detached, but when the aerial was detached and the gas-pipe-connected earth wire was detached from the earth terminal and attached to the aerial terminal, and the earth terminal left unconnected, the signals were quite as strong as with both aerial and earth. Several theories were expounded, but no satisfactory solution was given. Perhaps the readers of this report may be able to throw light on this apparent mystery?

Hon. sec., Chas. Phillips, 247, Evering Road, Upper Clapton, E.5. (Letters only.)

The Radio Society of Highgate.*

A very attractive programme of lectures has been drawn up for the next three months, and includes a special series of lectures on the elementary theory of wireless reception, and the construction of apparatus suitable for the reception of broadcasting. These lectures are being given on Fridays, at 7.45 p.m., at the 1919 Club, South Grove, Highgate, and should prove of great interest and assistance to all those who are taking up, or thinking of taking up, wireless for the first time. Lectures of a more advanced nature are also being given.

A complete programme of lectures, and full particulars of the society, may be obtained from the hon. secretary.

Hon. sec., J. F. Stanley, B.Sc., A.C.G.I., 49, Cholmeley Park, Highgate, N.6.

Exeter and District Wireless Society.

At the meeting of the above society at 31, Longbrook Street, Exeter, on February 12th, a lecture was given by Mr. W. Smitham on "The Principles of Wireless." After a brief account of the transmission of wireless waves through the ether, and a description of the various detectors which have been used up to the present, Mr. Smitham went on to describe the various means of amplification, illustrating them with diagrams. A discussion followed. Any person wishing to join the above society is invited to communicate with the secretary.

Hon. sec., F. S. Valentine, 10, College Avenue, Exeter.

Swansea and District Radio and Experimental Society.

The Swansea and District Radio Experimental Society recently organised and held Swansea's first wireless exhibition, which was a huge success and was attended by many people.

The exhibition was held for one day only, but really should have been for three or more days.

The opening ceremony was conducted by Mr. John Lewis, the deputy mayor, who took the place of the mayor, who was at a St. David's Day function.

A very encouraging opening speech was given by the president, Capt. Hugh Vivian, and a hearty vote of thanks was accorded to the deputy mayor, proposed by a vice-president of the society, Mr. Kirkman, B.Sc., A.Inst.P., Fellow of Phy. Soc., Lond.

Beckenham and District Radio Society.

A most interesting lecture took place at the above society's headquarters on Thursday, March 1st, by Lieut. Walker (2 O M).

Great appreciation of the evening's programme was shown by all present.

It is hoped to have a number of well-known amateurs lecturing in the near future.

Sec., Mr. J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

Isle of Man Radio Society.

A meeting was held on Monday, February 12th, at the secondary school. There were eighteen members and two visitors present. In the absence of Mr. T. H. Colbourn, Mr. A. L. Downward presided. At the conclusion of the preliminary business, the chairman called upon Mr. Gillmore to address the meeting. Mr. Gillmore dealt with the subject of primary and secondary cells. He explained that when two dissimilar metals were moistened by acidulated water and brought into contact with each other, they would generate an electric current. Continuing, he explained the action of the Fuller, Bunsen, Daniel, and Leclanché cells. He emphasised the importance of a depolarising agent in the construction of a cell if it were to be of any practical utility. Mr. Gillmore then passed on to the secondary cell or accumulator. Before concluding, the speaker gave some hints for the successful operation of accumulators in the hands of amateurs. Next week Mr. J. P Johnson will speak on "The Use of a Single-Valve Set."

Joint hon secs., Mr. J. S. Craine, 6, Belmont Terrace; Mr. J. P. Johnson, 16, Hildesley Road, Douglas.

The Liverpool Wireless Society.*

The annual general meeting of the Liverpool Wireless Society was held at the Royal Institution, Liverpool, on Thursday, January 25th, Mr. E. B. Grindrod in the chair. There was a very good attendance.

The secretary read a report of a special impromptu meeting of the society, which met to discuss the question of a new and up-to-date receiver, and it was unanimously decided that the society's present apparatus now being somewhat prehistoric (the society having been established pre-war), it was urgently necessary to have a special "whip round" the members for the necessary funds. One of the members present very kindly offered to provide the greater portion of the necessary funds and guaranteed a cheque for £50, which was handed over the following day. Promises were also made by the members present at this impromptu meeting to the extent of £23, and the secretary was then instructed to write to the members not present inviting them to join in the subscription list. As an expression of appreciation of the generosity of the principal donor, Mr. C. R. Honiball, this gentleman was elected the first honorary life member of the society.

RADIOTORIAL

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

THE LICENCE QUESTION.

In this issue of POPULAR WIRELESS will be found several letters from readers on the vexed question of home-made sets and the rights and wrongs of "dodging" the licence fee.

The letters published represent only a fraction of the correspondence I have received on this question during the last week or so. In touching on the subject in a recent number, I seem to have stirred up a veritable hornets' nest of outraged amateurs—and, quite frankly, I am delighted.

This delight is hardly unseemly, because it proves quite clearly that a large percentage of my readers are really keen on wireless as a serious hobby. They are not merely "playing about." They evince a keen desire to advance in their study of wireless, and quite rightly, they cannot do this to any degree of satisfaction without getting the necessary experience by building their own gear.

Probably many applicants for experimental licences have noticed that their applications have recently been ignored. I regard this as a good sign, for it shows that the whole question of granting licences—other than the B.B.C. variety—is under serious consideration. In fact, I am unofficially informed, from a very reliable official source, that the question of issuing a new class of licence is practically a foregone conclusion.

Some correspondents ask what I would do if I was in their position. As the Editor of this paper I can hardly publish what I would do. I cannot say: "Go ahead, and build your set, and risk the consequences." I feel sure every reader will appreciate that. Because Editors have to be very careful indeed when it comes to advising their readers to break the law. All I can say with safety is that every potential maker of a set has my sympathy and best wishes for the rapid issue of home-made set licences. I believe this class of licence is not only essential if wireless is to stay as a permanent hobby, but that its general effect would be to the ultimate benefit of manufacturers and to the B.B.C. Manufacturers should specialise in the production of useful component parts as well as complete sets. And if the fee for the "home-made set" licence is increased in fair proportion, the B.B.C. will not lose.

I may say that I have sent a letter to the Postmaster-General informing him of the widespread desire of readers of POPULAR WIRELESS to build their own sets, and urging him to facilitate the granting of the "home-made set" licence. In fact, I am doing everything in my power to assist in drafting out some plan whereby the amateur is allowed to make his own gear without detriment to the revenue of the B.B.C. Let us hope something will come of it, and quickly at that.

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, The Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send the necessary postage for reply.

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

A. M. L. (Norwich).—I have plenty of room for an aerial of the full height and length allowed by the P.M.G., but do not quite know what type to erect. Would a "sausage" or cage aerial be suitable?

You do not state the nature of the transmissions you most wish to receive. If you are merely interested in broadcast telephony we would advise the use of a single aerial about 30 feet high. If you intend to devote your time more to the reception of longer wave-lengths a twin aerial or even a sausage aerial will be most suitable. The sausage type is not as a general rule to be recommended for reception of low wave-lengths if you can have anywhere near the total measurements allowed for an aerial. The high natural wave-length of this cage aerial renders it difficult to tune down below about 300 metres if the aerial is of any size. For experimental work the low wave-lengths will provide ample scope for investigation, as the transmissions of amateurs on 180-200 metres are very useful for when testing out circuits. We would advise you to stick to the single type of aerial if you wish to get the best results in telephony reception.

* * *

A. B. (Argentine).—From what distance can a single valve receive telephony?

This question needs a great deal of qualifying before it can be answered. If the valve is used without reaction, about 40-50 miles is a good range. With reaction it will often exceed this, and has been known to give results on telephony over thousands of miles. American broadcasting has been heard in England on a one valve set. These results are, of course, not usual and depend largely upon the conditions prevalent at the time. The power of the transmitting station will also have a great effect on the range of reception of the set. Roughly speaking 50-70 miles for good reception of telephony on low wave lengths should be a fair result using one valve and reaction, the transmitting station using about one to one and a half kilowatts. The height of aerial, etc., of the receiving station will, of course also effect matters, but the above should be possible on all single valve reaction sets, using moderate aerials and during average conditions. Without reaction 35-45 miles is a fairly good result.

* * *

F. T. H. (Palmer's Green).—If I use a basket coil for a tuned anode coil, what value should it be for 2 L O, assuming that the reaction will be acting upon it?

For broadcasting wave-lengths you will find that basket coils of about 40 turns for both the reaction and the anode will be somewhat near the mark. Wind the coil with fairly stout wire—about 26 D.S.C.—using nine spokes and a one inch centre hole.

* * *

M. P. D. (Cornwall).—I have a 3-valve set, and have just burnt out a valve by letting the H.T. voltage get across the filament. Is there no safeguard that can be used?

There is a fuse on the market, we believe, but you will find that a small 2·5 volt pocket-lamp placed in series with the high tension battery will form quite a good fuse.

* * *

J. J. T. (Manchester).—Asks for a criticism of a one-valve and crystal set.

As you are employing the valve as an H.F. amplifier you will find that the crystal circuit will need to be tuned if efficient results are to be obtained. For broadcasting, a basket coil of about 38 turns on a one inch former will be somewhere near the mark if used as the anode coil. A variable condenser of about ·0002 mfd. maximum should be shunted across the coil; the tuning will be found to be very sharp. Yes, you can use silicon for the crystal, but we think you will obtain better results if you employ some form of treated galena, such as Hertzite or permanite. You are wrong in inserting a grid leak and condenser. The leak is only used for rectifying valves, or as an earth leak in front of an H.F. valve coupled to the tuned anode coil of a previous H.F. valve. You will not need a battery and potentiometer for the crystal if you use one of those named above. The choice of valve is not very important, as long as you do not use a very soft one. An "Ora" will do quite well, or any valve that can be used for amplifying. No, those Dutch valves are only useful for detectors, as they are very soft. A plate voltage of 60 should be ample, probably you will not need as much as that. Yes, it is better to have filament rheostat, as a very little difference in filament current may mean all the difference between good and bad results. A 6 volt 40 amp. accumulator is ample.

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from previous page.)

A. P. L. (St. Albans).—I have recently burnt out a valve and have replaced it by one of a different make. I find the results are not nearly so good, have I got a poor valve? The make is Mullard Ora.

The valve is probably quite a good one, but as you have changed the type of valve you will most likely find that a different value of grid leak will be necessary. Different valves need an alteration in the value of the leak if you are to get the best out of the valves.

* * *

"EDONA" (Shrewsbury).—I have a 3-valve set, and wish to use different H.T. potentials on the various valve plates. Can this be done, using the one H.T. battery?

Yes; this is quite easily accomplished. Instead of taking the transformer primaries to a common H.T. lead, take each one to a movable plug. These plugs are inserted into the H.T. battery at the various points most suited to the separate valves. Of course, separate H.T. batteries can be used, though this is not necessary.

* * *

"AMATEUR" (Co. Down, Ireland).—I have a loose coupler type crystal set. Can I add to it so that I could hear 2 L O?

Yes, you can add to the set fairly easily. You would need at least two H.F. amplifying panels and probably an L.F. amplifier as well. On the whole, as the set is not of a particularly efficient description as you now have it, you would do better to dismantle it and either make up a 2-H.F., crystal and 1 L.F. set, or a four-valve set. You will find the articles by Mr. Hersey, which appeared in our issues Nos. 26, 34 and 35, of great assistance. These articles describe a unit set which is very useful, as any number of valve panels may be added at will.

* * *

"SECOND YEAR" (Nr. Burnley).—I am thinking of building a dual-amplification set, using one valve and crystal. What size coils do I need? Can I use honeycomb coils?

Yes, for the A.T.I. and the secondary you can use coils of about 35 and 50 turns, according to the wave-lengths you require.

* * *

What H.F. transformer do I need?

A plug-in transformer will be quite O.K. Use one to cover the necessary wave-lengths, and tune it by means of a variable '0002 condenser across the primary. See our issue of No. 36 for the construction of H.F. transformers.

* * *

What voltage do I require on the anode?

About 45 to 70 volts. This depends upon the type of amplifier used. Remember that you need a valve that will amplify. It is no use obtaining a soft valve, which will be only useful as a detector.

* * *

What size aerial do I need, and do I need two variable condensers?

Use the ordinary standard P.M.G. aerial. You need three variable condensers altogether, one for the primary A.T.I., one for the secondary, and one for the H.F. transformer. You will find that the circuit needs some experimenting with before good results are obtained.

* * *

R. B. W. (Glasgow).—What size coil do I need for 300 to 440 metres? What capacity should the condenser be? Need the earth wire be insulated?

A coil of about 60 turns of 22 d.c.c. on a 3 inch diameter former should prove satisfactory. The condenser should be about '0005 to '001 and is best connected in series between the coil and the aerial. The earth lead need not be insulated. This is because all that the lead is likely to touch is already earthed, and would thus only help the oscillations on their path. In the case of the aerial we want the oscillations to go through the set, and thus no path to earth must be provided. Hence the need for highly insulating the aerial.

* * *

A. B. C. (Hampstead).—I am thinking of building a small portable crystal or one valve set. Can I use variometer tuning, using basket coils? If so, how large should they be for 350–450 metres?

The use of basket coils for variometer tuning will give quite good results. We presume you intend to

(Continued on next page.)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from previous page.)

let them slide, one over the other, in a flat position. You can use a thin cardboard former for each, having about 9 slots and a centre diameter of 1 in. to 1½ in. Winding with 26-d.c.c., about 42 turns on each coil will be sufficient. The coils are, of course, connected in series with one another, and in series between aerial and earth. No, you do not need a variable condenser.

* * *

S. C. S. (Haywards Heath).—Is it possible to burn out a valve on four volts? The one I use is an "Ora," and no filament resistance is provided on the panel.

With the type of valve you mention and others of fairly similar characteristics there is no danger of doing so, but you will find that using just the one valve the full four volts will not be required, and by not including a filament resistance you will be wasting a certain amount of current, quite apart from the question of efficient results. With regard to this latter you will discover with a filament resistance that there is a more or less critical adjustment for the filament temperature of a valve where either a decrease or an increase will result in a falling off of signals. It is only possible to discover this point by means of a filament resistance.

* * *

"PUZZLED" (Northampton).—Why is it that a crystal will only allow current to pass through in one direction?

The action is thermo-electric—in other words, an electrical effect produced by the generation of heat at the point of contact between the crystal and the other element of the detector.

* * *

F. M. (London, E.).—Could not wireless messages be sent by means of a machine that would send them in the form of a code only decipherable by some specially set receiving apparatus quite apart from the question of wave-length? Something like, for instance, a Yale lock and its key.

Such a scheme for transmitting messages by code only decipherable by the receiving instruments at the one particular station has already been introduced in Sweden, and it is intended to operate by this method between the new high-powered station at Grimetown, near Gottenburg and the other Scandinavian countries and America. This system, styled the Cryptographic wireless telegraph, automatically turns the telegrams into secret code at the sending station and transfers them into straight text at the receiving station.

* * *

R. T. R. (Bampstead).—What is the "peanut" valve?

An American valve of small dimensions that will function quite well on a 1·5-volt dry battery filament supply.

* * *

W. S. P. (Hanley).—I am 30 miles from Manchester. Could I hear it on an aerial 35 ft. high and 60 ft. long with a crystal set?

We are afraid that, although with fine adjustments it would be possible, it is very doubtful.

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from previous page.)

L. F. (Birmingham).—Which makes the best earth—copper gauze, copper plate, or copper piping ?

We should use the copper gauze in preference to either of the two others. Bury the gauze as deep in the earth as is practicable, in a horizontal position, though this is not very important.

* * *

"DUMMY" (Blackburn).—I have a coil wound for 12½ in. with 26 enamelled wire. What is the wave-length if the coil is 4½ in. in diameter ?

About 300 metres to 3,400 metres, using an average-sized aerial.

Do I need a condenser for tuning this coil ?

You would not be able to tune the coil solely by means of a condenser. The coil should either have a slider or be divided up into a number of tappings taken to studs and a switch arm. The condenser could then be employed to give you fine tuning. A variable condenser of about ·0005 mfd. would be quite large enough.

* * *

"AMPLIFIER" (Burnley).—What would be the ranges in miles for telephony reception on a crystal set using (*a*) H.F. amplification, (*b*) L.F. amplification ?

Roughly speaking, if H.F. amplification were used without reaction, as would be necessary if only one valve were employed, the range would be approximately 50 miles maximum. With one L.F. amplifier, a crystal set will only receive telephony up to about 30 miles as a general rule. With good conditions and efficient sets, these ranges are, of course, sometimes exceeded, while in many cases the opposite occurs.

* * *

"IGNORAMUS" (Windermere).—I should like to be able to hear all the broadcasting stations on telephones and, say, one or two on a loud speaker. What set should I require ?

You would need quite four valves, as you are a considerable distance away from even the nearest station. For reception of London on telephones, one H.F., one Det., and two L.F. valves should be O.K. You may find that for Manchester and Newcastle—your nearest centres—another L.F. valve is needed in order to operate a loud speaker successfully. Why not build the set up by units ? You can then add valves at will, and need only use the number of valves you require for any one station. See our issues Nos. 26, 34, 35 for a useful unit set.

* * *

"PATENSE" (Drayton Park).—How long should the earth wire be ? If I lengthen the phone leads, will it interfere with reception ?

Keep the earth lead as short as possible. In any case, use thick wire for it ; 7/22 copper wire, as used for the aerial, is about the best. No, the lengthening of the phone leads will not reduce the signal strength if they are not made too long. Use ordinary lighting flex for this purpose.

* * *

P. N. (Dulwich).—Which will be the most efficient for an eight-mile range for loud-speaker work—a two-valve set employing one L.F. or a crystal detector with 2 L.F. stages of amplification ? Is there any reason why I should not use a crystal detector, thereby saving filament current and being able to use another stage of amplification with the same consumption ?

For loud-speaker work, a crystal detector with two L.F. will be much more efficient than just two valves. Using a good stable crystal detector, carborundum and steel with a battery and potentiometer for preference, there is no objection at all to such a valve-crystal combination ; in fact, we have always had a distinct inclination to the employment of a crystal detector in most valve circuits. Naturally, from time to time even the most stable of crystal detectors will require a slight readjustment, and for this reason those amateurs who can afford to bear the slightly increased initial and running expenses, and possess fairly comfortable available charging facilities, prefer the valve detector.

Will dull emitter valves function as amplifiers with valve or crystal detectors ?

Yes.

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

"COSMOS" (Dunedin).—Is a grid leak necessary in an amplifying circuit?

Generally speaking, a grid leak is employed only on the grid of the detector valve.

* * *

H. F. R. (North Mount Vernon).—Do ether waves travel through or over mountains?

To a greater extent they are presumed to travel over them, although they have been proved to penetrate to varying distances into the earth and through such projecting natural obstacles.

* * *

Do intervening mountains affect the strength of wireless messages?

Yes, in certain circumstances very considerably. For instance, a mountain can have a "shielding" effect to stations closely overhung by them, although it is not noticeable in every individual case.

* * *

What geographical conditions affect wireless messages most?

The proximity of rivers and the sea, more especially when such lay directly between the transmitting and receiving station, we should think, unless inversely the nature of the natural conformation of the intervening areas will more aptly and adequately answer that question. Wireless waves will more easily radiate, or radiate with less loss in energy, through absorption over water or moist ground. Naturally, large deposits of metal ores will tend to reflect ether waves and cause inefficiency in wireless communication with a point so affected.

* * *

"AMATEUR" (London).—I get strong signals on my super-crystal set, and am thinking of adding an L.F. amplifier for a loud speaker. Will this be O.K.? Would an old gramophone horn do?

If the signals are unbearably loud when you have the amplifier fitted, the set should be capable of working a small loud speaker. You will be able to adapt a gramophone horn fairly satisfactorily for use as a loud speaker. Of course you will still have the gramophone effect, and the apparatus will not give such pure tones as are obtained by the use of ordinary headphones.

* * *

B. J. F. (Tottenham).—I have constructed the crystal set described in POPULAR WIRELESS recently, and would like to increase the wavelength. Can I do this?

Yes, quite easily. Place basket coils (loading coils) in series between the aerial lead-in and the aerial terminal of the set.

* * *

"AERIAL" (Muswell Hill).—I have my aerial arranged on pulleys, so that I can let it down when required. Ought I to clean it at all?

If the aerial wire that you are using is the bare 7/22 copper, a periodic clean will do good. If the wire is insulated, or, rather, protected, by enamel, there is no need to clean the wire. In any case, the insulators should be examined periodically and the accumulated soot and dirt removed. A little vaseline smeared round the insulators will help to preserve good insulation during wet weather. If the aerial wire is of the bare variety, a little cleaning up of this will also help to improve your results. The oxide which coats the wires will resist the passage of the oscillations, and thus weaken your signals. Rub the wire from end to end with fine emery paper until the copper is once more bright. The same should be done to the down lead.

* * *

"INTERFERENCE" (Dorking).—Is there any really satisfactory method of telling when your set is oscillating?

Unless you have a milliammeter in the aerial you will not be able to tell if your set is oscillating slightly. If the signals are distorted you may be sure oscillation

(*Continued on page* 140).

The *whole* programme or snatches!

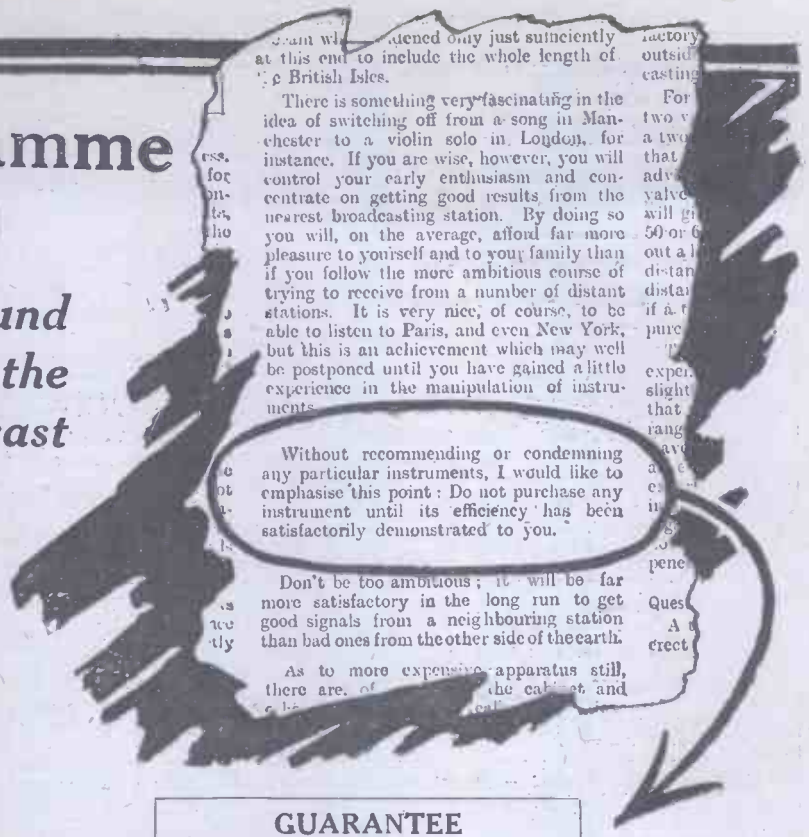
Read what Capt. Round says about receiving the long-distance Broadcast Concerts.

In an interesting article in POPULAR WIRELESS, Capt. Round—the well-known Radio Engineer—made pointed references to the mistaken desire possessed by some listeners-in for picking up every possible Broadcasting Station.

To design an instrument to do this is easy, but such a set would not be so easily controlled as the BROADCAST MAJOR, which is operated by *one dial only*. In addition, atmospherics, jamming by other stations, etc., would make listening-in anything but a pleasant occupation.

It is our experience that, while the enthusiastic experimenter finds it an absorbing pastime to obtain snatches of song from a station several hundreds of miles away—amid the interruptions of the ether—the average person is quite content to listen to the *whole of the programme* broadcast from the nearest centre.

This is exactly what the BROADCAST MAJOR is designed to do. It gives volume and purity of tone, which will be a pleasurable surprise to those who have had to strain their ears to catch the tinkle of a crystal set.



...ened only just sufficiently at this end to include the whole length of the British Isles.

There is something very fascinating in the idea of switching off from a song in Manchester to a violin solo in London, for instance. If you are wise, however, you will control your early enthusiasm and concentrate on getting good results from the nearest broadcasting station. By doing so you will, on the average, afford far more pleasure to yourself and to your family than if you follow the more ambitious course of trying to receive from a number of distant stations. It is very nice, of course, to be able to listen to Paris, and even New York, but this is an achievement which may well be postponed until you have gained a little experience in the manipulation of instruments.

Without recommending or condemning any particular instruments, I would like to emphasise this point: Do not purchase any instrument until its efficiency has been satisfactorily demonstrated to you.

Don't be too ambitious; it will be far more satisfactory in the long run to get good signals from a neighbouring station than bad ones from the other side of the earth.

As to more expensive apparatus still, there are. of ... the cabinet and ...

Catalogue of Radio Components and full list of Amateur Transmitting station.

3d. post free.

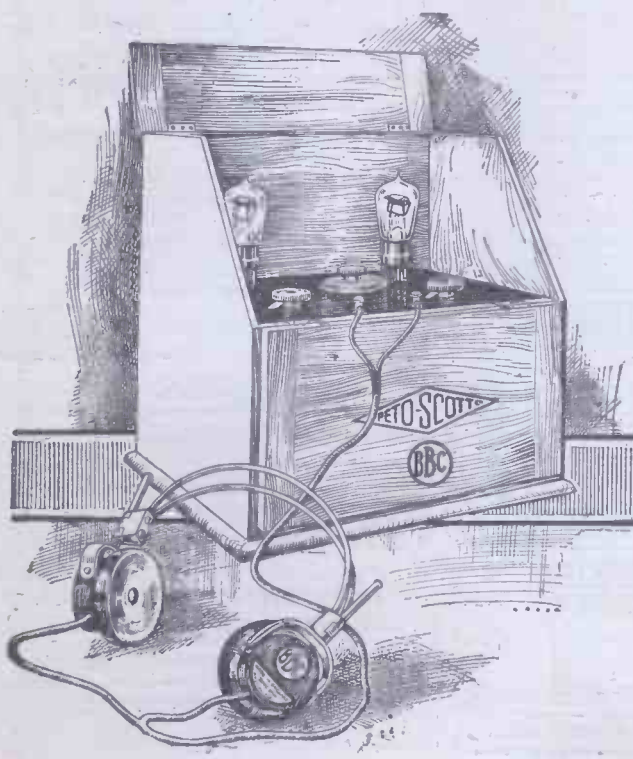
GUARANTEE

We guarantee that every Instrument is actually tested on our own Aerial and that it must give you complete satisfaction after a seven days' test in your own home or money willingly returned in full.

Broadcast Major

(Passed by P.M.G.)

The simplest Receiving Set you can buy. All wave-lengths from 300-500 metres—**the concert wave-lengths**—being obtained by the rotation of a single dial. Even a child can use it successfully. Has a range of 25-30 miles from any of the B.B.C. stations—London, Manchester, Birmingham, Cardiff, Newcastle and Glasgow. Solid Oak Cabinet, hand-polished throughout and fitted with nickel-plated piano-type hinges.



EQUIPMENT SUPPLIED.

The following equipment is supplied without extra charge with every instrument. One Accumulator—6 volts 40 amp. hours. One H.T. Battery—60 volts, both made specially for us. One pair of Western Electric Headphones, Two efficient Insulators and a coil of Aerial Wire.

Ready for immediate use—nothing more to buy.

¶ When this Set is required for use with Broadcast Licence, a royalty to B.B.C. of 35s. must be paid at time of purchasing. The royalty of 25s. due to Marconi Co. is being paid by us.

COMPLETE

£9:9:0

VALVES 15s. each extra

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Featherstone House,

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RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 138.)

is occurring, or if you hear a loud "pop" when you touch the grid connection of the first valve, and when you remove your finger. This is not an infallible test, but, combined with the distortion of signals when the set is oscillating, it forms a useful guide.

* * *

E. L. (Cirencester).—I cannot erect an outdoor aerial, so contemplate an indoor one of eight parallel wires across the room (12 ft.) about 3 inches below the ceiling. Will this be O.K. ?

You should get fairly good results from this if you keep the wires as far apart as possible. We advise the use of about six wires, as eight is rather a large number. Keep the wires well insulated and about 6 inches below the ceiling. You will need one or two H.F. valves to enable you to hear any broadcasting. Use the usual earth connections and tuning coils, of course.

* * *

A. P. (Glasgow).—What experience and training do I need to become a wireless operator on board ?

You will need a fairly good theoretical knowledge of wireless, both telegraphy and telephony, and some practical knowledge of the use of the various sets now installed on ships. Your best plan would be to join some wireless school and work up for the P.M.G. first-class certificate, which is necessary if you wish to become a wireless operator.

Is the dull emitter valve provided with a gas-filled bulb instead of a vacuum ?

No; it is provided with the usual "hard" vacuum, but has a special filament so constructed that it will emit electrons freely at a low temperature. An article dealing fully with the dull emitter valve appears in this issue of POPULAR WIRELESS.

* * *

E. B. (Wanstead).—*Re* the super crystal set described in No. 38 of POPULAR WIRELESS, what do the terminals A and G and sec. for V T stand for ?

A is for the aerial, G for the earth (Ground), and the two terminals V T for the insertion into the circuit of a valve if required (Vacuum Tube). If this latter development is not contemplated those two V T terminals can be wired in series with the phone terminals in order to provide accommodation for an additional pair of telephone receivers.

* * *

S. A. (Leytonstone).—At present I have a single slide coil, and receive quite good results from 2 L O. Will it improve matters if I add another slide ?

As your results are, as you state, quite good, we would advise you not to attempt to modify your present set. We do not think that you will find any appreciable improvement by adding another slide, as you will not be experiencing any jamming from ships, etc., in which case the addition of another slide, providing as it does a closed circuit autocoupled, proves slightly beneficial.

* * *

F. N. (Loughboro'.).—What make of valve is a C.V.C., and what current does it require ?

This is a Cossor product, and requires 3·5-4 volts for the filament and 20-30 volts on the plate.

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"Clear as a Bell."

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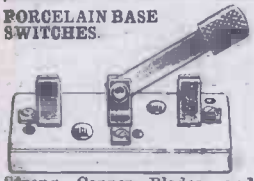

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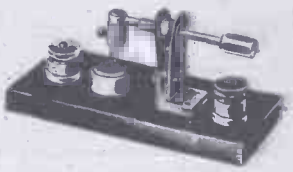

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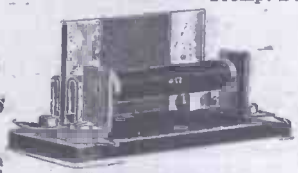

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T/Y

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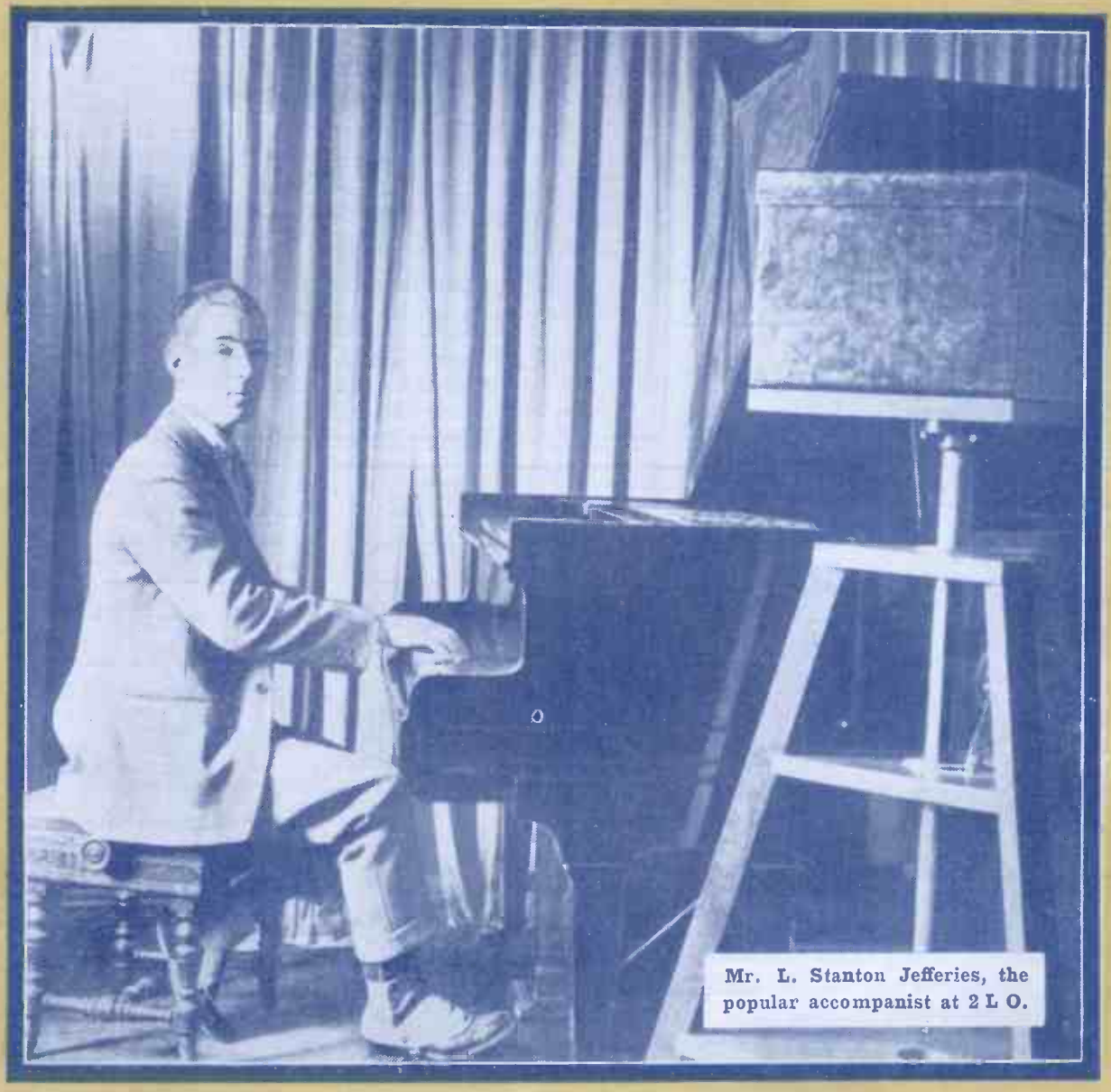
R/Y

POPULAR WIRELESS WEEKLY, MARCH 24th, 1923. REGISTERED AT THE G.P.O AS A NEWSPAPER.

WIRELESS QUESTIONS ANSWERED FREE.

Popular Wireless

No. 43. Vol. III. PRICE THREEPENCE WEEKLY. March 24th, 1923.



Mr. L. Stanton Jefferies, the popular accompanist at 2 L O.

FEATURES IN THIS ISSUE.

A Broadcast Receiver.
The Electron.
Atmospherics.
The Glasgow Station.
A Large Capacity Condenser.
The Licence Question.

A Four-Page Beginners' Supplement and Articles by Sir Oliver Lodge and Lt.-General Sir Robert Baden-Powell.

POPULAR WIRELESS

March 24th, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S., D.Sc. [Every Friday.

TOPICAL NOTES AND NEWS.

A "Shocking" Business.

POPULAR WIRELESS stall at Olympia had rather a hectic time of it the other day.

Pending the arrival of Major Phillips's wireless controlled train, a spark coil was rigged up and a large bowl of water placed on a front bench. A handful of silver at the bottom of it attracted a large crowd—but the shocks they received when trying to grab the money brought over a larger one. Somebody was lucky enough to scoop 6s. 6d. at one shot—very nearly broke the bank—and another—a lady—managed to lift 4s. 6d., and went away with the anticipation of an orgy at Selfridge's shining in her eyes.

Anyhow, it was good fun and the "shocks" received by various brave and daring visitors were scarcely uncomfortable.

* * *

Notes on Cardiff.

Instead of the double aerial now in use, one of the sausage type is shortly to be erected. This will increase the radiation.

A new Steinway piano and a Welte reproducing cabinet have been installed at the station.

By kind permission of the management of the Capitol, Cardiff's magnificent picture house, Miss Lilian Davies, the Cardiff singer who achieved such success in the title role of "Polly," was lately enabled to delight those of her townspeople who possessed receiving sets.

Broadcasting from 5 W A has been heard in Southwold and Cromer on two valves, and as far as Northumberland on three. Reports on the quality of transmission will be gladly received by the station director at 19 Castle Street, Cardiff.

* * *

Cinema Loud Speakers.

THE Capitol Cinema, Cardiff, has been equipped exclusively with Magnavox Loud Speakers. This Cinema is said to be the largest in Great Britain, having a seating capacity of over 3,000, and owing to the efficiency of the equipment the Wireless Concerts can be heard in every seat.

* * *

The Manchester Exhibition.

THE Manchester All-British Wireless Exhibition and Convention at the Burlington Hall, Manchester, has proved a great success. The needs of the public are being very thoroughly catered for and every possible step is being taken to appeal to the interests of the purchasing public by means of practical demonstrations, displays, and lectures.

* * *

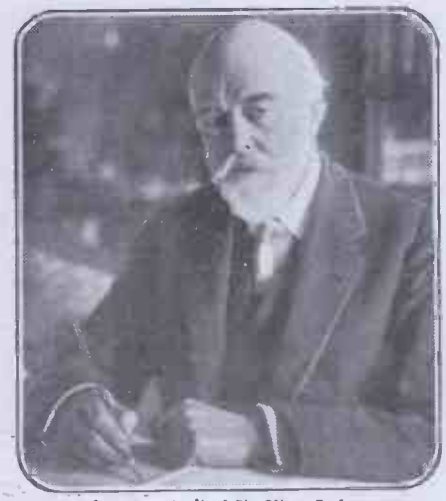
High-Speed Wireless at Sea.

FURTHER wireless facilities for passengers travelling between Europe and America on the giant White Star liner "Majestic" have just been provided by The Marconi International Marine Communication Company, Ltd.

A short time ago the "Majestic" was fitted with high speed wireless transmitting apparatus; and high-speed automatic receiving apparatus has now been added in order to facilitate the handling of the ever increasing quantity of wireless messages dealt with by this vessel.

Not only is the "Majestic" the largest ship afloat but it is also a favourite with business men. Its wireless traffic exceeds that of any other ship, and special facilities are required to deal with telegrams expeditiously.

The high-speed transmitting apparatus has proved of great value in despatching the



A new portrait of Sir Oliver Lodge.
[*Photo Hoppe*

large number of messages which are sent when approaching the United States; and the fitting of automatic receiving gear will be of still further advantage in enabling the ship to maintain its high reputation for the expeditious handling of telegrams.

During the "Majestic's" first voyage to New York with this apparatus on board messages were recorded at high speed over a distance of 700 miles.

* * *

A Radio Duel.

A GERMAN wireless station has lately been broadcasting concerts and propaganda for the special benefit of Germans in the Occupied Territory.

To the concerts the French authorities had no objection, but they decided upon measures to interfere with the propaganda side of these nightly programmes.

The other night Eiffel Tower won the first round of the duel. After listening-in to a few musical items, F L, on hearing "news from the Ruhr" announced, started to "jamm." The result was charming.

F L acted similarly, and with as great success, when a German artiste began to sing "Deutschland über Alles."

* * *

Various Items.

In response to a request by the editor of "Fire" a special wave-length of 320 metres has been allotted for fire service wireless communications.

* * *

The British Broadcasting Co. have received a letter from a correspondent in Massachusetts, who claims to have picked up London (2 L O) on February 20th, and listened to the last piece of music and the closing down. If the statement is correct this is the first time that the London station has been heard in America.

* * *

Sir William Joynson-Hicks stated, in reply to Mr. Foot, that the number of broadcast receiving licences issued up to February 28th, was 56,000, and the number of experimental receiving licences in force on the same date was approximately 30,000.

* * *

The Aberdeen Station.

THE Broadcasting Company have under consideration the erection of a station at Aberdeen, but it will probably be some time ere definite action is taken. The item that gave most pleasure on the occasion of the opening of the Glasgow Station was the bagpipe music. This was the result of a happy idea on the part of Mr. Reith, an hour or so before the opening ceremony.

* * *

Radio and Parliament.

THE B.B.C. have not yet given up hope of being able to broadcast the Budget speech in the House of Commons. Why any objections should be raised at all passes all understanding, unless it be feared by the Government that the "peace and tranquillity" of this happy land might be disturbed if this innovation was brought about. I hear on good authority that the progress of the Boat-race will not be broadcast this year.

* * *

Only Once a Week.

PROBABLY I shall be accused of being hard to please, but surely it is obvious that a good many people now using wireless sets would welcome one evening a week devoted to really good orchestral music? Take the success of the Queen's Hall promenade concerts. Third-rate stuff by a good orchestra—and 2 L O's orchestra is good—makes one inclined to switch off until it is over.

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

Room for Improvement.

THE Sunday programmes for 2 L O are probably the most popular with those listeners-in who like a reasonably good-class concert.

On weekdays, to my mind, the orchestral selections are not up to scratch. I have said so before, and many readers of POPULAR WIRELESS seem to agree.

The majority of the pieces played by the orchestra are by musical nonentities, and are not worth listening to. Let us have better orchestral selections, not necessarily "high-brow," but at least distinctive.

£5 FOR A CRITICISM.

The Editor will award a prize of five pounds to the reader who sends in the best postcard criticism of the B.B.C. Orchestral Concerts.

There is a good deal of argument going on nowadays to the effect that the music played by the B.B.C.'s orchestras is not generally popular, and that at least one evening a week should be devoted to good-class music. The Editor is anxious to obtain as many opinions as possible, in order to ascertain the true feeling of the majority of listeners-in.

This offer of £5 for a criticism of the orchestral music does not apply to the dance music played by 2 L O's orchestra or the orchestras at other stations. It applies only to the musical selections, the titles of which appear in the daily papers.

Criticisms should be sent to the Editor, "Popular Wireless," The Fleetway House, Farringdon Street, London, E.C.4, on a postcard, and should reach this office not later than March 31st.

Scotland Yard Experiments.

MAJOR VITTY, in charge of the wireless department of Scotland Yard, has had wireless telephony installations fitted on the roofs of one or two of the motor vans used by the "Flying Squad" of detectives.

The experiments aim at showing how far wireless can be used to co-ordinate various forces of police engaged on the same investigations, one being to connect by wireless two vans travelling in different directions.

* * *

Amateurs at Auction.

THE other day I dropped into a London auction room where a considerable amount of wireless gear came under the hammer. Most of it was ex-service apparatus, in, it must be added, a rather battered condition. The room was crowded and bidding was keen. I recognised quite a number of well-known amateurs intently studying catalogues, among whom was 2 S Z evidently determined to still further increase the quantity—although I can't say quality—of his gear. 2 S Z, by the way, seems to get better and better in point of quality of transmission. 9.30 on Sunday morning he tells me is his "open time," for tests with all who care to call him up.

Wireless Street Organ.

THERE was much jealousy amongst the piano grinders of Blackheath the other day, when what seemed to be a barrel organ, drawn by a small donkey, came along with a tiny aerial on top, and drew up beside them.

This was Messrs. Burndept's "Wireless Organ"—an ingenious contrivance which should prove a nice little "ad" for that enterprising firm.

* * *

"Merrie England."

APPLICATIONS were made to the Nottingham magistrates by several local publicans for licences enabling them to instal radio sets for the entertainment of their customers, but they were opposed by the Rev. Canon Field, as president of the Nottingham branch of the Church of England Men's Society.

He urged the real object was not of a beneficent character, but to increase the sale of drink by attracting a greater number of customers.

The Bench, without giving any reasons, refused the application.

Manchester and F L.

MANCHESTER broadcast station now retransmits the time signals from Paris Observatory every night.

These are received from the French military station at Eiffel Tower on a small aerial next to the transmitting aerial at Trafford Park, and automatically retransmitted on broadcast wave-length with a delay of only one three-hundredth part of a second.

Difficult technical problems had to be faced by the broadcasting engineers, but now Greenwich time can be heard accurately in a series of signals starting at 10.44 p.m.

* * *

Lessons by Radio.

A COURSE of lessons in wireless broadcasting is to be provided by Edinburgh Education Authority in connection with the continuation classes in Boroughmuir School.

"Listening-in" installations have been fitted up in the Vale of Leven and in Oban. In both places the programme from the Glasgow Station was heard quite clearly.

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.
London Broadcasting Station, Strand ..	2 L O ..	369 ..	11.30 to 12.30 every morning and usually every evening, 5 to 5.45 p.m.; 7 and 9.30, News; 7.15, Orchestra; 8.25 to 10.30, Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5 N O ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2 Z Y ..	385 ..	Every evening, usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5 I T ..	425 ..	Every evening, usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5 S C ..	415 ..	5 to 10 p.m.
Cardiff Broadcasting Station	5 W A ..	353 ..	5 to 10.30 p.m.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Paris	F L ..	2,600 ..	11.15 a.m., Weather Report; 6.20 to 7 p.m., Weather Report and Concert; 10.10, Concert.
Königswusterhausen ..	L P ..	2,800 ..	4 to 6.30 p.m.
The Hague	P C G G ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert).
Haren	O P V H	1,100 ..	12 o'c. and 16.50 o'c. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m., News Items; 5.15 to 6.10, Concert; 8.45 p.m., News Items; 9 to 10 p.m., Concert.
School of Posts and Telegraphs, Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45 to 10 p.m. Saturdays, 4.30 to 7.30 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

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

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

All times given are G.M.T.

WIRELESS AND THE BOY SCOUTS ASSOCIATION.

By LIEUT.-GENERAL SIR ROBERT BADEN-POWELL, K.C.V.O., K.C.B., C.B., C.V.O., LL.D., F.R.G.S.

Every Thursday the London station broadcasts a talk to Scouts, and the following article, specially written by the Chief Scout for POPULAR WIRELESS, will appeal to all Scout readers.

THE recent development of wireless broadcasting in this country has added yet another means of rapid thought-communication to those which we already possess. Within a very brief period science has bequeathed to us the land-line telegraph and telephone and the wireless telegraph. To-day we are witnessing the arrival of the latest gift of science—the wireless telephone.

Hitherto, the only avenue of approach to the millions who make up society has been through the Press. Never before in the history of journalism has such an organisation existed for the dissemination of news as the modern daily Press. Yet even that has its limitations. The best daily paper in existence can only convey its news at the speed of the newsboy who races down the street with it in the city in which it is produced, or of the train or aeroplane which carries it for distribution in country districts.

The wireless telegraph has, of course, for many years played a very important part in the commercial and industrial development of all civilised communities. Its value as a means of saving life at sea has, moreover, been demonstrated over and over again since the beginning of the present century.

The scope of its utility, however, though wide, has always been restricted by the fact that it can only be used as a means of communication between specially trained operators. This, of course, puts it outside the reach—or, at any rate, the interest—of the millions.

Its Uses in Organisation

The ordinary land-line telephone is free from these two drawbacks. It lacks both the unintelligibility of the telegraph and the comparative slowness of the newspaper. It enables a straightforward message, which needs no deciphering, to be transmitted almost instantaneously over hundreds of miles. But—once more there is an important limitation—the ordinary telephone cannot reach the ears of millions of people simultaneously.

In making it possible for this wonderful feat to be performed, the wireless telephone promises to exercise a more far-reaching influence over society than has been achieved by any other invention of modern times. Properly used and controlled by the individual and the State alike, it should prove a potent factor in welding the social, economic, and political interests that exist, not only among the individuals of this nation, but among the various nations that constitute this Empire.

Wireless telephony broadcasting, apart from its interest and value as a means of distributing news, music, weather reports, etc., is particularly suitable as an instrument of inter-communication and control in the service of such a widespread organisation as the Boy Scouts Association.

In every sphere of activity efficient organisation calls for the swiftest available means of transmitting intelligence from those in command to the members of the various sections and sub-sections under their control.

In the past even the quickest method of effecting this has always necessitated some method of "relaying" the information on from one department to another. When the different groups comprising the organisation are situated in all parts of the country, as in the case of the Boy Scouts Association, this relaying system leaves much to be desired at times, particularly in moments of sudden emergency. Wireless telephony provides a means of direct communications between all branches of the Association, and it is hoped, as opportunity offers in the future, to take fullest advantage of the facilities it affords.

Qualifying for Badges

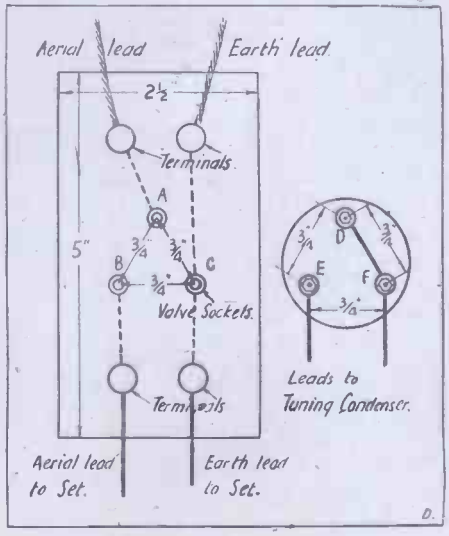
At present, in order to qualify for a *Telegraphist* badge a Scout must understand the elementary principles of a wireless telegraph installation. Many Scouts and Scoutmasters, of course, possess a very sound knowledge of wireless principles, and, moreover, are the owners of excellent portable outfits and amateur equipments. It is hoped, however, to inaugurate a much broader scheme for wireless instruction among Scouts in the near future. Now that so many new wireless societies are coming into being throughout the country, it may be possible to arrange for local Scouts to benefit by attending their lectures and demonstrations, etc.

An *Electrician* badge, involves a knowledge of how to make a simple electro-magnet, the action of simple cells, and the working of electric bells and telephones.

An applicant for a *Pilot* badge must, among other things, be able to fix positions by means of cross bearings, an operation which is, of course, constantly involved in wireless position-finding. This, incidentally, is a branch of wireless which should prove of special interest to Scouts. Equipped with a directional aerial and a suitable chart, a Scout should be able to guide himself over any area of the country by day or by night. Not only can he set his course from observation of the direction of received signals, but he can also check his position periodically by taking cross bearings on any number of the transmitting stations which are constantly in action.

A USEFUL EARTH SWITCH.

IT requires but little experience to realise the advantages of using the tuning condenser in series with the aerial when working on short wave-lengths. To rapidly change the condenser from series to parallel, a double-pole change-over switch is usually employed. As these are not simple to construct, I think the amateur will find the following method much easier, with the added advantage that an earthing switch is provided.



First cut out an ebonite panel about 5 in. long and 2½ in. wide. Then mark it off as shown in the diagram, and drill it to take four terminals and three valve sockets, taking great care that the holes for the three valve sockets are at equal distances from each other—*i.e.* forming the corners of an equilateral triangle. Now fix the terminals to the panel, and connect up at the back as indicated by the dotted lines. A hole may be drilled in each corner of the panel, and then it may be screwed down in any convenient position.

Next cut out a circular disc of ebonite and mark off three holes on it to correspond with the valve sockets on the panel. Drill these to take three valve legs, and screw the legs on the disc. Then connect two of these by a piece of copper wire and attach a flexible lead to the one and another lead to the other leg. These two leads are then connected to the tuning condenser.

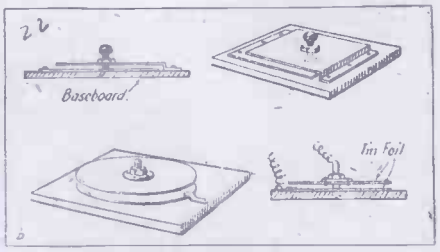
Now for the operation of the switching arrangement. If F is plugged into A, and E into B, the condenser is placed in series with the aerial. If F is plugged into A, D into B, and E into C, the condenser is placed in parallel with the aerial-tuning inductance. Finally, if D is plugged into A, and F into C, the aerial is earthed.

TWO SIMPLE VARIABLE CONDENSERS.

By A. W. D.

THE first is constructed out of two pieces of sheet zinc, about 6 in. by 4 in. The bottom sheet should have a hole drilled in the centre about ½ in. diameter, and a small hole at each corner to fasten it down. The top zinc will have to be bent at one end as shown in the diagram, so that when it is on its board it will just clear the under-sheet. A hole must also be made in the centre of this plate. Solder an ⅛-in. nut to this hole. All that remains to be done then is to mount the plates on a piece of well-waxed wood (ebonite would be better).

First tack the bottom plate on the board, and in the hole that was made in its centre



fasten a small piece of ebonite. This is for the point of the screw to engage upon when the top plate is placed in position. Now fasten the upper plate, being careful that the two plates do not touch, and in such a position that when an ¼-in. screw is passed through the nut it will engage on the ebonite underneath.

A small ebonite knob fastened on to the head of this screw will be an advantage.

The action of this type of condenser (book type) is that the thickness of the diclectric is altered by means of the screw.

The second condenser is of a similar type, but is made out of two gramophone records. The records are warmed, and paraffin wax evenly smoothed over their surfaces; then covered with tinfoil by warming the latter and pressing it on. It is not absolutely necessary that the foil should be in one piece, but if several pieces are used it should be seen that all make good contact with each other.

Contact with the Plates.

The bottom record is then fastened down to the base-board, and from underneath the board a ¼-in screw about 1½ in. long should be passed up through the centre hole in the record. If the hole in the board is made smaller than the screw, the screw will cut a thread in the wood and fasten in quite tightly. The top record will have to have a nut fastened to the centre hole, to enable it to be adjusted. The best way to do this is to cut a small disc of sheet brass, fasten this with solder to the nut on the disc, and then fasten the disc to the record with small brass pins.

It will be readily seen that the capacity is altered by means of screwing the top record up and down. Contact is obtained with the foil on the bottom record by means of a small piece of springy brass screwed to the board and pressing on to the foil. The contact to the upper record will, of course, be by means of the screw in the centre.

HOW TO MAKE A SERIES PARALLEL SWITCH.

A SERIES parallel switch is not at all difficult to construct, and will save the bother of changing over connecting wires. Perhaps there will be room to mount it on the panel, varying the dimensions to suit the available space.

Two pieces of thin sheet brass will form the selectors. These will have to be about 2½ in. long and ⅜ in. wide. Hammer them on a piece of flat iron to make the metal hard and springy, file out the hammer marks, and drill or punch two holes in each. One hole will be in the centre and one at the end. Next a small piece of ebonite, 1¼ in. by ¼ in. by ¼ in., will be required to form the cross-bar.

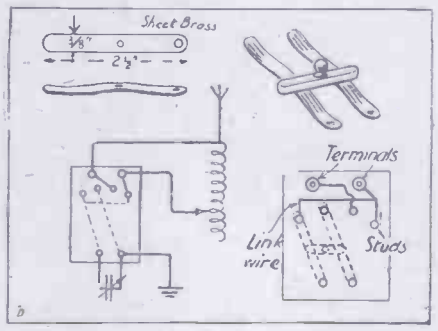
How it is Mounted.

Two small screws will fasten the brass to the cross-bar from underneath. The holes to take the two central contacts must be centred with the cross-bar screws, so that the selectors will move evenly. The diagram shows how to mount the parts, and how to connect the switch to the circuit.

The studs are made out of brass-headed chair nails, with pins long enough to go right through the ebonite. No. 1 and No. 4 studs are linked together with a piece of copper wire as shown.

It will be observed that when the selectors are right over to the left the aerial and condenser are in series, in the centre position the aerial is "earthed," and over to the right the condenser is placed in parallel. If mounted as shown in the diagram the base should be 3½ in. by 3 in. by ¼ in.

If it is desired to mount the switch on the top of a tuner or valve panel the base can be dispensed with and the panel drilled correspondingly.



THE G.E.C. VALVE DEVELOPMENT LABORATORY.

IN general the method used for pumping out the gases from thermionic valves is the same, whatever the size of the valve, and is similar to the method employed in the M.O. Valve Works. The pumping system consists of a mercury vapour pump, backed by a rotatory oil pump, which in turn is backed by the vacuum supplied by reciprocating pumps in the sub-station room.

Process of Baking.

The exhaust treatment of the valve consists of a period of baking which removes the layer of gases condensed on the glass surface in the valve followed by a period of bombardment, during which the gases dissolved in the metal parts are liberated. During the baking the valve is enclosed in a gas oven and heated to a temperature of about 400° C.

In the bombardment period, the valve filament is heated by electric current, while a high voltage is applied to the anode. A stream of negative electrons given off by the hot filament are attracted to the anode by virtue of the high positive potential applied to the latter, and those electrons strike the anode when travelling at velocities depending upon the magnitude of the potential on the anode. The electrons are stopped in their course, and then travel in the metallic anode circuit in the ordinary way of metallic conduction.

Electron Bombardment.

The kinetic energy which each electron possesses immediately before impact with the anode is converted into heat as a result of the impact, and the effect of the enormous number of these impacts is apparent in the visible heating of the anode. For each milliampere of current passing across the space between filament and anode, 60,000,000,000,000,000 (sixty thousand billions) electrons per second are required to carry it.

During the bombardment of medium-sized transmitting valves about 100 milliamperes of spare current are employed, and about 10 milliamperes for small receiving valves.

This method of electron bombardment is used as being the most convenient one in which to heat up the metal anode, which is necessary in order to liberate the gases dissolved in it. If this were not done, these gases would otherwise be given off during the operation of the valve in the wireless transmitting circuit and would interfere with its steady operation.

A BROADCAST RECEIVER.

By H. G. HERSEY (Member of the Wireless and Experimental Association).

Mr. Hersey's constructional articles are well known to readers of POPULAR WIRELESS. They are, without doubt, the best articles of their kind yet written, and in this and following articles Mr. Hersey will give full particulars for the making of various types of receivers.

THE piece of apparatus I am about to describe has been designed primarily for the purpose of broadcast reception.

The instrument is to consist of a very simple and inexpensive tuner and single-valve detector. Certain terminals, however, are to be duplicated in such a way as to permit various circuit alterations to be made if desired. These will be described later in this article.

Explaining the Variometer.

With a view to simplicity of operation, also to curtail expense as much as possible, the variometer type of tuner is to be used. This will give us a range of wave-lengths to cover all the broadcasting stations without the aid of either a variable condenser or switches and studs. By this it will be followed that once the valve is switched on

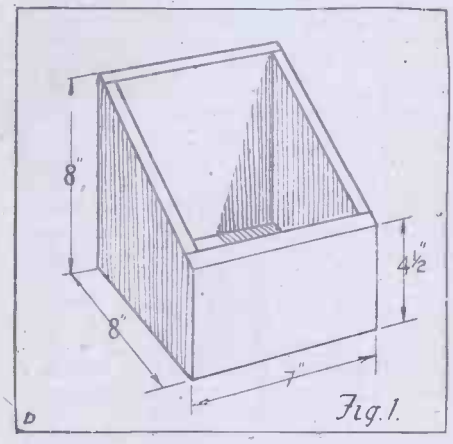


Fig. 1.

there is but one tuning adjustment to make. Reaction not being permitted by the P.M.G., it is therefore not made use of in this panel.

To the reader who may be a little hazy as to how a variometer tuner actually works a few words will not be considered out of place. Two coils are constructed in such a way as to permit them working either in unison or in opposition to each other. This is effected in practice by constructing a coil that will permit a second coil to be rotated 180° on its centre; the two coils are connected in series. A current passing through the outer coil will set up a magnetic field in a certain direction. The current will now pass through the centre or second coil, and this coil can be placed so that the magnetic field set up by it is in the same direction as the outer coil. The two coils are now working in unison, and are at their maximum wave-length value. If the centre coil be now rotated 180° the field set up by it will be in opposition to the outer coil, the two tending to neutralise each other.

In this position the wave-length value of the coils will be at its minimum. Assuming, when the coils are at their maximum value, the wave-length to be 600 metres and 200 at their minimum, it will be seen that any wave-length between 600 and 200 metres can be obtained by varying the position of the centre coil in relation to the outer coil.

Several other types of tuning coils will be dealt with in later articles. The reader may desire to use these with the present panel, therefore some standard form of mounting should be decided upon, so as to make the instruments as neat as possible in appearance when completed. A sloping panel, desk fashion, should appeal to many, and for this reason will be adopted.

The base or cabinet for the ebonite panel should be constructed (Fig. 1) from some suitable wood, such as teak or dry oak. The same should be polished or stained and varnished. The panel upon which the various parts are to be assembled should, for preference, be made of ebonite, both for its high insulating properties and its professional appearance. Should the cost be too great for the reader, a piece of well-seasoned hard wood might be used, and strips of ebonite could be let in to mount the terminals, etc., upon. Should you desire to use a high-frequency panel at a later date the little extra upon ebonite will not be spent in vain.

Grid Leak and Condenser.

The panel should be marked out upon a piece of ebonite 7 inches by 9 inches, as per Fig. 2. The position X is for the valve-holder. A filament resistance suitable for panel mounting should now be purchased. A hole is drilled in the centre of position Y for the resistance spindle, and the two small holes each side are for the screws which hold the resistance to the panel, their actual position depending upon the make of resistance. The six holes along the top are for the tuner and valve terminals, the six upon

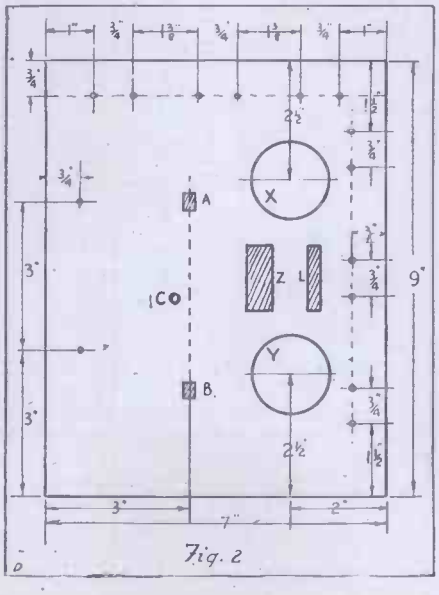


Fig. 2

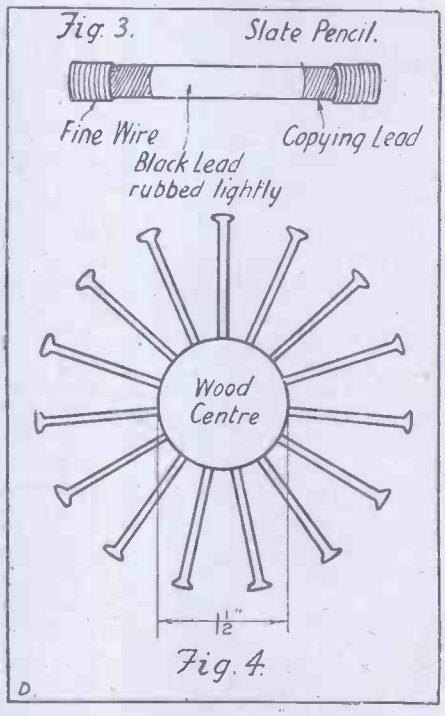


Fig. 4.

the right-hand side being for H.T., L.T., and phones. The aerial and earth terminals are on the left, the size of holes for these terminals being left to the reader, according to terminals purchased.

The grid condenser should next be mounted. This may be purchased ready for mounting, ·0002-3 mf. in value, for about two shillings. The reader can make this component by following instructions given in POPULAR WIRELESS, No. 26, page 569, except that mica be used for the dielectric and the copper or tinfoil be made to adhere to the same by means of shellac varnish. The grid condenser, when ready, should be mounted in the position Z, Fig. 2, by screws, and a strip of fibre or ebonite upon the underside of panel. The grid leak can be constructed according to instructions given in No. 26 POPULAR WIRELESS, reproduced here, Fig. 3. The leak should be mounted under the panel in position L, Fig. 2.

Winding the Coils.

We have now almost built a detector panel except for wiring, and we can turn to the tuner. A piece of wood about ¾ inch thick is cut into a circle 1½ inches in diameter, and 15 holes are drilled or burnt equidistantly apart around the circumference. Fifteen 2½ inch French nails should now be obtained and forced into these holes, and we have a former upon which to wind our coils, in basket style, Fig. 4. Commence by winding on 32 turns of No. 28 S.W.G. D.C.C. wire. A loop or twist should be made to denote the

(*Continued on next page*).

A BROADCAST RECEIVER

(Continued from previous page.)

end of the 32 turns. Now wind on 4 more turns of wire, and twist or loop again. Now continue to wind on 20 turns, and the coil is so far completed.

The coil should now be well treated with shellac varnish (made by dissolving shellac in methylated spirit). When the coil is almost dry the nails should be carefully removed, and the coil laid by to harden. When set, the wire between the two loops or twists in the centre of coil should be care-

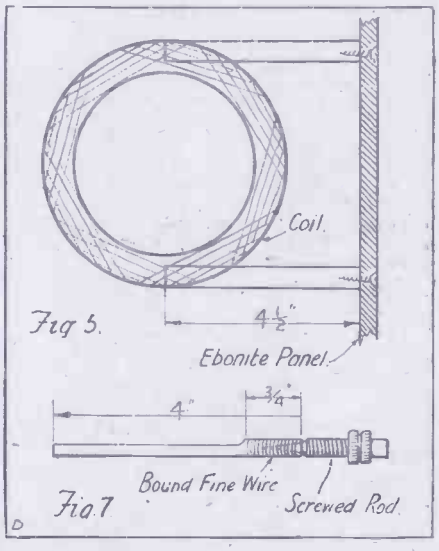


Fig. 5. Fig. 7

fully cut out, leaving us with two basket coils of different sizes, the larger to be the fixed, and the smaller to rotate in its centre.

In the positions A and B, Fig. 2, two pieces of wood ¾ inch by ½ inch by 4 inches should be screwed to the ebonite so as to jut out on the under side of panel, Fig. 5. It is upon these the fixed coil is to be mounted by binding with thread. The whole should be thoroughly shellac varnished.

A Suggested Mounting.

The centre coil requires to be mounted in such a way as to be rotated inside the larger coil from outside the panel. Any method of mounting the reader may think of that will fulfil this purpose can be used. The method adopted by the writer is as follows :

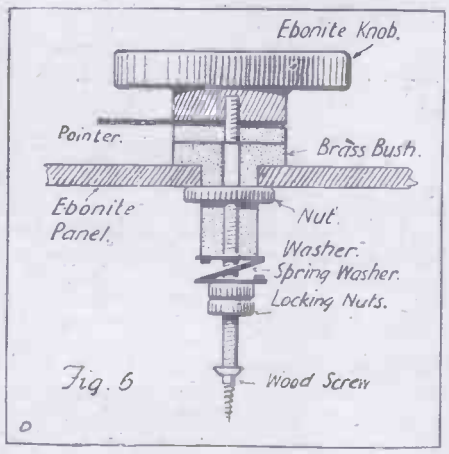


Fig. 6

A brass bush is let into the ebonite panel in the position C (this should be a little out of the centre of A and B) and secured on the underside by a nut. Through this bush (Fig. 6) a length of screwed rod is inserted. On the outer side a boss with lock screw is placed, leaving enough screwed rod upon which to place an ebonite knob and pointer. On the underside two washers are placed, then a spring washer, followed by two lock nuts. The screwed rod should be cut clean about ¼ inch from the lock nuts, and a small ¾ inch brass woodscrew should be soldered to its end.

A piece of wood should next be cut out with a fretsaw, as in Fig. 7, and the end bound with fine wire where the woodscrew is to be inserted to prevent splitting. The movable coil is bound to this piece of wood with thread, and the whole shellac varnished. The coil should be mounted so as to clear the larger coil when rotated by the spindle. A pointer and ebonite knob should now be screwed to the spindle, and an ivorine scale fixed to the ebonite by small screws, or it can be made to adhere by a solution of celluloid dissolved in amylacetate.

The Wiring.

From the two inside ends of the centre coil two short lengths of rubber-covered flex should be soldered and bound together along the wood spindle up to the brass-

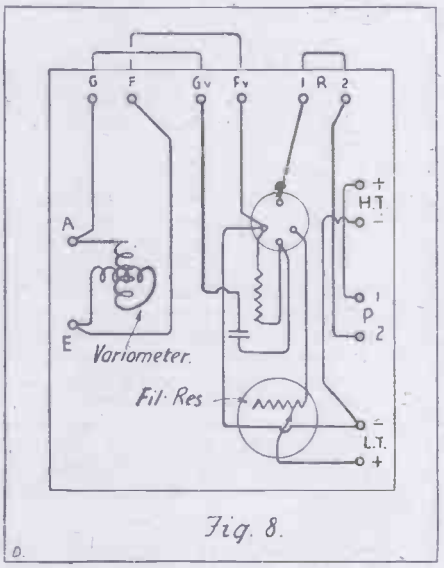


Fig. 8.

work ; here the flex should be well bound to the spindle. The flex should hang loose, and one end be connected to the outer coil, leaving one inner coil and one outer coil end free.

The wiring of the panel is easy to follow from Fig. 8. Commencing with the valve side from L.T., take a lead to the spindle of the filament resistance. From the one end of the resistance take a lead to right-hand filament leg-socket of valve-holder. Another lead is taken from L.T. to the left-hand filament leg, completing valve filament circuit. From H.T. a lead is taken to P1, from P2 to R2, and from R1 to the plate or anode leg of valve holder. The H.T. and L.T. should next be joined together. From the left-hand filament leg two leads are taken, one to Fv and one to the grid leak.

From the grid leg two leads are taken, one to the grid leak and one to the grid

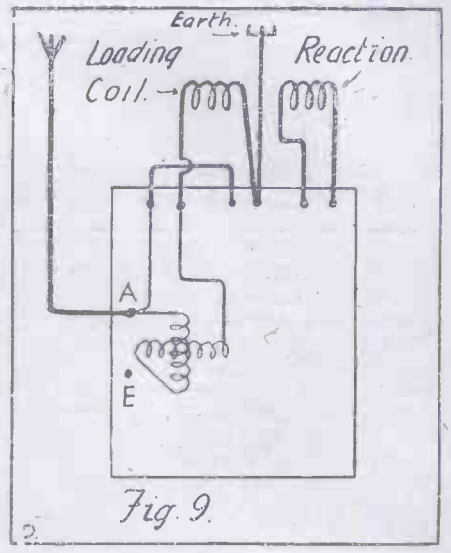


Fig. 9.

condenser. From the grid condenser a lead is taken to terminal Gv. This completes the valve wiring, and you will see a separate valve detector in itself has been made.

The two ends of the variometer should now be connected, one to terminal A and one to E. Terminals A and E should now be connected to terminals G and F respectively, completing the panel. The panel should now be screwed to the base by countersunk screws along the edges.

Alternative Arrangements.

For use as a simple detecting panel connect aerial and earth to A and E. Connect G and Gv and F and Fv together, and short the terminals R1 and R2. A small blocking condenser placed across the phones will improve results. The wave-length range of panel is from 360 to 580 metres on an average P.M.G. aerial, and 280-400 metres with ·0003 in series with aerial.

Upon examining the panel the reader will observe that it will lend itself to many

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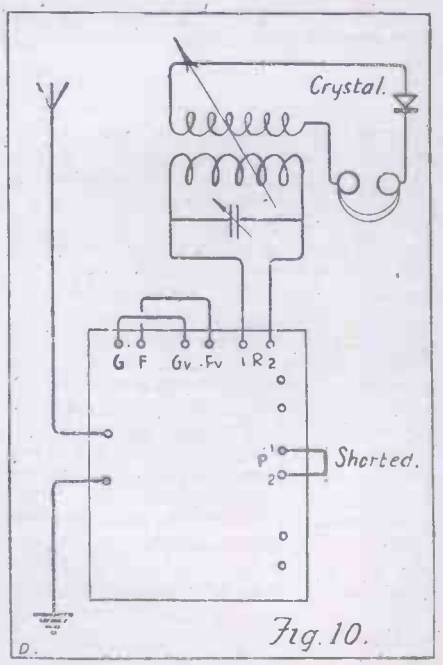


Fig. 10.

THE ELECTRON.

By B. R. CUMMINGS.
(Radio Engineer of General Electric Company.)

THE electron is being referred to more and more in technical and semi-technical publications, and it is the object here to point out some of its most unusual characteristics, with the hope that those who take interest in the many developments of science will find an incentive to investigate further this most fascinating branch of the electrical art.

The electron is defined as the unit charge of negative electricity, and plays a most important part in the composition of all matter. Those of us who have studied chemistry, even in its most elementary form, know that all materials are composed of atoms, the atom being defined as the smallest particle of any material which retains the characteristics of the material. So that there are atoms of iron, of copper, of oxygen, and of all of the elements.

The First Shell.

For a great many years it was believed that the atom was indivisible, and that it, itself, was the smallest possible subdivision of matter. More recently it was discovered, however, that the atom is composed of a number of units, the number depending upon the material of the atom.

It has been shown that all atoms consist of a nucleus which is called the Proton, which is in reality a positive charge of electricity. Surrounding this nucleus are a number of electrons, the number and arrangement of which depend upon the material of the atom. The structure of the atom is frequently referred to as a constellation, and may be pictured as resembling our solar system, the positive nucleus being represented by the sun, and the electrons surrounding it being represented by the planets.

The arrangement of electrons about the positive nucleus has been the subject of much investigation; and while there are differences of opinion as to the specific number of electrons and their exact arrangement, it is commonly agreed that one series of atoms, representing a number of materials, have from one to eight electrons surrounding the nucleus in what is referred to as the first shell, all of the electrons lying on the surface of a sphere.

Ultimate Analysis.

The atoms of the next series of elements have, in addition to the first shell of electrons, a second shell which includes from one to eight electrons in addition to those in the first shell, also lying on the surface of a concentric sphere. Another series includes a third shell, and still another a fourth shell, so that the number of electrons associated with the positive nucleus varies from one in the hydrogen atom to as many as a hundred or more in the atom of the heavier metals.

It is contended by some scientists that the electrons have definite orbits about the positive nucleus, which still further brings the modern conception of the ultimate form of matter into a system similar to our solar system.

Quite recently, it has been shown that the positive nucleus, itself, is very probably complex and may consist of a combination of two or more units. The probable formation of this structure is, as yet, unknown.

From the foregoing it is apparent that all matter consists, in the ultimate analysis, of the same thing—that is, of positive and negative electricity, and that different materials, as we know them, have their varying characteristics due to differences in the arrangement and number of electrons in their atomic structure.

Cause of Electron Emissions.

In any material there is practically an infinite number of atoms, associated with which there is a still greater number of electrons. These atoms are in constant motion, except when the material is at a temperature corresponding to absolute zero, and while in such motion they collide with each other continuously. Such collisions result in electrons being freed from many of the atoms, so that all materials include a number of so-called free electrons, which are moving back and forth in the material at extremely high speeds.

These electrons are the carriers of electricity in any material; in fact, they, themselves, are electricity. Materials which we know as good conductors of electricity, such as copper, have a comparatively great number of free electrons. Those materials which we know as insulators, such as glass and porcelain, have a very small number of free electrons. When an electric current flows there is a progression of the free electrons through the material making up the circuit.

If the temperature of the material is increased, the speed of the electrons is increased, until, if the temperature is made sufficiently high, as in the filament of a receiving vacuum tube, the electrons break through the surface of the material into the space surrounding the material.

Why We Can't See Electrons.

The characteristics of the electron are extremely interesting. These characteristics are not assumed, but have been established by the most painstaking kind of research work. The electron is so small that we can never hope to see it directly, for it is much smaller than the shortest wave-length of light, and therefore is incapable of reflecting light. Its diameter, when expressed as a fraction of an inch, is so small as to be meaningless, but some conception of its size can be had from the following:

If a drop of water, which consists of hydrogen and oxygen atoms, and therefore includes a great number of electrons, were magnified to the size of the earth, and all of the electrons associated with it magnified in the same proportion, even then each electron would only appear as large as a grain of sand.

The number of electrons associated with various materials is also startling. For example, when a conductor is carrying one ampere of electricity, ten billion billion electrons pass each point in the conductor every second.

The third characteristic of electrons, which is unique when compared with our ordinary conceptions of materials, is the velocity of its travel.

Those of us who use vacuum tubes in our receiving equipments know that electrons are given off at the filament, travel across the intervening space between the filament and the plate, and finally enter the plate and then travel through the conductors of the circuit. The current in the vacuum tube is composed of electrons, being referred to as the electron current, or, to differentiate it from currents flowing in conductors, which are also electron currents, it is more specifically referred to as a thermionic current. When electrons leave the filament of a vacuum tube and start their travel toward the plate, they are moving at a speed of approximately 50,000 miles a second.

In practically all libraries will be found articles and books dealing with the electron and its characteristics. Since explanations of a growing number of scientific phenomena are based upon its properties, it is urged that those who are interested in the advancements being made in science familiarise themselves with, at least, its fundamental characteristics.

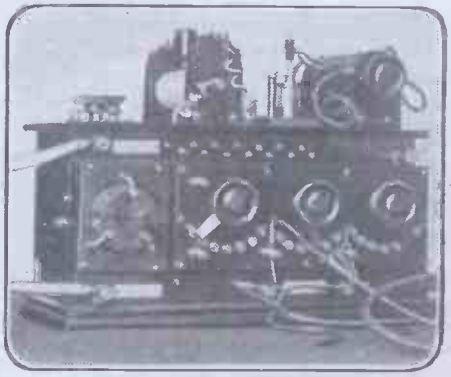
A BROADCAST RECEIVER.

(Continued from previous page.)

circuits for experimental work. If you wish to increase wave-length range the loading coil should be connected up per Fig. 9. The loading coil should be tapped, and the tuning between the studs is done by the variometer. If on these longer wave-lengths where reaction is permitted the reader wishes to make use of reaction, he can do so by taking the shorting wire off the terminals R1 and R2, and placing a reaction coil between R1 and R2, coupling the coil to the aerial loading coil, Fig. 9. Now, should you desire to make the set into a simple H.F. set, connect as per Fig. 10, by placing a tuning coil across terminals R1 and R2.

The Secondary Coil.

For broadcasting, this coil should consist of about 80-90 turns of No. 26 S.W.G. D.C.C. wire, and the condenser ·0002 mfd. alternatively. The coil could be made up to 130 turns, and a slider used, wound on a cylinder 3 inches diameter. This forms a tuned plate circuit. The secondary coil may consist of a few more turns than the primary, and a crystal is used for rectification. A circuit of this kind will greatly increase the range of reception.



Complete crystal receiver, made by Mr. H. Dennis, 2, Bloom Park Road, Fulham, S.W.6.

SOME WIRELESS OBSERVATIONS.

By SIR OLIVER LODGE, F.R.S., D.Sc., M.I.E.E. (Scientific Adviser to POPULAR WIRELESS.)

This is the fourth of a series of articles by our Scientific Adviser, written specially for the experimenter and research worker.

Part 4.—A Plea for Easy Specification.

WHEN working with ordinary coils and condensers in the laboratory, the specification of capacity in microfarads is convenient enough, and so is the specification of inductance in terms of henries or secohms.

But when working with wireless wavelengths, it is convenient to have the aerial capacity, and the inductances associated with it, expressed in terms of length, because the geometric mean of those two lengths—that is, the square root of their product—gives the wave length direct when multiplied by 2 π, that is practically, for rough estimate, by 6. Six times the square root of the inductance and capacity multiplied together is a close approximation to the wave-length; and in predetermining the inductance required for any given case, this must surely be a handy rule.

It is well known that capacity in electrostatic measure is a length, and that inductance in electromagnetic measure is also a length. The truth is that in all units—that is to say, in absolute measure—capacity is really K times a length, while inductance is μ times a length. And it is natural to express the one in static measure, under the convention that K=1, and the other in kinetic—that is, magnetic—measure with the totally different convention that μ =1. For the one has to do with charge, and the other with current.

Something More Tangible.

The capacity of an ordinary amateur aerial is some simple fraction of its height or linear dimensions: about one-twentieth of the length of an isolated thin single wire measures its capacity. But the fraction may vary for different aerials from a twentieth to about a twelfth, as will be shown later. A microfarad is far too big a unit for convenience. A millimicrofarad, or even a micromicrofarad, has to be employed; and they are by no means convenient. The length corresponding to a microfarad is 9 kilometres. So a millimicrofarad is 9 metres, and a micromicrofarad is nine-tenths of a centimetre; that is to say 10 micromicrofarads equal 9 centimetres. So that for a rough estimate it may be taken as a centimetre, though it is a trifle smaller.

On the other hand, a henry is 10,000 kilometres. So a millimicrohenry—or what is sometimes called a billihenry—is exactly one centimetre. While a microhenry is 10 metres, and a millihenry 10 kilometres.

Conversion from one set of units to another is always a nuisance. But after all a henry and its sub-multiples have no particular meaning which the imagination can seize hold of; whereas the length of a metre or a kilometre is easily imagined. Hence it might be well to have the coils used for wireless thus marked—that is, marked in terms of length—using any unit of length that is handy for the purpose and suitable to the coil. Thus, take an aerial of capacity 1 metre, and put a coil of 10,000 metres inductance in series with it. The geometric mean of the two is 100 metres, and the wavelength therefore 600 metres.

The metre as a rule is the most convenient unit of length under the circumstances, since wave-lengths are commonly so specified. But some people prefer to work in centimetres; and it is easy enough to remember that a billihenry is 1 centimetre. The farad is not a convenient unit. It was always much too big; but it can be remembered that a microfarad is equivalent to a length of 9 kilometres.

In wireless work, however, it is certainly more convenient to express capacity as a length, whether it be agreed to specify inductance also in that way or not.

Intensity of Radiation.

It is curious to note that a farad coupled to a henry (or, what is more practicable, the thousandth of a farad coupled to a thousand henries), would have a slow oscillation period of six seconds; and so give a quite inappreciable wave 1,800,000 kilometres long.

A microfarad connected to a henry of inductance would oscillate a thousand times in six seconds; and so generate a still feebler wave 1,800 kilometres long. Whereas a microfarad coupled to a microhenry would have a frequency a thousand times as great, and so might give a strong wave of length 1,800 metres: the same wave being also generated by a millimicrofarad coupled to a millihenry; the last being more simply expressed as a 9-metre capacity and a 10,000-metre inductance.

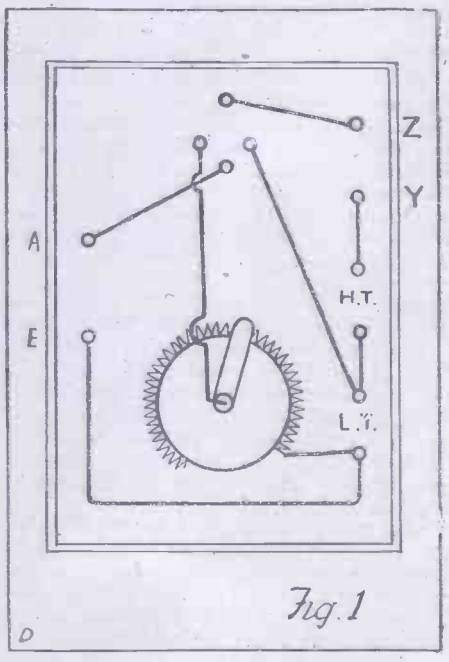


Fig. 1

The intensity of radiation increases very fast as the wave is shortened. If other things were equal—which they seldom are—the radiating power from a given stock of energy would increase with the fourth power of the frequency of vibration; so that halving the wave-length would multiply the radiating power 16-fold. But short waves are less penetrating and less suitable for very long distances. Otherwise, for all near work, short wave-lengths or high frequency is an advantage.

A UNIVERSAL VALVE PANEL.

THE amateur who, having used a crystal detector, wishes to add a valve amplifier is often undecided whether to employ low or high frequency. To such, the following arrangement may be useful as it will enable him to use the

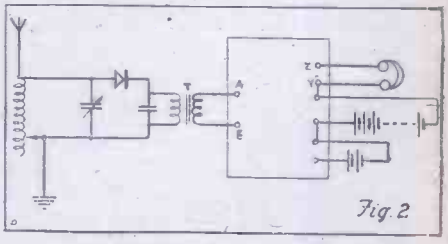


Fig. 2

apparatus he already possesses, and to change from one system to the other with one valve panel at the expenditure of very little trouble. It has also the advantage that the crystal circuit is not disarranged, and can be used alone should necessity arise.

Changing Over.

The valve panel illustrated in Fig. 1 should be constructed, and a transformer and an extra tuning coil (a variometer as described in POPULAR WIRELESS, No. 35, page 817, will suit very well) provided.

For low-frequency amplification the trans-

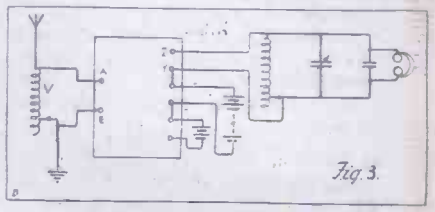


Fig. 3.

former, T, and the valve panel should be connected to the 'phone terminals of the crystal set as indicated in Fig. 2; the 'phones and batteries are then connected to the appropriate terminals on the panel.

The high-frequency connections are shown in Fig. 3, the extra tuning coil being introduced at V. It will be noticed that the high and low tension terminals are identical in each circuit.

Switches could, of course, be provided to rapidly bring in high or low frequency amplification as desired, but as this would be a complication that *might* cause trouble from self-oscillation due to the involved wiring it is not to be recommended.

ATMOSPHERICS, STRAYS, AND STATICS.

By SEXTON O'CONNOR.

PART I.

ONE of the outstanding problems at present facing the wireless expert is that of devising some means of freeing radio reception from the effect of atmospherics, a term which covers those mysterious disturbances variously referred to as statics, strays, or X's.

The difficulty has existed ever since the erection of the first receiving aerial, and, in spite of a vast amount of inventive ingenuity still remains a fertile source of annoyance.

With the development of modern ultra-sensitive valve receivers, the degree of atmospheric interference has, in fact, increased enormously in comparison with that experienced in the early days of the coherer and magnetic detector, in spite of the greater selectivity of the aerial circuits now in everyday use.

Luckily for the amateur, and for those interested in broadcasting, such interfering effects are comparatively insignificant upon aerials tuned to the shorter wave-lengths with which they are concerned. No doubt,

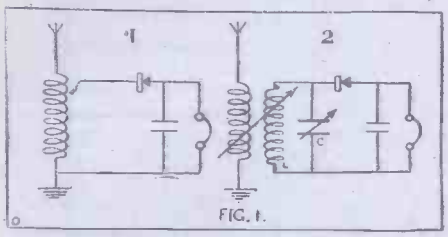


FIG. 1.

however, many of our readers who enjoy the possession of multi-valve sets and the privilege of trafficking with long-range transmission have from time to time picked up a sufficient number and variety of "grinders," "clicks," and "hisses or sizzles" to convince them firmly that there is "something rotten in the State of—the ether."

Some of the Causes.

The source of the trouble is to be located in the ever-varying electrical condition of the atmosphere, which is practically never in a quiet state of electric equilibrium, although it is apparently constantly and frantically endeavouring to achieve this condition.

Owing to a number of involved and complex causes, static charges are gradually being accumulated, up to a certain point, and are then slowly or suddenly discharged in the earnest effort to find a common level or slope of potential.

One common instance of this phenomenon is the ordinary discharge of lightning. Another and more widespread effect is that arising from the potential gradient that exists in the atmosphere, the upper layers of air being usually more positively charged than the lower. Consequently an elevated aerial is always liable to tap air layers at different electric potentials, thus affording a relief path and causing a more or less intermittent current to pass through the detector and phones to earth.

This electrostatic distribution in the atmosphere continually varies from time to time at any given spot. Further, for each locality there is a diurnal and a seasonal cycle, night-time being more prolific in "strays" than day-time, and summer than winter. Geographically such effects are considerably more pronounced in the tropics than in England.

The effect in the phones ranges from sharp clicks or hisses to grinding noises, which are frequently sufficiently violent to drown even strong signals. They are generally intermittent, but at times produce an almost continuous roar. Dr. Eccles' description of a typical séance with the ethereal bogeys at early dawn is as follows:

A Damping Effect.

"Starting to listen about half an hour before sunrise, the strays heard in the telephone are loud and numerous, and much as they have been all night; then about fifteen minutes before sunrise a change sets in, the strays get weaker and fewer rather quickly, until at about ten minutes before sunrise a distinct lull occurs of perhaps a minute's duration. At this period there is sometimes complete silence. Then the strays begin to appear again, and within ten minutes of the lull they have settled down to the steady stream proper to the daytime. These day strays are weaker and fewer than the night strays except on rare occasions. Similar phenomena occur at sunset."

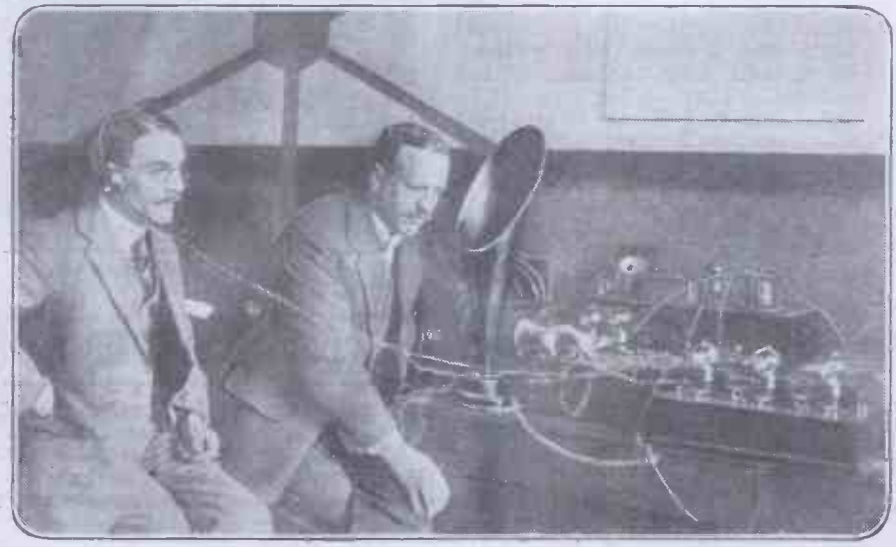
The ordinary type of elevated aerial, tuned to a given wave-length, is shock-impulsed by the impact upon it of aperiodic atmospheric energy (which is usually hundreds or even thousands of times stronger than the average signal strength). Nevertheless, because of its definite tuning, the response to the shock-impulse is a highly damped effect, somewhat similar to that upon a swinging pendulum if it were to be struck by a succession of blows of different strengths, applied at various points along its length and in different directions. A pendulum so treated will vibrate violently during the impact of the blows and for a short time thereafter, but it will not swing freely at its natural or fundamental frequency; nor will the resulting amplitude of vibration be anything like as great as if all the blows had been applied to the bob at properly timed intervals and in the same direction.

The Closed Tuned Circuit.

The mere fact, then, that the aerial is definitely tuned to a given frequency tends of itself to diminish the full effect of the received stray. Its strength can be still further diminished by using a separate closed detecting circuit, loosely coupled to the aerial, as was first utilised by Marconi and covered by the well-known "four sevens" patent. For example, the arrangement 2 shown in Fig. 1 will be less affected by atmospherics than that marked 1, partly owing to the added selectivity imposed by the separate tuned detector circuit, and partly owing to the energy loss occurring across the loosely coupled inductance coils.

Many arrangements have been devised for the specific object of eliminating the effect of atmospherics from radio reception, and it is proposed to give a short account of some typical examples. Before doing so, however, it may safely be laid down that up to the present the net result in practice of the many schemes suggested has been merely to ameliorate or lessen the trouble experienced from this cause without totally removing it.

At the same time, it should also be borne in mind that the introduction of modern continuous wave transmission, combined with heterodyne reception has, in itself, proved a great boon in lessening interference trouble. The high pitch of the heterodyne receiver note alone renders it more easily distinguishable by the ear from the lower-pitched range of static or "grinder" noises.



The Receiving Set installed in the C.I. Department, Scotland Yard.

TWO WAYS OF BROADCASTING.

By HARRY TATE.

Those who have seen the author's sketch, "Broadcasting," will appreciate his feelings when speaking into the microphone at 2 L O instead of an inverted coal bucket!

I OFTEN used to wonder what it felt like to speak via the ether to thousands of unseen listeners. I know now. I have never had such a peculiar evening in all my life as on that Friday when I and my company broadcasted a little skit we are working at in connection with broadcasting.

Unfortunately we couldn't transmit the "props," and we had to do our best to give the impressions required without them.

There we were, shaking hands with each other, and bobbing up and down in front of a pile of wire and cylinders like maniacs. First I would bawl something down it, and then one after another the members of the cast would do the same. We all had to keep in front of the beastly thing, and endeavoured to aim straight at its centre hole each time.

I often wonder what sort of idiots the others in the room thought we were, as we shook hands and patted each other on the back, forgetting that none of you listeners-in could see what was taking place.

Then my imagination kept on picturing the various homes listening-in and their expressions as they heard the pandemonium we were kicking up at Marconi House. Altogether it was a most peculiar evening.

Where They Laugh.

I learned a considerable amount of useful detail, however, and am making arrangements to elaborate the broadcasting burlesque that I am now producing.

I have spent several evenings lately listening-in, so as to get a good idea what it all sounds like, and I think we shall be able to give a pretty good burlesque of the kinds of concerts and entertainments now being broadcast. We hope to give the whole show, letting the audience have a peep at each end of the business.

The trials of the very green amateur, who builds his own set, will afford great scope. We shall go right through the erection of the receiving station, showing the difficulties of aerial erection and the building of the set out of all sorts of scraps, and then the exciting moment when the amateur first listens-in.

It has been very difficult to produce a wireless burlesque, because you never know when the audience is going to laugh. They laugh at the most surprising places.

For instance, as soon as I mentioned the 4s. 6d. receiving set they simply shrieked. Then later on they roared again, apparently without reason, and you never know when they are going off.

I hope to give a whole wireless concert on the stage shortly. "The wireless station of Tittyfolol calling," etc., and the announcement of a song, followed by the most fiendish of ragtimes, or something of that sort.

Of course, the parrot who sits on the receiving aerial and calls "Hullo" will have to come in.

I am also producing a "wireless" piano—a real beauty, absolutely no deception—and on wires. Oh, yes, it will play, perfectly.

I don't quite know why it is, but to stage a wireless concert is a very difficult proposition. There seems to be nothing to get hold of. It isn't like the ordinary concerts, while it certainly isn't picturesque.

The receiving end will have to be shown too. We shall have to have father and mother, grannie and the kids, all clamouring for the phones, or else listening with varied expressions of enjoyment, surprise, contentment, and disgust at the weird and wonderful ejections of a large black loud speaker.

More "Light Stuff" Wanted.

Apart from the adaptability of wireless as a stage burlesque, I really think it is a great advance, and will prove a necessary adjunct to every home. I don't think there is quite enough light stuff in the broadcasting programmes. I should like to have more fun and really good humour, although I suppose it is difficult to get the humour that will stand the test of wireless. It takes a really funny man to be funny down one of those microphones, and to still sound funny when his voice is heard miles away in the receiver.

I don't quite know what to think about the idea of broadcasting the shows from the theatres.

I cannot see why it should be at all detrimental to them, unless the play to be broadcast is really poor.

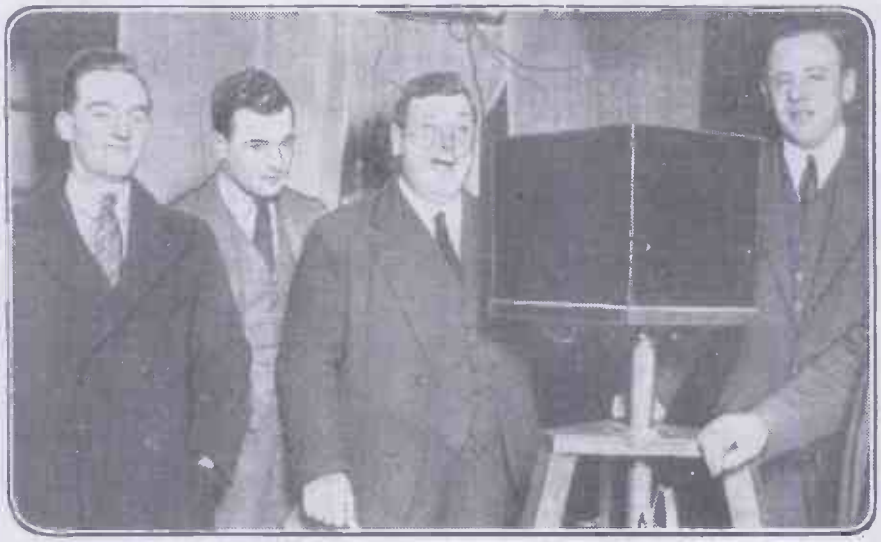
I am inclined towards the opinion that if a play is good and likely to be a success, the people who have heard it by wireless will want to go and see it.

"Although *I* say it——"

Of course the poor plays and indifferent entertainments would probably suffer by being broadcast. If people are disappointed by the speech and music, it is not likely that they will be at all anxious to go and see the show at the theatre. But in the case of the good shows I believe that broadcasting will prove a very useful advertisement.

Take the case of my own little burlesque, "Broadcasting." I gave it by wireless the other day, but since then I have heard of quite a number of people who, having listened-in to it, have announced their intention of coming to see it.

Until it becomes possible to see by wireless I don't think that broadcasting can be looked upon as a rival to the theatre. With the advent of television, however, the whole play, scenery and all, could be broadcast, and then, I am afraid, the theatres will be rather badly hit. But that will not be for a long time yet, and until then I see no reason why the managers of theatres should be as perturbed as they are over the proposal of the Broadcasting Company to transmit scenes out of the different shows.



Harry Tate and Co. speaking into 2 L O's microphone.

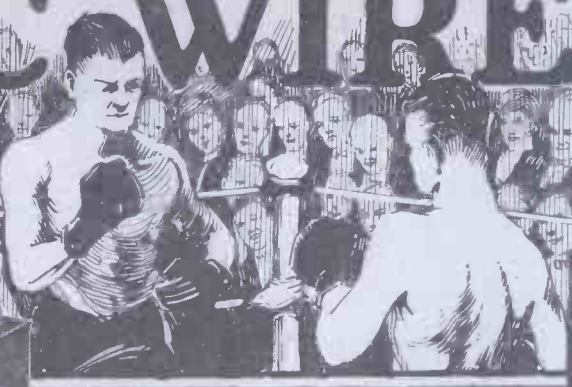
CATALOGUES.

WE have received a number of small leaflets from the Igranic Electric Co., Ltd. These pamphlets give descriptions of some of the more recent developments made in the smaller accessories for wireless sets. The Gimbal system of mounting honeycomb and slab coils is explained, showing how these coils may be used in the special holders as variometers if necessary, thus doing away with variable condensers. Vernier adjustment filament resistances, variometers, and intervalve transformers are also described in these leaflets.

* *

A. H. Hunt, Ltd., have just brought out a new catalogue dealing with wireless accessories, including H.T. cells, accumulators, voltmeters, ammeters, etc.

T·M·C WIRELESS



for boxing

A T.M.C. Wireless Set will give you the full account of the fight as it proceeds, round by round.

Or you may be interested in football, the latest news, Stock Exchange quotations, the weather forecast, delightful concerts, or an evening of dancing.

You can have all these, enjoyably and pleasurably, in the comfort of your own home, with a T.M.C. Wireless Receiver.

There is no trouble to you—T.M.C. have engineers in every large town, who will install and periodically inspect the apparatus.

T.M.C. Wireless is particularly simple to work, and gives every satisfaction.

T.M.C. Wireless Receivers, which are fully approved by the Postmaster-General, bear the seal of the British Broadcasting Company.

The wide variety of models are entirely British made.

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Come and listen to them any evening up to 10 p.m. at our showrooms in London, Birmingham, Belfast, Bristol, Cardiff, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Sheffield.

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The "Everset" Crystal. No adjustment necessary. Fits any crystal receiver,

10/- each

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THE GLASGOW BROADCASTING STATION.

By C. CREED MILLAR (2 M G).

A description of the opening of the new Scottish Station, and details of the apparatus installed, specially compiled by our representative in Glasgow.

ON the evening of Tuesday, March 6th, Scottish listeners-in were delighted to hear the skirl of the bagpipes which heralded the opening of 5 S C. Mr. J. C. W. Reith, the general manager, then announced that 5 S C, the Glasgow station of the British Broadcasting Company, was calling. After a few remarks he introduced Lord Gainford, chairman of the company, who read telegrams of congratulation from Mr. Bonar Law, the Lord Provosts of Edinburgh, Dundee, Aberdeen, and Perth, and from the Principals of the Universities of St. Andrews, Edinburgh, and Aberdeen. In the course of his speech he emphasised the difficulty of pleasing everyone, but said that the company would make every endeavour to provide a programme to suit all tastes.

The Lord Provost of Glasgow, Sir Thomas Paxton, Bt., then made a short and interesting speech and formally declared the station open.

The Lord Provost of Glasgow opening the station with a speech to listeners-in.

Plenty of Scotch!

Several orchestral and vocal items were then given. After this. Sir Donald Macalister, Principal of Glasgow University, referred among other things to the valuable work which William Thomson (later Lord Kelvin) had done in the early days of wireless, and expressed the hope that the station would radiate nothing but peace and goodwill to men.

At nine o'clock, Sir William Noble assured his hearers that broadcasting in Scotland would be well looked after, the general manager being a Scot from Glasgow, two of the six directors also being Scotch, and that four others liked "Scotch"! He expressed sorrow that Edinburgh had perforce to be left without a station, but the scheme laid down by the B.B.C. and approved by the Postmaster-General had been carefully considered.

To an experimenter present, two points of interest were noticeable, first that the speakers stood two or three feet from the microphone, and, second, that during certain of the speeches, the sound of the speech in a loud speaker at a demonstration on the floor below was heard in the studio immediately as each word was spoken, having travelled over a mile of land line and back to the receiving aerial via the ether, being considerably faster than an echo, thus showing the great velocity of the wireless waves.

The Power Supply.

A short description of the station will probably be of interest. The station proper is situated in the tower of the Glasgow Corporation's Power Station at Port Dundas, while the studio is situated about a mile from there in a place centrally situated and convenient for the various concert halls and theatres.

The power supply is from the Corporation power mains 500 volts D.C. supply. This is transformed by a rotary converter to 500 volts alternating current at 300 cycles. This A.C. is then led to the instrument room, which is situated at the top of the tower. The current is then supplied to a static transformer which has two secondaries, one to supply the high tension at about 10,000 volts, and the other to supply the low voltage current for lighting the filaments of the rectifying valves. The H.T. is passed through the rectifying valves, where it becomes pulsating direct current. It is then passed through a smoothing device consisting of chokes and condensers, and emerges as a supply of almost perfect D.C. The carrier wave is almost pure, the ripple being unnoticeable even a few miles from the station.

The "Drive" Valve.

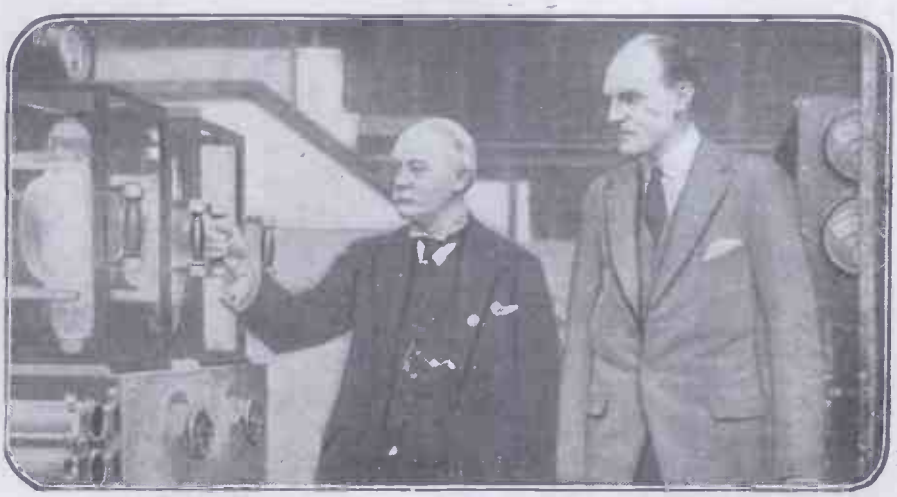
The H.T. is then supplied to the "Drive" valve and power valve plates. The purpose of the "Drive" valve is to cause the power valve to oscillate. If the power valve oscillated of its own accord, the modulation might be seriously impaired. The foregoing describes the apparatus for producing the carrier wave.

Amplification.

Commencing now at the studio, let us deal with the modulation apparatus. The artistes sing a few feet from the microphone, which is of a special type, and is mounted on a pedestal in the centre of the studio. A current is thus varied, and these variations are amplified by a special amplifier with dull emitter valves, the filaments of which are coated with thorium oxide to increase the emission. The degree of amplification is varied by an operator, who listens in on a receiving set continuously, to suit the individual voices.

The current is then passed over a special cable laid through the existing Post Office conduits to the actual station about a mile away. The variations are then further amplified by a two-valve power amplifier.

(*Continued on next page*).



Lord Gainford examining the transmitting gear. With him is Mr. Reith, General Manager of the B.B.C.

THE GLASGOW STATION

(Continued from previous page)

the last valve the plate of which is connected through a radio frequency choke to the anode of the power valve. The H.T. supply is connected through a speech choke, consisting of a large number of turns of wire on an iron core, to the plates of each of these valves.

The microphone current causes a greater or lesser current to flow through the modulator valve, thus taking away the power from the oscillating valve. In this way the carrier wave is modulated by the speech. The basic principle of this type of control is the form of "choke control" familiar to amateur transmitters. The size of the valves can be seen from the photos and the cost is in the neighbourhood of £20 each.

The Aerial and Earth.

The aerial, which is of the cage type, consists of four wires separated round hoops of about 4 ft. 6 ins. diameter, and is about 180 ft. long. The top, which is attached to one of the Power station chimneys, is about 230 ft. above ground level. The "earth" is composed of three plates buried on each side of the tower except the aerial side.

Each instrument frame and also the main earth from the oscillator panel is connected to a plate in the centre of the floor. From this plate twelve copper strips radiate, four to each earth plate. In view of the height of the transmitting room above the ground, it has been found necessary to insulate these earth leads all the way down to the earth plates. The aerial insulators consist of 16 porcelain reels strung "in series," the finished insulator being about 7 ft. long.

The Musical Director.

The actual transmitting apparatus was installed by the Marconi company under the direction of Mr. J. I. Lloyd. The studio apparatus is of Western Electric manufacture and was installed under the supervision of Mr. A. E. Thompson, who was associated with the Birmingham station. The musical director, Mr. Herbert Carruthers, has an excellent knowledge of Scottish musical taste, having been organist in one of the best Glasgow churches.

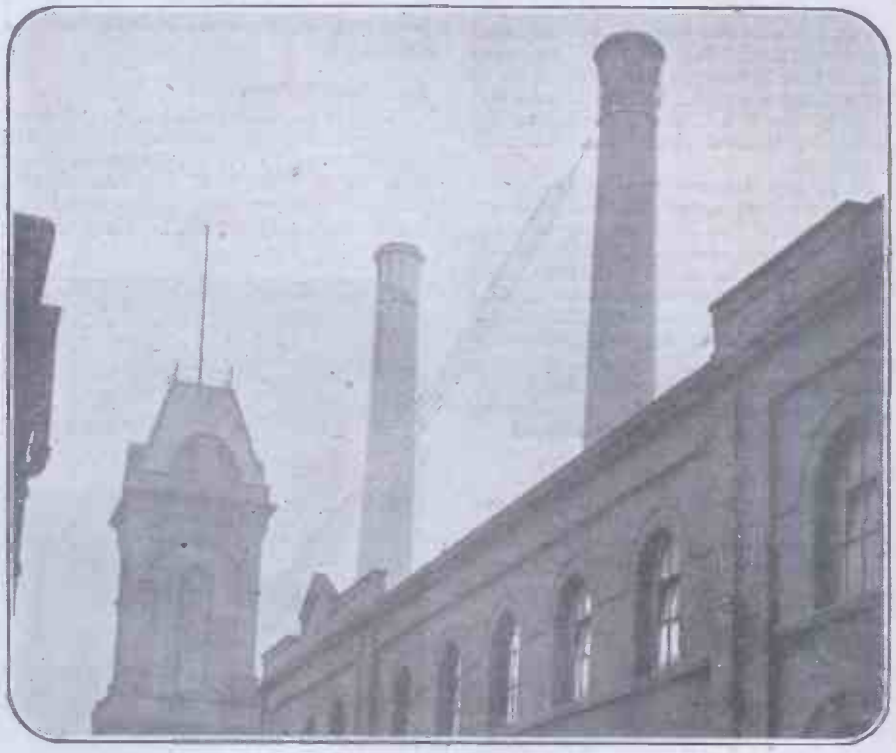
Official Range.

The range is given officially as 75 miles, but there is no doubt that, under favourable conditions, this will be greatly exceeded, although considerable difficulty was experienced in some northern districts on the opening night, when double power (*i.e.*, 3 kilowatts) was used.

It is understood that, before deciding whether Aberdeen is to have its own station, the B.B.C. will see whether or not 5 S C is able to cover the ground. There is a possibility of a power of 3 kilowatts being eventually used.

Note.—The photographs with this article were specially taken for "Popular Wireless." Applications for their use must be made to the Editor, "Popular Wireless," The Fleetway House, Farringdon Street, London, E.C.4.

The rectifying, drive, and power panel. The earth plate strips cannot be seen in this photo, but meet just in front of the power panel and travel to earth via a specially insulated tube let through the floor of the transmitting room.



The "sausage" or cage type aerial has been adopted at the Glasgow Station. The normal range of 5 S C is given as 75 miles, but this is, of course, much greater in actual practice.

THE RADIONETTE V 2

P.M.G. Broadcast Receiver.

The RADIONETTE V 2. Price 10 guineas, inclusive of B.B.C. duty, without Valves.

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40 miles for Broadcasting Stations with Headphones
25 " " " " " Loud Speaker
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with a couple of wires stretched across the ceiling of any room or with any other type of indoor aerial will take 6 to 12 headphones within 10 miles of any Broadcasting Station.

For Private Dances, Restaurants, and Tea Rooms the Radionette V 2 is all you require.

The best guarantee we can offer is

A SEVEN DAYS' FREE TRIAL IN YOUR HOME.

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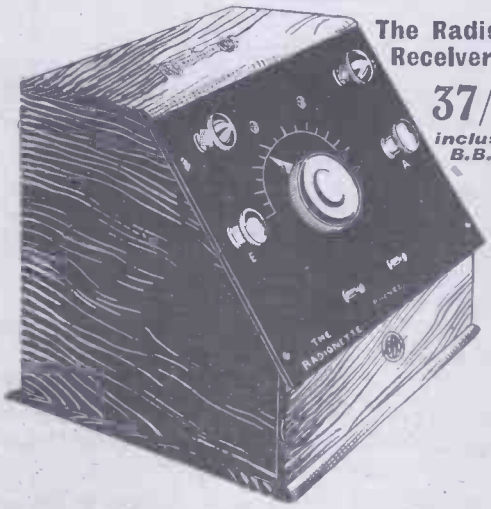

The Radionette Receiver, only 37/6 *inclusive of B.B.C. duty.*

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The Radionette No. I outfit includes Radionette Receiver, a pair of Siemen's super-sensitive headphones two Crystor aerial insulators and 100 ft. Copper aerial wire.

Price, including Broadcasting Duty, **£3-10-0**

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Please send me your Radionette ..... for which I enclose the sum of ..... on condition that you refund me this sum (less carriage 3/-) if I return the outfit to you undamaged within seven days of receipt.

Yours faithfully,

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Address .....

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(Please write clearly.)

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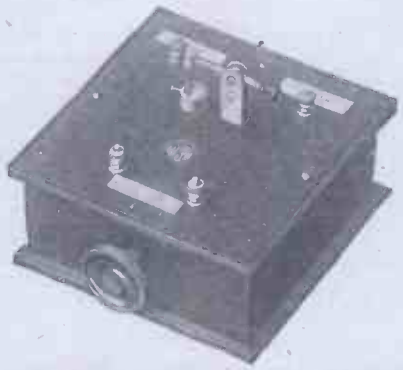
CRYSTONE JUNIOR CRYSTAL SET



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Complete with HEADPHONE, AERIAL WIRE, INSULATORS and LEADING-IN TUBE (Postage 2/-) **£2-14-6**

2-Valve Sets, Including B.B.C. £9-0-0
Complete with ACCUMULATOR, AERIAL WIRE, VALVES and INSULATORS (Carriage 3/-) **£12-19-6**

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Complete with PHONES, ACCUMULATORS, AERIAL WIRE, VALVES and INSULATORS (Carriage 3/-) **£18-14-6**

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LIGHTWEIGHT PHONES, 2,000 ohms, superior finish, equal to the best makes ONLY **25/-** (Post 1/-)

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" " " handle and cord), 4,000 ohms	10/-
DOUBLE HEADPHONES (French type), 4,000 ohms ..	21/-
" " " 8,000 ohms	22/6
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" " " (BROWN'S make), featherweight type "F," 4,000 ohms	30/-
" " " " type "D," 4,000 ohms	52/-
REPAIRS to Headphones and Adjustments by competent staff.	12/6
VARIABLE CONDENSERS, .001 mfd.	10/-
" " .0005 "	7/6
" " .0003 "	5/-
" " VERNIER	2/9
CRYSTAL DETECTORS (on ebonite base, complete with terminals)	
LEAD-IN-TERMINALS, ebonite with brass terminals (excellent make) .. .. 6-in., 1/6; 9-in., 1/9; 12-in.	2/-

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ONE SET SELLS NINE

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Another set was quickly sold on the recommendation of the purchaser. Nine sales in 12 days were traced to the first purchase; a chain of nine recommendations each by a different purchaser. The case is typical of scores we have recorded. Facts speak louder than words—louder than any Loud Speaker that can be imagined.

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CRYSTAL OR VALVE RECEIVING SET?

Don't go by the prices! We do not believe in fancy prices. You can pay much more than the cost of a "Melohay" and get a much inferior set. If you want a Crystal set there is none at the price to equal the

"MELOHAY" No. 2 at 35/-

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The sensitiveness of this set is remarkable. The speaking and singing voice, Instrumental Music, etc., are received not only with wonderful clearness but with very exceptional volume. You cannot get such value except in a "Melohay."

IF YOU WANT A VALVE SET YOU CAN FIND

nothing with a single valve to give you such good service and satisfaction as the

"MELOHAY" B Model at £6 6s.

B.B.C. Royalty. Carr. and Packing extra.

This model fully complies with the requirements of the Postmaster-General yet for efficiency is unequalled. The most simple to operate.

A range of other Crystal and Valve Sets, amplifiers, loud speakers, headphones (from 1 Guinea), etc.

For EVERYTHING IN WIRELESS send to

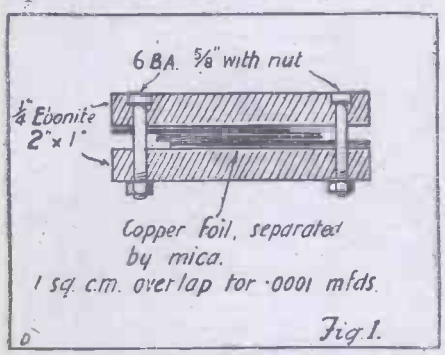
HAYES, LIMITED,

342-344, Euston Road, LONDON, N.W. 1.

Telephone: MUSEUM 3541

A CHEAP VARIABLE CONDENSER OF LARGE CAPACITY.

A VARIABLE condenser of large capacity—say, .002 mfd.—is an item which is not within the reach of everyone's purse, and its construction entails an accuracy and mechanical skill not possessed by the average experimenter. A small variable condenser of .0002 mfd. is not very expensive, and the following details show how this may be increased to a much more useful size without great expense, and still be continuously variable.



The idea was originally used for economical reasons, but with the introduction of broadcasting the small capacity is a decided advantage; in fact, taking the place of the so-called vernier.

In the first place, it is necessary to put together several fixed condensers, the smallest equal to the variable one at its maximum, the second double the first, and the third double the second, and so on according to the maximum required.

Fig. 1 shows the construction of a fixed condenser, and by making the overlap of each double the previous one, the successive ones may be constructed.

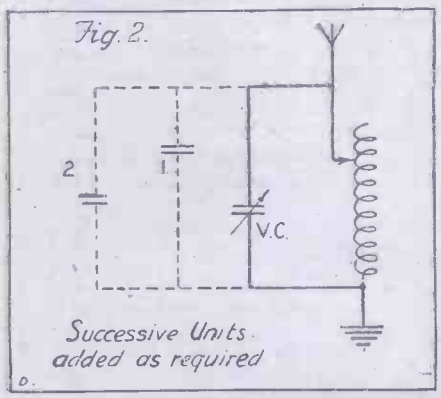


Fig. 2 shows how each is adjusted. The first is arranged in parallel with the variable, using temporary connections, and the area of overlap decreased until No. 1 gives the same signal with the variable at minimum as the variable at its maximum does alone. The tuning is best done on the silent point of a continuous wave station, and, though rather tedious, is very fascinating. No. 1 is then placed permanently in parallel with the variable, and No. 2 adjusted in the same way to give the same signal as No. 1 plus variable. In this way the successive stages are built up.

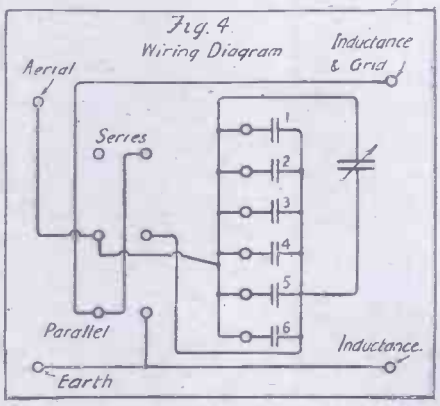
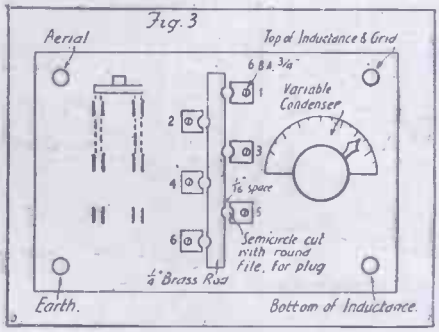


Fig. 3 shows the method of assembling. In brief, any of the fixed units may be placed in parallel with the variable condenser by means of plugs or small knife switches. The former are possibly the easier to make. Mounted by the side of the variable unit, and used in conjunction with a series parallel switch, the whole makes an extremely useful and cheap tuning condenser. Fig. 4 shows how the wiring is arranged.

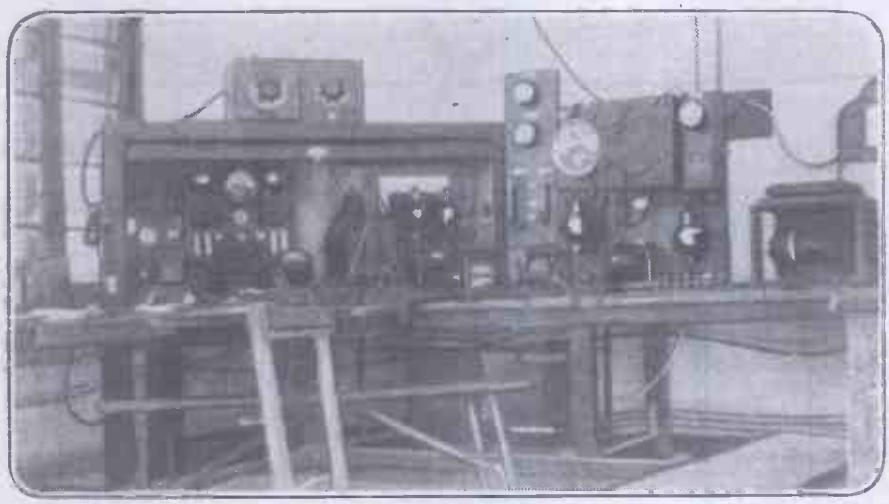


A CRITIQUE OF THE WIRELESS EXHIBITS AT OLYMPIA

(Continued from last week by "Popular Wireless" Technical Staff).

A FIVE-VALVE Jacobean Cabinet holds the chief place on the Fellows Magneto Co., Ltd., stall. In it are incorporated a Brown loud speaker and a Microphone amplifier. The back of the cabinet lifts out very easily and thus provides very handy access to the "works" of the whole set. Sharing the honours with this set is a "Super" two-valve receiver. This contains one H.F. amplifying valve and a detector, but the range claimed for it is responsible for its name; it has nothing to do with the Armstrong "Super," of course.

Siemens Bros. & Co., Ltd., combined crystal and valve set requires special attention among the many exhibits of the above firm. Neatly arranged, it is capable of acting as either a crystal rectifier alone, a valve detector alone, or a combined crystal detector and valve magnifier. All variations are controlled by the simple movement of a single three-way switch. Either H.R. or L.R. phones can be employed, or, if desired, both types together.



250 and 500 watt combined transmitter. Sent in by Mr. M. Keenan, 5, Turner Street, Townhead, Glasgow.

A four-valve cabinet set also is worth noticing, as it claims to be so selective that if it were operated next door to 2 L O you would be able to tune out that station and receive any other within range.

On the Metropolitan-Vickers, Ltd., stall is shown a very neat cabinet four-valve set, 1 H.F. Det. 2 L.F., using variometer tuning throughout. It employs reaction on the tuned anode of the H.F. valve. The switches controlling the tuning are so arranged that a little slot in the switch arm enables you to mark the exact position of the station on an aluminium plate. A plugging arrangement allows of the use of either the two valves—H.F. and Det.—or the addition of a two-valve L.F. amplifier. It is said that the New Jersey station W J Z has been received perfectly on this set at Manchester.

(To be concluded next week.)

POPULAR WIRELESS Beginners' Supplement

PART IX. CONCERNING AERIALS.

By MICHAEL EGAN.

THE function of an aerial, whether used for the transmission or reception of wireless signals, is to act as a suitable medium in which to produce electrical vibrations. By means of various kinds of instruments, electrical vibrations are set up in a transmitting aerial at a certain place. The vibrations so caused give rise to energy waves which flow out in all directions through space, and these energy waves in turn set up sympathetic vibrations in a receiving aerial many miles away. In each case, the first duty of the aerial, as it were, is to enable electrical vibrations or oscillations to be produced in it.

The simplest, though not the most efficient, form of aerial is a single length of wire stretching up out of the earth. If the wire is a long one, it will have a natural tendency to vibrate slowly, and, if it is a short one, it will have a natural tendency to vibrate rapidly. This characteristic can be illustrated by a simple analogy. If you bend a short cane between your hands, for instance, and then let go your grip on one end, the cane will spring back and "vibrate" fairly rapidly. On the other hand, if you repeat the experiment with a very much longer cane, you will find that the vibrations occur much more slowly.

A Necessary Condition.

Whether the cane be long or short, however, it must be gripped firmly at one end in order to permit of good strong vibrations being set up in it. If it be held carelessly or loosely, it cannot be vibrated. This is analagous to the necessity for connecting a wireless aerial to earth. One end of the aerial is gripped firmly by the earth, so to speak, and if the connection between the aerial and earth be made carelessly and loosely—*i.e.*, if there is a bad electrical contact between them—it will be impossible to produce electrical vibrations in the wire. In practice, therefore, it is advisable to solder the end of the aerial wire to some metal object that is firmly connected to the solid earth.

As I have already explained in a previous article, the length of the waves sent out from wireless transmitting stations varies considerably. Some stations send on very long waves, whilst others send on comparatively short waves. When the waves are long, moreover, they arrive at the receiving station comparatively infrequently. On the other hand, when the waves are short they arrive at the receiving station very frequently. The waves that are sent out from the big station in Paris, for instance, are 2,600 metres in length, whilst those sent out by the Birmingham broadcasting station are only 425 metres in length.

A Matter of Length.

I have chosen these two stations at random. Now, what does this difference in wave-length actually signify? It signifies, in the first place, that the waves from the Birmingham station arrive at a receiving aerial about six times more rapidly than those sent out from Paris. In other words, about six complete waves arrive from Birmingham in the time taken for one complete wave to arrive from Paris. Now, at which of these frequencies is the receiving aerial going to vibrate? Will it vibrate rapidly in sympathy with the waves from Birmingham, or will it vibrate slowly in sympathy with the waves from Paris?

The answers to these questions depend almost entirely upon the character of the receiving aerial itself. Every aerial has a tendency to vibrate at a definite frequency. A short aerial will tend to vibrate at a comparatively high frequency, and a long aerial will tend to vibrate at a lower frequency, as indicated by the analogy of the short and long canes in a preceding paragraph.

A very long receiving aerial will, therefore, tend to respond to the waves sent out from Paris, whilst a shorter aerial will tend to vibrate in response to the waves sent out from Birmingham.

This does not mean that you must alter the actual length of a receiving aerial each time you wish to receive signals of different wave-length. By means of a variable tuning coil and a variable condenser you can alter the natural frequency of your aerial within limits. These limits, however, will be determined by the actual amount of wire that comprises the aerial itself. You cannot just go on adding coils of wire and condensers to a short aerial indefinitely, in the hope that you will make it suitable for the reception of long waves. You can only do so *within limits*. But if you want to get the best results the length of your aerial should be proportionate to the length of the waves you wish to receive.

Loop and Frame Aerials.

I referred just now to the necessity for having one end of the aerial firmly embedded in the ground. I should have mentioned that this is only one means of rendering an aerial suitable for being vibrated. It is not the only means. If you recall the analogy of the violin string, you will notice that this is an instance of vibrations being produced in something that is gripped firmly *at both ends*. The same conditions can obtain in connection with a wireless aerial. Instead of "earthing" one end of the aerial, both ends may be "made fast" to the receiver.

This is the way in which a "loop" aerial is connected up. Each end of the wire that forms the aerial is taken to one side of the receiver—*i.e.*, to the terminals marked "aerial" and "earth." The aerial may, therefore, be regarded as being held at both ends by the receiver. It is, as it were, stretched between the "aerial" and "earth" terminals.

An aerial of this kind has a very marked directional characteristic. If used as a transmitter, it will radiate most of its energy in the direction in which the plane of the loop points, and, if used as a receiver, it will absorb the greatest amount of energy from the same direction. Though outdoor loop aerials are usually formed by a single large span of wire, when used for indoor purposes this form is not convenient, owing to the small amount of space available.

This difficulty is overcome, however, by winding a number of small loops on a wooden frame of convenient size, all the loops being joined together in series. That is to say, the loops are all wound from the same long stretch of wire, the size of the frame, and the number of turns of wire determining the total length, and, hence the natural frequency of the aerial.

In Birmingham and round about the children enjoy Uncle Tom and Uncle Edgar just as the London Uncles are enjoyed.

TRACING FAULTS IN VALVE SETS.

By G. V. DOWDING, Grad.I.E.E.

CONTINUAL crackling, rushing, roaring noises, that drown all signals save the loudest, and cause one to tear the phones off, gently or otherwise, according to one's temperament, are the most common symptoms of a "seedy" valve set. The worst part about it, too, is that there are quite a number of different things that can cause the trouble. Probably the most usual is that one of the cells in the H.T. battery has developed an internal fault, and is indulging in a little effort of local and individual internal activity—in other words, is "dud." By cutting cells out of circuit one by one, the faulty cell can sometimes be located and dispensed with; but the best scheme is to endeavour to borrow another H.T. battery from the owner of another valve set to try out, because, generally speaking, when one cell of an H.T. unit gives out, the others will very quickly follow. Buy another battery, but do not throw the old one away, because, to a certain extent, it will recover and will prove a useful "stand-by."

Having tested the H.T. battery and finding that to be O.K., the next thing to do is to examine the accumulator. Take note whether there is any sign of sulphating, which can clearly be identified by the white substance that collects on the plates should this be happening. Sulphating is caused by carelessness in not keeping the cells well charged, or in allowing them to stand idle for lengthy periods without attention. To avoid trouble from this source, everyone that handles accumulators should possess a voltmeter, and should test the cells while they are connected to the set, with the valves turned on, at frequent intervals. As soon as the voltage per cell falls below 1·8 volts under these conditions it should be taken along to the electrician for re-charging.

Some Elusive Points

Keep the terminals of the accumulator well greased to prevent corrosion, and the top dry and very slightly greased to prevent acid creeping. If the aforementioned advice is strictly followed, there will be one, at least, of the many causes of "roaring" prevented.

The next possible cause lies in the metallic connections of the circuit. A loose or dirty connection can cause the trouble, and all leads, terminals, plugs, and sockets should be run over and carefully cleaned and tightened. Take out the valve or valves, and clean the valve pins or "legs" and their sockets. Examine the small terminals situated on the back of the telephone earpieces. Possibly there might be a fault in the earpieces themselves. They might even be partially burnt out if very heavy work has been carried out without the insertion of a telephone transformer. If there are several telephones in series on the set, try shorting them, one pair at a time, and if conditions should improve to any considerable extent while doing so, then the telephones that are so "shorted" will be the culprits. The same test can be carried out with each individual earpiece by connecting their little terminals together.

Examine the filament resistance from the point of view of its action, and run it backwards and forwards several times rather quickly; this will, of course, clean up the point of contact between the moving arm and the wire.

That fairly well covers all possible causes of the "roaring" trouble, as far as the outside of the set is concerned, and should the careful application of all the foregoing tests not result in successfully cutting it out, then one can only come to the conclusion that the fault exists somewhere in the inside wiring. At this point I would not advise the beginner to attempt to dismantle the set, although later on I hope he will find that it is not much more difficult to deal with the set from that point of view than it is from the outside.

Local Interference

Intermittent rushing and roaring sounds can be caused by the passing of electric trains and trams, whilst regular humming sounds can be induced from electric light or power mains, and it is only fitting in such an article as this that a few words should be said on how to handle such interference. In the first place aerials, wiring, and earth leads should be kept as far away from and as near to right angles as possible to any electric light, power, or phone wires or cables. Should one be situated uncomfortably close to such mains or to a tramway, electric railway, or power-station, then undue low frequency amplification should be avoided. Such interference is usually of low frequency, and, therefore, it stands to reason that low frequency magnification should be avoided. Two L.F. should be the maximum, and should only be employed where a stage or so of H.F. amplification is used, as this latter will act to a certain extent as a filter to such disturbances. Better still, cut L.F. amplification out altogether, and give the loudspeaker a miss, sticking to the phones, which, after all, have quite a number of other advantages.

Having carefully taken note that the above has been carried out carefully, and still the interference is markedly noticeable, there are still a few other things that can be done. The most useful will be to employ what is known as a counterpoise, or balanced earth. Quite a number of the disturbances mentioned above make themselves evident in the form of earth currents caused by leakage, and the introduction of a balanced earth will prevent such currents entering into the set. In effect, such an earth is really another aerial similar in dimensions, direction, etc., to the real aerial, and insulated in the same way with the usual insulators and lead in tube, but suspended only a few feet above the ground. Should this fail, then, as a last resort, one can try screening the set. This is accomplished by either placing the complete set in a box, made of soft sheet iron, so that as little of the set and its wiring is exposed as possible, or by lining the inside of the set, should it be fairly easily accessible, with lead or tin foil. In each case, a wire should be taken from the screening material, and connected to a direct earth, and not the balancing earth. The object of such a screen is to shield the set from the electromagnetic waves generated by such things as A.C. mains, "sparking" tramcars, etc.

Complete Failure

Now we come to perhaps what is the most baffling of all symptoms—complete failure. There is nothing so totally disheartening to the beginner as a valve set that absolutely refuses to produce a sound in the phones. Practically all the points dealt with in that part of the article dealing with continuous rushing and roaring noises obtain in the case of complete loss of signals. Connections must all be examined, tightened and cleaned, etc., just as detailed in the other case. Perhaps the H.T. battery has completely "petered out." Test it by momentarily shorting it with a small piece of wire across its terminals. A nice, crisp spark should result; if it does not, then the days of that particular battery are numbered. Don't carry out the same test in the case of the accumulator employed for the filament lighting of the valve, because this type of battery does not possess the internal resistance of a dry battery, and would therefore momentarily pour out as much current as the wire would carry. As you will by now no doubt know, this would cause the cell to discharge more current than it should be allowed to do, which would cause the plates to buckle. However, it need hardly be added, even dry batteries should not be unnecessarily "shorted," because, as a matter of fact, their design is such that their rate of comfortable discharge is considerably below that of its voltage divided by its internal resistance. That is a little application of Ohm's Law which you need hardly worry about if you are not interested.

"Freak" Results

Dealing with total loss or partial loss of signals, mention must be made of the aerial and local conditions. However, as such articles as "Hints on Aerials" and others that have appeared in this supplement have dealt with the faults and maintenance of aerials in detail, I will pass the aerial and its insulation and freedom from damp, etc., as O.K.

With regard to local conditions, I must make mention of what is known as amplifying heterodyning. This is, in effect, the re-radiation or building up of the ether waves by the relaying action of the more powerful valve receiving stations. Such is presumed to be the cause of many of the so-called "freak" results obtained on crystal and one-valve sets, and would appear to be a quite feasible explanation. Therefore, should you have several neighbours who possess five, six, or seven valve sets, there may come an evening when not one of them is enjoying the reception of broadcast concerts, and you are not able to obtain assistance in your reception by means of the relaying action of such stations. This is put forward more or less tentatively and may well be open to criticism; but if accepted, provides, anyway, quite a possible explanation of such phenomena as "fading," "giraffing," and general "freak" results, which, although quite an interesting side-line of wireless, are rather without the scope of discussion in this article.

AMPLIFIERS FOR CRYSTAL SETS.

IN the first place it is useless to add another crystal detector to the set in the hope that it will increase the range of reception or signal strength, because crystal detectors do not, like valves, amplify, they only rectify, and this latter is only necessary once in the life of a received signal. But it must be added that where one is a good distance from the broadcasting station, and signals are weak on a crystal set, by *replacing* the crystal for one admittedly less stable but more sensitive it is possible to increase the strength of the signals considerably. For instance, a really sensitive detector consists of a galena crystal with a fine gold wire contact, but it is very tricky to handle and keep in adjustment.

The next step that the earnest seeker of loud speaker signals on a crystal set will take unless he is warned in time, is to search round for some entrance into the set into which he could pour some local energy from a dry battery in order to help the received signals on their way through the telephones. Such a procedure, however, will not prove wise; nice, sensitive crystal detectors will lose their sensitive points very rapidly if a local battery is brought into circuit, even with the help of that mysterious instrument, the potentiometer.

Low-Frequency Amplification.

With the assistance of a microphone and a spare telephone earpiece, a microphonic relay can be constructed on the lines described in another issue of POPULAR WIRELESS, or microphonic relays can be purchased complete and ready for use, but they possess several limitations. In the first place such contrivances are very tricky to handle, require very careful adjustments, and are very sensitive to mechanical vibration. Finally, they can only be usefully employed as amplifiers of signals audible before their introduction into the circuit.

If signals are just audible on your crystal set, and you desire to increase their strength so that several people can listen in comfortably, then a one-valve low frequency amplifier should be used. This is connected to the telephone terminals of the crystal set and should, if of good construction, magnify the signals by at least four times.

In cases where signals are comfortably strong, and it is desired to employ a loud speaker, probably a two-valve low frequency amplifier will be required. This may sound a lot, but very loud signals are required for efficient loud speaker work. As a matter of fact, if your crystal set is providing comfortable signals to everybody who desires to listen in, then bar the loud speaker—you will not consider it worth all the extra initial expense and expense of upkeep. Good telephony on a crystal set in headphones is unsurpassable.

Signals Must Be Audible.

The addition of low frequency amplifying panels does not in any way affect the connections of the set, except that the telephones are transferred to the "Output" (phone) terminals of the amplifier, while this latter is connected to the phone terminals of the set. Also it must be added that low frequency amplification does not increase the range of reception of a set to any appreciable extent. In order to do this, the valves must be employed in a high-frequency capacity, which merely means that they must amplify the signals before they come to the stage where they are detected. Generally speaking, low-frequency amplification is useless except when dealing with audible signals. To bring them into audibility, high-frequency amplication is required, and unfortunately it is not so easy in its application. The awkward part about it is that the amplifying must come between the tuner and the detector. The signals will require tuning in by means

A Norwegian Operator in his Cabin.

of a variable inductance coil and perhaps a variable condenser in the usual way, but immediately they have been tuned in they must be amplified before they pass through the detector.

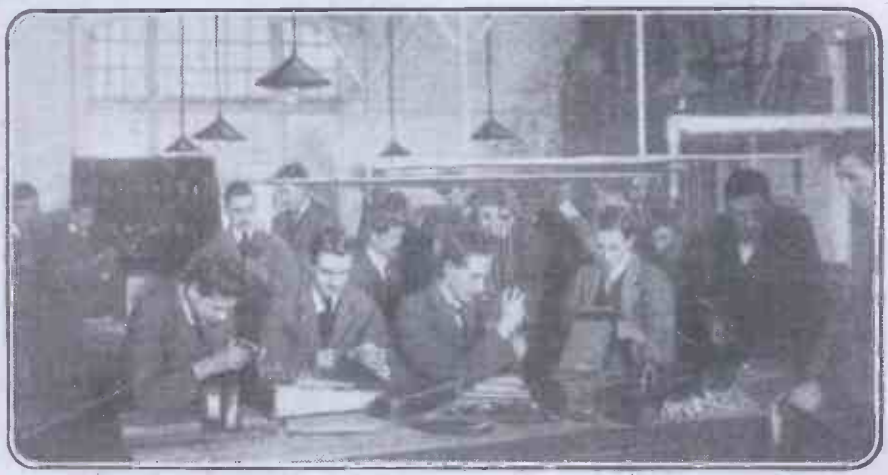
A More Difficult Stage.

This would sound rather paradoxical without further explanation. It must be understood that even in the case of a humble possessor of a crystal set and an "averagely good" outdoor aerial, signals from American broadcasting stations will be cutting by in the form of ether waves and inducing small currents of electricity into his aerial. But these currents will be small in every sense of the word, and far too small to actuate his telephone receivers without some very considerable amplification.

We will take a more practical example. Let us presume that you are thirty-five or so miles away from a broadcasting station, and that in ignorance you have purchased a crystal receiver, believing that with it you will be able to comfortably receive the concerts from the broadcasting station. Now there will be, comparatively speaking, quite a fair amount of energy induced into your aerial by this broadcasting station, but not sufficient to actuate the telephone receivers without amplification; further, it will be useless to pass this current through the detector for rectification until it has been strengthened, because amplification cannot be performed with a weak current of electricity so weak that it cannot actuate sensitive wireless phones *after* it has overcome the resistance of the detector.

It will be judged from the foregoing that although high-frequency amplification is very desirable in certain circumstances, it is rather difficult in its application in the case of the ordinary crystal receiver. Therefore if it is a question of considerably increasing the range of reception there are two alternatives only, and they are firstly to purchase a more suitable and sensitive receiver or to endeavour to graduate out of the "beginner's" stage as soon as possible, and join the ranks of the "experimenter."

Possessing but a broadcast licence activities of this nature are decidedly limited, but one can, even with B.B.C. stamped apparatus, carry out quite a few experiments in *arrangement* of instruments as differentiated from actual *modification*. For instance, no official objection is raised to the addition of B.B.C. stamped apparatus to B.B.C. stamped sets providing the internal wiring of such are not interfered with.



One of the practical classes in wireless held at the Cottridge Day Continuation School, Birmingham. The station call sign is 2 U K.

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

Q. Why is steel used for permanent magnets and soft iron for electro-magnets?

A. Because the arrangement of the particles of metal varies in the two cases. When steel is magnetised these particles arrange themselves end to end, forming continuous chains of magnets. The same happens in the soft iron, the only difference being that soft iron is more easily magnetised than steel. But, when the magnetising influence is removed, in the case of the iron, the little particles resume their former positions, and do not remain end to end, as is the case when the iron is acting as a magnet. The steel particles, on the other hand, remain in their end to end position after the magnetising influence has been removed, and thus the magnetic properties of the metal are preserved. Before magnetisation the particles in both metals are arranged in apparently no definite order, but are scattered about in all directions; it is only when the magnetising force acts upon them that they rearrange themselves in definite lines, end to end, down the bar of metal, and thus form the magnet.

* * *

Q. Why does the bulb of a valve get black after use?

A. The black coating on the glass is due to the particles of filament that have been torn off and flung on the glass by the tremendous force of the electrons as they fly from the filament to the plate. Eventually this tearing off of lumps of filament, though very small, results in the wearing out of the thin wire, and this is why the valves eventually "burn out."

* * *

Q. What is meant by a soft valve?

A. A valve which, though it has been evacuated to a certain extent, still contains some residual air or gas. The degree of softness or hardness of a valve depends upon the degree of evacuation to which the valve has been submitted. A "soft" valve will be found to be a very good rectifier or detector, while the hard type is best used as an amplifier.

* * *

Q. Will 8,000 ohm phones do for a crystal set?

A. Yes, quite well, but either 8,000 or 4,000 can be used.

* * *

Q. What crystal is the best?

A. You will probably find that one of the forms of treated galena will be most satisfactory. Try Hertzite or Permanite, using a copper or silver "cats-whisker" contact.

* * *

Q. What capacity should the telephone condenser have?

A. About ·001 mfd. The value is not all that critical so that you need not have it exactly ·001 mfd.

* * *

Q. How much wire shall I want to wind a coil to tune to 1,000 metres if I use a former of about 3" diameter?

A. If you use 24 gauge S.W.G. enamelled wire about 8 ozs. should be ample. You will need somewhere about 120 turns.

* * *

Q. What is the wave-length of a coil whose dimensions are 4" diameter, 5" long, and wound with 110 turns of 26 S.W.G. D.C.C.?

A. Roughly, about 280 to 1,000 metres if you are using an average sized aerial.

* * *

Q. What plate voltage must be used for two "ORA" valves?

A. This cannot be said definitely. You should have a H.T. battery capable of being tapped so that you can vary the voltage between 30 and 60 volts. Probably 45–50 volts will be somewhere near the correct value.

* * *

Q. How is an Experimental Licence obtained?

A. Write to the Secretary, G.P.O., London, and ask for an Experimental Licence form. This must be filled in and returned to the G.P.O. The 10s. fee will be payable when the licence application has been passed, after payment of which the licence will be forwarded.

* * *

Q. Is there a licence for the home-made set?

A. Unfortunately, there is no such licence at present. Those who make their own sets have to apply for special permission to use them, unless they obtain a full experimental licence. Unfortunately, neither of these is easy to get, though they are certainly worth the attempt. Shortly it is to be hoped that a new licence will be issued for those amateurs who construct their own sets, but who do not intend to experiment seriously.

* * *

Q. Why is reaction allowed on some sets and not on others?

A. Because it depends upon how the reaction is obtained, as to whether it is likely to cause interference to other listeners-in or not. If the reaction effect is obtained by coupling the reaction coil to an internal coil—like the H.F. transformer—where there is a valve between it and the radiatory system (aerial), then the reaction cannot cause interference. If the reaction coil were coupled to some part of the aerial system, it would be capable of energising the aerial, setting up oscillations in it, and thus transmitting a continuous wave which would create a "howl" in every valve set for some distance round.

* * *

Q. How do I know when my accumulator is fully charged? How long should it be on charge?

A. The cells should be gassing freely and should have taken on a milky appearance. You will find that it is best to allow the battery to gas for about one hour before taking it off. It is impossible to state the length of time that the cells should be on charge, as this depends upon the size of the battery and the rate of current which is allowed to pass through the accumulator. Never charge at a greater rate than about one-tenth of the actual ampere-hour capacity of the accumulator. Thus, if the actual capacity is 30 ampere-hours, do not charge the accumulator at a rate greater than three amps. This rule applies also to the discharge of a battery, so that from it can be calculated the number of valves that the battery will successfully operate. Taking as an average consumption for each valve about ¾ amp., a thirty ampere-hour actual capacity (60 ignition) should not be allowed to light more than four valves at once; in fact, four valves is just on the safety mark, and if the valves consume more than ¾ amp., as some valves do, three valves should be set down as the limit.

Mr. L. Smith and his home-made set, College House, London Road, Braintree

CORRESPONDENCE.

To the Editor, POPULAR WIRELESS.

Dear Sir,—Will you allow me to voice a protest re the remarks of "Experimenter who Enjoys Broadcasting Reception." We who possess a broadcast licence also appreciate the grand performances radiated from the Broadcast Company.

Why don't people stick to their experiments without endeavouring to dampen the enthusiasm of wireless novices. A company that can surmount the difficulties that must have presented themselves to the Broadcast Company at its inception needs no "panicky" letters from "listeners-in." The Postmaster-General, with his competent staff, is quite equal to any emergency, and I suggest that "Experimenter" had better continue with his research work, and forget the hundreds of thousands who have paid for their licences, and have also paid the royalty on their receiving sets—but, in the estimation of the aforesaid gentleman, have failed to put the Broadcast Company on a good financial footing.

Wireless instruments at present are commanding good prices, and I have yet to learn *that anyone is obtaining something for nothing* (according to our friend) when they venture into the radio world.

Wishing your paper every success and complimenting you on your new cover-page,

I remain, yours faithfully,

WILLIAM BEALE.

7, Holborn Road, Plaistow, E.13.

To the Editor, POPULAR WIRELESS.

Dear Sir,—As an appreciative reader of your deservedly popular paper, I am interested in the correspondence appearing in your columns relative to the present licensing system. Apparently the "Experimenter who Enjoys Broadcasting Reception" has a somewhat peculiar sense of logic. Perhaps he will explain how one can possibly become an experienced experimenter without being allowed to experiment. As well forbid a child to walk until he can prove himself capable of running. I also refuse to believe that there is a "tremendous number of people" who desire to avoid payment for entertainment. During the past thirty years my employment as a public official has brought me into contact with a very large number of people in most walks of life, and I am glad to say that I have found more than 99 per cent. of British subjects honourable men and women, anxious to render just dues to their fellows. Your correspondent, while pleading for a broad-minded view of the subject, really appears to me to favour a narrow view.

We all recognise and appreciate the splendid work of the B.C.C., and no one, I feel sure, will object to paying an increased annual fee for an experimental licence if necessary; but please allow us the maximum amount of freedom. I, for one, hope and believe that the P.M.G. will do all in his power to encourage people to experiment, so that this new and wonderful science may be better appreciated and developed.

Inventive minds are not altogether a monopoly of technical workers, nor are brains restricted to professional electricians. Thomas Edison is said to have started life as a newsboy. Who, therefore, can gauge the potential power of many another boy in similar circumstances? It should not prove a difficult matter to efficiently protect the interests of the B.B.C., and at the same time afford liberal encourageemnt to all who desire to experiment in the fascinating pursuit of "wireless."

Yours faithfully,

H. J. BICKNELL.

14, Gresley Road, London, N.19.

(The Editor's remarks on the licence question appear on the Radiotorial page.)

NOTES ON THE MANCHESTER ETHER.

MANCHESTER, like all other cities, has its other shakers, who keep up a very high standard of transmission. Prominent among these is 5 A J, who is to be heard with most other amateurs on Sundays. He usually has a lady rendering delightful vocal items, and evidently possessing a wireless voice, to judge by the way the songs come through. We wonder what it is that causes that shuddering sound (I can describe it with no other word) which occurs when he first switches on. Is it the artist suffering from "etheritis"?

Those "Ether Ramblers."

Then there is 2 W K, who considers his tests incomplete without a French-horn solo. We say solo, but we are not sure if it is quite correct, as we think that on at least one occasion there was a vocalist and piano as well. Did 2 W K catch that train to Leicester that 2 B C recommended?

We feel sure that in the near future 2 F Z will fall asleep in the middle of an announcement. Possibly he finds the transatlantic broadcasting of great interest. Like 2 W K, he has his inevitable instrument, in this case a harmonium, very vigorously played—on one or two occasions we have felt great admiration for the performer's endurance. 2 F Z's recently acquired habit of wandering over the ethereal countryside causes us a lot of steeplechasing; these cross-country runs are very trying, especially when one is anxious to hear the whole of a transmission. 2 N B, on the only occasion on which we have heard him, descended to the same trick to keep his conversation private.

What We Can't Stand.

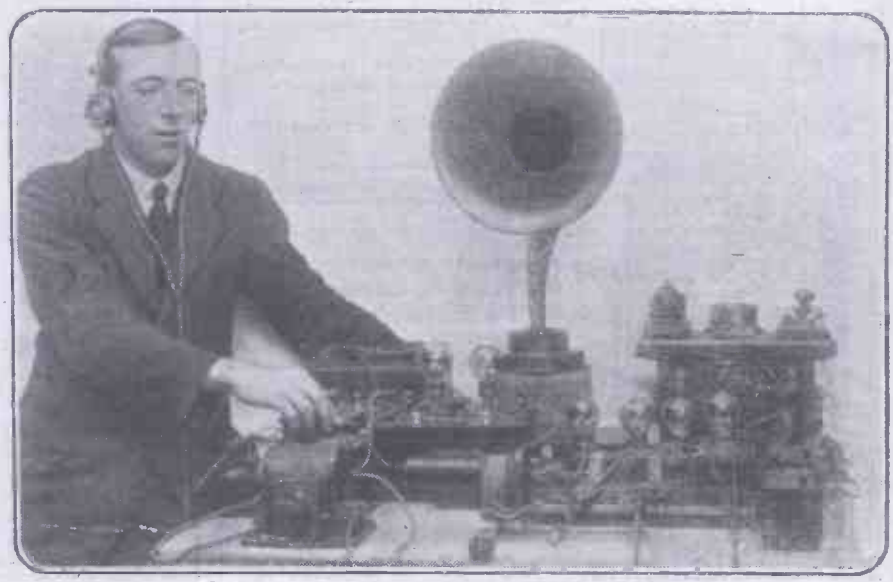
Sundays are the best days for listening-in to the amateur, as 2 Z Y refrains from transmitting until 8.30 p.m., and also the air station is not working. Although this latter station is on 900 metres, it has some very irritating harmonics. These two stations between them swamp everything, and we hope that they will always leave Sundays to the amateurs. From the above one might get the idea that we did not like 2 ZY. This is far from being the case, for we listen to their nightly concerts with much pleasure. The managers of the station are to be congratulated on their kiddies' corner.

The Manchester ether frequently and capably responds to the pleasant vibrations from 5 I T and 2 L O, but, unfortunately, the latter is given to fading away at critical moments.

The ether fiend makes himself felt in Manchester—there seems to be two types: the kind that tune in quickly, and those we can put up with; but what we can't stand is the person who keeps his set in a state of perpetual oscillation for the whole duration of the concert.

Amateur photos, if accepted and published in POPULAR WIRELESS, are paid for at the rate of 10s. 6d. per photo.

Short articles on construction of component parts are also welcomed by the Editor, and are paid for at our usual rates.



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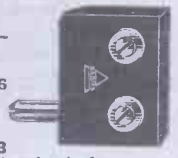

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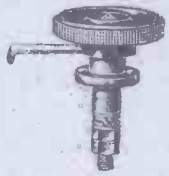

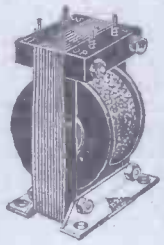

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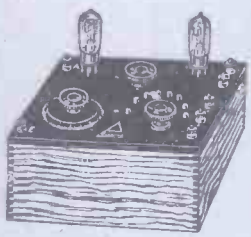

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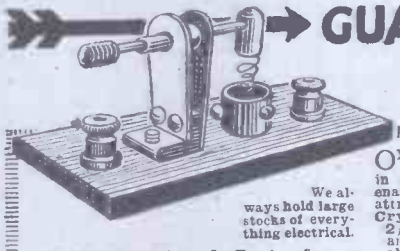

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WHEN SIGNALS FADE.

By G. H. DALY.

YOU have invited a number of friends to listen to a special wireless concert on your new receiver. Everything is going splendidly when suddenly the voice of some star artiste (it is sure to be during the most important item) grows fainter and fainter until it gradually dies away altogether. Hurriedly you try a little re-tuning; but to no purpose, for the voice persistently dies away and is not heard again for perhaps some minutes, when it swells louder and louder, probably exceeding its previously normal strength. But only to fade again—and so it goes on, much to your exasperation.

Not at all New.

Why do signals fade? This question has been receiving the attention of wireless scientists for the last twenty years, but so far no satisfactory explanation has been put forward. There are, however, many theories on the subject, all of which have numerous adherents.

By experiments which have been carried out recently at a number of stations, it has been found that fading takes place when the reaction coil of one particular station is tightened up to oscillating point; but this must be put down as merely a local phenomenon, for fading has been experienced on reception stations situated hundreds of miles from any other receiver.

A number of people consider that fading is due entirely to some unknown factor in the valve when used either for transmission or reception. This, however, is unlikely, for in the early days of wireless, when the coherer, and, later, the magnetic detector were used as detectors, fading was proportionately quite as apparent as it is to-day.

As a matter of fact it has been proved that fading takes place whether the detector happens to be a coherer, magnetic detector, interrupter, crystal or valve, and also whether transmission is carried out by spark, continuous wave, or telephony. So it is safe to say that fading occurs whatever type of wireless set is used.

Effect of Clouds.

The question now arises—is fading due to the action of the receiving or the transmitting station? It is said that the most likely offender is the transmitter, for it is certain that very few transmitters can possibly maintain an absolutely even output of energy at all times. For there are bound to be minute variations in the output of the generator, and loss of energy owing to the heating up of the various parts of the circuit at certain periods.

It is also thought, in the case of broadcast telephony, that slight alteration of the wave-length may be caused by artistes moving about the transmitting studio; but this is hardly likely to be the actual cause of fading, for re-tuning—as signals begin to fade—does not, as a rule, bring them back again, so that fading is not a matter of wave-length.

On the other hand it has been found that signals from one particular transmitter, while fading at one receiving station, do not necessarily fade at another only a short distance away, and if fading is due to the variations in the output of a transmitter it is only natural to conclude that signals would fade at all receiving stations at the same time, which is not the case. Another section attribute the cause of fading to atmospheric conditions. They say that if a heavy rain cloud passes between the transmitter and receiver a certain amount of energy is absorbed.

Experiments have proved however that intervening clouds do not decrease the strength of signals. But, of course, it can be argued that there are clouds and clouds. It may have happened that in these particular experiments mentioned, the clouds passing between the transmitter and receiver were merely light clouds, such as the "wool-pack," and there is no reason why these should affect the wireless waves; but clouds such as the gigantic thunder clouds, in which every raindrop contains a heavy charge of disruptive electricity, may possibly have something to do with fading. In addition to this, meteorologists tell us that certain ordinary-looking clouds sometimes descend to earth with a velocity for which neither wind nor gravitation can account. This is thought to be due to the cloud being attracted to earth, owing to its high electrical charge, and such clouds may be huge absorbers of wireless waves.

Climbing Over Mountains.

It has been demonstrated—in order to prove that clouds do not cause fading—that signals from aircraft flying above clouds are frequently stronger than signals from aircraft below clouds. But this phenomenon may be due to a greater altitude at which the aircraft is usually flying when above the clouds. For the higher an aeroplane is in the sky the stronger are the signals emanating from it more often than not.

A more probable suggestion is that fading is due to the variations in the ground over which the wave is radiated, combined with very minute fluctuations in the output of energy from the transmitter. For instance, in the case of the Post Office wireless station at Niton (G N I).

To operators on ships passing up the St. George's Channel, fading from G N I is very apparent. According to the last-mentioned theory this is because of the mountains of Wales, which intervene between the St. George's Channel and Niton. The nearer the ships are to the mountains—that is, the Welsh coast—the more apparent is the fading.

Adherents to this theory state that when Niton is radiating an even amount of energy, signals will be received by ships in the Channel at an even strength. But supposing there is a minute decrease in Niton's output—which is too small to be noticed by nearby stations—the waves will fail to climb over the high Welsh mountains for the time being, until the output increases again, when the signals will return to their normal strength for a short time.

It may happen that there is a ship-station a few miles ahead of the vessel, which has just experienced fading, and signals on this ship have not faded at all. The theory explains this by saying that the ship which experiences no fading is passing, at that particular time, mountains of a lower altitude or a rift or a series of valleys in the Welsh mountains; and thus that particular section of the waves from Niton are not interrupted by the mountains.

More Feasible Explanation.

From reliable observation it has certainly been ascertained that mountains or hills near the receiving station affect the signal strength to a greater extent than do mountains near the transmitter. This is thought to be due to the fact that radiated waves are propagated upwards from the transmitter, and then slope down to earth again some distance away.

Yet another theory is that fading is due to the movement in the reflective surface of the Heaviside layer.

Adherents to this theory state that, normally, waves on leaving the transmitter travel upwards into the atmosphere, and on striking the surface of the Heaviside layer are reflected down to earth again. But any movement or eruption in the surface of this layer is bound to cause irregular reflection, and this produces "freaks" (*i.e.* signals which are received over an exceptionally long distance when transmitted by a low-power station). Now, says this theory, if the Heaviside layer causes freaks, is it not probable that it causes fadings?

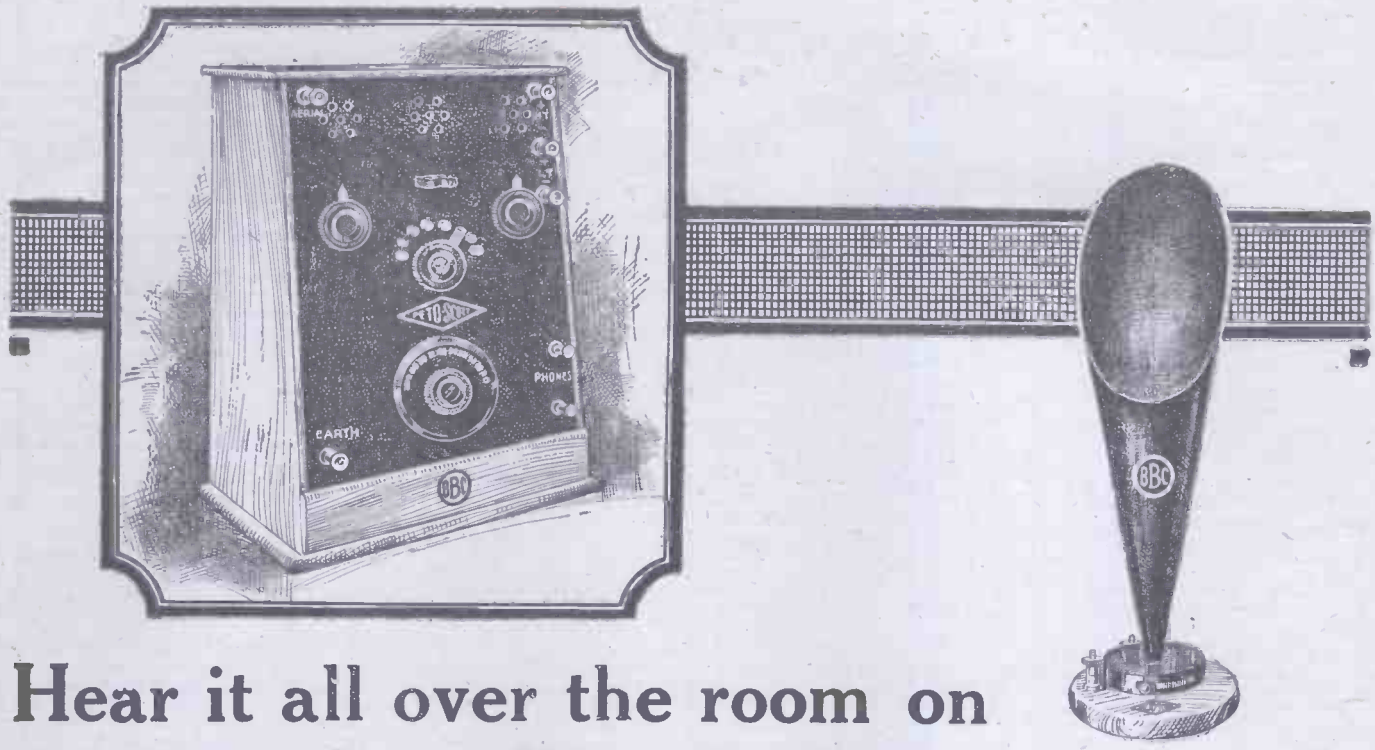
If, for instance, the surface of the layer is disturbed, wireless waves which in the ordinary way would be reflected back to earth, might strike the disturbed part of the layer in such a way that they would pass through the layer into outer space. For it is thought probable that owing to the composition of the layer, waves which strike it at an angle of 90 degrees will be bound to penetrate through the layer instead of being reflected, and thus that particular portion of the waves would be lost, thus causing fading.

Why It Cannot Be Proved.

After a certain period the Heaviside layer would resume an even surface, which it would usually tend to do, especially at night, owing to its high kinetic viscosity, and this reflection of wireless waves to earth would again take place, when reception would once more be normal, until another movement took place in the Heaviside layer. Therefore, fading would be experienced every time an eruption took place on the surface of the layer.

Of all the theories the last to be described is undoubtedly the most probable; but it will be impossible to establish any definite proof until more is known of the mysterious reflector of wireless waves, which is situated many miles above the earth's surface.

It remains at present, one of the fascinating "unknown quantities" that lends to modern science the ever-present element of romance in impending discovery.



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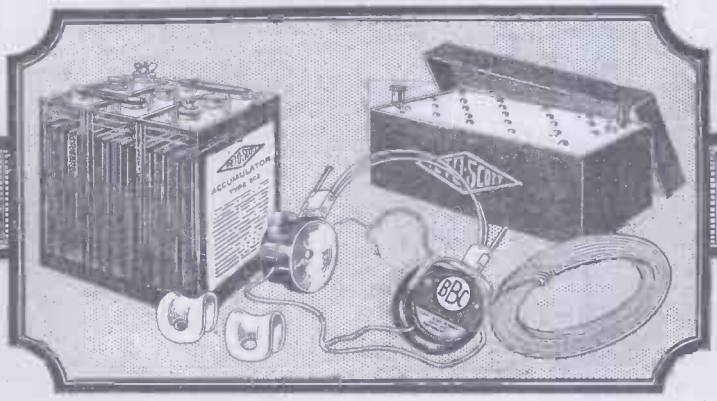

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WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

Hoylake, West Kirby, and District Wireless Association.

A general meeting was held at the Green Lodge Hotel, Hoylake, on January 22nd, when the chair was taken by the vice-president, Mr. S. Evans, A.M.I.E.E. The chairman then called upon Mr. Oscar C. Waygood, A.M.I.E.E., to give his lantern lecture on "Transformers."

Questions were answered by Mr. Waygood at the conclusion of his very informative lecture. Mr. J. H. Harley proposed a vote of thanks, which was seconded by Mr. S. Evans, who also proposed a vote of thanks to Mr. S. H. Cocks for his handling of the lantern.

The meeting concluded with a distribution of the new membership cards by Mr. J. D. Wood, the hon. secretary.

Hon. sec., Mr. J. D. Wood, 7, Grosvenor Road, Hoylake.

St. Bride Radio and Experimental Society.

A meeting was held on Tuesday, January 9th, at St. Bride Foundation Institute, Bride Lane, E.C. 4, when a formation committee was established to make preliminary arrangements, draft rules, etc. The committee met again on Tuesday, January 23rd, and have now completed all the details necessary to place before a general meeting. This meeting, which it is proposed shall be preceded by a short address and demonstration, will be held at a date in the near future convenient to an influential gentleman who has kindly consented to become president of the society. Due notice will be given in the technical press, but anyone interested should send their name to the hon. secretary at the above address, when notice of meeting will be posted.

The Leeds and District Amateur Wireless Society.*

A general meeting was held at the Grammar School on January 19th, Mr. G. P. Kendall, B.Sc. (vice-president), being in the chair. After the usual business had been discharged, the chairman called upon Mr. H. F. Yardley, M.I.R.E., to give a paper and demonstration on the "Armstrong Super-regenerative Receiver." The lecturer referred the meeting to the similarity which exists between the "Turner Trigger-Valve Relay" and the Armstrong circuit, and explained briefly the principles of ordinary regeneration or retro-action as is extensively used to-day. An Armstrong super two-valve set was sketched and each part of the receiver examined closely from the theoretical standpoint. Mr. Yardley related some practical experiences with such a set, and successfully demonstrated the set on view by producing 2 L O out of a loud-speaker with a 16-in. frame.

The discussion which followed was keen and prolonged, many members relating their experiences and pet theories on the subject. Mr. J. Croysdale has been particularly successful with his circuit, having succeeded in raising U.S. broadcast and 9 A B on a frame, using two valves. The meeting was of the opinion that the radiation from the super-regenerative set was not nearly so bad as generally supposed, since the current-limiting property of the valves would ensure that no excessive H.F. currents would flow in an ordinary aerial system, should such be used in place of a frame.

Hon. sec., Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

Walthamstow Amateur Radio Society.*

The society on Monday, January 15th, gave a demonstration to the Walthamstow Literary and Debating Society at the Hut, Y.M.C.A., Church Hill. A crowded audience enjoyed radio telephony from 2 L O through Mr. Pearson's 3-valve set with loud speaker. Mr. Allan, president of the society, answered many questions from the audience. Among other notabilities present, Mr. V. L. McEntee, M.P., our local member, displayed great interest in the apparatus shown and used, and asked many questions. A host of new friends and many new members were made. On Thursday, January 18th, Prof. E. M. Baker, B.Sc., M.I.E.E., gave a very fine lecture on "Telephony and Broadcast Reception."

Hon. sec., R. H. Cooke, 49, Ulverstone Road, E. 17.

The Bournemouth Radio and Electrical Society.

The above society has now been formed, and all those interested in wireless or any electrical matters are urgently requested to communicate with the secretary, who will be pleased to supply them with any information about same.

Hon. sec., A. O. Sparks, "Maranoa," 3, Cotlands Road, Bournemouth.

Carlisle and District Radio Society.

The Carlisle and District Radio Society has just been formed and a strong committee appointed.

Hon. sec., Charles E. Crompton, 107, Warwick Road, Carlisle.

Watford and District Radio Society.

On Friday, February 16th, the above society gave its second public demonstration at headquarters.

This proved even more popular than the first one, and the capacity of the large hall used was severely taxed to accommodate the 160 visitors present.

Hon. secretary, F. A. Moore, 175, Leavesden Road, Watford.

The Leeds and District Amateur Wireless Society.*

An instructional meeting was held recently, when Mr. W. G. Marshall gave the second part of his valuable paper on the subject of "Inductance and Capacity." The elements of capacity and the important effects of the inclusion of a condenser on A.C. circuits of H.F. or L.F., were thoroughly examined. The formula $\frac{1}{2} K V^2$ was explained to a nicety, and the effects of capacity on phase relation of current and voltage in A.C. work closely considered.

Hon. secretary, Mr. D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown Road, Leeds.

Birmingham Experimental Wireless Club.*

An unusually entertaining and instructive lecture was given before the above club on February 23rd, by Mr. Abbott on the subject of "Wireless Procedure."

The lecturer traced the origin of many of the call signs in regular use with both ship and shore stations, and how they have been changed from time to time to meet the new regulations and requirements of rapidly growing wireless traffic.

Hon. secretary, A. Leslie Lancaster, c/o Lancaster Bros. & Co., Shadwell Street, Birmingham.

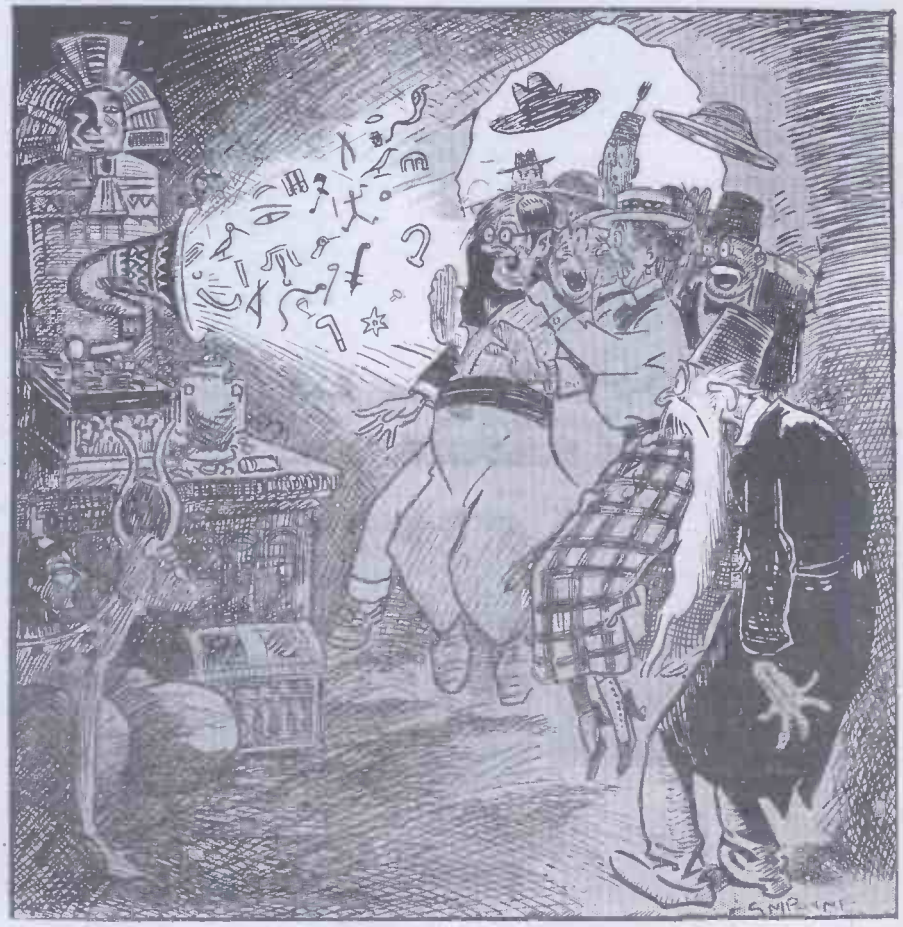
Bethnal Green and District Radio Society's Concert.

The members of this progressive society gave a radio concert at their headquarters, Men's Institute, Wolverley Street, Bethnal Green Road, on Saturday last, February 24th, when the hall was filled by a highly appreciative audience.

A loud speaker had been kindly lent by Mr. W. Wells, of Cambridge Heath, and this was efficiently operated by the society's treasurer, Mr. J. E. Brash.

The society meets at the Men's Institute, Wolverley Street, Bethnal Green Road, E.2, on Tuesday evening, at 7.30 p.m., when the hon. secretary, Mr. S. A. Dennison, will be pleased to welcome new members.

ANOTHER "FIND" AT LUXOR.



RADIOTORIAL

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

My letter to the Postmaster-General, urging the immediate issue of a new licence for the amateur who wishes to make his own apparatus, has been acknowledged. I am informed that "the matter is under consideration and that an announcement will, it is hoped, be made at an early date."

There the matter stands at the time of writing, but it appears that the position of the amateur who wishes to make his own gear is at least appreciated by the authorities, and that something is to be done in the matter.

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send the necessary postage for reply.

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

C. P. L. (Rotherham).—Would the Kallirotron which you described recently prove more sensitive than the Armstrong super-regeneration circuit ?

No, because in a sense their functions are widely dissimilar. The Kallirotron is purely an amplifier of initial impulses and is aperiodic whereas the Armstrong circuit is a radio-frequency amplifier.

Does one connect the input terminals directly to the tuner and the output terminals to a detector ? Could a crystal be used ?

The input is connected to the output terminals of an ordinary tuner-detector circuit, whilst telephone receivers should be connected to its output terminals. Detection should be carried out before the introduction of this circuit.

* * *

A. T. C. (Greenwich).—What causes self-capacity in coils ?

It is the capacity occurring between the adjacent turns of wire. Thus if you have a number of turns close together and all parallel, or nearly so, you will have a certain amount of self-capacity. If the coil is dipped in paraffin-wax, the wax will settle between the turns and form a dielectric of fairly high specific inductive capacity, and the self-capacity of the coil will thereby be increased. Basket coils and honeycomb coils are so wound that the turns have a considerably larger space of air between them than they do in the ordinary solenoid or slab type. Also, where the wires cross, they cross at an angle, thus minimising any capacity effect between the turns. The result of too much self-capacity is to damp the incoming oscillations too rapidly, and "flat" tuning would ensue. Of course, all circuits have a certain amount of capacity, and if we could eliminate it all, the circuit would not oscillate at all. A certain amount of self-capacity is therefore needed, but we do not want too much.

* * *

C. P. (Wellington).—I have a four-valve set, using one valve for high-frequency amplification. I am troubled with considerable "howling" and the set will violently oscillate at the slightest adjustment. I am not using a reaction coil. The set is one that I built myself from combined instructions given in POPULAR WIRELESS.

Unless very carefully constructed and handled, high-frequency circuits will very easily oscillate at radio frequency. The best plan will be to employ a 400 or so ohm potentiometer to provide a control of the high-frequency valve grid. The potentiometer should be connected across the L.T. battery.

* * *

T. B. (Thorpe-le-Soken).—Why is it that bare wire or enamelled wire is always prescribed for outdoor aerials, whereas in the case of frame aerials cotton or silk covered is always recommended ?

Merely, we think, a matter of appearance. Green or white silk or cotton covered wire would look better in the case of frame aerials than bare or enamelled wires, whilst in the case of the outdoor aerial fabric covering would rot and look untidily ragged after a while. In both cases the actual covering or insulation does not affect the reception of signals except that in the case of bare wires employed for outdoor aerials corrosion causing an increase in the "skin resistance" will reduce the electrical efficiency of the system to a considerable degree.

* * *

"AMATEUR" (London, N.).—Can a valve be employed to rectify A.C. for the purpose of supplying the H.T. for a valve-receiving circuit ?

Yes, if a properly designed filter to smooth out the peaks of the alternating current is also employed. When using a valve for rectifying connect the plate and the grid together and employ them as the one electrode using the filament as the other.

* * *

W. G. N. (Ealing).—Can dual amplification be employed using a valve instead of a crystal detector ?

Yes ; although by employing a valve you will be getting away from the chief attraction of the dual amplification system whereby it is claimed that results using just the one valve are nearly as good as those obtainable from three valves with less distortion. We must add, however, that it is by no means an easy matter to get the best out of dual amplification circuits as they prove most difficult to construct and handle in practice.

* * *

L. T. (Aberdeen).—Although I can hear 2 L O faintly I am unable to hear the new Glasgow station. Why is this ?

Aberdeen seems to be very peculiarly situated in respect of wireless reception and this "giraffing" has been noticed by many other listeners-in. It is difficult to advance a theory, but it would seem that the wireless waves are reflected down to Aberdeen. It is more a question of a "freak" reception from 2 L O than a failure from Glasgow, we should be inclined to think, although you give no details as to the sensitivity of your set.

* * *

T. K. (Birmingham).—Are the dark marks on old valves due to the electron emission ? That is to say, are the electrons actual bits of the filament which are thrown off by the heat ? Will a valve filament, if this is the case get thinner and thinner during the time it is in use ?

Yes, to all intents and purposes the metal of the filament is brought by the passage of an electric current to such a heat that it causes an evaporation similar to that which occurs in the case of heated water. This "evaporated" material is thrown off in the form of particles presumed to be the basic and indivisible particles of which all matter is formed, *i.e.*, electrons. Naturally, the filament will decrease in size during this process as the temperature will increase with the diminishing of the amount of material ; temperature being roughly proportional to the rate at which heat ($=I^2R$) is developed by the current.

(Continued on next page.)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from previous page.)

"AMATEUR" (Barnstaple).—Having experimented for some considerable time with valve circuits I have come to the conclusion that regeneration can occur by the insertion in the plate circuit of inductance even although this latter is not connected to the ATI. If this is right, can you tell me how it happens?

Regeneration in such a case takes place through the grid and plate of the valve, which form, as it were, a small condenser.

How can I mathematically determine the required inductance?

The inductance required for such regeneration is given approximately by the following formula:

$$L = \frac{1}{W^2\left(Cm + C + \frac{Cm}{\mu}\right)}$$

where $w = 2\pi n$ (n = frequency), C = total capacity across the inductance L including the plate—filament capacity of the valve and the self-capacity of L, Cm = grid-plate capacity of the valve, μ = the factor of the amplification of the valve. L and C in henries and farads.

* * *

T. O. (Rugby).—How is the wave-length of a coil found out?

By first calculating its inductance in microhenries, adding this to the inductance of the aerial in microhenries, taking the capacity of the aerial in microfarads and applying the formula:

$$\text{Wave-length} = 1885\sqrt{K\ (\text{in microfarads}) \times L\ (\text{in microhenries})}.$$

Most results of mathematical measurements in wireless are very approximate, and even with the greatest of care this particular instance is liable to at least 10 p.c. error, so that one can afford to be approximate with the minor factors. The average capacity of the amateur aerial is between ·0002 and ·0003 mfd., while the inductance will be somewhere round about 15 mhs. Check this roughly by multiplying the length of the aerial plus lead-in in FEET by 1·5, this will give you approximately its fundamental wave-length in METRES. Call this Y; suppose we take the capacity to be ·0002 then the inductance must equal in microhenries.

$$\left(\frac{Y}{1885}\right)^2 \div \cdot 0002.$$

That will bring the K and L coefficients of the aerial to as nearly correct as possible or rather as near as we require them. Calculate the inductance of the coil by means of this formula:

$L = 9 \cdot 8\ D^2N^2LK$, where D = Diameter of the coil in Cms. N = number of turns per Cm. L = length of the coil in cms. K = the correction factor which is based on the ratio of the length of the coil to the diameter.

It varies from ·96 where the diameter is ·1 of the length to ·2 to where the length is ·1 of the diameter. Where the diameter is similar to the length, this factor is ·69. Where the length is twice the diameter it is ·82, where the length is five times the diameter ·92, and from these you must guess somewhere about the figure that will meet the case of the coil you have under consideration. Having then worked the above out, the result will not be in microhenries, but cms., and must be divided by 1,000 to bring it to microhenries. Take this, and add it to the inductance of the aerial, take the capacity of the aerial and apply the first formula given above, *i.e.*, $1885\sqrt{K\ L}$. Where a parallel condenser is employed the various degrees of capacity can be added to the capacity coefficient in the above, and will give quite a fair approximation but, remember that the only accurate method of calculating wave-length is by means of a callibrated wavemeter.

* * *

H. G. (Ilford).—How can I make a resistance of about 10,000 ohms to act as a coupling between valves in a circuit that I am working on?

Obtain a piece of glass tubing 2" in length by ¼" diameter. Obtain a piece of bristol board 2" wide, and coat it with a mixture consisting of 6 parts of Indian drawing ink and 1 of powdered graphite shaved from a grade "H" pencil. Dry this in a warm oven, and cut a piece off 1¼" in length, and carefully wrap it around the glass tubing. Clamp it into position with two strips of soft brass at each end, and cover the space between the clamps with a layer of dry string or cotton tape, which should afterwards be well coated with shellac varnish.

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

R. M. (Brighton).—Can the usual type of variable condenser be used in transmitting circuits?

Not satisfactorily because they will not stand the high transmitting voltages although in certain cases it is possible to increase their breakdown voltages, and also effective capacity by as much as from 2 to 5 times by supplying an oil dielectric. A good grade of pure oil such as castor, Russian white mineral, etc., can be used after all moisture has been strained from it by filtering it through blotting-paper, although, of course, the addition of such tends to increase the losses and should not be used unless absolutely necessary.

* * *

"FRAME" (Hendon).—Supposing I were to construct a frame as large as possible in order to 'fulfil' the requirements of efficient frame aerial work which you tell me is that the larger the frame the more sensitive it is, how large could I go for broadcasting wave-lengths?

The most efficient frame aerial for receiving broadcasting wave-lengths with a ·0005 mfd. variable condenser across it sends effecting the tuning would be one turn of wire on a frame 35 ft. square, but for practical purposes this would be too large. That is to say, that if you could afford the space for such, you could erect the more efficient suspended type of aerial and dispense with a frame altogether. However, for ordinary purposes an average size for efficient frame aerial work is to make it four feet square and wind six turns of wire for the range of wave-lengths that you desire. It must be added that a good example of the relative efficiency of frame aerials is to hand in the examples quoted. The 35 ft. square frame would prove twenty times as efficient as the four foot square frame.

* * *

A. T. L. (Norwich).—I am leaving this address for several months, and wish to pack up the set until I return. What is the best way to store the accumulator?

If you intend to leave the battery for several months without attention, you will have to take special precautions to preserve its condition. Give the cells a good slow charge so that they gas freely for several hours and then empty the acid out. Rinse the cells several times with clean distilled water, and when they are quite clean leave them to dry. The negative plates may be found to warm up a little during the process, but this will not result in any injury. When you wish to use the accumulator again fill up with fresh acid of 1·25 specific gravity, and give the battery a long slow charge until the cells gas freely for about six hours. After this, the battery may be used as usual. It is advisable to go through this process if the cells are to be left for any length of time, otherwise, sulphating and crumbling of the positive plates may occur.

(Continued on next page)

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RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 184.)

T. M. E. (London, N.E.).—What radiation current or current in the aerial is obtainable with a 10-watt amateur station ?

Somewhere around ·65 of an amp.

What range is possible with C.W. using 10 watts ?

Normally somewhere about 500 miles.

* * *

W. J. W. (Fulham).—Is it possible to pay the 7s. 6d. due to the B.B.C. on a home-made crystal set ?

No ; we are afraid this cannot be done. The only thing for you to do at present is to apply to the Secretary, G.P.O., for an experimental licence.

* * *

"BATTERY" (Winchester).—I have just had a 6-volt 60 amp. accumulator delivered to me, but it contains no acid and has not been charged. Can I charge it myself ?

Yes ; you can charge the cell quite successfully, provided you take a fair amount of care over the process. Do not fill the cells with acid until you are ready to commence charging. When ready, fill the cells up to about ¼" above the plates with dilute sulphuric acid of specific gravity 1.25. Be sure the acid is pure ; acid for batteries can be obtained specially made up at many chemists, or from accumulator dealers. Commence charging as soon as the acid has been added, and charge very slowly, at not more than 1 amp. The charging may be continued day and night, or may be intermittent, during the day only, but be sure that no charge is taken out of the cells until they are fully charged. The accumulator should be kept on charge until all the plates have been gassing freely for at least 8 hours, longer if possible. It will not hurt the cells if they are allowed to gas for 12 or 14 hours. A great deal of harm can be done to a battery by not giving it a sufficient first charge.

* * *

P. T. M. (Sutton).—I have been told that the large black insulators that I am using are not really efficient. Is that so ?

Your description of the insulators is not sufficient for us to tell if they are efficient as regards their insulating properties, but probably they give rise to considerable capacity effects between the aerial and the suspending wire or rope. To reduce this you could have two or three insulators in series. The small china ones will probably have less capacity, but we believe it has been found that some of the new glass insulators recently brought out are the most efficient both as regards the insulation and the capacity losses. To the average amateur, however, it is hardly worth while worrying over the losses occuring through the capacity of the insulators, for, in any case, the use of three or four insulators of the china type at each end of the aerial will give quite as efficient results as are required in most cases. Unless very critical experimental work with aerials is to be done, we should not worry all that much over the class of insulator employed, as long as it does really insulate, and especially in wet weather.

(Continued on page 188.)

RADIOTORIAL QUESTIONS AND ANSWERS

(*Continued from page* 186.)

"HONEYCOMB" (Mill Hill).—I wish to make a set of coils for all wave-lengths up to about 3,000 metres, using primary, secondary, and reaction. What values of honeycomb coils do I need?

You will need coils of the following numbers of turns: 25, 35, 50, 75, 100, 150, 200, 250, 300. These will take you well over 3,000 metres, and will enable you to get down to the amateur wave-lengths. The first two or three may be wound with 22 D.C.C., but the others should be wound with 24, 26, or 28 D.C.C., according to their size. Use formers of about 2 in. to 2½ in. diameter and 1 in. wide, with 15 spokes each side. In each case the secondary coil is a size larger than the primary, and is tuned by a ·0005 mfd. condenser. For reaction use either a 35, 50, or 75 turn coil, according to the wave-length you wish to receive. Do not forget the regulations regarding the use of reaction, and, if possible, react upon the H.F. anode coil. The anode coil may also be of the honeycomb type of about the same size as the secondary, or a little larger if desired. Tune with a ·0003 mfd. condenser. This anode coil will have to be changed to suit the wave-length in the same way as are the other coils.

* * *

W. R. (Cricklewood).—What voltage will a dull-emitter valve stand?

As regards this question there can be more than one answer. For instance, the actual voltage that the filament will stand is about 6 volts, but at this voltage—and, in fact, long before this is reached—the filament is white hot, and the dull-emitter properties of the valve will have been destroyed. You will be able to go on using the valve as an ordinary valve, but as a low temperature valve it will be no longer of use. With regard to the voltage that the valve will stand without losing its properties, it is difficult to give any exact data, but never allow the filament to get really bright, and always with the valve on the least possible current consistent with good results, otherwise the coating on the filament may be destroyed and the valve rendered useless as a dull-emitter.

* * *

T. K. (Tonbridge).—I was told recently that instead of using a 6 volt 30 amp. accumulator I could use three 6 volt 10 amp. cells in parallel. This arrangement allowed the cells to be put in series when charging off high voltage mains, and thereby claimed to save expense. Is this plan satisfactory?

Although the scheme may result in a small saving in charging expense, you will find that all the cells must be in good condition and of exactly the same voltage before they will act satisfactorily in parallel. The trouble about this sort of arrangement is that if the voltage of either cell should drop below that of the others they will tend to discharge through the faulty cell. We do not advise the use of this method except for those experienced in the handling of accumulators.

* * *

J. S. (East Ham).—I have a crystal set, employing primary and secondary coils. Do I need variable condensers? If so, what sizes should be used?

For really fine tuning you need two condensers, one across the primary coil, and the other across the secondary. If a slider is used on the primary you may be able to dispense with the condenser, but the secondary coil, having tappings, needs a ·001 mfd. variable condenser across it. In any case, a small variable condenser across the primary may improve reception, say, ·0005 mfd. if without a slider, ·0003 mfd. with a slider.

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POPULAR WIRELESS WEEKLY, MARCH 31st, 1923. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

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Popular Wireless

No. 44. Vol. III. PRICE THREEPENCE WEEKLY. March 31st, 1923.

AN EVERYDAY SCENE IN THE WIRELESS STORES.

FEATURES IN THIS ISSUE.

Breaking the Great Silence.
A Useful Helix.
Batteries for Valve Sets.
The Care of Accumulators.
Making a Unit Receiver.
Latest Patent Inventions.

Articles by Sir Oliver Lodge, Lord Robert Cecil and Sir J. Kenneth Mackenzie.

POPULAR WIRELESS

March 31st, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S., D.Sc. [Every Friday

TOPICAL NOTES AND NEWS.

2 Z Y's Time Signal.

THE Manchester station of the British Broadcasting Co., now re-radiates nightly the time signals from the Eiffel Tower at 10.44 p.m. These signals are of great importance to the mercantile marine and others, and it has been felt for some time that to re-radiate them on a broadcasting wave-length would be a great convenience to the general public. The Paris station works on a wave-length of 2,600 m., and the Manchester station receives the messages on that wave-length and transmits them on its own wave-length of 385 m. This is done automatically by the electrical connection of the receiver to the transmitter. The delay introduced is very small, the re-transmitted signal being only 1-300th part of a second behind the original. The aerial used for receiving Paris is a small one running almost directly underneath the main transmitting aerial at Trafford Park. Furthermore, the receiver used is installed only a few yards from the high-power transmitter which is passing on the signals on the broadcasting wave-length. The engineers of the Metropolitan-Vickers Electrical Co. are to be congratulated upon what they have done in the way of achieving selectivity of reception.

* * *

Careless Aerials.

ALTHOUGH aerials are shooting up by the hundreds, it is strange how many of them are "faulty" from a technical point of view.

Very little attention seems to be paid to the position of the down lead by the majority of new wireless amateurs.

For all practical purposes there are only two types of down leads the average amateur can use—the inverted L and the T. But I notice many aerials having the down lead neither in the middle of the aerial or at the end. Very often the down lead is joined to the main aerial wire three-quarters from one end—very seldom in the exact centre or at the far end.

This carelessness in the matter of down leads will result in considerable falling-off in results when listening for distant stations.

* * *

Back Home Once More.

THE other night the London Broadcasting Station had the interesting experience of listening to its own broadcast music as received in a little village 12 miles from Liverpool. The received signals were relayed back on the landline to 2 L O by an enthusiastic listener-in desirous of acquainting "Uncle Arthur" with the excellence of his transmission. The latter announced that the orchestral selection being broadcast could be heard louder after its adventurous journey to Liverpool and back than in the studio of the broadcasting station itself.

The Autocrat.

BY the way, it seemed rather an autocratic action on the part of the Air Ministry to order 2 L O to close down the other day during the latter's morning transmission. No doubt there was a very good reason for taking the above drastic step, and permission was given for "out of hours" transmissions with a "proviso" that should the "exigencies of the services" require it, it should cease, but really, there isn't a war on, is there?

"Uncle Jeff" of 2 L O

Train Wireless.

I HEAR that before very long all Pullman cars on main line train services will be fitted with wireless. This was the view of Sir Davison Dalziel, M.P., chairman of the Pullman Car Co., after he had "listened-in" on a journey from Dover to Victoria.

Sir Davison said that from the time the broadcasting station opened he heard a musical programme with delightful clearness and he was thoroughly satisfied with the experiment.

* * *

Peter Pendleton Again!

CAPTAIN P. P. ECKERSLEY'S chats from the London Broadcasting Station are always entertaining because he is a natural and gifted humorist, but I have heard it expressed that people are becoming just a little tired of his "oscillation theme." Personally, I consider him at his funniest when dealing with "naughty reacters," but I would not like to see him overdo it. A description of 2 L O on the lines of his description of Writtle would prove most entertaining. For those thousands of people who have joined the ranks of the listener-in since "Writtle days" there is a treat in store should "Mr. 2 Emma Tock W-r-r-r-r-ittle" decide one day to give an "accurate technical" description of 2 L O.

Wireless in "The House."

MR. WHITLEY, the Speaker of the House of Commons, has had a wireless set installed at his private residence. There is, I hear, talk of installing a set in a committee room of the House of Commons "in order that members may keep themselves advised as to the quality of the broadcasting sent out under the auspices of the Postmaster-General's department."

* * *

Southend's Lead.

SOUTHEND is the first town in the kingdom to have wireless loud speakers installed in one of its theatres. The Repertory Company at the Ambassadors Theatre are the pioneers in this respect, and the audience is now entertained during the period before the curtain goes up by a wireless concert.

The set has four valves and is capable of receiving telephonic messages from America. In all respects, the experiment has been an unqualified success.

* * *

The Wireless Lighthouse.

THE first vessel to benefit by the "wireless lighthouse," established by Marconi's on Inchkeith Island, Firth of Forth, is the steamship Royal Scot, owned by the London and Edinburgh Shipping Co.

This boat, which is employed on the London and Leith service, has been fitted with a special type of wireless receiver, which will detect the signals sent out by the "wireless lighthouse," and enable the navigating officer to pick his way through the dangerous channels of the Firth of Forth in the thickest fog.

The Royal Scot has just returned to Leith after her first round trip to London with this apparatus on board, and reports that the "lighthouse" signals were received perfectly during the whole time the vessel was within range, and that the ship's officers were able easily to use the apparatus.

The "lighthouse" sends out a directional wireless beam, which gives a distinctive signal as it passes through each point of the compass. The wireless waves are projected so as to sweep round the surrounding sea in just such a way as a light would from a lighthouse. Thus, instead of fixing a point by visual means, the result is obtained aurally, and is in no way interfered with, whatever the weather conditions may be.

* * *

"Two 'Ell Oh Testing!"

I WONDER what 2 L O is up to now; The last few nights, instead of closing down at 10.30, as usual, he has been "testing." Amateurs who listen-in to these tests are invited to send in their reports to the London station. For the sake of those in the studio I hope they are not contemplating the further extension of their microphone.

NOTES AND NEWS.

(Continued from previous page.)

Pushed Out.

IT looks as if the amateurs are to be completely driven from the ether, at any rate during broadcasting hours. I overheard one or two of them plaintively discoursing on the hope expressed by 2 L O that the power may be increased still more. As one of our smaller "ether-shakers" remarked: "We sha'n't be able to get a wave in edgeways."

* * *

2 L O House-Hunting.

I HEAR that 2 L O will have to go house-hunting, owing to the fact that the Air Ministry objects to having their official transmissions on rather flat C W jammed by the musically modulated waves emanating from the Strand. The Air Ministry declares that 2 L O must separate themselves from their august presence by at least a mile. Captain Eckersley seems quite unperturbed, and says that they have several alternative sites to choose from for their new and more permanent London broadcasting station. I wonder if he will tear up and take with him that maze of wires on the Marconi House roof used as an earth screen.

* * *

Radio and the Stage.

THERE is a clash of opinion among theatre managers as to whether or not the radio version of a show keeps people away who otherwise might either attend that particular performance or go to some other theatre.

While many have stated that broadcasting threatens the theatre with dangerous competition, others have freely given facilities to the Broadcasting Company to radiate their shows in whole or in part.

The Covent Garden operas, "The Last Waltz," "Cinderella," and "Polly" have been broadcast, part of "The Lady of the Rose" and "Battling Butler."

The Theatrical Managers' Association, which represents the provincial theatres, at its annual meeting in London the other day, unanimously passed a resolution recommending its members to give no broadcasting facilities at present.

* * *

Glasgow's Opera Programme.

EXCERPTS from the following operas, as performed by the British National Opera Co., will be broadcast from the Glasgow Broadcasting Station every evening during next week. Easter Monday, "Carmen" (Bizet), commencing 6.45; Tuesday, "The Mastersingers" (Wagner), 6.0; Wednesday, "Samson and Delilah" (Saint-Saëns), 7.30; Thursday, "Magic Flute" (Mozart), 7.0; Friday, "Twilight of the Gods" (Wagner), 6.0; Saturday, "Aïda" (Verdi), 6.45.

* * *

The Super-Crystal Set.

I HAVE heard from quite a number of amateurs who have constructed and are obtaining excellent results on the Super-Crystal Set recently described in POPULAR WIRELESS, and various ranges up to 40 miles for the reception of the broadcasting stations have been recorded. If any reader has, under normal conditions, been able to exceed this, I would be pleased to hear from him.

ARIEL.

Broadcasting a Concert from the Glasgow Broadcasting Station.

Broadcasting Programmes

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

TELEPHONY AND MUSIC TRANSMISSIONS

Station.	Call sign.	Wave-length in metres.	Remarks.
London Broadcasting Station, Strand ..	2 L O ..	369 ..	11.30 to 12.30 every morning and usually every evening, 5 to 5.45 p.m.; 7 and 9.30, News; 7.15, Orchestra; 8.25 to 10.30, Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5 N O ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2 Z Y ..	385 ..	Every evening, usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5 I T ..	425 ..	Every evening, usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5 S C ..	415 ..	15 to 10 p.m.
Cardiff Broadcasting Station	5 W A ..	353 ..	5 to 10.30 p.m.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Paris	F L ..	2,600 ..	11.15 a.m., Weather Report; 6.20 to 7 p.m., Weather Report and Concert; 10.10, Concert.
Königswusterhausen ..	L P ..	2,800 ..	4 to 6.30 p.m.
The Hague	P C G G ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert).
Haren	O P V H	1,100 ..	12 noon and 4.50 p.m. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m., News Items; 5.15 to 6.10, Concert; 8.45 p.m., News Items; 9 to 10 p.m., Concert.
School of Posts and Telegraphs, Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45 to 10 p.m. Saturdays, 4.30 to 7.30 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

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

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

All times given at G.M.T.

BREAKING THE GREAT SILENCE.

Every Radio experimenter is keenly interested in the phenomenon of wireless music being audible to the deaf. A well-known specialist explains this phenomenon in the following article, which has been specially written for "Popular Wireless."

By A PHYSICIAN.

A NEW world is opening for those who have been condemned to live in the Great Silence.

That is the only conclusion which can be drawn from the wonderful discovery, already well authenticated, that deaf people have been able to hear wireless messages spoken in an ordinary tone of voice.

Naturally doctors, and men of science generally, are full of interest and enthusiasm. They may not understand exactly how the miracle has been wrought—few of them even pretend to do that—but they are able to realise its extraordinary possibilities.

Explanations of a sort, it is true, have been given. That which seems to find most favour with ear specialists is that the telephones of the radio set press not only on the ears, but also on the bones of the skull. These bones carry the "vibrations" inwards to the innermost ear, where the hearing sense is placed.

Direct Wireless Reception.

In other words, the telephone replaces the inner "drum" of the ear, which may have been broken or damaged or diseased.

This explanation would be quite satisfactory were it not that deaf people seem to hear the wireless voice better than the spoken voice even when no telephones are used and when the sound is transmitted through a loudspeaker. That can only mean that some other factor in addition to the skull bones is at work.

Our bodies, of course, must "receive" wireless waves just as wires or aerials receive them. It has been suggested that these waves pass through the bones of the head and actually affect the sensitive, hearing portion of the ear at the same time as the broadcasted voice is speaking.

Hearing is "tuned," as it were, to receive the special sounds, which therefore are heard when other sounds, for which there has been no tuning, are missed. Curiously enough, the idea is a very old one for the poet Milton wrote:

"I was all ear,
And took in strains that might create a soul
Under the ribs of death."

Causes of Deafness.

The ear consists of three chambers—an outer, a middle, and an inner one. It is shaped like a tunnel, and divided by partitions which are usually called "drums." The first of these drums lies between the middle and outer ear, the second between the middle and inner ear.

What is called "middle-ear disease" is the commonest cause of deafness. It is an inflammation of this middle chamber, which has usually spread up from the back of the throat, along the tiny tube which connects throat and ear.

If this inflammation is of a severe character, the middle ear may be destroyed. In almost all cases the outer drum is broken; in many cases the three tiny bones which, like a chain, connect the two drums and carry the vibrations of sound from one to the other, are unseated from their positions.

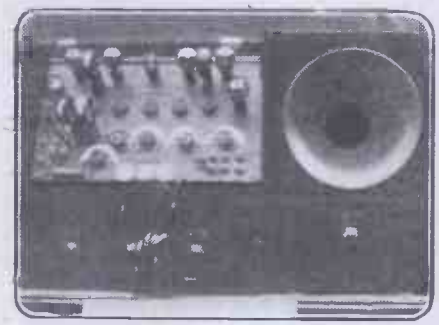
When that happens, the outer chamber and inner chamber of the ear are no longer separated. They make one long tunnel. But this of itself is not enough to cause deafness.

Hearing is never lost so long as the second drum, the drum between the middle and inner chambers, remains normal. For it is this drum which brings the sounds right to the sensitive hearing cells and their nerves.

Consequently, people who have suffered from middle ear disease are not, *as a rule*, completely deaf. They hear, though the finer shades of sound are missed to them.

It is when the inner drum has been injured by the inflammation, or become diseased, that deafness occurs. Sound, when this tragedy takes place, can no longer reach the hearing cells. The door, so to speak, is banged, barred, and bolted against it.

Sometimes the inner drum, which should be made of elastic, soft material, like thin indiarubber, becomes hardened. Sometimes it turns into bone. In either case, there is a more or less complete "blockage" of vibration. That is, a more or less complete deafness.



Mr. L. H. HIRST'S set, 227, Quarmly Road, Quarmly, Huddersfield, Yorkshire.

Through a Closed Door.

And yet, in a sense, the man or woman so afflicted is not deaf at all. The hearing cells and nerves are as good as ever—only no sounds can reach them.

Real, absolute deafness, would mean that the hearing cells themselves, the innermost sanctuary, were destroyed. This very rarely happens.

It follows that, if sounds can be got past or through the thickened inner drum, they will be heard.

There are two ways of making people hear you through a shut door. You may speak through the key-hole or you may get them to listen so carefully and closely that even low tones will reach their ears.

It is quite possible, of course, to combine these two ways, and that, probably, is what the wireless voice does when it reaches a deaf person. The key-hole, in this case, is the skull bones which surround the innermost ear, and which can carry vibrations past the useless drum to the nerves.

While that is being done, it is probable that the nerves of hearing are "tuned" by the wireless waves, just as listeners tune their ears to catch the sounds of a voice or a footfall.

Can the Skin Hear?

It is quite true that this explanation is not complete. We have still a great deal to learn about the effect of wireless and other etherial waves on the human body. Do they, for example, "speak" to every tiny cell of our being? In other words, is hearing something more than a mere sense located in the nerves of the ear?

Within the last few weeks it has been found by an Italian man of science that seeing is not absolutely confined to the eyes. Blind people are able to detect changes of light and shade on their skins. The skin, as is well known, is extremely sensitive to light, and rapidly changes colour under its influence.

It is possible, even probable, that some vague power of detecting also the vibrations which we call sound belongs to the skin, and is shared in a small degree by every portion of the body. To this power, perhaps, wireless waves are able to appeal though ordinary sounds fail to do so.

In any case, the strange and happy discovery which has been made is bound to lead to a new study of deafness, and to new means of treating it. For what can be done with one voice—that of the loudspeaker—can be done with all voices.

The terrible silence of deafness has been broken at last.

Every Reason to Hope.

In the case of children born deaf, and so condemned to become mute as well, this discovery may be revolutionary. Many of these children possess the nerves of hearing in a healthy condition, their trouble being due mainly to deformity of the inner drum. Attempts will now certainly be made to "reach" them by means of wireless.

Nor have we arrived, as yet, at the full development of this new knowledge. Modern sound amplifiers are so ingenious and so practical that it is actually possible to increase the sound of the footfall of a fly until it can be heard by ordinary ears.

Provided that deaf ears can hear in the slightest degree, there seems to be no reason why they should not be made to hear clearly.

Doctors, indeed, are already looking forward to the time when, by means of a device embodying the use of wireless waves and sound amplification, every deaf person who still possesses nerves of hearing will be able to return to the joys and blessings of conversation with his fellows.

Is there reason to deny that other lost senses may ultimately share in this wonderful restoration?

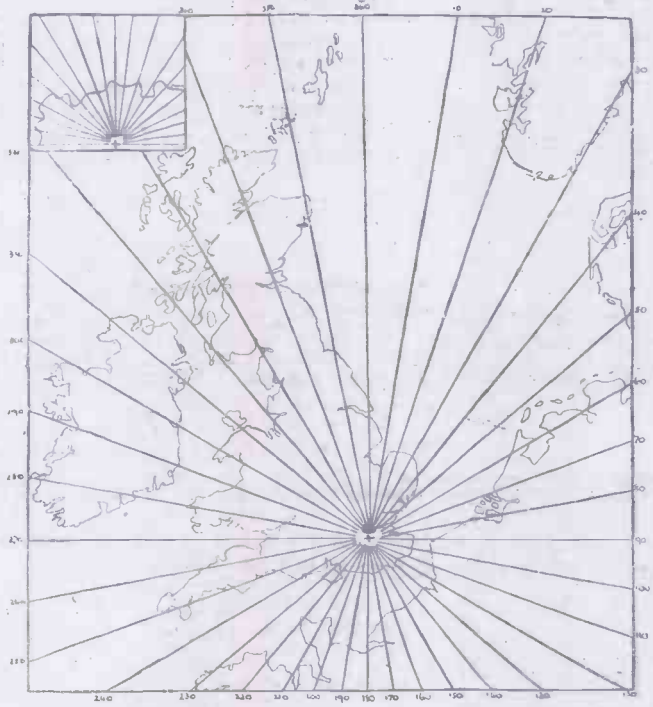
FRAME AERIALS AND THE "POPULAR WIRELESS" MAP.

By ROBERT ENGLAND.

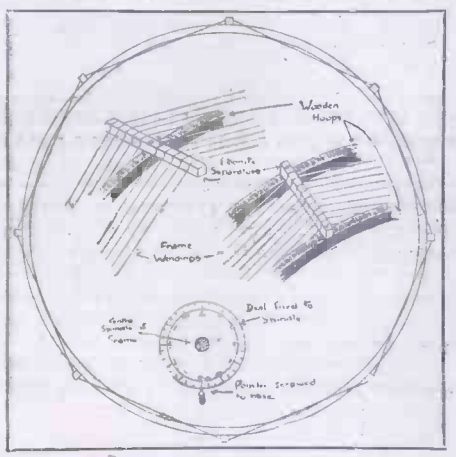
THE marked selective and directional properties of the frame aerial are already well-known to most amateurs, and no doubt many are at present enjoying that relative immunity from interference which this type of aerial affords.

Making the Frame.

The frame is quite easy to make, and the particular type shown in Fig. 1 can be put together in a few minutes. As will be seen, use is made of one or two large wooden hoops such as are obtainable at any toyshop. Short lengths of square ebonite or fibre rod, drilled and slotted, are screwed on at intervals round the outside edges of the hoop or hoops, and these serve to support the windings.



The complete frame may be suspended from a hook in the ceiling, but a rather better method is to mount it on a swivel fixed in the top of a stout box, such as a small gramophone cabinet.



"Setting" Adjustments.

Some very interesting hours may be spent with a frame aerial used in conjunction with the map and directory of wireless stations recently issued by this journal. Known stations may be picked up in a very short time, while any unknown station that may be heard can easily be located and recognised.

In order to use your map and frame in this way, mount loosely on the lower part of the latter a circular dial numbered in degrees from 0–360, and also fit a small pointer as shown. Then fix your own position on the map as accurately as possible, and from this point draw a series of radiating lines at, say, every ten degrees up to the edge of the map, numbering these from 0–360 as before. (The small inset map may be treated in the same way.)

To "set" the map and frame, pick out any well-known station on the map and listen-in to its transmission, varying the position of the frame until one of the two "maximum" positions is found. Now supposing that this station is on line "90" on the map, loosen the dial from the frame, and keeping the latter in the maximum position, rotate the former until "90" appears under the pointer. Now fix the dial rigidly to the frame.

Locating Unknown Stations.

In order to hear any particular known station, simply set the frame so that its pointer indicates the figure corresponding to the number of the "map line" on which the station is situated; you may then be certain that your frame is in the best position for receiving from that particular transmitter.

To locate a strange station, swing the frame into one of the maximum positions and compare the dial reading with the map. Thus a dial reading of 45 indicates a station on map line 45 *or* 135. A short study of the map and directory, compared with the character of the transmission, should now enable the station to be definitely located.

Errors due to what are known as "night effects" may cause some little trouble, and it is advisable to confine definite direction-finding experiments to the hours of daylight.

A LOUD-SPEAKER FOR CRYSTAL SETS.

THE idea of using the diaphragm of a high resistance phone as a diaphragm of a microphone in an independent voltaic circuit simplifies the loud speaking of wireless signals, as received by crystal sets. The circuit is arranged as in Fig. 1.

The microphone is constructed as follows: A round stud of carbon $\frac{3}{8}$ in. in diameter is waxed on the middle point of a high resistance telephone, and a spiral of very fine copper wire (No. 44—No. 48) is connected to it and led away to a terminal (t.). The phone is mounted in a vertical position on a base, 4 in. by 3 in. by $\frac{3}{4}$ in. The microphone contact may be effected in several ways, but the one described is the easiest and one of the most efficient that an amateur can construct. A carbon point is mounted on a springy brass strip which is pressed towards the carbon stud by a screw mounted on a firm metal bearing. See Fig. 2.

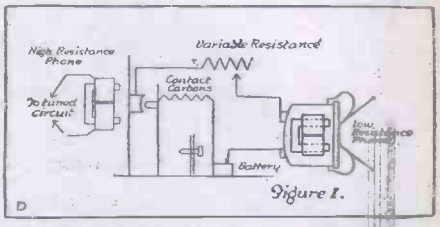


Figure 1.

Useful Amplification.

This microphonic arrangement is introduced into an independent voltaic circuit by connecting the stud terminal (t.) to one pole of a battery of about 2 volts. The second lead from the microphone is taken from the springy bearing, and is connected to one terminal or lead, of a low resistance phone. The circuit is completed by inserting a variable resistance (maximum resistance 15 ohms) between the second lead of the low resistance phone and the second pole of the battery.

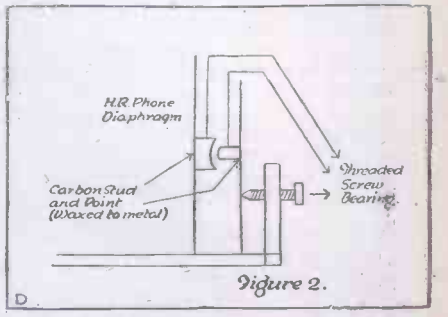


Figure 2.

The principle of the microphonic amplifier is simply this: as soon as any vibration is set up on the diaphragm of the high resistance phone as a result of an incoming wireless signal a corresponding voltaic set of impulses will be set up in the low resistance phone circuit. If the resistance and the microphone are carefully adjusted, considerable amplification can be affected (about four times the strength of the incoming signal). If the microphone distorts, even when a minimum current is flowing, a small choke condenser, bridged across the stud and the contact, will practically cure the trouble.

Miss Ellis Jeffreys and Miss Margaret Bannerman (Principals in "Decameron Nights" recently staged at Drury Lane Theatre) enjoying the pleasures of Broadcasting on a GECOPHONE Set.

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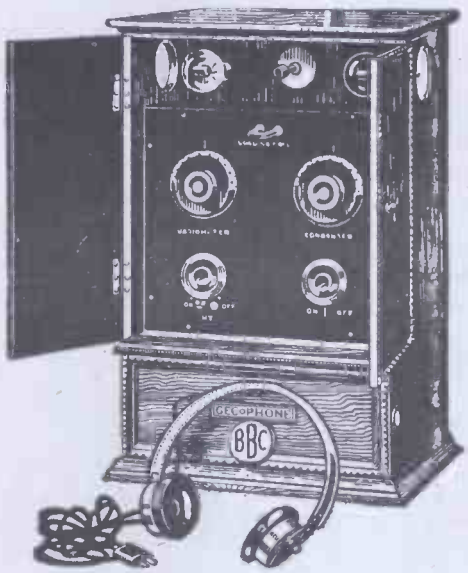


GECOPHONE 2-VALVE SET

A cabinet set in polished mahogany of handsome appearance, complete with valves, all batteries, and one pair double head-phones. Approximate range 100 miles.
Price complete £25 0 0

GECOPHONE CRYSTAL SET No. 1 complete with one pair double head-phones and aerial equipment. Approximate range 25 miles.
Price complete £5 10 0

GECOPHONE CRYSTAL SET No. 2 for more selective tuning, complete with one pair double head-phones and aerial equipment. Approximate range 30 miles.
Price complete £9 15 0

SOME WIRELESS OBSERVATIONS.

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

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

PART 5.—DESIDERATA FOR A RECEIVING COIL.

IN the first place, to keep its capacity down, the actual wire used in coils for a receiving set should be thin, so as to expose but little surface. The wire should be of the highest conductivity, but the smaller its diameter the better, so far as this desideratum is concerned. Also the shorter the length the better, since the capacity varies directly with the length. The only disadvantage of a very fine wire is that its resistance is high. But, after all, resistance does not much matter. The vibrations are damped out by radiation and other causes, and so long as the wire is able to carry the current, that will suffice. For a receiving station the current is feeble, and the thinnest wire will serve. It may be coated with silk or enamelled. And if a stranded core is employed, the enamelling of each separate strand is sufficient to keep them isolated from each other.

Thickness of Insulation.

But it is well to wind the turns of wire not too close together. Hence a fairly thick cotton covering might be applied outside the real insulation, so as to diminish the capacity effect of each turn upon the others. The thickness of the ultimately covered wire may therefore be three or four, or even ten times the thickness of the copper core; but I doubt if it is ever necessary or advisable to use a covering as thick as that. And were it not for the practical experience which has developed "basket" or open winding, I should have been disposed to advocate a close compact coil, wound so as to give maximum self-induction for a given length. In any case, maximum self-induction must be aimed at, whether the covering of the wire be thick or thin. I shall assume then that the wire to be used has an external diameter or thickness T, and that the copper core has the thickness t, and shall proceed to consider what is to be done with it.

Determination of Required Inductance.

Given the aerial capacity and the wave-length, or range of wave-lengths, desired, we can at once determine the inductance or range of inductances necessary. Here is the formula, which gives the coil self-induction as the square of the wave-length divided by forty times the aerial capacity; everything being expressed in the same units of length:

$$\text{inductance} = \frac{\text{square of wave-length}}{\text{40 times the capacity}},$$

$$L = \frac{\lambda^2}{40\,C}$$

For instance, to receive a wave-length of 200 metres with an aerial whose capacity is 1 metre, which would be a likely value for a single wire elevated by a pole 20 metres high, the coil must have an inductance,

$$L = \frac{40{,}000}{40} = 1{,}000 \text{ metres},$$

that is, 1 kilometre, or 10^5 centimetres, or a tenth of a milli-henry. To get a wave-length of 1,000 metres with an aerial of 2 metres capacity would need a self-induction

$$L = \frac{10^6}{80} = 12{,}500 \text{ metres},$$

that is, 12½ kilometres or 1¼ milli-henry. Twice this value would be needed if the capacity of the aerial were halved. But if the wave-length were to be doubled the inductance must be quadrupled.

Gauging Coil Dimensions.

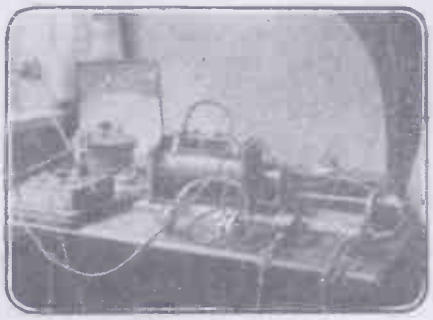
Now, to get the necessary self-induction in a coil, using the smallest length of wire, we shall show in another chapter, what has already been stated, that it must be wound on a frame of the following shape and dimensions, viz. a disc coil of external diameter 14 units, of internal diameter 8 units, and with the channel for the wire a square, 3 units in the side. There remains only to determine the size of the unit which will give the required inductance L, for wire of given external thickness T. The formula for determining the actual size of the coil's external diameter D is:

$$D^5 = 66{\cdot}6.\,LT^4$$

or

$$D = 2{\cdot}31\sqrt[5]{LT^4};$$

and once having determined D, the size of the coil is known in every detail, also the number of turns of the given kind of wire, and the length of wire necessary.



Mr. B. C. BIRAM'S Set, 15, Banksia Road, Rosebank, Cape Town, S.A.

The use of this formula will be best illustrated by an example. Suppose the inductance required is a millihenry, that is to say, 10 kilometres or 10^6 centimetres; and let the thickness of the covered wire be 2 millimetres or ⅕ centimetre; then D^5 comes out from the above formula as

$$\frac{66{\cdot}6}{625} \times 10^6,$$

or a trifle more than 10^5; and therefore the extreme diameter D=10 centimetres practically. The internal diameter d will then be $\frac{8}{14}D = 5{\cdot}7$ centims, the breadth of the coil, or the side of the square channel in which the wire is wound,

$$b = \frac{3}{14}D = 2{\cdot}142 \text{ centims.}$$

the number of turns of covered wire of thickness 5 turns to the centimetre will be

$$n = \left(\frac{b}{T}\right)^2 = 115$$

the mean radius of a turn is $r = \frac{1}{4}(D+d) =$ nearly 4 centims, and hence the total length of wire is $l = 2\pi nr = 27{\cdot}6$ metres.

Or it may be more convenient to work with inches, so far as the workshop dimensions are concerned. If we are dealing with the same self-induction we must divide 10^6 centimetres by 2·54 to bring it to inches. Or we may take as example a round number: Let the required inductance be L = 400,000 inches, while T, the thickness of the wire, = $\frac{1}{10}$th inch. Then we can reckon the external diameter of the coil, in inches, as:

$$D = \sqrt[5]{\frac{66 \times 400{,}000}{10{,}000}}$$

$$= 4{\cdot}84 \text{ inches.}$$

So that the internal diameter will be $d = 2{\cdot}72$ inches, and the side of the square channel $b = 1{\cdot}03$ inch. The number of turns will be $\left(\frac{b}{T}\right)^2$, or $n = 106$, and the length of wire used $l = \frac{1}{2}\pi n(D+d) = 1260$ inches or 35 yards.

Checking this by $L = 3\,nl$, (see elsewhere later on), we find it comes out right.

An Important Factor.

The result we see is not a large coil, even for so thick a covered wire. By diminishing the thickness of the wire the coil can be much decreased in size. For if the size of the channel is given, then the use of a wire of half the thickness will give a 16-fold inductance because it depends inversely on the fourth power of the thickness. This is indeed obvious. For if the wire is half as thick, double as many turns can be put in each layer, and there will be twice as many layers, so the number of turns altogether is quadrupled. And as the inductance depends on the square of the number of turns, that will be magnified 16 times.

As regards size of bobbins for a given thickness of wire, we can make this statement: doubling the linear dimensions of the bobbin for a given wire will magnify the self-induction of the resulting coil 32 times. This is not quite so obvious, but it clearly appears from the formula, since L varies with the fifth power of D, and $2^5 = 32$.

Meanwhile the question obtrudes itself: Where does the 66·6 or 2·31 come from? That is rather a long story, and must be the subject of another chapter.

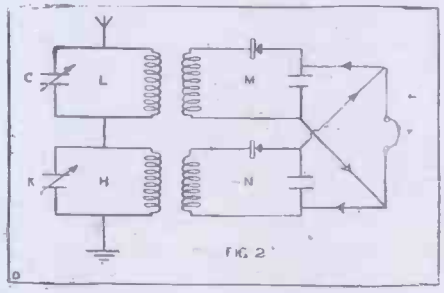
ATMOSPHERICS, STRAYS AND STATICS.

By SEXTON O'CONNOR.

PART II (Conclusion).

ONE of the early methods adopted to lessen atmospheric interference was the Marconi balanced-crystal circuit. Two crystals are connected in parallel, but conducting in opposite directions, and are so set that one gives good rectification for weak signals whilst the other gives practically no rectification.

The latter will, therefore, have practically no effect upon the strength of the desired signals, but when the aerial is shock-impulsed by a stray, both detectors become almost equally effective, and the phones are only affected by the net *difference* between the currents passed in both



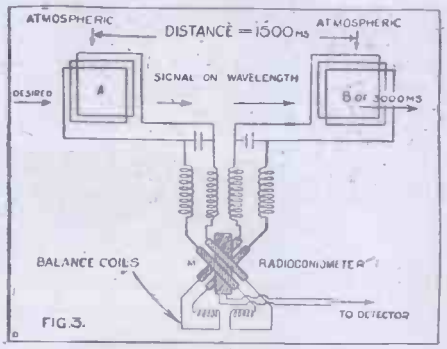
directions. Two valves may be similarly arranged to give the same effect.

Another early method, and one that is perhaps not so well known, consists in the use of two separate aerials, both linked in opposition to the same receiving circuit and phones. One of the aerials is tuned to the desired signals, whilst the other is set slightly out of tune.

Rejecting and Detecting.

The latter, being detuned, will be relatively unresponsive to the signal wave-length, which will be effectively picked up by the former aerial alone. When, however, both aerials are simultaneously struck by an atmospheric, they are both shock-impulsed into forced oscillation. In such circumstances both will have practically the same effect upon the receiving circuit, and, as they are coupled to this circuit in opposition, the transferred energy will, to a certain extent, balance out in the phones.

A slight variation of this arrangement is shown in Fig. 2. Here only one receiving



aerial is used, but it comprises two branch circuits, one, C L, tuned to the desired signal frequency, whilst the other, K H, is slightly detuned.

The desired signal sets the aerial branch C L into oscillation, and the energy is transferred through the detector circuit M into the phones T. Meanwhile, the branch circuit K H, not being in tune with the desired signals, is comparatively unaffected, and only a relatively small amount of energy is transferred to the detector circuit N, and this does not appreciably affect the signal strength.

The Weagant System.

The impact of a stray upon the aerial will, however, be sufficient to set both branches C L, and K H into forced vibration for a short period. Whilst this is taking place, equal amounts of energy are being fed into both detector circuits M and N.

The circuits M N being arranged in opposition across the telephones, the energy flowing therein will tend to balance out, so as to leave the phones unaffected. Owing to the inherent slight difference in the tuning and damping of the two aerial circuits, the opposing E.M.F's. in the phones will not have *precisely* the same frequency and wave-form, nor will they be of exactly opposite phase, and so a perfect balance cannot be achieved, although interference is very considerably reduced.

The Weagant system is based upon the results of a series of experiments made with a directional loop aerial. Atmospherics of the "grinder" type when received upon such an aerial showed no appreciable difference in strength, no matter in what direction the vertical plane the loop was pointed.

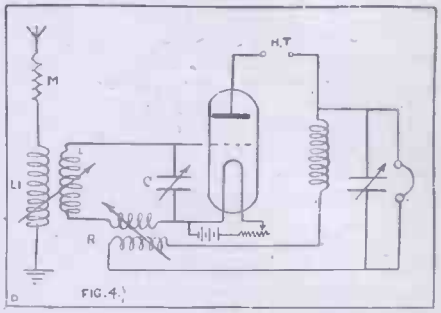
This fact is only consistent with the known directional properties of the loop aerial upon the assumption that the atmospherics in question are caused by electro-magnetic waves or impulses propagated *perpendicularly* to the surface of the earth, as if they originated at a great height above the ground and descended with practically no horizontal component. The aerial system employed is illustrated in Fig. 3. Two loop aerials A, B, are arranged in the plane of the transmitting station and are spaced half a wave-length apart.

For the desired signals, travelling horizontally in the direction of the arrow, there will be a phase difference of 180° in the E.M.F.'s induced in the two loops A, B, which are separated by a distance equal to half the wave-length being received. Both aerials are, however, symmetrically placed as regards any vertically propagated atmospheric effects, and there will in consequence be no phase difference in the E.M.F.'s induced from such atmospheries. This fact is utilised in order to separate the two effects—signal and atmospheric.

By coupling the two aerials to a common receiving circuit through a rotating-coil system M, similar to the Bellini Tosi direction-finder, the currents due to atmospherics are balanced out, whilst those due to the desired signals are combined so as to give rise to a cumulative effect in the detector circuit.

Another method of attacking the problem is shown in Fig. 4. This depends upon the sensitivity of a valve retroactively coupled at R, the strength of the coupling being so adjusted as to be below the threshold or point of self-oscillation. The aerial A is rendered aperiodic and is deadened by the insertion of a high resistance, M.

The impact of static charges upon such an aerial will be rapidly damped out, and if



the coupling between L and L1 be kept sufficiently loose they will not affect the circuit L C (which is tuned to the desired wave-length) sufficiently to set the valve into oscillation.

Persistent impulses due to the signal energy will, however, succeed in getting through to the sharply tuned circuit L C, and will impulse the grid, so that the valve is set into oscillation and the signals are heard in the phone. The loss of sensitivity deliberately imposed upon the aerial is sufficiently compensated by the extra sensitivity of the valve as a detecting instrument, particularly when set near the threshold of oscillation.

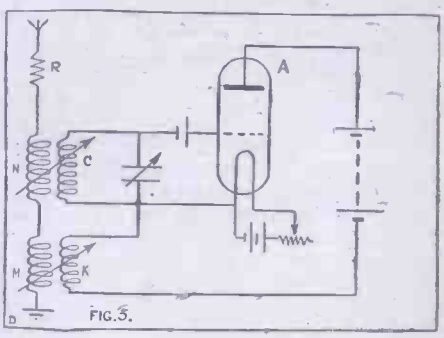
A Regenerative Method.

A further example of the use of the valve as a static eliminator consists in interposing one or more "limiter" tubes between the aerial and the detector circuit. A limiter tube generally consists of a two-electrode valve with an applied plate potential of such a value that it is near the saturation point of its characteristic curve.

In such circumstances the valve can only pass a limited amount of current in excess of that which it is already carrying, no matter how great is the excess potential applied to its plate.

Accordingly, when a static strikes the aerial, the result upon the limiter valve

(*Continued on page* 203.)



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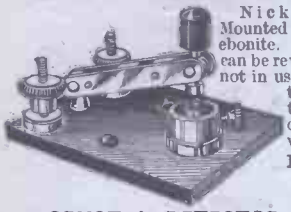
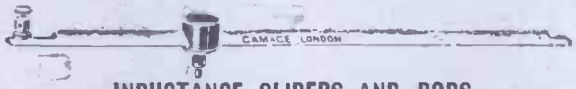
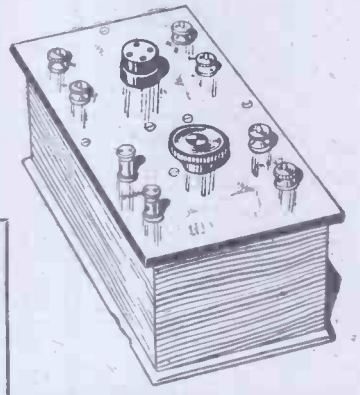


Nickel-plated. Mounted on polished ebonite. Crystal cup can be reversed when not in use, thus protecting crystal from dust. Price with crystal Post 4d. **6/6**



INDUCTANCE SLIDERS AND RODS

Complete as illustration, with Terminal and Holes drilled ready for fixing. The Slider, which is fitted with smoothly-working Plunger, ensuring perfect contact on the inductance coil, is of Polished Ebonite, handsomely finished. All metal parts are made of Brass, Burnished and Lacquered: ¼in. Square Rod (13in. or 14in. in length), with Slider. Price Post 4d. **3/9**



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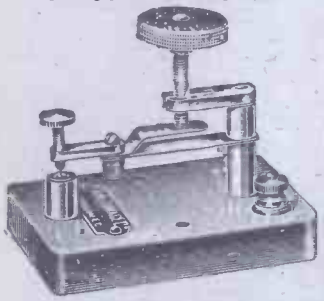
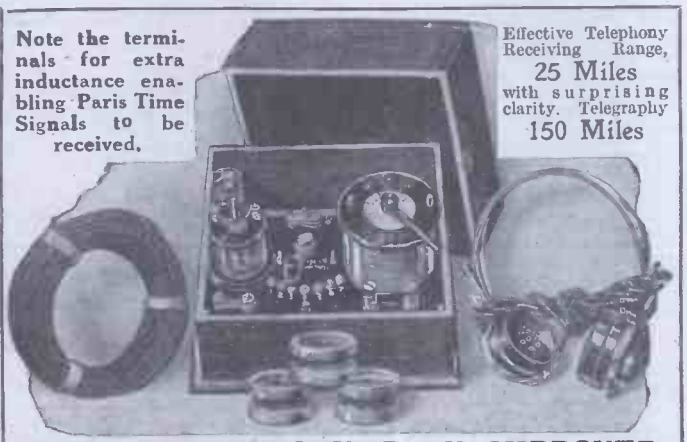


London made. Silicon and Gold Point, base 3½ x 3 x ⅞ in., of Polished Mahogany, Burnished and Lacquered Brass work, Ebonite knob. Price Post 4d. **4/6**

Note the terminals for extra inductance enabling Paris Time Signals to be received.



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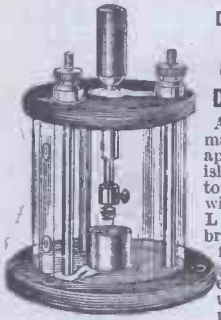
SPECIAL OFFER OF HEADPHONES

Super-sensitive Headphones, stamped "B.B.C." Suitable for any type of sets, valve, or crystal. Resistance 2,000 ohms. Price complete with cords. Post paid. **26/6**

DUSTPROOF UPRIGHT CRYSTAL DETECTOR



A beautifully made piece of apparatus. Polished ebonite top and base, with Burnished Lacquered brass Metal fittings. Very sensitive and efficient in use. Transparent cover protects the "Permanite" Crystal from dust. Price, complete with crystal, - - - Post 6d. **7/-**

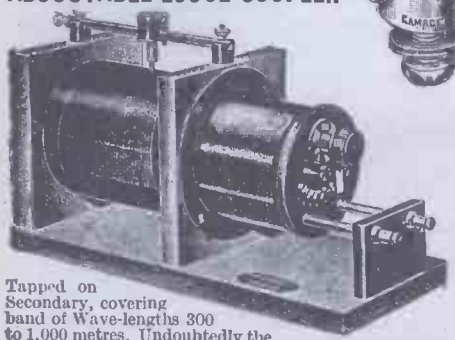
CRYSTAL CUPS

Similar to illustration (actual size), Turned Brass, Burnished and lacquered. Price Post 2d. **6D.**

CONTACT STUDS

High-class make and finish. No. 1 as illustrated, 3/16 in. dia. by ¼ in. thread with Flange, Washer and Nut.
No. 2, ¼ in. dia. by 1 in. thread, without Flange.
No. 3, ¼ in. dia. by ¼ in. thread, without Flange. No. 4, 5/16 in. dia. by ½ in. thread without Flange. Post 4d. Per dozen **1/6**

ADJUSTABLE LOOSE COUPLER



Tapped on Secondary, covering band of Wave-lengths 300 to 1,000 metres. Undoubtedly the most efficient for shorter wave-lengths, especially with Crystal receivers. Post paid. Price **37/6**

SPECIAL PURCHASE OF Variable Condensers IN PARTS FOR ASSEMBLING

Every one guaranteed to work perfectly if assembled with reasonable care. These parts are of the finest quality and workmanship, and once this offer is exhausted, can never be repeated at the price. Each set complete in box.

Capacity ·0003 mfd. Price **8/-** Capacity ·00045 mfd. Price **9/-**

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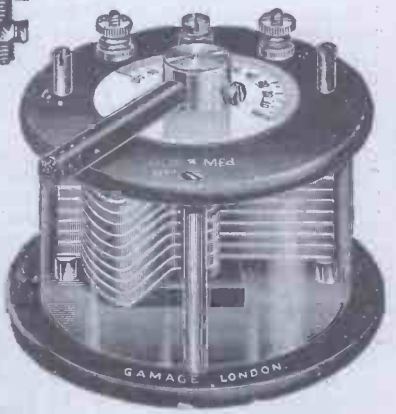
Early ordering essential to secure. Post 9d. extra.



FIRST IN 1908 **GAMAGES, HOLBORN, LONDON, E.C.I.** FOREMOST TO-DAY

WHO OWNS THE ETHER?

This article is merely intended to amuse. It simply suggests a possible view of Property in the Ether, which might have been taken but for the Wireless Telegraphy Act of 1904.

ALLINGTON suffered badly from "valvitis." In spite of almost piteous appeals from Marconi House, he also favoured plenty of reaction. "Your friends think so much more of your set if it deafens them," he used to say.

His loud speaker had been blaring forth the latest popular waltz. No words could describe the excruciating noise that issued from the trumpet. Now and again the set would break into a howl; but all was music in the owner's ears. At the end of the waltz the usual complaint came through from Marconi House; and this time it contained veiled threats.

"Above and Below."

"Look here, Gordon," said Allington. "You are a lawyer. Just tell me about this: My uncle left me this little house and the cabbage-patch in fee simple, whatever that may mean; and the old solicitor johnnie told me that I own everything that is above or below my land. Well, then, I own the ether over my land; so why on earth should that confounded fellow tick me for off oscillating?"

Gordon filled his pipe and settled himself comfortably in the armchair.

"Yes, that is all right so far as it goes; but there is also a principle of the law that you must not use your property in such a way as to interfere with your neighbour's enjoyment of his property. Unfortunately your neighbours seem to have the bad taste to prefer the concert from Marconi House to the music you produce."

It was then that Allington had his brain-wave.

"Suppose I take out my reactance so that I don't interfere with my neighbours, surely I can bring an action against the broadcasters for interfering with my ether and disturbing it when I am doing my best to keep it quiet for the sake of its health? Hang it all! They are just as bad as the fellow whose dog worries a farmer's sheep! I shall write to them at once! What right have they to disturb my ether?"

When Herbert Wanders.

Gordon smiled.

"It seems to me that the position is rather like this. The ether is probably what the law calls a 'res nullius.' That is, it belongs to no one until they capture it. You probably know that wild animals are regarded in this light?

"Suppose you take a fancy to a nice little piece of the ether, which we will call Herbert. It makes no difference on whose land you capture him; and, although you will be liable for trespassing on another's land, Herbert will become your property when you succeed in capturing him. He remains your property so long as he is under your control; but if he escapes, he becomes a 'res nullius' again, and belongs to no one unless they capture him.

"Now if Herbert has a habit of wandering, but returns to you from time to time for nourishment, rest, or any other reason, he will be your property so long as he has an intention to return. Further: if anyone detains him when he is trying to return, they will be guilty of an actionable wrong. But if he gets out of hand, and ceases to intend to return, he will become the property of the first person who captures him."

Just the Difference.

"But Herbert is under my control!" exclaimed Allington. "He never wanders; and I won't have him disturbed! I shall bring an action!"

"Steady!" replied his friend. "Don't be too hasty. That is only the view of the Common Law, or law that has gradually grown up from customs and decided cases. You must also consider the Wireless Telegraphy Act of 1904. It may override your right to protect little Herbert from disturbance; and the provisions of the Act will prevail over and alter the Common Law."

But Allington was well worked up by now.

"Hang the Act! I won't have little Herbert worried! What right——"

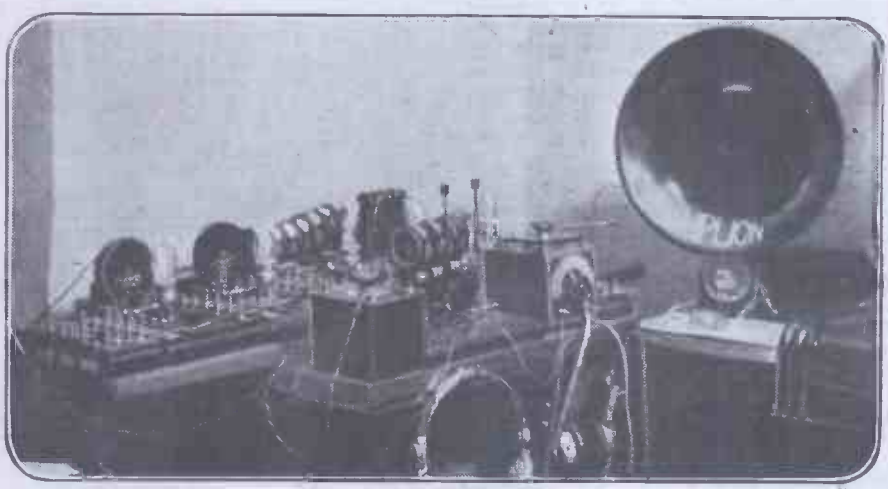
There was a knock at the door, and a police-constable entered with a blue paper which he solemnly handed to Allington.

"Heavens! A summons! Whatever for?"

"Your neighbour, sir. Mr. Lestrange says he's complained to you often enough about that gramophone thing of yours. He says it's a nuisance, but 'tain't no good speaking to you, so now he's taken out a summons."

It was surprising how quickly Allington cooled down.

"I don't think I shall bring that action, after all," he said. "I should have to read the Wireless Telegraphy Act, and I never could understand legal documents."



5-Valve Panel Experimental Set built by Mr. J. S. Wadson, 38, Cromwell Avenue, Hammersmith, W.6.

ATMOSPHERICS, STRAYS AND STATICS

(*Continued from page* 200).

is simply to cause it to reach the saturation point, and no more. The initial adjustments ensure that this increase cannot much exceed that due to the average received signal energy, whereby the note in the phones due to the static is kept down so as not to overpower the signal note.

A distinctly ingenious arrangement is that illustrated in Fig. 5. Here, as before, the receiving aerial is deadened or rendered relatively insensitive by the insertion of a high resistance, R. Aperiodic oscillations due to the impact of atmospherics do not affect the tuned grid circuit of the valve A, which is loosely coupled to the aerial through the coils C, N.

Persistent, though weak, oscillations of signal frequency do, however, succeed in setting the tuned circuit C L into vibration. These applied variations reappear in an amplified degree in the plate circuit of the valve, which comprises a coil, K, coupled in turn to a coil, M, in the aerial. This results in the transfer to the aerial of energy from the plate battery of the valve at a frequency corresponding to the applied signal energy.

The energy so transferred to the aerial in turn affects the grid through the coupling N C, and further enhances the plate output through the coupling M K. Thus, by a species of regenerative coupling, the deadened aerial is rendered acutely sensitive to the impact of signal energy of the required frequency, whilst maintaining a profound indifference to applied impulses arising from the impact of atmospherics or other sources of interference.

To further increase the selective action one or more rejector circuits may be inserted between the coupling C and the grid of the valve. These may also act to introduce a "time lag" effect, which prevents the valve from responding to impulses of short duration—*i.e.*, typical stray or vagrant effects.

WIRELESS AND THE LEAGUE OF NATIONS.

By THE RT. HON. LORD ROBERT CECIL, K.C., M.P.

First Delegate of S. Africa Committee of the League of Nations, and Chairman of the Executive Committee of the League of Nations Union.

THE waste of war falls on all nations with the result that the world is poorer, and we also as part of the world. But it may be said we did not fight the war for material gain; we fought it to establish good faith among the nations, to obtain security, to safeguard peace. It was to be a war to end war.

Even here the results are not very encouraging. I do not think international affairs have been strikingly notable for good faith since the Armistice. I think close examination of what has gone on in various parts of the world and especially in Asia Minor would tell a very different tale. As to security and peace they are yet to come.

All that we can say, and it is after all a very great thing to be able to say, is that we have erected as a result of the war a great organisation designed to embrace all the nations of the world to promote international co-operation and to achieve international peace and security. That is what is meant by the League of Nations.

A Vital Necessity.

Nations are to be encouraged to work together in a number of social and philanthropic directions, and in my recent broadcast speech I endeavoured to show that to achieve international co-operation, international public opinion must be fostered and increased. I said also that if public opinion is to have a free course, two conditions are necessary. There must be publicity, and there must be an early reduction of armaments. But the first condition is full and free publicity.

Further, it is vital that the nations should agree as soon as possible to reduce their armaments so as to make it possible for opinion to operate. There is no arguing between an armed and an unarmed nation—if the first gets the worst of the argument he will inevitably throw his sword into the scale. Quite recently we have seen armed action by one great nation against another, right or wrong, but certainly out of harmony with the spirit of the League. The reduction of armaments, therefore, is necessary for peace. It is no less necessary for the economic life of Europe.

Direct Personal Contact.

I am convinced that the present development of wireless science will be an important factor in the fulfilment of these conditions. I am told, for instance, that we are within a measurable distance of being able to converse between London and New York as freely as we now telephone within the metropolitan area of London.

The ordinary telegraph has done a great deal to break down barriers of international prejudice and ignorance, and now, through wireless telegraphy and telephony, we can converse across England and the Continent.

To-morrow we shall be able to "ring up" New York, San Francisco and Melbourne. Not only shall we have more rapid and more correct interchange of information, but, what is of almost as great importance, we shall really get to *know* one another and benefit from the direct contact of personality. This must tend to bring nearer the realisation of an all-embracing League of Nations and the securing of lasting peace.

Think of it well, for without peace there can be no prosperity. Without peace civilisation, as we know it, must be destroyed. Without peace we and our descendants will have to endure all that we went through in the late war, and much more, for each war is more terrible than the last.

The Road to Peace.

But there can be no security for peace without disarmament, and you cannot produce disarmament until you allay suspicion. Armaments used to be regarded as an insurance against war. Experience has shown that they are nothing of the kind. The real insurance is disarmament, to secure that we should be ready for great sacrifice if need be, and in any case, for great and continued exertion.

A CRITIQUE OF THE WIRELESS EXHIBITS.

(Continued from last week.)

THE Ashley Radio valve sets have a novel type of reactance. It is operated on something like the gate change principle of a motor, and is decidedly interesting. On all the Ashley sets the careful wiring and excellent finish is noticeable. The arrangement of the primary and secondary coils on all the valve sets made by this firm forms another interesting novelty. On the Burndept Stall the Etherphone V was the most interesting exhibit. It is a four-valve set, one H.F., one rectifier, and two L.F. This set has been tested out at Brighton—the "blind spot" area—and excellent results have been obtained. The whole set shows first-class workmanship and is a joy to operate.

Metro-Vickers are now fitting reaction on their two or more valve cabinet sets.

Previous cabinet sets, two and four valve, which have already been sold, may be returned and fitted with reaction for 10s. The circuit is in two parts:

Panel 1: 1 H.F. tuned H.F. transformer, 1 detector.

Panel 2: 2 L.F. note magnifiers.

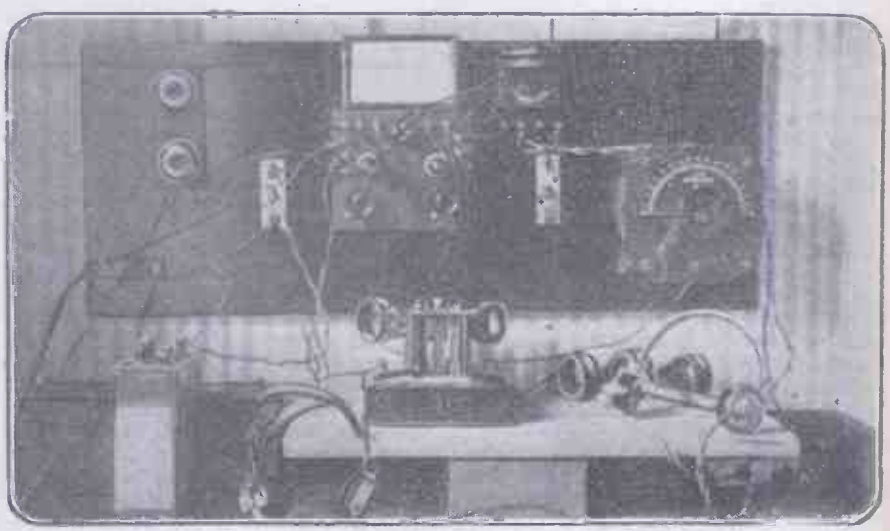
The new reaction conversion is a small coil coupled up to the transformer (H.F.), and will give a hundred per cent. increase in signal strength, thus making it twenty-five per cent. better than the previous best. It will not go right up to the oscillating point, but as near as safety will permit. The reports from Trafford Park are very enthusiastic on its capabilities.

An interesting innovation in the popular crystal sets is the production of one and two note magnifiers, which fit in the space provided for phones. These have a fixed filament resistance, and therefore have no controls to manipulate.

Generally speaking, wireless firms who possessed stalls at the Ideal Home Exhibition, showed considerable ingenuity in their display. Such items as sparking aerials tastefully laid out, lighting effects, etc., attracted quite a number of visitors who would otherwise have passed by disinterestedly.

This, of course, is the first step towards selling the goods, and the rest lies in the hands of the representatives. Prices seemed quite reasonable, and there was plenty of evidence to show that the public is not now being gulled to pay heavy sums for inefficient "mystery boxes." The reason for this is that the subject of wireless is no longer quite the mystery to the average "man in the street" that it was a year ago.

By freely mixing with the "crowd" we were able to gauge that the majority of visitors to the wireless section considered the display a credit to the wireless trade.



Mr. W. Taylor's home-made set, 23 Gloucester Road, Walthamstow, E.17.

SIMPLE HOME-MADE TRANSFORMERS.

By R. A. WATSON, M.A.

EVERY owner of a single-valve set is filled with a burning ambition to add just one more valve. He can pick up a great deal with his set, but there are always certain transmissions that are just beyond his range, except perhaps on particularly favourable evenings, and nothing is more tantalising than to know that the desired signals are there though they cannot be tuned in. To increase your range a stage of high-frequency amplification is required,

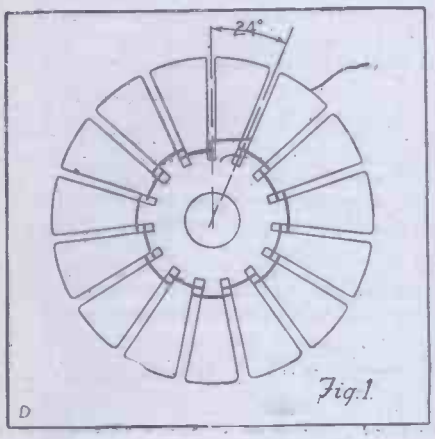


Fig. 1.

for note magnification merely intensifies signals with which the set is already capable of dealing. One H.F. valve working in front of the rectifier usually trebles the distance from which transmissions can be received.

There are three ways in which the radio-frequency amplifier may be coupled to the rectifying valve: resistance-capacity, tuned plate, and air cored transformer. Of these the first is not suitable for general purposes, since it is inefficient on wave-lengths below 1,000 metres. The second, though extremely good, is not easy to handle, especially if the operator has had little or no experience of high-frequency work. It needs, too, a variable condenser and a fairly large set of mounted coils if anything like a wide range of wave-lengths is to be covered.

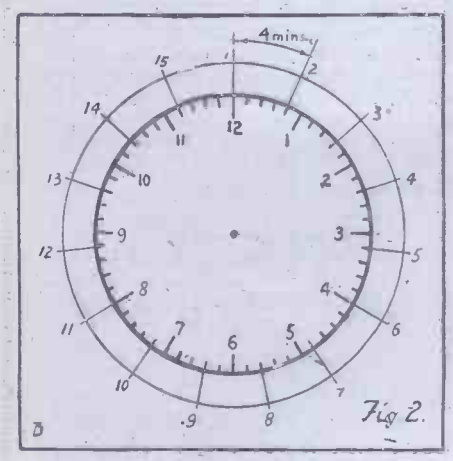


Fig. 2.

The third method, using transformer coupling, will be found perfectly satisfactory. It is not difficult to handle and it gives good results on all wave-lengths. The main objection to its adoption lies in the cost of the necessary transformers, but these, as we shall see, can be made quite easily and at trifling cost.

Marking Slot Positions.

For the windings we require half a dozen basket coils, each containing about 60 turns of No. 32 single-cotton-covered copper wire, which costs about 7s. 6d. per lb. About 4 oz. should be ample for making all the coils needed. To make them, cut out a cardboard disc 3 in. in diameter, and make any odd number of equally spaced slots, as shown in Fig. 1. Many people, by the way, find it difficult to divide a circle into an odd number of parts. This can be done with the greatest ease if you have a protractor, for by making the slots 24 degrees apart you obtain 15 of them. Even if a protractor is not available the task is quite simple. Lay your watch on the card as shown in Fig. 2, and make a pencil dot at each four minutes from 12 o'clock right round the dial. As each minute division represents 6 degrees, you thus have as before 15 divisions 24 degrees apart.

Give the card a coating of shellac, anchor the end of the wire by boring a couple of small holes and passing it two or three times through them, then wind as shown in Fig. 1, weaving the wire in and out of the cardboard divisions. When the coil is finished anchor the other end of the wire and give both card and windings a coat of shellac.

Useful Temporary Arrangement.

The simplest form of transformer is seen in Fig. 3. It consists of nothing more than the binding of an old book—the stouter and heavier the better—with a cork glued to the middle of the inside of each cover. A coil is slipped over each cork, the cover is placed about a quarter opened on the table, and the primary and secondary coils are attached respectively to the plate circuit of the first valve and the grid circuit of the second. Care must be taken to see that the windings of the two coils run in the same direction. Now tune the set in the ordinary way, and as soon as signals are heard, open or close the book cover slightly until the best degree of coupling is found. It is an advantage to have the secondary coil rather bigger than the primary, as in this way a small step-up in voltage is obtained.

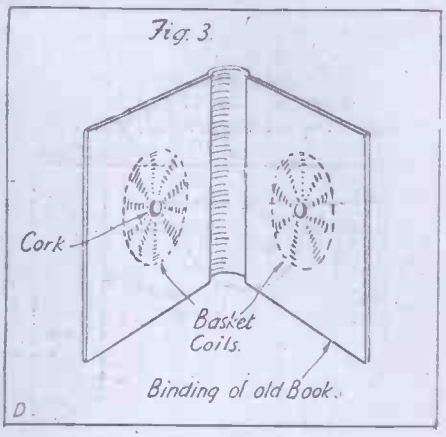


Fig. 3.

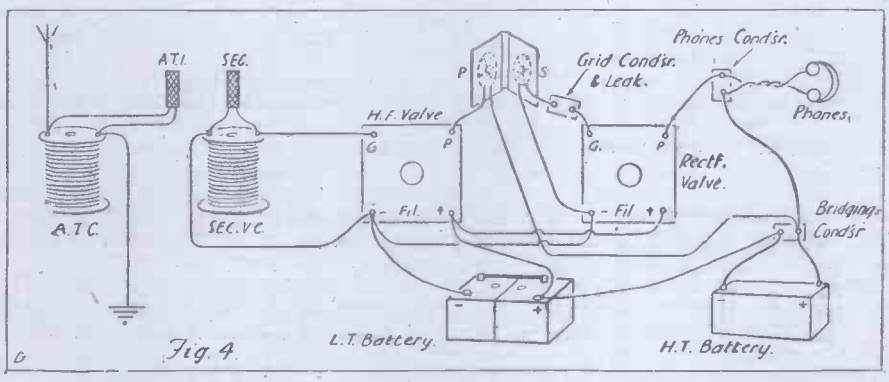


Fig. 4.

For the benefit of those who have never tackled the job of connecting up a high-frequency transformer, a sketch of the completed two-valve set is given in Fig. 4.

The book transformer will do quite well for early experiments, and will act as a stop-gap whilst something more solid is being prepared. We can either replace the bind-

(Continued on next page.)

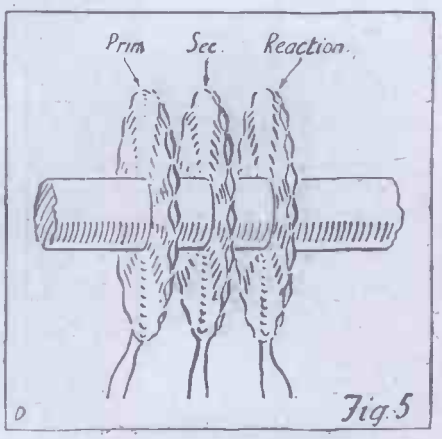


Fig. 5.

SIMPLE HOME-MADE TRANSFORMERS.

(Continued from previous page.)

ing by a wooden stand made of two pieces of polished wood hinged together, or we can effect a great improvement by constructing the simple apparatus shown in the next two drawings. To do this, obtain a 6-in. length of round wooden rod, which will

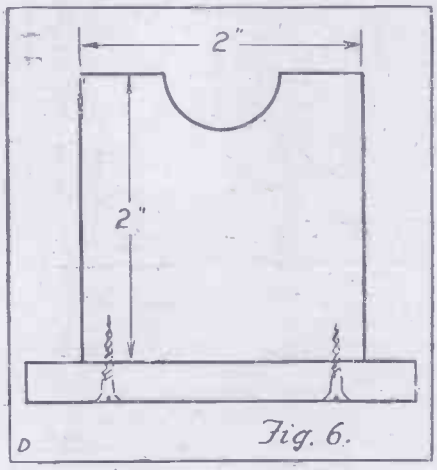


Fig. 6.

pass comfortably through the holes in the cards on which the coils are wound, and give it a coat of shellac. Now cut out a pair of supports for the rod as shown in Fig. 6, mounting them on opposite ends of a baseboard.

A Universal Transformer.

The rod holds not only the primary and secondary of the transformer, but also a third basket, which forms the reaction coil. This type of transformer is especially to be recommended, for if the reaction coil is coupled to the transformer instead of to the secondary coil of the tuning inductance, it becomes almost impossible to interfere with other people's reception by setting up oscillations in the aerial circuit.

Both of the transformers already described will cover a wide range, for to increase the

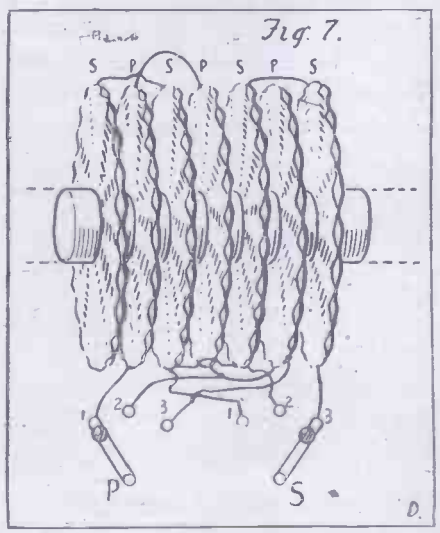


Fig. 7.

wave-length all that one has to do is to connect a second or third coil in series with both primary and secondary.

It is, however, more convenient to have a transformer with permanently mounted coils from which tappings are taken to rotary switches. Figs. 7 and 8 show how this is done. Five, seven, or nine coils are mounted on a length of rod with shellacked cardboard discs between them. The even numbers, which are wired in series, form the primary; the odds, connected in the same way, the secondary; tapping and wiring are done as shown in the last drawing, the switches being mounted on ebonite blocks fastened to the baseboard. A pair of terminals similarly mounted should be placed at either end of the board, and marked primary and secondary.

Tuning Between Studs.

In this last type of transformer the coupling between primary and secondary coils is not variable, for they are placed close together with only the shellacked cards between them. To make sure that the various portions of the transformer will tune satisfactorily without the use of a variable

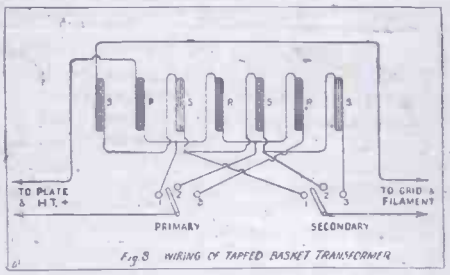


Fig. 8. WIRING OF TAPPED BASKET TRANSFORMER

condenser, it is as well to reduce the size of the coils a little in order to make the jumps between studs on the switches smaller.

CORRESPONDENCE.

The Editor, POPULAR WIRELESS.

Dear Sir,—I wish to inform you that I am, and for the past few weeks have been, receiving London, 2 L O, a distance of one hundred and eighty miles, on a home-constructed crystal set, consisting of a crystal detector and variometer.

The programmes transmitted from this station have been followed out with ease, while Manchester, fifteen miles away, comes in very strongly.

I am situated at a height of seven hundred feet above sea-level, and the aerial is a single wire one hundred feet long and twenty-five feet high. The set is earthed to a water-pipe three feet away.

If not encroaching too much upon your space, perhaps you will publish this letter, as I think it might be of interest to your readers.

Yours faithfully,
PHILIP J. NORRIS.

Woodlands View,
Mellor, nr. Stockport.
March 19th, 1923.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have been very interested in the correspondence in POPULAR WIRELESS re Licences.

I am one of those persons (and I daresay there are many more) who are not content to simply buy an instrument and enjoy the concerts of the B.B.C., but find the pleasure greatly increased by making and fitting up their own set and gradually improving on it, and at present there is no licence which allows of this unless one is very well up in the scientific side of wireless.

Although, of course, I am not in a position to know if it is workable, the following are my ideas:—

(A) Both the present licences have this to be said against them: (1) The broadcast licence does not foster the scientific side of wireless; (2) The experimental licence is only issued to those who already have considerable scientific knowledge, and therefore to a certain extent the same applies to No. 1. Further, the holders of experimental licences do not contribute to the B.B.C., although I am quite sure the greater number of them enjoy their concerts.

(B) Would not one licence (cancelling the two at present in use) covering all receiving sets, whether purchased or home-made, and having a clause, re interference with other stations, such as is now contained in the conditions for an experimental licence, meet the case? The licence fee and the contribution to the B.B.C. now have to be considered. This could be arranged as follows:—(a) The fee to be the same as at present—the B.B.C. to receive a portion as now and an initial sum paid to the B.B.C., the amount to be according to the type of set installed, and a further sum paid on the addition of extra units; or (b) the fee to be such a sum that would include the amount required by the P.O., and a contribution to the B.B.C. which would enable them to carry on the good work they have started, such contribution to be in lieu of the initial sum mentioned in (a).

It appears to me (but again, of course, I am in no position to know) that at present when everyone is buying sets, that the B.B.C. funds are assured; but what of the time, a few years hence, when practically everyone will possess a set and the sales drop off? For that reason, I think a yearly subscription would be the fairer way, and would assure the B.B.C. of a more or less certain income. Personally, I think it only fair that if people enjoy the excellent programmes which the B.B.C. are now giving they should pay for them, and I should think no one would mind paying what would be only a nominal sum each year in comparison to the enjoyment they would have.

Yours truly
"WAITING."

Radstock,
nr. Bath.
March 16th, 1923.

ORA

The Valve for perfect reception

A CONVINCING STATEMENT.

The International Meteorological Expedition operating in North West Perth, W. Australia, and using a portable wireless equipment, consisting of a 3-valve receiver with small portable aerial, received quite easily the time signals from all the high power stations in the world.

They reported very satisfactory results despite the fact that conditions were very unfavourable indeed.

Needless to say, Mullard "ORA" valves were used.

The admirable manner in which these valves sustained several trans-shipments, submersion in water during landing, and severe rough handling generally, is the subject of a very interesting letter sent to us recently by Mr. John Wishaw of Mount Lawley, Western Australia.

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.

Standard Price 15/- each.

THE MULLARD "R" VALVE is now Reduced in price from 22s. 6d., to 17s. 6d.

The Mullard Radio Valve Co., Ltd.

(Department P.W.)

45, NIGHTINGALE LANE, BALHAM, S.W.12

Contractors to H.M. Admiralty, War Office, Royal Air Force, and Post Office.

Telephone : BATTERSEA 1068. Codes : ABC (6th Ed.) BENTLEY'S. Telegrams : RADIOVALVE, WANDSCOM, LONDON.

Trade Mark RADIO MULLARD VALVE

THE CARE OF ACCUMULATORS.

By H. B. HALL.

A NEW accumulator should not have the acid put in it till just before charging. If it is likely to have only occasional use or indifferent care, $\frac{1}{10}$ less decimal point gravity of acid (*i.e.* 1·19 if 1·20 is recommended) will be safer, and efficiency not noticeably less; 1·18 is not too low.

After one or two charges and discharges some active material from the plates will generally be found in the bottom of the case. This is seen mostly in the corners; and if at any time, either on charge or discharge, or even when not in use, it should touch any two plates, positive and negative, it will probably ruin the whole accumulator.

When seen to have reached a dangerous point it must be got out. This sediment ruins more cells than any other thing. Excessive rate of charge and discharge causes most of it.

Removing Sediment.

Drill a $\frac{1}{16}$ hole in the corner of the lids of each cell, then take out vents, and empty acid in a clean jar, and let it settle. Rinse out the cells with soft water until all that will dislodge has come out. The small holes you drilled in the corners will perhaps take a knitting pin, and stir up any that has got solid, and will enable you to get out the last bit of dirt. Then put in the cleanest of the acid again, and at once have it charged. Plug the little holes you made with celluloid cement or a rubber plug. Whether there is any dangerous sediment to come out or not, this will often inprove the capacity of the accumulator. As to the sympathy of the charging man for your cells, you can only hope for the best.

The top of the accumulator must be kept as free as possible from acid, and the terminals and all metal parts kept coated with vaseline. To ease a sulphated terminal, warm it, and if you have to use pliers, go carefully. Clean it well afterwards, and vaseline.

New plates, 4 in. by 4 in., formed and burnt to your size, can be bought for about 1s. pos., 1s. 9d. neg. each. Other sizes at about the same proportion. Negatives are necessary when they warp dangerously or have gone brittle, or too spongy, and shedding the active material too much. In this last condition they do hold the charge for a short time, perhaps a week.

Repairing Celluloid Casing.

New positives are necessary if gone hard and dry looking, and are dull brown, cracked, or broken, fanned dangerously (*i.e.* likely to touch a negative bridge), or shedding much material. For sulphation I would have the plates out, and scrape them, and over charge, also adding 20 grains (weight) of carb. soda for a 4-volt 20 amp. accumulator or half this if for one cell only. This will help matters if done soon enough. Larger cells in proportion. If positive handles greasy, and of good colour, it is all right. A bad + plate goes down in half a day.

To get plates out, draw off acid, and run a sharp, thin knife round the lids. Disconnect the bridge, and jar the corners gently on a solid block of wood. Go carefully, minding the partition, so that the corners do not crack. When once started jar the long side of the case. Don't pull much.

To mend a fracture in celluloid and stick the lids on again, get one ounce of acetate of amyl (pear drops), about 9d., and paint the parts to be mended with it, giving several coats. Dissolve some celluloid shavings in some of it, and you have a cement that will fill up holes and cracks, and make a job of the lids. Beware of the partition. If this leaks, you will only get 2 volts instead of 4. Celluloid is workable in hot water, if you want to make angle plates for corners, etc.

Convincing but Fatal.

Tests for condition of cells are as follows: When plates, especially positive, lose their characteristic colour, charge is getting low. Try each 2-volt cell on a valve. If it fails as you watch, or if one cell gives a better light than the other, the whole accumulator must be charged at the earliest possible moment. Taste (by practice). Bring both terminals (4 volt) to within $\frac{1}{2}$ inch of one another by means of wire. Touch with the tongue and note result.

Final and *fatal* test. "Shorting." Dig a knife edge in one terminal and momentarily let it touch the other terminal. If your knife is now a saw, the accumulator *was* all right. (Note the steel that has fused and the tempering colours showing around the arc. And realise the heat that has been generated all in a moment. This heat has been exceeded, in a way, inside the cells, but of course not so local, the bulk of the plates diffusing it. No plates can stand much of this.)

Final Hints.

Don't discharge at more than $\frac{1}{10}$ of the rated capacity, or even less than this for fairly constant work. And reckon $\frac{1}{10}$ of a reputed 40 amp. accumulator as 2 amp., and other sizes accordingly. Exceeding this, except for short periods, is not good for the plates. The same applies to charging. This is why the more valves you use the larger should be the accumulator.

Beware of the acid getting on the clothes. It burns holes at this strength. Liquid ammonia kills it in the cloth, but is worse than the acid itself on the skin. A discharged accumulator standing by is like a dry battery at work. It is eating its inside away.

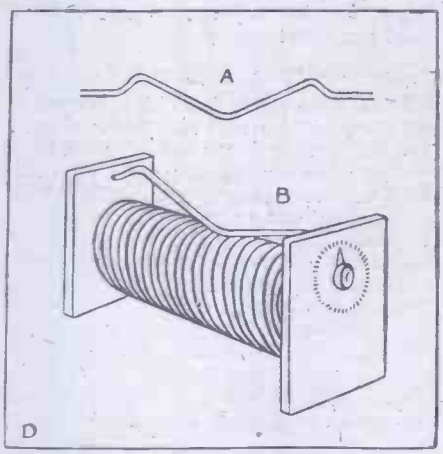
A broken lug should be burnt on, but it may be soldered, or mended with a brass plate, or threaded brass wire and nuts. In either of these last two cases be sure to coat the mend well with paraffin wax before replacing.

Always keep the dielectric well up, and make up for loss in evaporation only with pure distilled water. Ordinary house tap water may cause peculiar and dangerous sediments and deposits to collect.

Finally, remember always that an accumulator is a chemical and not a mechanical device.

A USEFUL WIRE HELIX

THIS wire helix takes the place of the ordinary coil slider, over which it has several outstanding merits. First it is exceedingly cheap and simple as compared with assemblage of rods, standards, springs, contacts, etc., involved in ordinary slider construction. It produces its shifting of the contact point by a rubbing contact parallel with the turns of the wire, instead of across them, so that it avoids the common tendency to drop in between two adjacent turns; it is possessed of a smooth movement instead of a clattering movement, and does not wear off copper particles which short the adjacent turns.



The fact that it works by rotation permits operation by a neat rotating knob on one end, and it is cheapness itself, and can be made by any amateur, by bending a wire around a rod of suitable diameter, afterwards producing the straight ends with a pair of pliers. One end can then be bent at right angles and made into a pointer, to be turned by the fingers, with or without a dial, so that even a knob is not necessary.

The contact is a straight-line traverse, parallel to the axis of the cylinder, along which line the insulation of the wire must be removed in the usual manner. Mount through holes in the coil end so that the helix is somewhat sprung against the coil, making good contact. The straight ends should be of appreciable length in relation to the helical portion, to facilitate this springing. The helix should be about 300°—$\frac{5}{6}$ of one turn. One-eighth inch diameter brass wire is about right for 4 inch length of the wound portion of a coil. For longer coils, heavier wire is better.

BRIGHT IDEAS

Are welcome. Send along the results of your experiments. We pay well for copy accepted for publication.

WIRELESS AT THE IDEAL HOME EXHIBITION.

By SIR J. KENNETH MACKENZIE, BT.

AS a mere visitor to the Exhibition now running at Olympia, mainly to see in what way it differed from similar shows previously held there for the same object, what struck me most forcibly and impressed me more than anything amongst the multitudinous exhibits designed for the convenience, ease, and use of mankind, was the marvellous strides and progress made in wireless. But one short year ago at the last Ideal Home Exhibition of 1922, the *only* wireless apparatus to be seen was a single little portable set shown occasionally in operation by Mr. Joyce of the B.T.H. Company, the centre of attraction of wondering and admiring groups. Nothing more; but now only twelve months later, what a change!

Popularity of Wireless.

Forty-two stands filled with apparatus of every conceivable type and construction as beautiful in their design as efficient for their purpose; to say nothing of a large hall fitted with a receiving set which filled it with music, song, and speech broadcast for the entertainment of an audience of at least a thousand. Can any human invention show a greater and more rapid progress than that? And these forty-two exhibitors show but a tithe of the innumerable types of apparatus now being made in this country only to meet the ever-increasing demand for what is undoubtedly the electrical invention which appeals more strongly and irresistibly to the general public than any other throughout the whole world.

Looking back, as I can, to the introduction and early development of the telephone and electric light, nothing in those wonderful discoveries ever struck popular fancy as has that of wireless telephony, nor become the craze it has. Why was this? Possibly because they were not so adaptable to individual pleasure, interest, and experiment requiring organisations on a large scale to bring them into popular use and enjoyment. Yet on the other hand wireless telephony needed the stimulus of Broadcasting stations to create the general demand for receiving sets of instruments, since until they came into being there was nothing much beyond Morse signalling to invite the public interest, and that appealed only to the select few.

Doubtlessly, the knowledge that a latent interest could be aroused in the public mind and turned to profit gave rise to the idea of creating a demand by providing first a means to supply it when created; rather a "cart before the horse" method, but fully justified since it has brought about a state of things which is simply wonderful.

Just Press a Button.

Be that as it may, there is no doubt that no scientific invention has "caught on" like that of wireless telephony, the possibilities of which seem limited only by those which State control may allow. Its very simplicity and effectiveness render it absolutely practicable even in the hands of the most ignorant whose mentality is accurately gauged and catered for by manufacturers of sets on the principle of "you press the button, we do the rest." Even such people may have in this way their wits and interest aroused, and be led to think of the marvels they are witnessing but do not understand which really border on the "uncanny."

When Facts Replace Theories.

Looking forward from what is to be seen in the wireless exhibits at Olympia, one wonders indeed how much more this infant prodigy can grow in regard to popular usage unless its existing trammels and limitations are removed, and transmission, made as simple and efficient for the private individual as reception, be allowed. Probably were it not for State monopoly, control, and objections, inventors and manufacturers could speedily perfect systems for simple private intercommunication which would supplant existing methods, and enable everyone properly equipped to speak and listen where and when desired. Then would a Utopian condition exist and distance be eliminated once interference were conquered, as one day it surely will be.

Seeing the enormous advance which only twelve months have made in Radio communication such a thing is quite compatible with reason, for there is no doubt the invention will overcome difficulties now existing and avoid the necessity for the costly and elaborate high-power transmission systems at present in use, making transmission as simple and effective as reception now is. Science is using a medium for Radio communication which it does not understand nor really know. Much more about than it did of electricity forty odd years ago; but when knowledge of the so-called "ether" becomes absolute, and facts take the place of theory, results will be obtained of which we at present have but a small conception.

A CHEAP BROADCAST RECEIVER.

AN excellent broadcast receiver—minus aerial and phones—can be made in an hour's time, with an expenditure of less than one shilling! The simple outfit here described is not only cheap, but is really effective and, within ten to fifteen miles of a broadcasting station, will give results equal to the most expensive crystal outfit yet received.

Procure a piece of smooth wood six inches long by four inches wide and about three-sixteenths of an inch thick. On to this wind fifty feet of No. 22 enamelled wire held in place by two thin strips of wood glued as shown in Fig. 1. This may be made still more rigid by a coating of shellac varnish, if desired, the whole being well-baked to harden. Four brass screws are then fixed at "A," "B," "C." and "D,"

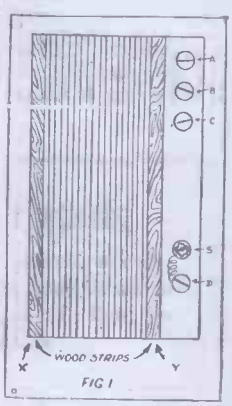


FIG 1

to be used as terminals. A small hole is made at "S," into which a piece of silicon (or galena) is fixed, being set in sealing-wax. Previous to fixing the silicon in the wax, a piece of the wire is scraped and bound around it, being then carried to a screw. A coil is made of fine copper wire (about two inches of it) and, fixed under "D," is bent round so that it will gently rest on the silicon and can be moved from point to point on its surface, as required. One end of the enamelled wire is attached to "C"; the other end is left free, fixed in place by a little sealing-wax.

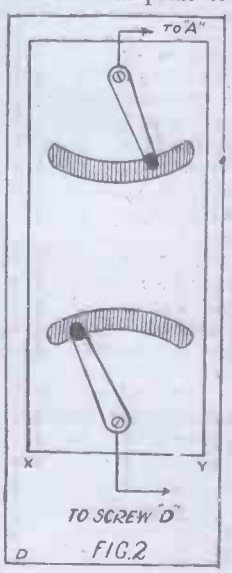


FIG.2

A piece of thin wood six inches long by three inches wide is now procured and slots cut in it, as shown in Fig 2. These slots may be cut with the leg of a cheap compass. Two pieces of thin brass are cut and bent slightly at the ends to go through the slots and slide over the wires, which will lie underneath, and which should be scraped to make contact. These strips are then fixed in place and a wire from the top one taken to screw "A," while a wire from the bottom one is taken to screw "D," the piece of wood now made being fixed over the piece upon which the wire is wound, resting upon the strips of wood at each side, to which it can be screwed or glued.

Fig 3 shows the completed article, which needs only attachment to aerial and ground and phones to be ready for use.

A broadcast receiver of this design has been used by the writer, in America, for more than a year, giving most excellent results. When residing five miles from "W.W.J.," the "Detroit News" Broadcasting Station perfect signals were received by using a steam radiator as aerial and a gas-pipe as ground. The receivers used were 2,200 ohms resistance. Addition of a condenser may be made across the telephone terminals, if desired.

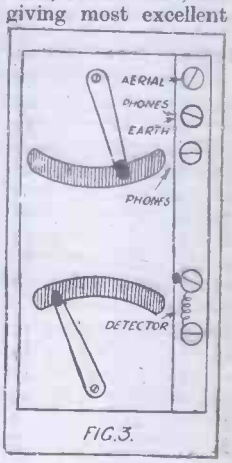


FIG.3.

Reg. Design
No. 594025.

THE DESKOPHONE SINGLE-VALVE SET
(P.O. No. 1019)
including Headphones, H.T. Battery, Accumulator, Aerial, Lead-in Wire, and Insulators.
PRICE COMPLETE
£7 - 15 - 0
PRICE without ACCESSORIES: £4-15-0.
Royalties, 32/6 extra. Valve Extra.

THE
DESKOPHONE TWO-VALVE SET
(P.O. No. 2020)
Tuner, High Frequency Amplifier and Detector, complete with accessories as with Single-Valve Set.
PRICE COMPLETE
£12 - 17 - 6
PRICE without ACCESSORIES
£9-17-6
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POPULAR WIRELESS Beginners' Supplement

PART X. BATTERIES VALVES.

By MICHAEL EGAN

EVERY valve receiver needs to be fed with electricity in order to produce signals. You put electricity in at one end, as it were, and signals come out at the other end. Of course, if there are no wireless waves arriving at your aerial, all the electricity in the world won't enable you to get signals. When there are no waves arriving, the electricity supplied from your batteries just flows round and round the receiver without doing any useful work.

The action of a valve receiver may therefore be resembled to that of a moving stairway. When the latter is once set in motion, it operates quite independently of whether it has any passengers to carry or not. When empty it moves upwards steadily. When passengers come along, it just takes them with it in its course—with, perhaps, an extra groan or two when the load is unusually heavy.

Waste Energy.

A valve receiving set behaves in a similar manner. Once it is connected up, the electricity flows round and round it steadily before any signals are received. When signals come, they float along to the telephones on the stream of electricity. They are thus saved the trouble of having to work their own way to the telephones.

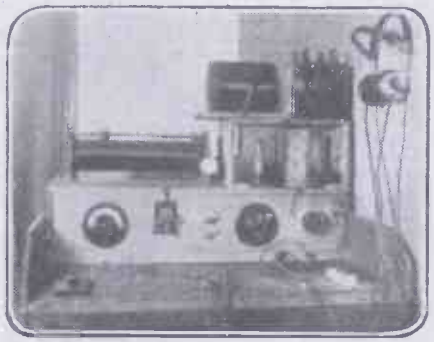
When you or I make use of a moving stairway, we save a good deal of energy. On arriving at the top of the stairway we are more fresh and energetic than we would be if we had walked up. Again, if we had a job of work to do when we arrived at the top, we should be able to do it more efficiently after being carried to it, than if we had wasted some of our energy in getting to it.

This serves to illustrate the superiority of a valve set over an ordinary crystal set. The ordinary crystal set has no electric current flowing through it. When signals arrive at a crystal receiver from the aerial, they have to work their own passage as far as the telephones, where their real work awaits them, *i.e.*, to vibrate the diaphragms of the latter. Consequently, they are rather wearied by the time they arrive at the scene of their labours.

En Route.

With a valve set, on the other hand, signals are transported in luxury as far as the telephones, where they apply themselves to their task with undiminished vigour. In fact, they can even be fed and nourished in transit, so that they regain some of the strength with which they originally set out from the transmitting aerial. Naturally, after travelling 100 miles or so from the transmitting station, they are considerably weakened and exhausted by the time they arrive at the receiving aerial. A valve set conveys them to the telephones on a stream of electricity, and if it is a sufficiently powerful one, gives them refreshment *en route*.

This sounds quite simple, doesn't it? But you mustn't forget that it is only an analogy. The theory of a valve is not really so simple as all that. Before embarking on an explanation of the theory, however, it will be as well to know something about the batteries which produce the electric stream on which signals travel to the telephones.



Mr. C. Sonmer's home-made set, 3, Cucade Road, S.W. 18.

As I have said, a valve receiver requires two batteries for its operation, each of which has distinct characteristics. One is called an "accumulator," and supplies a fairly large electric current at a fairly low pressure. The other is called a "high tension battery" and supplies a fairly small electric current at a fairly high pressure.

The current that flows from an accumulator may be resembled to the stream of water that flows through a large pipe that is connected to a small water-tank. And the current that flows from a high tension battery may be resembled to the stream of water that flows through a small pipe that is connected to a large water-tank. In the one case you have a large current (of water) flowing at a small pressure (exerted by the quantity of water in the small tank); and in the other case you have a large current (of water) flowing at a high pressure (exerted by the quantity of water in the large tank). The words "pressure" and "tension" are used interchangeably.

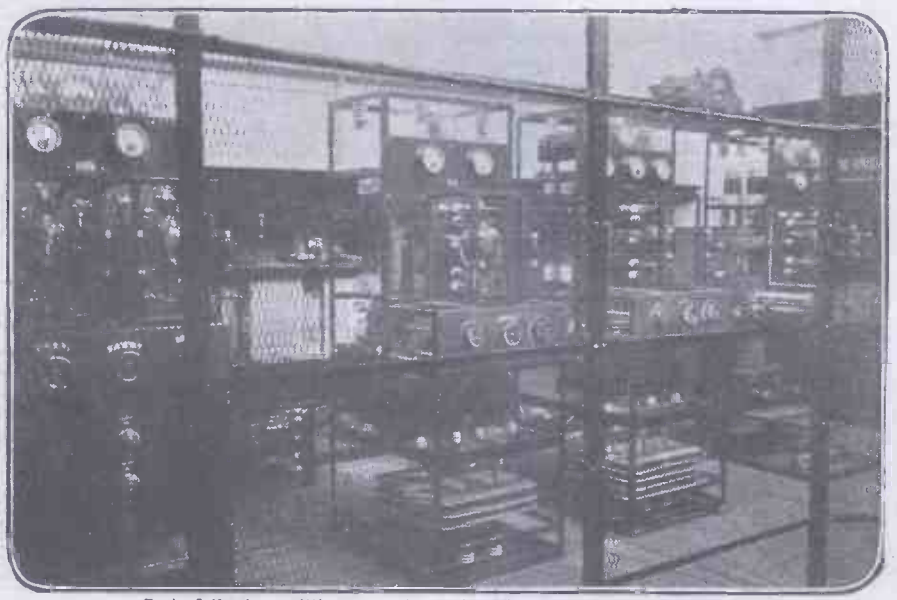
Every valve contains, at its centre, a thin wire, and the accumulator is connected to the ends of this wire. As soon as the connections are made, a fairly large current of electricity flows from one side of the accumulator, through the wire, and back to the other side of the accumulator. Now, the object of passing this current through the wire is to bring the latter to a certain temperature.

Types of Batteries.

The wire offers resistance to the flow of electricity through it, and in the process of overcoming this resistance, heat is generated—just as heat is generated in our own bodies when we have to "overcome resistance" of any kind. The bigger the current that flows through the wire the more heat is generated, as the efficient operation of the valve requires that the central wire be raised to a fairly high temperature, and it is necessary to use a fairly big current for the purpose.

Now, in most valves the central wire is surrounded by a metal cylinder. (Sometimes a flat metal plate is placed beside the wire.) This cylinder has to be charged with electricity, and, within limits, the bigger the pressure that is applied to it, the better the valve will work. For this reason, a high pressure battery is used. In the case of the wire the important thing was the amount of current that passed through it; in this case, the pressure, or tension, is the important thing.

The manner in which these two kinds of battery help to convey the signals to the telephones will be explained in another article.



Part of the transmitting apparatus at the Glasgow Broadcasting Station.

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

Q. Why does the wave-length change if you add wire to your aerial ?

A. If you add length to the aerial you will change its inductance and also its capacity. This means that the frequency of electrical vibration to which the aerial will respond will also be altered. If you add inductance or capacity, the frequency will become less. This, as you will see by reading the article in the supplement of our issue No. 41, will result in the wave-length being increased.

* * *

Q. Of what resistance should the potentiometer controlling the crystal voltage be ?

A. About 200 to 300 ohms. Do not forget that the majority of crystals do not need a potentiometer and battery, and unless you are using carborundum they will be unnecessary.

* * *

Q. Using one of the Dutch valves now sold by some firms, I find the bulb fills with blue light as soon as the H.T. is connected. Why is this ?

A. This phenomenon is called "blue-glow," and is caused by the application of excessive H.T. voltage on to the plate of a soft valve. The increased electron flow from the filament causes a number of collisions between the electrons and the particles of gas remaining in the valve. In a soft valve there are a comparatively great number of gas atoms, and these are bombarded by the electrons. The atoms are split up into ions and more electrons, and the gas is said to be "ionised." This ionisation results in the gas becoming incandescent and the blue light is emitted. You should cut down the H.T. voltage as soon as this phenomenon occurs, as otherwise the valve will soon burn out owing to the free ions of gas rushing to the filament and bombarding it. This occurs because the ions carry positive charges, and are thus repelled by the plate and attracted by the filament. Decrease the H.T. voltage until the "blue-glow" ceases.

* * *

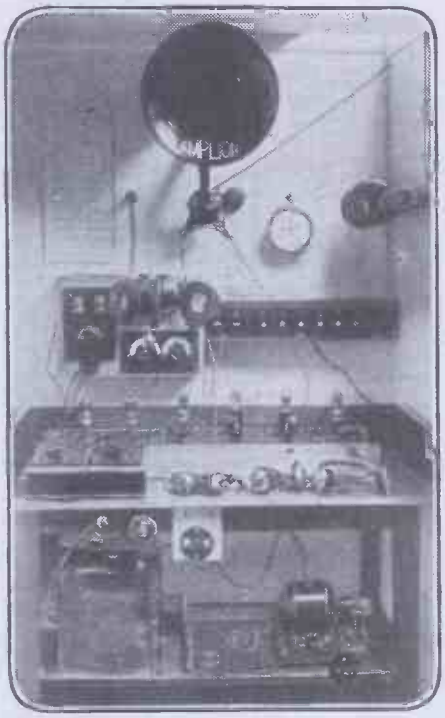
Q. In what order are unit panels placed ?

A. The aerial lead in and the earth are connected to the tuner, and then a H.F. panel is connected, the second H.F. panel follows, and so on. If only one H.F. panel is used, the detector panel will come next. After the detector panel come the L.F. panels. The phones or loud speaker are connected to the last L.F. panel. If no L.F. panels are employed, the phones are connected to the detector panel. If no H.F. panels are used, the detector panel will be connected to the tuner.

* * *

Q. With regard to Mr. Hersey's set—which appeared in your issues Nos. 26, 34, 35—can I use it with a frame aerial ?

A. This depends upon the distance from the broadcasting station. If you are more than two miles away you will need one of the H.F. panels as well as the detector, and possibly an L.F. panel, according to the distance from the transmitting station. The set can certainly be used with a frame aerial if you have a sufficient number of panels or units, according to the distance over which it is required to receive. In any case, one H.F. panel should be used for good results, unless you are fairly close to the station.



Mr. J. MacKay's six-valve home-made set, Kirkwall. All the B.B.C. Stations are heard.

Q. In erecting a double aerial, how many insulators should be used ?

A. Use two at each end of each wire, so that the wires are efficiently insulated from the spreaders ; and, in case of leakage, have another insulator or two between the spreaders and the supporting rope or wire.

* * *

Q. Can any metal be used as a "cat's whisker" on a crystal such as hertzite ?

A. No ; the action of the crystal depends upon the contact used. For the crystal mentioned you should use either brass, copper, or silver "cat's whiskers." Of these you will probably find silver will give the best results. In all cases the point of the "cat's whisker" should be fairly sharp, and not just a square cut end of wire. It always pays to do a little experimenting with the crystal contact, such as varying the gauge of wire used, the material, and the fineness of the point on the "cat's whisker."

* * *

Q. Is an earthing switch necessary ?

A. No ; it is not absolutely essential, but we would advise its use, especially during the summer months. When the set is out of use, it is always advisable to disconnect (by a switch) from the aerial, and to earth the aerial. This prevents heavy discharges of electricity—not necessarily lightning discharges—from running through the coils of the receiver, where it may strain the insulation of the wires and possibly cause a breakdown.

* * *

Q. Is there any advantage in having an H.T. battery of the plug-in type ?

A. Yes ; this class of battery enables you to vary the H.T. on the anodes of the valves to within about three volts. By this means the best results are obtained out of your set, for a little variation of the H.T. potential will often make all the difference between fair and good reception. This is especially the case when dealing with "soft" detector valves.

* * *

Q. Is there no way of avoiding the trouble of having accumulators for valve sets ?

A. Yes, you can use Dull emitter valves, but these are rather costly. They work satisfactorily from a dry-cell. Also, a new type of Leclanché cell is probably to be put on the market shortly which will light the ordinary type of valve. Three of these cells are said to be quite efficient and give steady lighting for 5 hours' continuous discharge. After this they must be allowed to rest, when they will recuperate and be fit for another 5 hours. When they finally run down, a little sal ammoniac soon puts them right. The cells are at present undergoing tests.

* * *

Q. Is it of any advantage to try different "cat's whiskers" on a hertzite crystal ?

A. Yes, it is always advisable to experiment a little with various gauges of wire, also with various materials. As the crystal is dependent for its action upon a thermo-electric effect caused between the "cat's whisker" and the mineral, a variation of the metal used for the contact will naturally have an effect either one way or the other. Silver usually makes a good contact.

* * *

Q. Is there any means of increasing the range of a crystal set other than by adding valves ?

A. No, we are afraid not. You may be able to add little improvements here and there, and slightly increase the sensitivity of your set, but, in order to increase the range of reception, valves will have to be employed.

* * *

Q. Should crystals be soldered into their cups ?

A. This depends upon the kind of crystal with which you are dealing. Carborundum can be soldered, and many of the others, such as silicon and hertzite, but in each case it is advisable to use some soft solder of low melting-point. Wood's metal will be found quite suitable, though as a matter of fact, if you can fix the crystals in firmly by means of screws, there is no need to solder them at all. Soldering will not do the mineral any good, and may, if carelessly done, result in reducing the sensitivity of the crystal.

A UNIT BROADCAST RECEIVER.

By H. A. Hersey, Member of the Wireless and Experimental Association.

No. 1.—THE TUNER.

IN my last article, instructions were given for the building of a simple tuner and detector valve combined. This article was intended for the amateur who desired an instrument that would be easy to manipulate and efficient in its working. Certain provisions were made that should the reader desire, at a later date when he became more proficient in wireless, to add to this panel further instruments, he would be able to do so without having to pull the

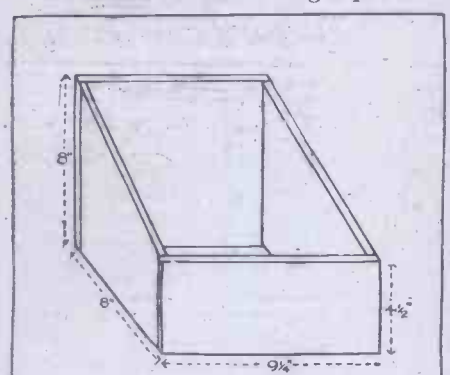


Figure 1.

set to pieces or to interfere with the internal wiring.

In the next few articles details will be given for the construction of a more elaborate receiver, consisting of a number of panels designed for broadcast reception built upon a unit system. Certain panels of these, such as low frequency or high frequency, may be connected with the tuner detector panel if the reader so desires. The first unit, to be described in this article, is to be the tuning unit, consisting of a tuning coil and condensers.

French Polishing.

A base for the tuning panel should first be made up according to Fig. 1. The wood used should be mahogany or walnut, and

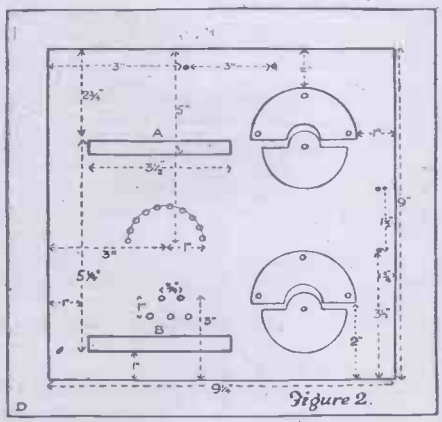


Figure 2.

well papered with medium, and finally very fine glasspaper.

The reader is advised to french polish the woodwork. To those not acquainted with french polishing, a few hints may prove useful. Take a piece of soft cloth and place inside it a small ball of cotton-wool to form a pad. The pad should now be soaked with french polish, purchased from the local oil and colour shop at about 2s. 10d. a pint. Rub the wood all over with an even motion tending to glide on and off the work in a backward and forward stroke.

If the wood rapidly soaks up the polish and the latter tends to churn up, place the work aside for about a quarter of an hour, and commence again. After a short while a glossy surface will present itself; if the pad now tends to drag on the work moisten it with a trace of linseed oil. Do not try to do too much at one sitting. If left for a final polish the next day the work so far done will have time to harden, and will come up much better.

Taking the Tappings.

For the panel a piece of ebonite should be purchased, size 9¼ in. by 9 in. by ¼ in. The panel should be marked out as per Fig. 2. Two holes each side are drilled for the aerial and earth terminals to tuner, and for the grid and filament terminals from tuner to valve panel. The positions A, B, represent the spaces for two pieces of wood to be screwed to panel on the underside as a means of support for the tuning coil. Between these are found markings for a switch, and ten studs. This is to be the aerial tuning switch, the studs connecting to tappings on the coil, beneath the tuning switch is the position for the series parallel switch for the tuning condensers. Right of the tuning switch is the position for the ·0003 variable condenser, and below this a small 5-vane Vernier condenser for fine adjustment.

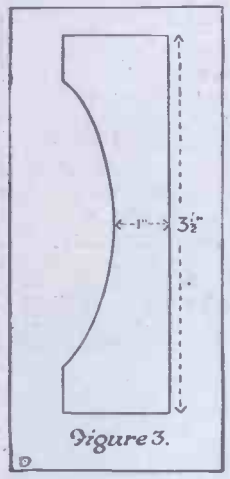


Figure 3.

This is of the cylindrical single layer type. A cardboard cylinder should be made or purchased 3½ in. in diameter and 5¼ in. long. This should now be given several coats of shellac varnish, both inside and out, and thoroughly dried. Half an inch from one end two small holes should be made, about ½ in. apart, to fasten the wire off. Half a pound of No. 24 S.W.G. D.C.C. copper wire should now be purchased. The end should be made fast to the cylinder by passing it through the two small holes half an inch from one end, leaving a short piece of wire for connecting. Ten turns should now be wound on and a tap made.

The latter can be accomplished by either twisting the wire to form a small loop, or the wire may be cut and the ends bared and twisted together. Should you choose the latter method, care must be taken that the wire does not slip back or all your work will be undone. Having wound on the ten turns, the reader should proceed by winding on a further ten turns and tapping, continuing this process until you have in all 100 turns upon the cylinder and ten taps, including one end. The coil should now be given two coats of shellac varnish after the final end has been made fast in the same manner as the starting end, and allowed to dry. The space taken up by winding should be approximately 4¼ in., leaving ½ in. at each end of the cylinder clear for attachment to the panel.

Two pieces of wood should now be cut

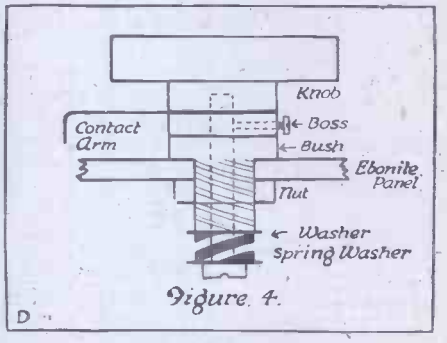


Figure 4.

as in Fig. 3. The coil should be placed upon these supports, one at each end, and tacked down by a few small brads, the tappings being uppermost. The coil is now ready for mounting upon the panel. The panel should be drilled to take the ten contact studs and switch. For the switch arm the reader may use any convenient type available of 1 in. radius, the writer's method of assembling being as per Fig. 4.

The Variable Condensers.

The series parallel switch should next be obtained or made up from two single switch arms connected by a strip of ebonite and mounted upon the panel below the tuning switch.

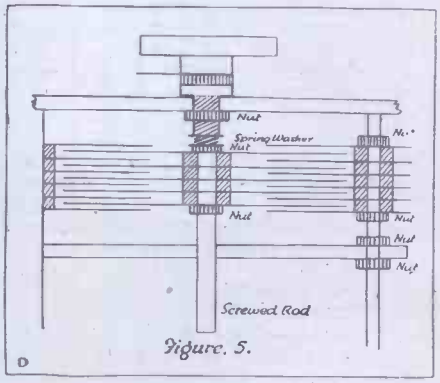


Figure 5.

The ·0003 mfd. variable condenser may either be purchased for panel mounting (cost about 12s.), or the reader may make the condenser up for himself by purchasing the various parts, and building them up, thereby saving about 6s.

Fig. 5 shows how a condenser may be made up from the parts purchased, requiring only a pair of pliers and a drill. The Vernier condenser is made up in the same manner as the large condenser, except that it consists

(*Continued on next page.*)

AERIAL INSULATION.

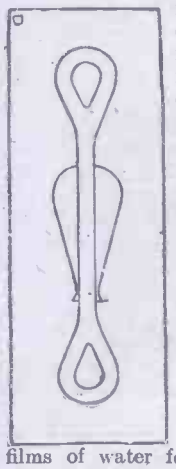
By H. P. WARAN, M.A., Ph.D. (Cantab), F.Inst.P.

THE outdoor aerial has to be suitably supported in the open air from supports like masts, buildings, or trees, according to the facilities locally available. These supports being conductors connected to the earth, we have to interpose an insulator between these supports and the aerial proper of copper wires, so that the electrical energy of the aerial may not leak away to earth except through the receiving instruments. Since all insulators are in practice conductors of high resistance, the current lost by leakage through them is expressed by Ohm's law, which states that

$$\text{C (current)} = \frac{\text{E (electromotive force)}}{\text{R C (resistance)}}$$

Hence, whether the aerial be a transmitting or a receiving one, the percentage of energy lost through bad insulation remains the same, and as such both require as perfect an insulation as can be given them. In fact, with the receiving aerials where the available energy is so very small, no insulation can be considered too good for the purpose.

The efficiency of aerial insulators is dependent on the following three principal factors. Firstly, the material of which it is made must have a high specific resistance, so that the current lost by conduction through its body may be negligible. In fact, all the usual materials—ebonite, porcelain and glass—are suitable from this standpoint.



Secondly, the insulator must have a high resistance along its surface, even when exposed to the action of the elements in the open air. This is a very difficult criterion to be satisfied, since the deposits of dust, smoke, and films of water forming over the insulators are highly conducting surfaces.

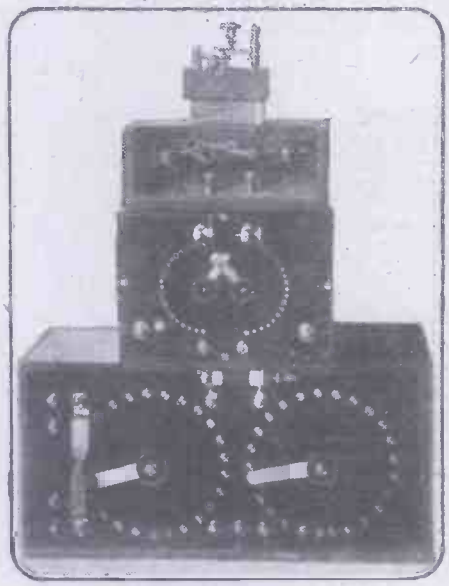
The usual types of ebonite and composition insulators are especially unsatisfactory in this respect, since their comparatively rough surface assists in the formation of such deposits which do not get washed away in a rain. Even in porcelain insulators the deposit is considerable, and the loss of signal strength is easily noticeable after they have been in use for a month or two.

Necessary Requirements

In fact, in a busy industrial locality the white porcelain soon begins to look quite black, and in this state it is perfectly useless as an aerial insulator for high-frequency currents. Some of the porcelain insulators seem to have been given a dark colour, presumably to make this deposit less noticeable.

The only effective safeguard against this deposit lies in providing a protective covering for the insulator. A new type of all-glass insulator, in which this protection is most effectively introduced, is shown in the illustration. The insulator itself consists of a central stem of stout glass rod ending in oval hooks at either end. The central portion of the stem is almost entirely enveloped by a glass bulb sealed on to the rod.

Thirdly, the insulator must have a minimum of capacity between the copper wire and the (earth connected) rope attached to it, so that the loss of high-frequency energy to earth through this capacity may be negligible. In this respect the usual type of reel, egg, or shell type of porcelain insulators are very inefficient. In these the aerial wire and the supporting rope pass within ½ in. of each other in the insulator, thus forming a small condenser between the earth and the aerial. The ebonite and composition insulators, too, suffer from this defect, especially in service, when their surface gets coated easily with a conducting deposit, or their surface insulation deteriorates by exposure to light. Hence these insulators, if used for an outdoor aerial, become efficient only when a large number of them are used in series at either end of the aerial, and even then periodically taken down and kept clean.



Home-made Crystal Receiver by Mr. Baxter, 6, Dover Road, East Gravesend.

In addition to satisfying the electrical conditions, a satisfactory aerial insulator must have the requisite tensile strength in ability to stand the maximum strains coming over the aerial on which it is to be used. We have already calculated these out, and found them to be well below 100 lbs. for the average amateur aerial. All these insulators are capable of standing a strain of well over 500 lbs., and as such are suitable enough for aerial insulation if they would maintain the requisite aerial insulation under service conditions in the open air.

For the latter purpose, which is the chief aim of an aerial insulator, the glass insulator of the type illustrated above is undoubtedly the best. Standing a strain of over 500 lbs. without any leakage or capacity losses, it maintains almost perfect insulation even at the very highest potentials used in wireless work.

A UNIT BROADCAST RECEIVER.

(Continued from previous page).

of three fixed and two moving vanes only. This condenser is for the very fine tuning required on short wave-lengths. The condensers being assembled and mounted upon the panel, we can mount the tuning coil. The two pieces of wood at each end should be placed against the panel on the underside in their respective positions A, B, and screwed to the ebonite from the front by two ¾-in. brass countersunk screws to each piece. The panel may now be wired.

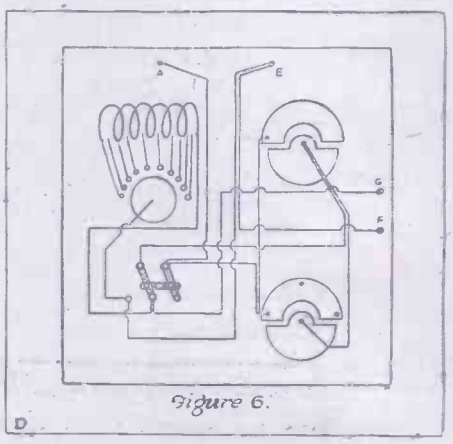


Figure 6.

The wiring up can be easily followed by reference to Fig. 6. The right-hand side end of the coil should be connected to the centre stud of the series parallel switch. The first tap of the coil should now be soldered to a lead and connected to stud 1, No. 2 tap to stud 2, and so on till the end of the tappings are reached. From the tuning switch a lead is taken to the left-hand stud of the series parallel switch and continued to the E terminal. From terminal E connect a lead to terminal F. From the centre stud of series parallel switch take a lead to the G terminal.

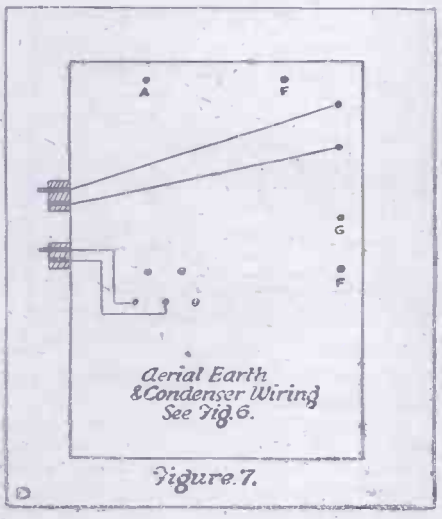


Figure 7.

RECENT WIRELESS INVENTIONS.

The following abstracts are published by arrangement with our Patent Adviser, Harold J. C. Forrester, Chartered Patent Agent, of Jessel Chambers, 88-90, Chancery Lane, W.C.2.

Grant of the following Patents can be opposed, and printed copies of the full specifications, with drawings, can be purchased from the Patent Office, Chancery Lane, W.C.2.

191,402.—A. M. LOW—SELECTIVE RECEPTION AND TRANSMISSION.—The receiving circuits of several stations are periodically completed at different times by rotary switches driven by stop-watches. A rotary switch driven by a stop-watch is installed at the transmitting station, so that signals can be sent out at any desired time, such that they will be received by any desired one of the receiving stations, but not by the other stations whose circuits are at that time not completed.

191,404.—A. M. LOW—DETECTORS. A coherer detector contains a mixture of silver and nickel particles, some, or all of which, may be previously heated in a sulphurous atmosphere. Fixed and adjustable electrodes may be provided in the coherer.

191,406.—A. M. LOW—AERIAL.—The exhaust stream of aircraft or other internal combustion engines is used as an aerial; connection being made to spikes projecting into the exhaust stream. For aircraft, the aerial is connected to a capacity earth, consisting of a coil of wire in the wings or elsewhere.

191,485.—BRITISH THOMSON HOUSTON CO.—NON-INTERFERING RECEPTION.—A valve circuit is inductively coupled to two oscillating circuits in series between the aerial and earth—one oscillating circuit consisting of an inductance and condenser in parallel, and the other of an inductance and condenser in series. The capacities and inductances are so chosen that interfering waves neutralise each other and do not produce signals; but other waves are added or subtracted so as to produce signals.

191,550.—W. W. BURNHAM.—INDUCTANCE COILS.—Circular inductance coils are secured to a block carrying plug and socket terminals at its lower end by being bound with tape to arms projecting from the upper end of the block.

191,618.—V. J. HINCKLEY—CONDENSERS.—The fixed and movable vanes of a condenser are made in the form of screw threads—the movable vanes being carried by a rod screw threaded to the same pitch as the vanes.

191,723.—BRITISH THOMSON HOUSTON CO.—MODULATING H. F. CURRENTS.—A modulator consists of an oval laminated iron core, on which are wound in opposition two windings in series with the aerial. A coil included in a microphone controlled circuit is also wound on the core. Distortion effects, particularly on short wavelengths, are diminished.

191,767—MULLARD RADIO VALVE CO. LTD.—VALVES.—The grid is cylindrically formed so as partly to encircle the kathode filament, leaving a longitudinal gap. This grid may consist of a zig-zag wire running longitudinally to the kathode.

191,777 — J. SCOTT-TAGGART.—REDUCING INTERFERENCE.—H.F. currents are rectified with or without previous amplification, and applied to a two-electrode valve—or to the grid of a three electrode valve—to which the telephone circuit is connected; a small positive potential being applied to the anode in the former case, and the valve or a "negatron" used instead, is adjusted to work under such conditions that positive impulses of more than a certain strength produce less effect than weaker impulses.

191,788—J. H. MOSS—SWITCHES.—Press button switches are made dust, damp, and gas proof by mounting the button on a diaphragm rendered flexible by radial corrugations.

We have arranged for Patent Enquiries addressed to our Patent Adviser to be answered direct by post, any enquiries of general interest being also answered in our columns.

THE BROADCASTING OF "BUTTONS."

EVEN Mr. Stanley Lupino was a little perturbed when he went to Marconi House the other evening to speak to the children via 2 L O's microphones.

When I arrived at the studio the well-known comedian was timidly examining the structure into which he had to speak. He had come straight from the Hippodrome, where he takes the part of "Buttons" in "Cinderella," and was still in his war paint.

"That's a rum thing," he said, glancing towards the microphonic structure in the centre of the room. "It's like a Ford car with the works out and the wheels off. Beastly unnerving-looking arrangement, though," he added, shaking his head doubtfully.

"If you hear a bang—"

He spent several minutes scrutinising the apparatus at a safe distance, and then was told it was time to go on.

"Right you are!" he said. "Show me where to stand and what to do. Let's get it over."

Clearing his throat and setting his face determinedly, he commenced:

"Hullo, children! 'Buttons' speaking. I wish you could see the thing I am talking into. Really awful it is, and I am afraid it will go off any minute, so if you hear a bang you'll know what has happened."

Microphone Wouldn't Laugh.

Mr. Lupino then told the children some funny stories, and finished up by telling them a little about the children's performance of "Cinderella" at the Hippodrome.

After wishing them "Good-night," he turned to me and gasped, "What an ordeal!"

"Didn't you enjoy it?" I queried.

"Enjoy it!" he grunted. "I never had such a bad time in all my life; and I am a comedian, too," he added meaningly. "I have never felt that I was 'getting the bird' more than I felt it to-night. You really can't be funny to a lot of metal like this thing in front of me. It simply can't be done.

The Clutching Hand.

"I don't mind trying to be amusing on the stage, for you can soon alter your tactics if you feel and see that the audience is getting bored, but to try to be humorous down a microphone—well, *I* can't do it, anyway.

"I felt all the time as if some invisible hand was clutching at my throat while someone whispered in my ear, 'You *are* an idiot. Do you think you are being funny, and amusing those children? Because you are not.' I would just as soon try and make a drain-pipe laugh as get any sign of expression out of that box of tricks." He pointed despairingly to the microphone.

"Sufficient for the Day—".

"I nearly chucked it up once or twice," continued "Buttons," "for I felt sure everyone had switched off, and that I was being given the most frightful 'bird.' Without seeing the faces of your audience it is terribly difficult to carry on at all. I've had quite enough for to-night; I'm going home."

With that Mr. Lupino bade us all a hurried farewell and fled from the Chamber of Horrors.

K. D. R.

WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

The Radio Society of Highgate.*

Of the three or four British amateur transmitting stations received in America during the recent transatlantic tests, it is with pleasure that we are able to report that one of the stations was owned and worked by a member of this society. The station referred to is 2 S H, owned by Mr. F. L. Hogg, who is thus one of the very few British amateurs who have been heard on the other side of the Atlantic.

The following lectures have been given recently: "Secondary Cells," by Mr. H. Andrewes, B.Sc., A.C.G.I.; "How to Make Your Set Efficient," by Mr. F. L. Hogg; "From Crystals to Poly-valve," by Mr. J. F. Stanley, B.Sc., A.C.G.I.

A special series of elementary lectures is now being given, full particulars of which may be obtained from the hon. secretary.

Hon. secretary, J. F. Stanley, B.Sc., A.C.G.I., 49, Cholmeley Park, Highgate, N.6.

Eastbourne and District Radio Society.*

Lectures are being held every fortnight in the Technical Institute, Eastbourne. An aerial is being erected on this building, with the kind consent of the authorities.

Hon. secretary, W. F. G. West, Bridle Gate, Willingdon, Sussex.

Liverpool Wireless Society.

The usual bi-monthly meeting of the above society was held on Thursday, February 22nd, 1923, at the Royal Institution, Colquitt Street, Liverpool. Mr. E. B. Grindrod occupied the chair.

Mr. A. J. Haining delivered a lecture on "Amplification" to a record attendance. Mr. Haining dealt exhaustively with the theory and principles of amplification. His explanations were given in language that was understandable to those whose knowledge of electricity was not that of experts. The various types of valve connections were described diagrammatically, and the relative advantages of each type pointed out in the light of professional knowledge, the semi-aperiodic H.F. transformer coming in for special attention.

The "Height" Radio Society.

A general meeting of those interested in the formation of a wireless society for Irlams o' th' Height, Manchester, was held at the Congregational Schools, Irlams o' th' Height, on Friday, February 23rd, G. F. Jones, Esq., in the chair. It was resolved that a society called the "Height" Radio Society should be formed. It was decided to approach certain gentlemen of the district, proposed at the meeting to take office as president and vice-presidents. The officers elected were as follows: Chairman, Mr. H. Challis Sowerby; hon. secretary, Mr. Fred C. Hodge 37, Bolton Road, Pendleton; hon. treasurer, Mr. C. Denton. Will all those in the district who are interested please communicate with the hon. secretary.

Bath Radio Club.

A gradually increasing attendance is to be noted at the fortnightly meetings of the Bath Radio Club. This is no doubt due, in a large measure, to the excellent lectures now being given to the members by Mr. Leslie Boxwell. On February 23rd he gave the fourth of his series, and dealt in an able way with the valve used as a detector, adding many practical details regarding the construction of a single valve set.

Hon secretary, Geo. J. Barron Curtis, F.S.A.A., F.C.I.S., 6, Pierrepont Street, Bath.

Southampton and District Radio Society.

A new name has been adopted, new officers appointed, and a general spring clean has recently taken place, and a more definite policy has been adopted in connection with our all-absorbing hobby of radio.

Lectures on H.F. amplification by tuned anode and transformer methods have been very ably delivered by prominent members of the society, and a paper on the thermionic valve was the very interesting item at our last meeting.

Hon. secretary, T. H. Cutler, 24, Floating Bridge Road, Southampton.

The Cheshunt Experimental Radio Club.

The seventh meeting of the above club was held on Monday, February 26th, at "The House," Churchfields Path, when a committee of seven was elected by vote. After election, the secretary gave a lecture on the theory of the Fleming valve, and explained a few of the most common valve circuits.

The club now possesses an experimental licence, and when suitable accommodation is acquired apparatus will be installed.

Hon. secretary, Mr. J. Bonnett, 9, Gew's Corner, Cheshunt, Herts.

Portsmouth and District Wireless Association.

At a meeting of this association, held on February 21st, an interesting lecture was given by Mr. J. H. C. Harrold, the president of the association, on "Direction Finding." Owing to shortness of time, the "receiving" part only of direction finding was dealt with. Mr. Harrold explained the different types of aerials used, and the method adopted in locating stations was briefly explained.

The Ilford and District Radio Society.

On February 22nd Mr. A. J. Thompson delivered a lecture on "The Magnetic Detector and Multiple Tuner." After explaining in a very explicit manner the way in which the detector worked, the lecturer dealt with the multiple tuner. He explained that his tuner was specially designed in order to operate the magnetic detector, which was a current, rather than a potential, operated device. Mr. Thompson's remarks were received with great interest, and a very hearty vote of thanks was accorded him at the conclusion of his lecture.

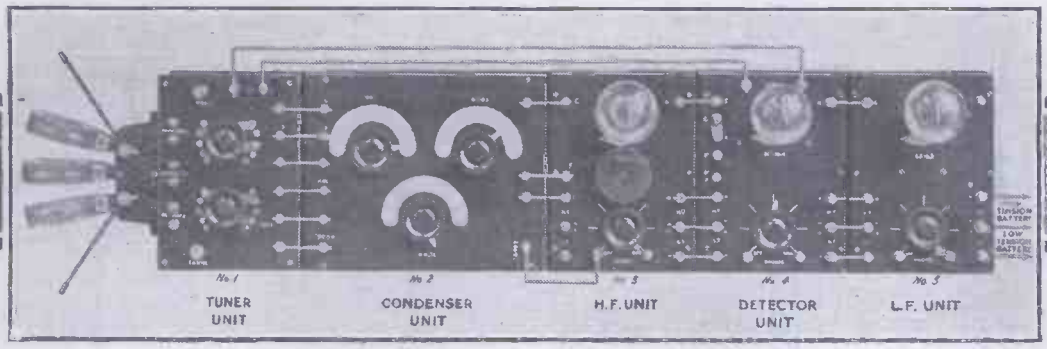
Hon. secretary, A. L. Gregory, 77, Khedive Road, Forest Gate, E.7.

Addiscombe and District Radio Club.

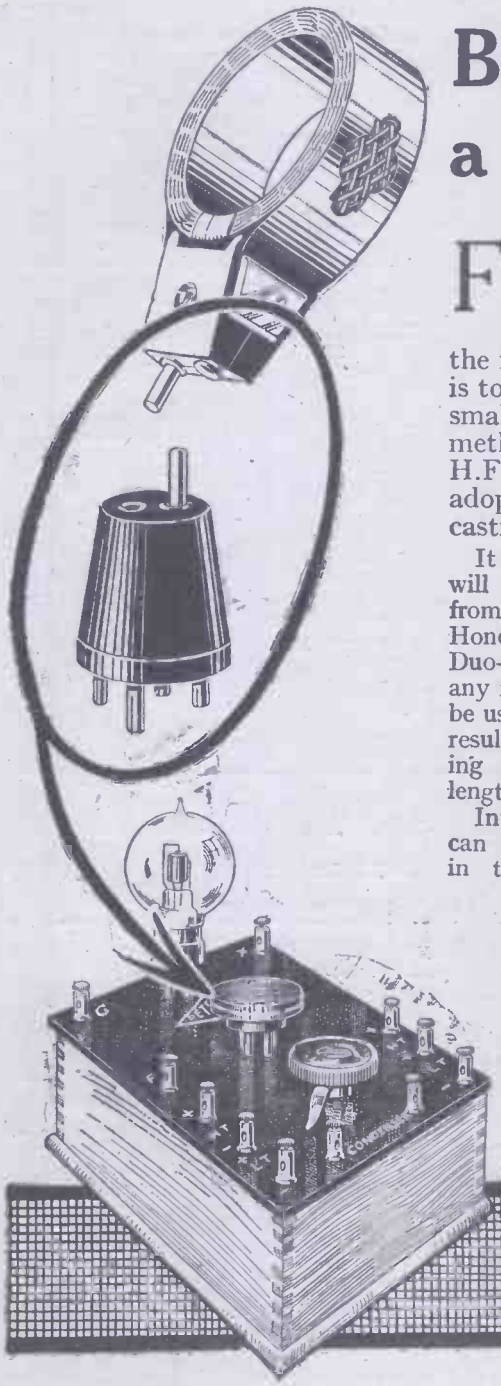
It is proposed to form a radio club in Addiscombe under the above name. Will enthusiasts interested please communicate with Mr. L. S. Davis (hon. secretary pro. tem.), 156, Cherry Orchard Road, Addiscombe, Croydon.

The Editor of "Popular Wireless" welcomes photographs of amateur sets from readers, or anything else of particular wireless interest. 10s. 6d. will be paid for each photograph used.

A TOPICAL EXTRACT FROM SHAKESPEARE (MARK ANTONY, COMMENCING TO BROADCAST HIS FAMOUS ORATION): "FRIENDS, ROMANS, COUNTRYMEN, LEND ME YOUR EARS—AND BY CAESAR, IF YOU OSCILLATE——!"



For those long-distance Broadcasting stations use a tuned Anode Circuit



FOR long distance work, you must use high-frequency amplification, and the most efficient method—as well as the most economical—of doing this is to use a plug-in Coil tuned by a small variable Condenser. This method gives louder signals than H.F. Transformers, and is usually adopted in Circuits used in Broadcasting Receiving Sets.

It is also much more selective and will readily tune out interference from near-by Broadcasting Stations. Honeycomb, Basket, Duo-lateral—in fact, any form of coil may be used with excellent results, the size varying with the wavelength required.

In order that you can use plug-in Coils in the place of existing Transformers, we have designed the ***TUNODE PLUG*** (registered design).

To use it, merely remove Transformer and insert ***TUNODE PLUG*** and a Coil, and you are ready to receive. There is no alteration to any of the wiring of the Circuit.

This is just another example of the wonderful adaptability of the Peto-Scott Standardised Radio Units. Valves can be added at any time at ridiculously low cost—but from the first Valve the Set is quite complete.

If you would know more of this *perfected* Unit System—on which thousands of amateurs obtained the knowledge which qualified them for their Experimenters' Licences—send 6d. for a copy of "Radio," a 24 pp. Booklet showing how each Unit is constructed

Price list of Sets of Parts

No. 1 Tuner Unit	27/6
No. 2 Condenser Unit	42/-
No. 3 H.F. Amplifying Unit ..	13/6
No. 4 Detector Unit	17/6
No. 5 L.F. Amplifying Unit ..	33/6
Cabinets for 1, 3, 4, and 5 ..	3/6
Cabinets for No. 2	7/-
TUNODE PLUG	3/6
Catalogue of all Radio Components, 32 pp.	3d.

PETO-SCOTT CO. LTD.,

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64, HIGH HOLBORN, W.C. 1.

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RADIOTORIAL

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

Dozens of letters still continue to pour in each day on the Licence question. Many of the writers offer carefully-thought-out alternative arrangements for the issue of licences, but it is, of course, impossible to print in POPULAR WIRELESS every letter received. I am preparing, however, a special selection from the correspondence on this question of the hour, and shall publish some of the outstanding letters in next week's issue. Meanwhile, write in to the G.P.O. also, and express your urgent desire for the issue of a class of licence which will entitle you to make your own gear.

It is only by constant asking that one gets anything from a Government Department, and the more one asks, and the louder one asks, the quicker do the askers get what they want.

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send the necessary postage for reply.

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

T. C. A. (Greenwich).—When employing a loose coupler is it necessary to alter the tuning of the coils when the distance separating the two coils is increased or decreased ?

Yes, varying the relative positions of any two coils such as are employed in loose coupled circuits will vary the inductance value of each individual coil to a certain extent. Generally speaking, however, this can be counteracted by a little condenser adjustment. After having loosened off the coupling a slight increase in the condenser reading in the case of both circuits will be required.

* * *

O. P. (Dundee).—Why are we always told to take the down lead of an aerial from either the dead centre or extreme end ? My aerial is fifty feet long ; why should I not take the down lead from a point, say, 15 feet from the one end?

We will answer the last part of your question first. Were you to do so you would be erecting a "T" aerial with irregularly balanced "arms." Now, how does the oscillatory flow of current take place in the case of the "T" type aerial when induced by the incoming ether waves ? It will commence its flow from the two extreme ends of the two "arms" simultaneously, will combine at the point where the down lead is connected, will rush to earth through the set, back through the set up the down lead (or should we in this case say up the up-lead ?), divide at the point of connection, flow to the extreme ends of the two arms, and will return and repeat the cycle until "worn out," or will continue its "swing" if the circuit is tuned so that it arrives back at its starting-point just in time to be pushed off by the next incoming wave—in other words, if the circuit is tuned in. Now what happens when the two "arms" are not of equal length is simply this, and that is that in the first place the current starting from the extreme end of the shorter arm will get to the down lead first and will precede the current from the other arm, will complete its journey to earth first, naturally, and will have turned to come back only to find that the other current is opposing it as it has not yet finished its journey to earth. So instead of combining together at the down lead each time and again at their point of return, thus forming, as it were, one combined current, it will tend to be divided into two separate currents which will oppose each other at various points, with the result that reception will be, to say the least, inefficient. This condition must obtain, therefore, you will see, unless the down-lead is in the absolute centre or at one extreme end of the aerial.

* * *

P. B. (Holyhead).—I see in various articles allusions to anode currents on one valve of as much as 2 milliamps. Surely this should be able to operate relays or even loud speakers direct without any amplification being necessary ?

Two milliamps. might be flowing in the plate circuit of a valve set, but it would not mean that signal strength was 2 milliamps., because this latter is represented, not by the continuously flowing plate current, but by the variations caused in it by the interposing of the varying charges on the grid caused by the received signals. Thus 2 milliamps in the case you mention, would be flowing around the plate circuit from the H.T. battery as soon as the required filament temperature had been reached, even although no signals were being received. The arrival of these latter would cause minute fluctuations in its intensity which, would, of course, actuate the telephone receivers accordingly.

* * *

L. N. (Okehampton).—Does the value of a grid leak require altering when more plate voltage is used ?

Generally speaking, no ; a variable grid leak is advantageous should serious modifications or alterations in the circuit be contemplated.

* * *

R. D. (Barking).—On a short wave ex-service tuner there is a small break in the change-over switch which, I am told, breaks the closed circuit. What is the exact reason for doing this ?

This is quite a normal arrangement. When receiving on the "Standbi" side, or rather when the crystal and phones have been changed over from the secondary coil to the primary, the closed circuit is liable to oscillate by itself and cause loss by opposing the free-oscillations of the open circuit, the one which is in use. Therefore, the change-over switch is so arranged that it breaks the closed circuit when the switch is taken over to "Standbi" and prevents this happening. There is on the change-over switch on the Mk. III, a switching device for carrying the buzzer circuit across the coil not in use. Thus the buzzer circuit will be the closed circuit when working on "Standbi," and the open circuit when on "tune." Amateurs will realise the many advantages of this latter arrangement.

* * *

T. T. (Hanwell).—How can I employ a three-coil holder made to instructions given in No. 39 of POPULAR WIRELESS in a crystal circuit ?

Three-coil holders are intended for use in valve circuits, and are hardly suitable for crystal work. In any case, you could only efficiently use two of the coils at a time, by employing them in the manner of a loose coupler, the one in the primary or open aerial circuit and the other in the closed circuit.

* * *

D. M. (Coventry).—Which will give the greatest range, reaction on to the A.T.I. or reaction on to a tuned anode coupling between valves ?

The latter will prove far more efficient in point of range of reception, selectivity, and for various other reasons. Also, it might be added, it is not liable to cause that interference that will misused reaction on to the A.T.I. or secondary.

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from previous page.*)

E. F. W. (Purley).—Will you supply details for constructing a transformer? Desired output, 10 volts, 5 amps.; maximum input, 205 volts, 50 cycles, A.C. main.

To construct a transformer for use with a primary supply of 205 volts 50 cycles the core should be 1¼ in. diameter of soft iron wire of, say, No. 22, and 12 in. long, the primary 1,200 turns of No. 22 D.S.C., the secondary 120 turns of No. 14 D.S.C. The output of this transformer will be 20 volts, which will be suitable for battery charging. The core must be particularly well made and packed tight, the primary wound on and the secondary on top of the primary, carefully insulating between them. The iron core wires should then be bent over the windings to form a closed magnetic circuit.

* * *

T. B. (Ashington).—I have a free supply of A.C. 240 volts, 40 periods, and wish to charge continuously a 6-volt 60-amp. accumulator. Please say minimum transformer necessary for this, allowing for loss in Noden valve and a margin, also size of rheostat necessary. Would above answer also work a spark coil taking a.c. 8 volts, 1½ amp. (All that I am allowed to use, *i.e.*, 10 watts.)

1. A transformer having an output of 8 amps. at 20 volts will provide a satisfactory margin. 2. If it is proposed to feed the spark coil from the transformer through the Noden valves a rheostat of 10 ohms. It is suggested that the preferable way would be to use the A.C. from the transformer secondary direct by screwing up or short-circuiting the trembler and a suitable resistance as under 2.

* * *

E. B. (West Ealing).—I desire to charge my accumulators off the lighting main, which is 102 volts alternating. 1. Particulars of transformer to give about 20 to 30 volts 4 to 5 amps. 2. Particulars of rectifier aluminium and lead type to use with above. I have plenty of 22 D.C.C. wire by me. Could this be made use of?

Assuming the supply is at 50 cycles, the periodicity not being stated, a transformer with 600 turns of No. 22 D.S.C. for the primary and 130 turns for the secondary would be required. The core should be 1¼ in. diameter, 12 in. long of No. 22 soft iron wire, and should be turned back over the windings to form a closed magnetic circuit. 2. Jars of earthenware of about 6 in. diameter by 8 in. deep, with aluminium and lead plates at least $\frac{1}{16}$ in. thick and having a surface of approx. 80 square inches immersed in a concentrated solution of ammonium phosphate formed by dissolving chemically pure ammonium phosphate at the rate of one pound to each gallon of water.

* * *

W. H. C. (Golders Green).—Please give particulars of windings, etc., required for making the transformer mentioned in the article this week on "The Charging of Accumulators." My supply voltage is 240 A.C., and the lamp I would prefer to use in primary circuit is 100 watt. 200 C.P. gas filled. My cells are each 2 volt 25 amp. hours actual capacity. What would the primary and secondary voltages be with such a lamp in circuit?

A transformer does not require any lamp in circuit in the primary. It can be connected directly across the circuit, and will only take a very small current with no load on the secondary. As a load is put on the secondary the primary current increases and automatically regulates itself.

Assuming your supply is at 50 cycles (this not having been stated) a primary of 1,500 turns of No. 22 D.S.C., and a secondary of 120 turns of No. 14 D.S.C. wound on a core of No. 22 soft iron wire 1¼ in. diameter 12 in. long. This core must be carefully formed and should be bent over the windings to form a closed magnetic circuit.

* * *

"CAPACITY" (Coventry).—What is the method of finding the number of plates required in a condenser of given capacity?

The method employed is a variation of the formula for the calculation of capacities. This formula, $K = \frac{A\,k}{11{\cdot}31 \times 10^6 \times d}$ can be used for any type of parallel plate condenser. K is in microfarads, A is the effective area of the plates belonging to one terminal, d is distance between the positive and negative plates and k is the dielectric constant of the material between the plates. All measurements are taken in cms. or square cms. Let us take an example. If we have a quantity of plates 2½ in. diameter and we wish to build a condenser of ·0005 mfd., and decide to use the ⅛-in. spacing washers, how many plates shall we need? Twist the above formula round so that A (total area of plates on one terminal) is given. Then $\frac{A\,k}{11{\cdot}31 \times 10^6 \times d} = K$, where d is the distance between the unlike plates, so that we shall have to calculate it from the size of spacing washer used and the thickness of the plates. (In a fixed condenser it is merely the dielectric thickness.) Using the ⅛-in. washers we have d = (⅛-in. — thickness of plates) ÷ 2 = (⅛-in. = $\frac{1}{16}$-in., say) ÷ 2 = $\frac{3}{32}$.

Bringing inches to centimetres by multiplying by 2·5 = $\frac{3}{32} \times 2{\cdot}5 = {\cdot}117$ cms.

Now we want a capacity of ·0005 mfd., therefore $\frac{A \times k}{11{,}310{,}000 \times {\cdot}117} = {\cdot}0005$, k in this case is 1 (dielectric constant of air).

∴ A = ·0005 × 11,310,000 × ·117 sq. cms.
= ·0005 × 1,323,270 = 661·6350 sq. cms.

This will, therefore, be our total effective area, and if we divide the area of each plate into it we shall have the number of surfaces required. In other words A = area of total number of plates minus one. Total number of plates = $\frac{\text{total area}}{\text{area of each plate}}$ plus 1 plate.

Now the diameter of each plate is 2½ in.; area is $\frac{4{\cdot}9}{2} = 2{\cdot}5$ sq. ins. approx. To find the area of a plate we must use the formula πr^2 (area of a circle). $\pi = 3.14$ and r is the radius of the circle. In this case we are dealing with semi-circles. Therefore the radius is half πr^2 Radius is 1¼ in. (half the diameter), ∴ the area is $\frac{\pi \times 1\frac{1}{4}}{2} = \frac{4{\cdot}9 \text{ sq. in.}}{2}$

Bringing these sq. inches to sq. cms. we multiply by 6·25. ∴ the area of each plate is $\frac{4{\cdot}9 \times 6{\cdot}25}{2}$ sq. cms = 15,625 sq. cms. approx.

From this we have that the number of plates = $\frac{661{\cdot}6350}{15{\cdot}625} + 1 = 42 + 1$ plate = 43 plates. These results are approximate only as the decimals, etc., have been taken to two or three significant figures and not worked right out.

* * *

J. H. L. (no address) asks if it would be possible to use a one-valve set with a frame aerial two miles away from the Broadcasting station.

Yes, this would be possible though the results would not be very loud. We think you would find a straight type of indoor aerial slung across the room near the ceiling more efficient. In this case the usual earth connection would be necessary, a water-pipe being quite suitable.

* * *

"RADIO" (Glasgow).—If I buy a Broadcast B.B.C. receiver and a Broadcast licence, can I add a home-made amplifier to it?

We are afraid not. The B.B.C. stamp must appear on *all* apparatus used under the broadcast type of licence, unless the holder has received special permission from the Secretary, G.P.O., to employ home-made apparatus under that licence.

* * *

C. L. (Norwich).—When charging my accumulator, how can I prevent the danger of overcharging, and how can I tell when it is nearing the end of the charge?

(*Continued on next page.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from previous page.)

You need not fear any danger from overcharging—that is in respect of the duration of the charge. It is more harmful to undercharge. No trouble will be caused by an overcharge providing the current is of 7 or slightly below, the marked charging rate. Towards the completion of a charge the cells will "gas." That is very easily discernible by the numerous small bubbles rising from both plates. Keep the cells on charge for half an hour or so after the commencement of "gassing" is noticed.

How can I tell the capacity and charging rate of an accumulator which has no directions on it ?

The capacity can be taken as ·65 ampere hours per square inch of positive plate, and the rate for charging as ·14 amperes per square inch maximum. An accumulator will, however, have a longer life if the charging current is kept well below the maximum.

* * *

F. C. (Bath).—How many and of what size zinc and glass plates shall I need to make a condenser ·0003 mfd. capacity ?

You would require 40 sq. in. of ordinary glass one-tenth of an inch in thickness between suitable zinc plates. The glass must be covered each side by the zinc plates, but the number of plates you could arrange to suit your most convenient size. Thus you could have but one sheet of this glass measuring 4 by 10 in. between two suitable zinc sheets, or two plates of this glass each 4 by 5 in. between three suitable zinc sheets, etc.

* * *

A. V. C. (Caterham).—About how many feet are there to a pound of No. 20 S.W.G. wire ?

262 ft.

Would an aerial 70 feet long and 18 feet high receive messages on crystal set ?

Yes, but 10 ft. or so higher would be more efficient.

Should I be able to receive messages from the wireless station at Birmingham, living 4 miles away, using the aforementioned crystal set ?

Yes, quite easily.

* * *

W. A. (Canterbury).—Could I increase the loudness of signals by putting a microphone button beside the phone, and leading two wires from it to another phone with a trumpet attached ?

No. The button would have to be attached to the reed or diaphragm of the receiver, and a small transformer used for the microphone circuit. It is not advisable to attempt to do this unless you have some considerable experience and skill in the handling of fine instruments, or the result will be but the damaging of the telephone receiver.

* * *

"Oxo" (Marlborough).—My aerial passes right over the house, being affixed to two trees each 50 feet high. This necessitates bringing the lead-in through the back of the house to a front room where I have my set, a distance of 35 feet. The aerial is 90 feet long. Will this prove effective ?

No. You can erect a very efficient "T" aerial, however, by taking the down lead from the centre of the aerial. This should be directly above the room in which you will have your set, judging by the sketch.

* * *

C. H. A. (Bristol).—Why am I advised to use stranded wire for all wireless work ?

Stranded wire has a greater area of surface than solid wire. High-frequency currents travel on the surface of conductors, therefore stranded wire has less "skin" resistance. It is also to be preferred on account of greater flexibility.

* * *

"Beginner" (Hampstead).—What should be the dimensions of a tubular variable condenser using air as a dielectric to have a maximum capacity of ·001 mfd. ?

This would be too large for practical purposes. You would require two tubes about 18 in. long, the larger ring being 6¼ in. diameter, with a spacing between the two of one-tenth of an inch.

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

"TRANSFORMER" (Hove).—I have a pair of 120 ohms resistance telephones. I understand that if I want to use these with a crystal set I must employ a transformer. If this is so, can you tell me the number of turns of primary and secondary winding, and the gauge of the wire I shall require to make one?

You will find it a very arduous task. The core must be soft iron. For the primary winding you will require 15,000 turns of 42 S.W.G., and the secondary 800 turns of 38 S.W.G.

* * *

C. G. B. (Sheffield).—(*a*) What is the inductance and wave-length of a tuning coil wound with 28-gauge wire D.S.C. on a former 2¾ in. by 9 in.? (*b*) What is a "jar" compared to microfarads? (*c*) Is it possible to receive telephony in Sheffield on a crystal set?

(*a*) 7,500 microhenries giving wave-length range to 2,900 metres on a 100-foot single aerial. (*b*) ·0011 mfd. (*c*) As possible as anywhere else if there is a station transmitting telephony within 15-20 miles. There is no broadcasting station within that distance but it is possible that there are amateur stations that transmit telephony.

* * *

A. B. C. (Sydenham).—I have read that an indoor aerial is not much good for a crystal set. Why should that be when I am also told that wireless waves will travel through anything?

In certain circumstances wireless waves will pass through, so far as we know, all substances, but even so it has been proved that they are capable of reflection in a similar way to light. Light will pass through clear glass, but can also be reflected by the same material; therefore, while wireless waves can, and will, pass through the walls of a building, there will be a certain amount of reflection, much more so than in the case of light and the glass. The reflection is more in the form of diversion.

* * *

C. V. O. (Laindon).—I am using a five valve set, and employing "Ora" valves. These, I understand, only require 30 volts on the plates My signals are very weak, however, and if I switch off two valves they become stronger. Why is this?

You are making a mistake that many often make regarding the plate voltage. If you increase the number of valves the voltage should be increased somewhat. Instead of 30 volts H.T., try about 75 volts. The low voltage would account for the weakness of reception.

* * *

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

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

What is the formula for basket coils placed in series?

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

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

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

What variable condenser should be used?

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

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

H. J. (Leeds).—Why should the earth lead be short ?

Because a maximum of current flows at the earthed end of the aerial. This current must flow through the earth connection from the aerial to the earth, and, by virtue of its being an oscillating current, from the earth to the aerial. Therefore, if the earth connection is long, its resistance will cause loss of current.

* * *

J. K. (Dundee).—I have just made a tuning coil with a single slider for adjusting the wave-lengths, but often I hear several stations at once. How can this be remedied ?

The interference can often be cut out, or partially so, by making two tuning coils, one sliding within the other. The signals are picked up by the slider on the outer (" primary ") coil, similar to the one you already have. The current is induced in the movable sliding coil (or " secondary "), and if jamming is heard, the movable coil should be drawn out until the desired station is alone audible.

* * *

R. W. (Brighton).—I am thinking of purchasing another pair of telephones, but as my receiving set is only fitted with two terminals, how is the second pair attached ?

Each pair of telephones has two leads : fix one lead of the first pair of phones to one terminal, and one lead of the second pair of phones to the other terminal. Join the two remaining leads together by wire or a metal clip and the circuit will be complete, enabling two people to listen in at once. Each pair of phones should be of similar resistance.

* * *

C. S. (Leeds).—What is a compound condenser, and how does it work ?

A compound condenser is a condenser with an arrangement whereby fixed condensers can be placed in parallel, thus giving an extensive range of capacity. If a ·001 mfd. variable condenser has a switch that will bring a small fixed condenser in parallel of ·001 mfd. when required, a variable range of zero to ·002 mfd. will be obtained. Further fixed condensers could be likewise arranged to the values of ·002 and ·004 to give a range to ·008 mfd., if such a range was required. The idea can be easily adapted to amateur sets. A small two-plate sliding variable condenser can have several small fixed condensers paralleled by switches to give a similar range of capacity to the more expensive multi-vane type.

* * *

M. C. V. (Tonbridge).—Can you give dimensions and windings of two high-frequency transformers of the plug-in type to give ranges from 200-500 and 500-700 metres ?

Obtain two ebonite bobbins 2½ inches overall diameter with ¼ inch square peripheral grooves. Using 42 S.W.G. S.S.C., wind similar number of turns for both primary and secondary in the same groove. Fifty-five will be required for the smaller, and 100 for the larger. The bobbin can be fastened to the legs at the base of an old valve, or screw-valve legs can be obtained from most dealers. The ebonite can be drilled and tapped, and these screwed in. A ·0002 mfd. variable condenser will be required across the primary.

* * *

" Buz-Buz " (St. Albans).—How is a buzzer connected to a crystal set for testing purposes ?

Merely by induction. The buzzer circuit preferably, with a small low resistance coil inserted between the battery and buzzer is brought into close proximity to the inductance, and the crystal adjusted to obtain the loudest induced signals that result. A point always to remember in connection with the adjustment of a crystal is that it should be adjusted to weak signals, therefore the buzzer circuit should be placed just as far away as will reduce the strength of the signal so that it is barely audible.

* * *

" Freak " (Oldham) asks various questions as to the efficiency of a six-valve set, employing four stages of low-frequency amplification, that he has designed, and asks whether it would be practicable to add one further stage of amplification, also low frequency.

(Continued on page 232.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 230.*)

It would not be wise to do so. As a matter of fact, three stages would be the limit. Due to microphonic effects with more than three a set is liable to be very "noisy," with a great tendency to "howl" or oscillate at audible frequency. Parasitic noises such as are caused by the proximity of power mains or telephone wires, "atmospherics," etc., are generally of low frequency, and for this reason also undue low frequency amplification should be avoided.

* * *

J. H. (Birmingham).—For what useful reason is a potentiometer control included in the circuit of my four valve set with two stages of high-frequency amplification? I do not use it, and it seems to make little or no difference whether I do or not.

You have not required to use the potentiometer evidently because you have not experienced any trouble due to regenerative action taking place between the two tuned circuits. When both the grid and plate circuits are tuned to approximately the same wave-length self-oscillation usually occurs, and it is then that potentiometer control operating on the grid of the high-frequency valve is useful.

* * *

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

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

* * *

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

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

Is any earth necessary with such an aerial?

Yes; an earth must be arranged.

* * *

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

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

Is a receiving valve gas filled?

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

QUESTIONS ANSWERED FREE BY POST.

The technical staff of "Popular Wireless" is at your service to deal with any of those tricky little problems that crop up. Perhaps you are not quite sure what size to wind a coil, exactly how to erect your aerial, what type of set you will require to hear a certain station, etc. Then drop a line to the Queries Department of "Popular Wireless," and your problems will receive immediate and expert attention.

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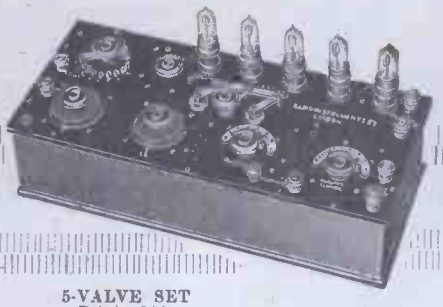

5-VALVE SET
Price: £40
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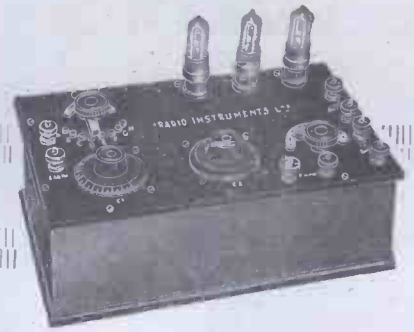

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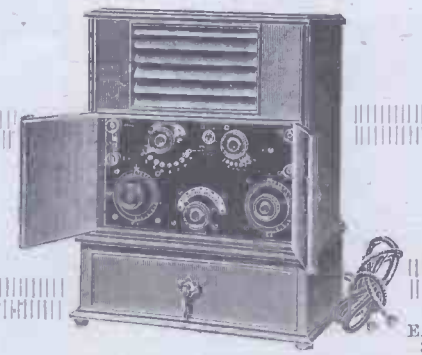

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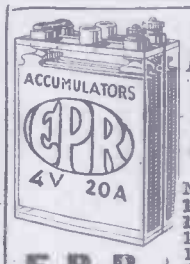

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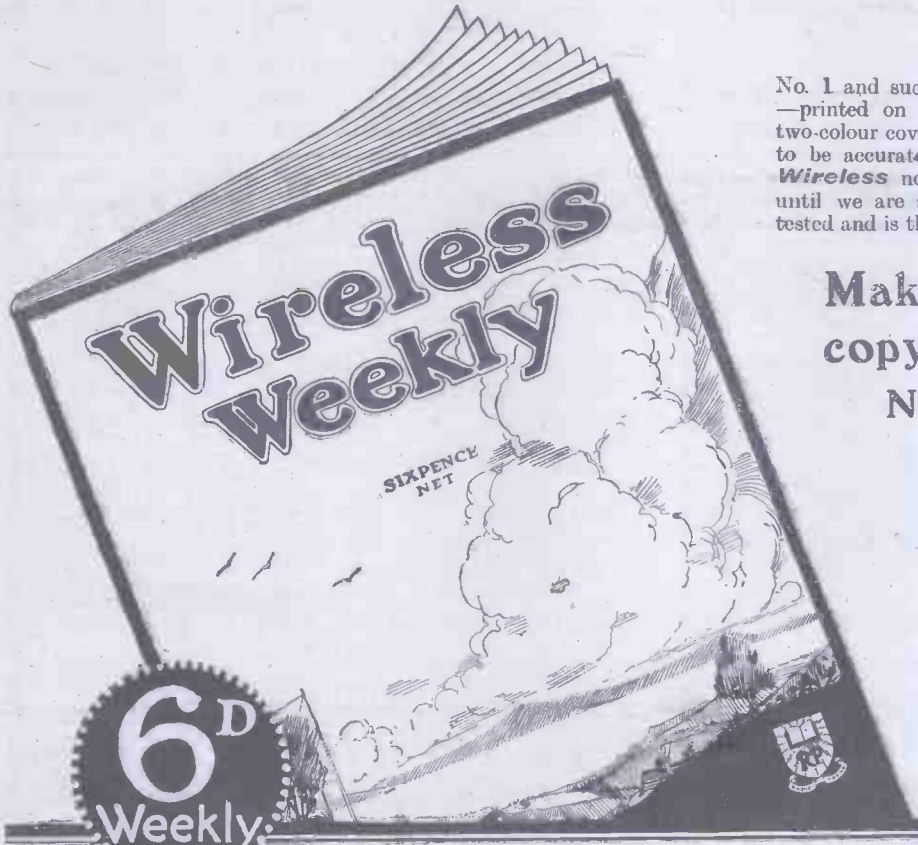
THE immediate success of ***Modern Wireless*** and the consequent perfecting of our organisation has enabled us to proceed with the publishing of a companion Journal to be issued weekly from April 11th, and to be called ***Wireless Weekly.***

At this early date, it is not possible for us to give a complete list of the Contents of No. 1, but a number of new features—some of which have never appeared in any other Wireless Journals—are being arranged. The Editorial side of this Magazine is in the hands of John Scott-Taggart, F.Inst.P., assisted by E. Redpath, Alan M. Douglas and G. P. Kendall, B.Sc.—all well-known in the Radio field.



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