Wednesday Vol. 1. No. 1. April 11th, 1923

Wireless Weekly

SIXPENCE NET

Edited by
John Scott-Taggart F. Inst. P.

Wireless Weekly

Vol. 1. No. 1.
April 11, 1923

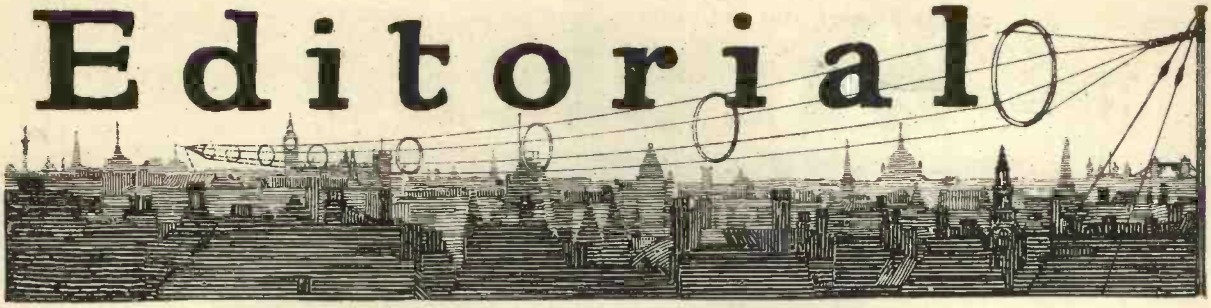
CONTENTS

Radio Press, Ltd.
Publishers of Authoritative Wireless Literature.
DEVEREUX COURT, STRAND, W.C.2.

All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

Nothing contained herein is to be regarded as permission or encouragement to infringe any patent rights.

Editorial



The Licence Problem

AT the moment of going to Press, the most acute problem which is facing all those interested in wireless, is that relating to the licence question. Everyone is agreed that the present state of affairs is impossible, and the Chairman of the British Broadcasting Company has gone so far as to state that there are four or five times as many listeners-in as licencees. We can well believe it, but whose fault is it? It is all very well to condemn illicit listening-in, but it is one of the fundamental axioms of law-making that no law should be passed which will result in wholesale evasion and cause more discontent and crime than the benefits resulting from the passage of the law.

There can surely be no one who is at all in close touch with the general feeling amongst the tens and evens hundreds of thousands of would-be experimenters who can blame the average man who listens-in without a licence. These illicit listeners-in must be brought into the fold of law-abiding citizens and the present regulations absolutely force perfectly honest and fair-minded men to contravene the regulations.

It must be laid down as a very definite principle that every British citizen should be entitled to make and experiment with his own wireless apparatus. If regulations are laid down to prevent a man doing this, those regulations will be disobeyed. It is no use complaining about those wicked people who make their own sets, or even about wicked publishers who tell them how to do so. The instinct is there, and will always be there, and the sooner that the would-be experimenter is given the freedom he desires, the better.

We believe that by the establishment of a third Constructor's licence, everyone will be

Ourselves

IN following our monthly journal *Modern Wireless* by a Weekly, we are prompted by a desire to supply the wireless public with a high-class journal which, at the same time, will be essentially topical. A monthly periodical of substantial size has many advantages and serves as a valuable work of reference, but it is not possible to supply the topical news and information which is made available by the publication of *Wireless Weekly*. The same high standards are being observed and the necessary additional staff has been engaged.

A list of the principal members of the Radio Press Editorial Staff is given on the opposite page, and readers will see that we have done all that is possible to ensure that both *Wireless Weekly* and *Modern Wireless* are irreproachable from the technical standpoint. We are wireless publishers only, and the great success of *Modern Wireless* and our Handbooks enables us to appoint a technical staff which we believe is unequalled in this country.

Sooner or later every reader, including even the beginners, will realise the desirability of having at his disposal wireless literature of a highly authoritative character. By "authoritative" we do not mean dull and stodgy, but accurate, useful and intelligible. Our aim is not to give occasional star articles by well-known figures in the world of wireless, but to overhaul every sentence which enters into our publications.

No one has yet cast the least reflection on the impartiality of Radio Press, and no one ever will. We decline to be bound to any society or organisation, but we aim at being the unofficial organ of everyone.

We now leave you to read through these pages. Their standard will be kept up, and even improved if you will support us and our advertisers. To those who may think that sixpence a week is a great deal (and we knew several weeks ago that at this date we would be alone amongst the weeklies) we respectfully suggest that good value is being given, and we trust that if any sacrifice is to be made our publication will be considered worthy of preference.

Every article will be scrutinised by a highly technical staff, and we intend to make *Wireless Weekly* a bright, interesting and accurate source of information and news.

We now leave the matter to your judgment.

THE PUBLISHERS.

happier in the end. The Broadcasting Company will get a regular annual and unfailing source of income; the manufacturer will get a permanent market for his component parts and materials; the experimental instinct will be fostered, and Science itself will be bound to benefit.

In the present negotiations, the Radio Society of Great Britain has taken a very active and commendable part, and the highest credit is due to its new President, Dr. W. H. Eccles, F.R.S., who has done admirable work in placing the home constructors' point of view before the authorities.

The Broadcasting Company, the manufacturers and the representatives of the experimenters have agreed to the third licence. Let us hope that it will be issued forthwith.

Let us also hope that those who wish to do away with the B.B.C. and whose tactics appear to be purely obstructionist will receive the measure of attention that they deserve. Minor objections should not be raised at this stage. Let us have this new licence, and then any other questions which may arise can be decided. Meanwhile, let us hope that the Post Office will expedite a decision on a point which has aroused the most heated feeling throughout the country.

The B.B.C. and Other Manufacturers

We have received from one of the associations of manufacturers a letter in which they have much to say regarding the system of B.B.C. stamping of instruments. They believe that the British Broadcasting Company ought to obtain their revenue in other ways than by imposing a royalty on apparatus. They, moreover, have much to say regarding the regulations governing the entrance of manufacturers and dealers into an agreement with the British Broadcasting Company.

We propose to publish the letter we have received in an early issue, as it is our intention to make the columns of this journal open to all and sundry to air their views.

At the same time, we cannot help but feel that to raise trouble at this stage with regard to the organisation of the B.B.C. will only adversely affect the experimenter.

We feel that it will be drawing a red herring across the path, if this association of manufacturers persists in presenting their views at a time when the new third kind of licence is being discussed.

If they have any complaints to make regarding the British Broadcasting Company, let us ask them to wait until this licence question is settled and it is not unlikely that most of their difficulties will disappear.

The British Broadcasting Company has as its prime object the financing of its concerts, and we feel that it is most unreasonable to ask them to dispense with a method of obtaining revenue which has been already sanctioned and which has been carefully considered by all concerned.

We ourselves believe that the British Broadcasting Company, if all goes well with the licence revenue, will quite possibly dispense with the royalty on apparatus. We hold no brief for the B.B.C., but we do feel that their difficulties at the present time are very great and that no new difficulties should at this stage be raised. Let us deal with one matter first and then tackle any further problems that arise.

We do not attach very much importance to the oft-repeated threat of the British Broadcasting Company that there is a danger of broadcasting ceasing altogether. We do, however, feel that they should receive the fullest support of all at this juncture. They are passing through a very difficult time and are naturally reluctant to dispense with existing methods of obtaining revenue until they have satisfied themselves that new methods will prove satisfactory.

THE NEWARK BROADCASTING STATION "WJZ"

A description of the American Station which is at present arousing much interest amongst experimenters in this country.

FOR some months past radio experimenters within a few hundred miles of New York have been receiving nightly concerts, news reports, lectures and other special features from "WJZ," the radio telephone station of the Westinghouse Electric and Manufacturing Co. at Newark, New Jersey. In fact, the waves from this station have travelled to far greater distances, and letters expressing appreciation of the programmes have been received from points as far away as Florida, Canada, Wisconsin, and even the British Isles. Never before has a radio telephone station sent out broadcast, on a regular schedule day after day, so complete and satisfactory a musical and news service; as a result of this, literally thousands of new receivers are being put into operation every week, and a tremendous interest in radio telephony has been aroused.

Fig. 1.—The Aerial System at "WJZ."

The Newark station is located upon the roof of the Westinghouse factory building at Plane and Orange streets, near the Lackawanna railway station in Newark, New Jersey, U.S.A.

The antenna and counterpoise are supported between two steel masts 125ft. high with a span of 150ft. The aerial consists of six wires equally spaced on 20ft. spreaders; the counterpoise is identical in construction and is supported 12ft. above the roof. Thus the effective separation of the two sections forming the radiating system is about 113ft. Six-wire cage down-leads run from both parts of the aerial to the radio station in a special building on the roof, and are connected through double-pole earthing switches. The general arrangement of the aerial-counterpoise system is shown in Fig. 1. The natural wavelength of the antenna-counterpoise system is not far from 500 metres, so that for transmission on 360 metres (the normal operating wavelength for broadcasting) series condensers of 0.0005 μF are inserted in each connection.

The radio telephone transmitter is shown in the photograph, Fig. 2. Four 250-watt three - electrode vacuum tubes are used as oscillators, and five somewhat similar but specially designed high-impedance tubes are used to modulate the radio frequency current generated by the other four.

The antenna, counterpoise, grid and plate leads are all connected in the coupled oscillation circuit to the flat spiral inductance illustrated on top of the radio set. This coil has 21 turns of $\frac{1}{32}$in. × $\frac{1}{2}$in. flat copper strip mounted on "micarta" spokes, and is earthed at the minimum potential point nearly midway between antenna and counterpoise.

The oscillator and modulator tubes run on 2,000 volts direct current, which is produced by rectifying the high-tension alternating supply current through six two-electrode vacuum tubes, shown on the left of Fig. 2. The filaments of these six tubes are lighted by alternating current at 10 volts, which is drawn from a transformer of small capacity having a centre tap.

Special filter circuits are provided to suppress the A.C. ripple, with the result that outgoing speech and music is heard with very little extraneous noise from the generator. In this circuit, again, it has been found necessary to provide an earthed filter arrangement to eliminate the frequency note of the 60-cycle alternating current used.

The three modulator tubes are connected on the choke control plan and are supplied with voice-frequency current from a speech amplifier containing two 50-watt three-electrode valves. An ingenious arrangement compensates for the inherent distortion which is so often found when valve transmitters are operated at full power for radio telephony, and the clarity of the speech and music sent out from WJZ is limited only by the characteristics of the standard long-distance wire line microphones used to pick up the sound waves and transfer them in electrical form to the speech amplifier.

Since the antenna is normally operated at a wavelength (360 metres) on which it shows comparatively high radiation resistance, the effective antenna current is only 5.5 amperes. At a total antenna resistance of 16 ohms this represents an aerial circuit power of nearly 500 watts, a large percentage of which is actually radiated. On 600 metres wavelength

Fig. 2.—The Transmitting Apparatus.

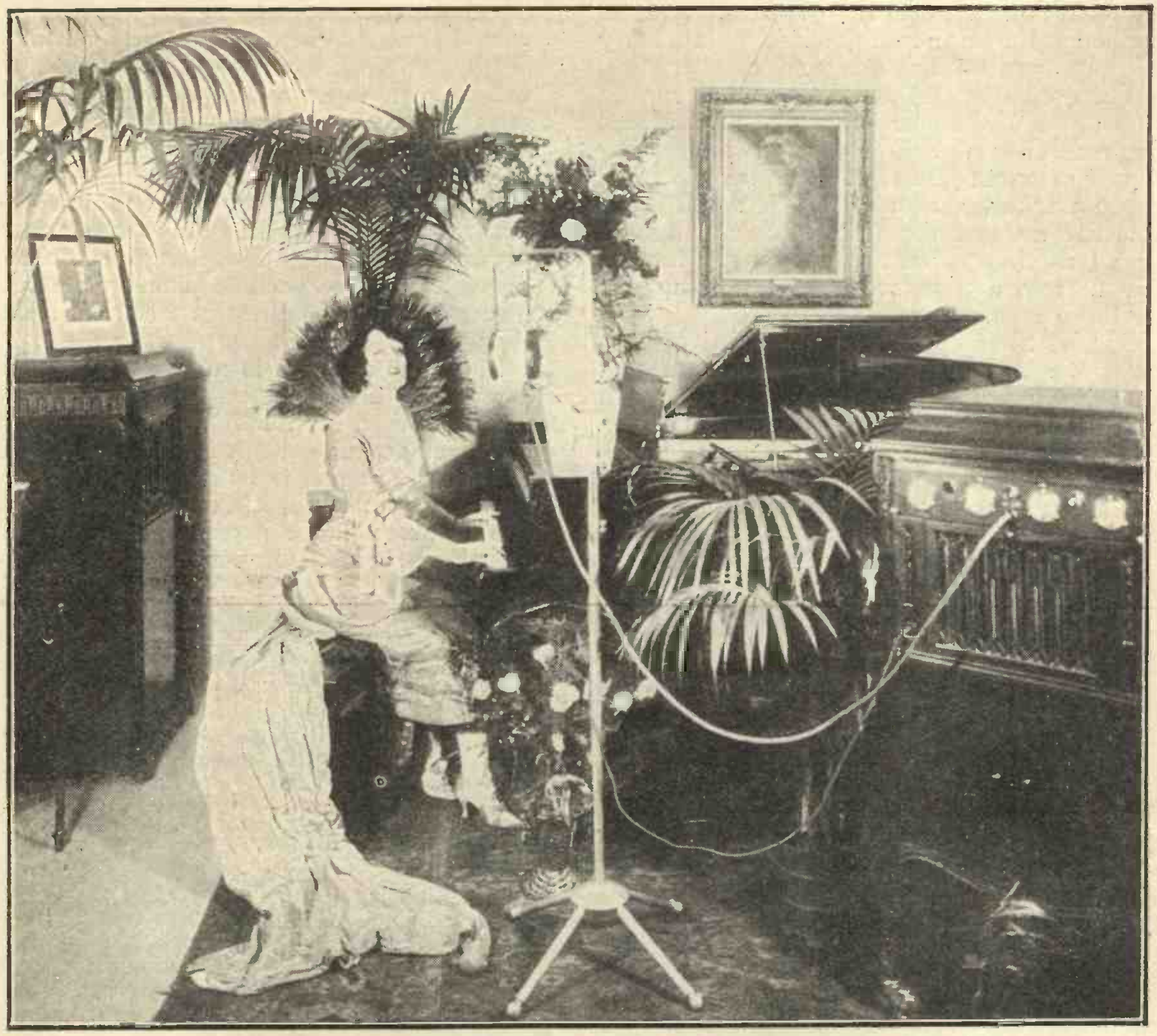


Fig. 3.—The Studio, with broadcasting in progress. Speech Amplifier on the right.

the antenna resistance drops to a point which permits an aerial current of 12 amperes. The output power is quite fully modulated.

Not the least interesting feature of the station lies in the completeness with which its details have been worked out. The complete radio transmitter is enclosed in metal and glass screens, and a blower is provided to keep the valve temperature at the best operating value. A switchboard is mounted on the right-hand side of the transmitter, so that the set may be connected at will to the station microphone for the announcements, etc.; to a gramophone used for reproductions; or to the studio which has been built on the first floor of the factory building for concert work. A completely interlocked light-signal and switch system has been arranged for control of the set from the studio, where special microphones for transmission of vocal, pianoforte and other instrumental music are installed.

The photograph, Fig. 3, shows the studio during transmission, the speech amplifier being visible on the right. The radio station is also equipped with a standard Westinghouse medium wave receiver, with a wavelength range of 150 to 2,300 metres. After the nightly musical programme, which lasts from 8.30 to 9.15 p.m., the 9.55-10.0 time signals from Arlington are received on this outfit, using a long single-wire antenna, and transferred electrically to the radio telephone transmitter. Thus the time-signals themselves, with the characteristic spark tone of Arlington "NAA," are re-transmitted on

360 wavelength for the benefit of listeners having short-wave receivers.

Obviously there is no appreciable time lag in this re-transmission, and consequently accurate Naval Observatory time is made available on the amateur wavelength. At 10.03 each evening a weather forecast is sent out by radio telephone.

The Westinghouse Company also maintains complete radio telephone broadcasting plants at its East Pittsburgh, Penn., and East Springfield, Mass., factories. These stations operate on schedules similar to that of Newark; new stations are being installed to serve other sections of the country, and one at Chicago has just been opened. The service is being extended in point of time and character also, so that before long the owner of the small radio receiver will be able to enjoy in his own home, anywhere in the United States, a complete programme of concerts, news and weather reports, market reports, church services, and selections direct from the stages of the theatres. The broadcasting of public speeches and debates might also be instituted.

A SPECIMEN "DAILY PROGRAMME."

10.00–10.15.	Résumé of the news of the day; musical selections.
10.55–11.00.	Weather forecast for New York and New Jersey.
11.00–11.15.	Musical programme.
12.00–12.15.	Résumé of the news of the day; musical selections.
1.00– 1.15.	Résumé of the news of the day; musical selections.
2.00– 2.05.	Musical programme.
2.05– 2.10.	Marine news.
2.10– 2.20.	Musical programme.
3.00– 3.15.	Résumé of the news of the day; musical selections.
3.55– 4.00.	Weather forecast for New York and New Jersey.
4.00– 4.15.	Musical programme.
5.00– 5.15.	Résumé of the news of the day; musical selections.
6.00– 6.15.	Résumé of the news of the day; musical selections.
7.00– 7.45.	Miscellaneous programme.
7.45– 7.50.	Broadcasting of suppliers of receiving equipment.
7.55– 8.00.	Tuning for regular evening programme.
8.05– 9.15.	General news; résumé of football games; music and artists.
9.55–10.00.	Arlington time.
10.03–10.06.	Weather forecast for New York and New Jersey.
10.06–10.07.	WJZ. Good-night.

The Licence Question

THE first genuine would-be experimenter whose application for an experimental licence has been unsuccessful, and who is prosecuted under the Wireless Telegraphy Act (1904) for carrying out genuine experiments, is requested to communicate immediately with this Journal.

A GOOD AERIAL

By E. REDPATH, Assistant Editor.

A Practical and Detailed Description of the Construction and Erection of an Efficient Aerial.

WITH the particular object of assisting readers who have not already erected their receiving aerials, or who are for any reason not satisfied with their present aerial equipment, the writer will, in this present article, give full constructional particulars of his own newly erected aerial, which, since it enables weak but clear telephony to be received over a distance of some 200 miles employing only a crystal receiving set, may be considered efficient.

The crystal receiving set referred to is that described by the writer in an article entitled "A Compact Broadcast Receiving Set" which appeared in No. 2 of *Modern Wireless*.

As will be seen from the sketch of the complete aerial (Fig. 1), the writer is fortunate in having good garden space available. This is not so much an advantage for the actual situation or length of the aerial as for the convenience of being able to join up the mast sections, attach all necessary fittings, make and fix in position the wooden base structure, and erect the mast complete in one length.

The first step, of course, is to measure up the ground and determine the exact spot where the mast is to stand. When this is done, and before any digging work is undertaken, two light pieces of wood, say ½in. or

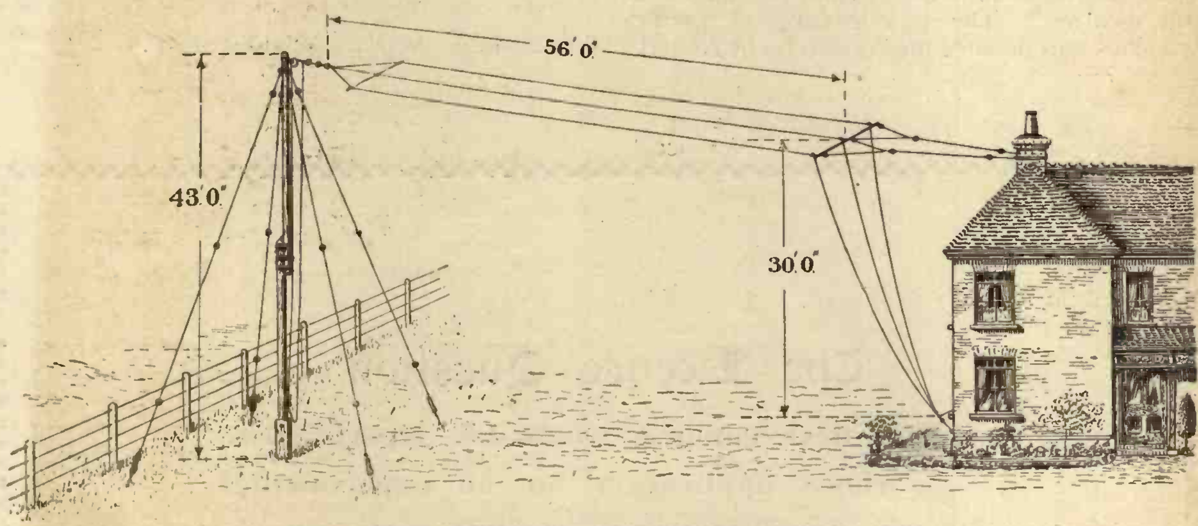


Fig. 1.—The aerial completed and ready for use.

The general dimensions of the completed aerial are as follows:—Height of mast above ground, 43ft.; approximate height of chimney on house, 30ft.; length of main aerial span, 56ft.; length of down-lead, 30ft. (approx.); number of wires employed, 3; length of bamboo spreaders, 9ft.; wire employed for aerial and down-lead, 7/22's stranded enamelled copper wire.

The complete arrangement and appearance of the equipment is shown in Fig. 1, and, with the assistance of a few capable helpers, the whole of the work was carried to completion in about seven hours.

¾in. square by 2ft. long, should be fastened together at right angles to one another and laid upon the ground with the four arms horizontal and pointing towards the four most convenient points where the anchors for the mast stays can be situated. The distance of each ground anchor from the base of the mast should be at least 16ft. If this can be increased say to 20ft., so much the better.

Take a length of string or fine cord and, having attached one end by means of a tack or drawing pin to the centre of the wooden cross, extend the string to the determined distance, taking care to keep it in line with the arm of the cross, and insert a peg in the ground to indicate the position of that particular ground anchor. Repeat the performance and obtain the positions for the three remaining ground anchors.

At a distance of 1ft. behind the marking-peg dig a hole 2ft. 6in. long by the width of your spade and at least 2ft. deep, taking care not to disturb that side of the hole towards the mast. For each ground anchor there will be required a stout piece of creosoted wood, angle iron or stout iron piping. If timber is to be used, a piece 2ft. 6in. long by 3in. or 4in. by 2in. will be satisfactory.

A 12ft. length of stout galvanised iron wire (say 7-20's) will also be required, and this is to be wrapped twice round the centre of the timber or piping and twisted together to form one double strand as shown in Fig. 2. The timber with wire attached is then to be laid in the bottom of the hole and the wire itself brought through a narrow slot cut in the soil with the edge of the spade. The hole should then be filled with earth and "tamped" down well.

The shape of the hole and method of bringing the galvanised wire through a slot in the side of it will be understood on reference to Fig. 3.

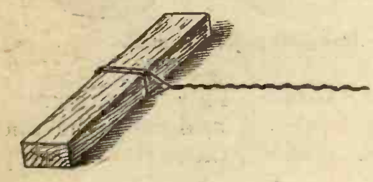


Fig. 2.—Timber with galvanised iron anchor-wire attached.

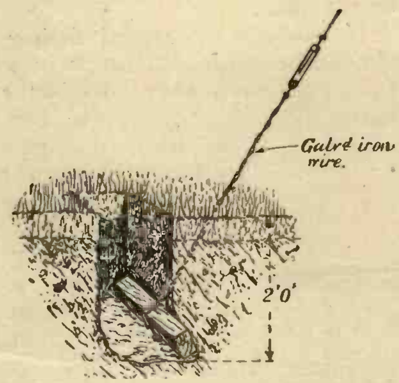


Fig. 3.—The ground anchor in position.

The next item to receive attention, or which, provided helpers are available, may have been receiving attention, during the digging and fixing of the anchors, is the actual construction of the mast and base structure. For the base structure itself there will be required the following timber:—Two pieces 4½in. by 2½in. each 7ft. long; two pieces 5in. by 3in., each 2ft. long; two pieces 4in. by 2in., each 6ft. long; and about 16 or 18ft. of timber 2½in. by 2in., together with a supply of 6in. and 4in. round wire nails.

The base structure should now be built up complete, as shown in Fig. 4, which, as all the particulars are given, requires no further explanation. When completed, the structure should be set up exactly where the mast is to

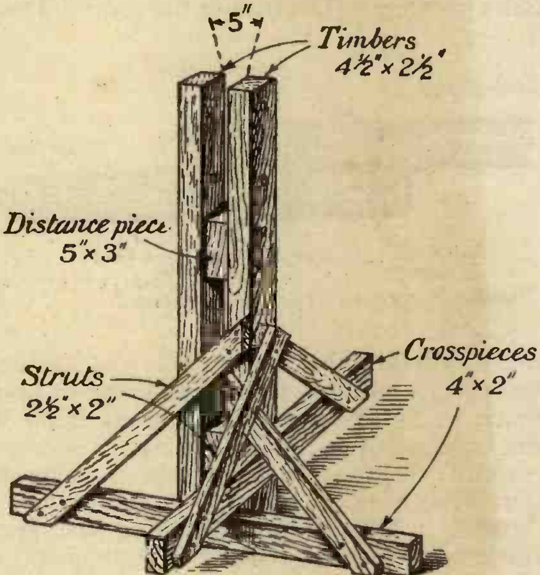


Fig. 4.—Details of the base structure.

stand, with the opening between the two uprights facing the direction in which the mast will lie upon the ground before erection. With the edge of a spade mark out upon the ground the area covered by the horizontal timbers at the foot of the structure, and, having removed the structure itself, excavate the hole in the shape of a cross to a depth of 4ft. There is no necessity for the hole to be any wider than affords comfortable working with the spade available.

The whole of the wooden base structure should receive two or three good coats of creosote or solignum. If a coat is applied at this stage it will have time to soak thoroughly into the wood whilst digging operations are proceeding.

The actual height of the finished mast will depend, of course, upon the size of pole available. In the case of the actual mast now being described, it was decided to employ two poles each 22ft. in length. These poles were suitably chosen from the stock at the wood-yard, so that one was considerably heavier than the other, the heavier one measuring 5in. in diameter at the base or "butt" and 3½in. at the top, and the lighter one measuring 3⅝in. at the butt and about 2in. at the top.

The upper part of the lower pole and the butt of the upper one were next slightly flattened on one side, placed carefully in alignment, one on top of the other, drilled and tightly fastened together by means of two ⅜in. bolts passing right through the centre of each

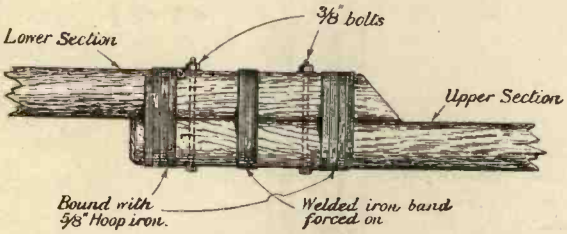


Fig. 5.—The joint in the mast.

mast. Before the upper bolt was secured, however, a wrought iron welded ring or hoop, made so as to be a very tight fit upon the masts, was slipped along the upper mast and carefully hammered down into position between the two bolt holes.

With a view to strengthening the joints further, the two lengths of ⅝in. wide hoop iron were wrapped tightly round the two masts, above and below the securing bolts. In doing this the end of the hoop iron was firstly nailed to one of the masts, and as each turn was laid in position it was hammered so that it took the exact shape of the mast, and was secured at each half turn by means of a ¾in. "clout nail." The complete joint is clearly shown in Fig. 5.

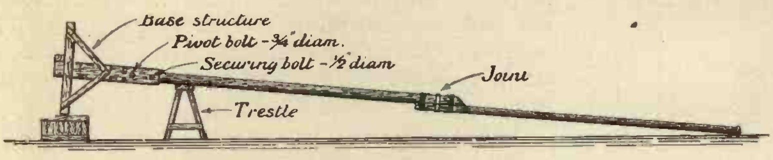


Fig. 6.—Fitting the base structure to the butt of the mast.

The next proceeding was to lift the butt of the complete mast on to a trestle, in which position the wooden base structure was fitted into place and the necessary bolt hole bored through the upright of the base structure and the butt of the mast. It was found necessary to shave off about ¼in. of wood at each side of the butt of the mast to enable it to fit into the space between the uprights, and, before the base structure was removed, the lower or pivot bolt was temporarily fitted and the base structure rotated upon it.

This demonstrated the necessity for rounding off the butt of the mast, which otherwise could not have been erected in the manner intended. The work at this stage is illustrated in Fig. 6.

Having applied a final coat of preservative to the timber, the base structure is now to be lowered into the hole, and, taking great care to keep the uprights perpendicular, the earth is to be shovelled back into the hole and thoroughly tamped down. In this connection it is perhaps a good plan to pour in three or four bucketfuls of water after some 18in. or so of the soil has been shovelled in. This ensures that all irregular spaces become filled in, and the subsequent settling of the ground is considerably reduced.

According to the original plan drawn out by the writer, the mast was to have two sets of stay ropes, one set of four wires from the top of the mast and a second set from a point

Fig. 7.—Iron fittings for the mast.

just above the joint. This arrangement was abandoned, however, and only the one set of stays fitted, namely, those from the top of the mast.

If possible a special fitting for the mast should be made, as shown in Fig. 7 (*a*), but, failing this, a very satisfactory job can be made by using 1in. by ⅛in. bar iron bent into the form of clips and bolted together as shown in Fig. 7 (*b*). A piece of this same material can be used for the pulley fitting, also shown in Fig. 7 (*b*).

With a view to securing the maximum efficiency in the complete aerial system it was decided to insert insulators into each of the stay wires. Insulators employed for this purpose should be of such a type that, in the event of the insulator itself breaking, the loops in the wire interlock and continue to hold the mast in position. The first insulator is to be placed about 3ft. from the mast fitting; the second insulator about 16ft. below, and the third a further 16ft. lower. The actual length of the stay wire will be determined, of course, by the height of the mast and the "spread" of the ground anchors.

All the stays are to be secured to the mast whilst the latter is upon the ground, not forgetting to attach a sufficient length of wire to the lowest insulator of each stay to reach the anchor wire when the mast is subsequently erected. A suitable "stretching-screw" is to be inserted between each anchor wire and stay wire to permit of a final adjustment of the tension upon the stay.

Whilst the mast is still upon the ground the aerial pulley and halyard should also be attached. For the halyard the writer used galvanised iron wire similar to that used for the stay, the object in so doing being to avoid the necessity for constant slackening and tightening which has to be done when rope is employed. The halyard should preferably be in the form of an endless rope, having either an iron ring or a "thimble" spliced into it to which the first aerial insulator can be attached. When all these fittings are in position the mast is to be carried bodily, placed between the two uprights of the base structure, and the lower or pivot bolt passed through the uprights and the mast. The trestle previously used under the back of the mast may now be placed beneath the mast at the joint.

Erecting the Mast

The following additional items will be required for use in the actual erection of the mast:—A block and tackle, 30 or 40ft. of bronze flexible steel wire rope or hemp rope; a strong ladder about 10 or 12ft. in length, and a further reliable anchorage in line with and about 16 to 20ft. distant from the base of the mast. For the last-named, the writer made use of one of the main uprights of a fence, lashing one end of the lifting tackle to the lowest point of the upright. The long length of wire or rope should now be attached to the mast just above the joint (in which position it cannot possibly slip down the mast), and led back over the ladder, held in a vertical position, to the free end of the lifting tackle.

Everything is now ready for the actual erection, and the position of affairs will be understood on reference to Fig. 8. It is now only necessary to pull steadily upon the rope of the lifting tackle to rear the mast slowly into a vertical position, when the second securing bolt can be passed through the uprights and mast, thus making everything secure. Great care must be exercised when the mast is *almost* in a vertical position, as a careless pull upon the tackle rope may possibly bring the mast down with a rush upon the wrong side. One of the assistants should stand by to remove the ladder, which, when the mast is sufficiently high, will be released from the pressure of the lifting rope.

It may also be considered desirable to have helpers at the stay ropes, but in the writer's case this did not prove necessary. Should there be no convenient fence to which the lifting tackle may be secured, it will be necessary to dig a hole and provide a ground anchor similar to those already provided for the mast stays. With the mast in its final position and both securing bolts inserted, it remains only to screw up the nuts of the securing bolts, placing large washers beneath them so that the nuts do not bite into the wood, and fix up the mast stays to the anchor wires, inserting suitable "stretching screws"

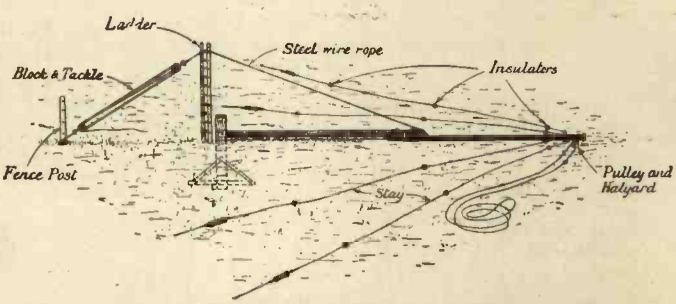


Fig. 8.—Showing the mast with stays fitted, and lifting tackle all ready for erection.

as already mentioned. The complete mast is shown in Fig. 1.

The Chimney Fitting

Having, with the assistance of a suitable ladder and "roof-board," or "cat-ladder," mounted upon the roof and carefully measured the chimney stack, take a length of 1in. by ⅛in. hoop iron and bend into the shape shown in Fig. 9, in which the dimension (*a*) corresponds to the width of the chimney stack and the dimension (*b*) to its length. If there is any difficulty in obtaining the length of ⅜in. round iron, screwed and fitted with nuts as shown in Fig. 9, it may be dispensed with and galvanised iron wire, as used for the aerial stays, substituted.

The aerial spreader at the down-lead end will require to be supported at a suitable distance from the chimney stack, so that the down-leads are well clear of the gutter and wall of the house. Having estimated just what this distance will be in any particular case, construct on the ground the arrangement shown in Fig. 10, consisting of a stout bamboo or light wooden spreader 9ft. in length and provided with insulators at the ends, and at the centre for a three-wire aerial.

Next measure out upon the ground the total length of aerial which can be erected, and attach another 9ft. spreader at the mast end. The arrangement at this end differs from that of the house end, and is illustrated in Fig. 11. It will thus be seen that the complete aerial is first built up on the ground, but, to allow of subsequent adjustment if found necessary, the attachment of the aerial wires to the three insulators upon the spreaders at the house end should in the meantime be of a temporary nature.

Temporarily remove the aerial wires from the spreader and fix the complete arrangement shown in Fig. 10 to the chimney. The spreader will then lie in the gutter at the edge of the roof, and is easily accessible by means of a ladder to re-attach the aerial wires.

The completed aerial should now be hoisted into position and observed carefully to see that everything appears in order. Provided the measurements upon the ground were carefully done, the aerial wires should all take an equal strain. The aerial should now be lowered whilst the wires are securely attached to the insulators on the spreader at the house end. The method adopted here is illustrated in Fig. 12.

Whilst the ladder is still in position the three down-leads should be straightened as much as possible, and, having been cut to the desired length, should be twisted together for a few inches, carefully cleaned and securely soldered either to the insulated leading-in wire or to a clip or "tag" which can be attached to the leading-in fitting. The completed aerial is shown in Fig. 1.

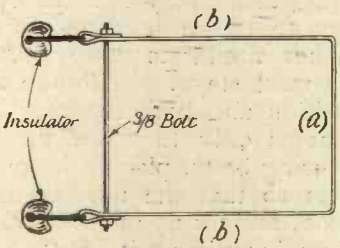


Fig. 9.—Iron chimney-band with insulators attached.

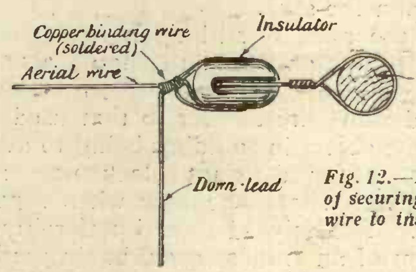


Fig. 12.—Method of securing aerial wire to insulator.

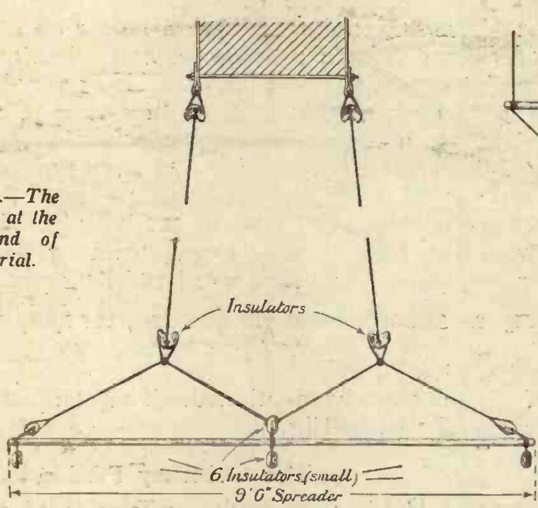


Fig. 10.—The spreader at the house end of the aerial.

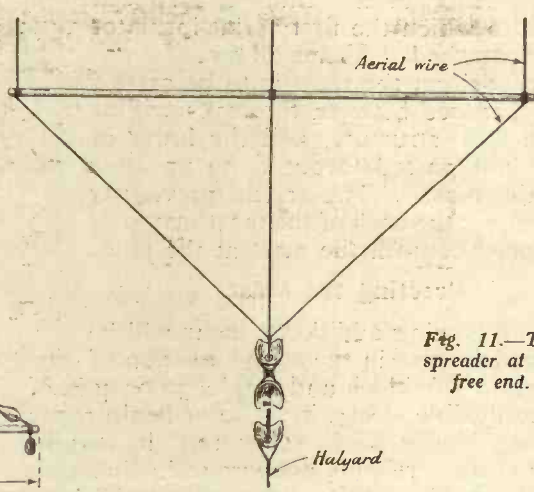
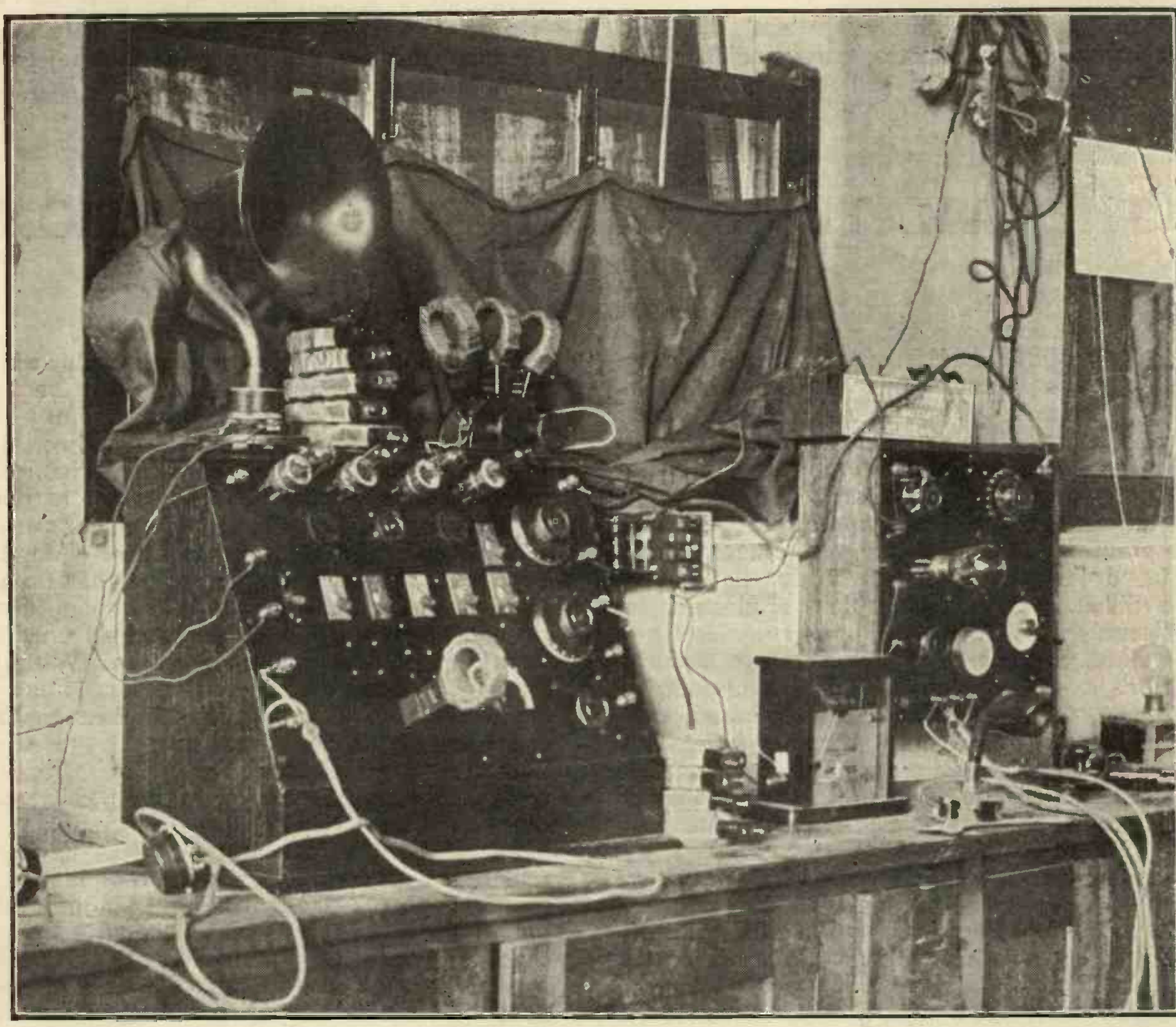


Fig. 11.—The spreader at the free end.

"2 OF"

Wireless in schools is at present engaging a deal of attention. This photograph and description shows what can be done in this direction.



THE above photograph shows the wireless installation at the Lowestoft Secondary School, owned by the Physics Master. The set comprises a four-valve receiver and a C.W. and telephony transmitter, the former being shown on the left and the latter on the right.

A wireless receiving set was first installed at the school in March, 1921, but consisted then of only a crystal set, which was very soon superseded by a single-valve set, on which in May of the same year the "Dutch concerts" were clearly audible. Both sets have been constructed by the owner, with some assistance from a few of the scholars, mostly out of the components of a Mark III. receiver, and other ex-Army material.

The receiving set has one high-frequency valve employing the tuned anode method of coupling, a detector and two low-frequency valves. By means of the change-over switches shown on the front of the panel any number of valves from one to four can be used, a two- or three-coil circuit can be employed, and the aerial condenser can be put either in parallel or series with the aerial coil. Head 'phones or a loud-speaker may be switched in as required. The change-over switch, shown between the two sets, enables a quick change to be made from sending to receiving, as it automatically switches on the aerial, filament current, and high-tension current to either set as required, while an intermediate position serves to earth the aerial.

By using all four valves and the loudspeaker, the broadcasting can be received well enough for from 30 to 40 boys to hear at once. The morning weather forecasts issued by the Air Ministry are received regularly, and are posted in the school and in an adjoining public park.

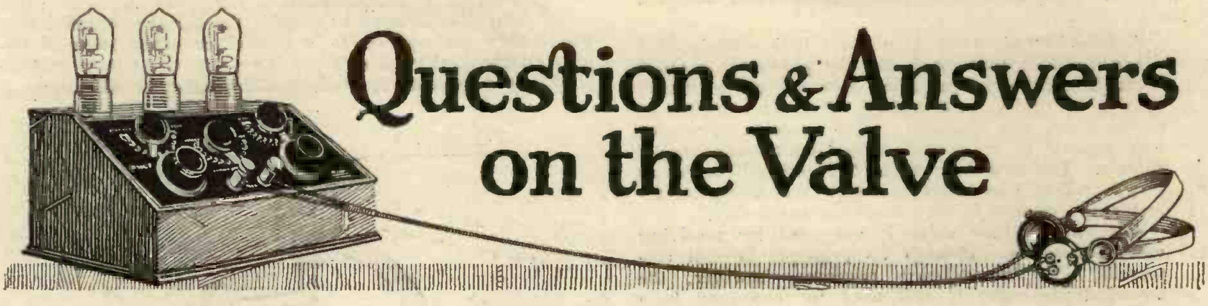
Unfortunately, being right on the coast, considerable jamming from ships is experienced, especially from those working on 300 or 450 metres, and it is quite likely that the next move will be to try the Hinton rejector circuits, as explained in *Modern Wireless*, No. 2.

THE AMATEUR WIRELESS ASSOCIATION

By GEORGE SUTTON.

What it is; how to join it; and what it does for the experimenter.

MEMBERSHIP of an Amateur Wireless Association is becoming increasingly necessary to every person who has to do with wireless reception, either as an admitted listener in or as a more or less genuine experimenter. Had the Associations kept pace with the increase in number of receivers, the present somewhat confused licensing position might have been avoided. It is a pity that applicants for licences often invert the proper mode of procedure, and perhaps the amateur associations in the past have been in a measure to blame. It used to be a rule in some societies that no one could become a member unless he possessed a receiving licence. This rule, it is hoped, has now been abolished. The most convenient course for an intending applicant for a licence is to approach the secretary of a wireless society first and take the advice which that worthy gentleman will be only too ready to give. This will undoubtedly save the harassed officials of the General Post Office a lot of work involved in the scrutiny of badly filled-in blue forms which they have no option but to turn down. A multi-valve receiving set is as difficult to operate properly as the fiddle; yet no one having arrived at years of discretion would think of buying a fiddle, and after being told a few things about it at the music dealer's shop, go home thinking that he could master it without further instruction. The Amateur Wireless Association invites aspirants to allow them to advise on the purchase of the instrument, and, if desired, will help with instructions regarding the "tuning in" and other necessary points. No one who really desires to experiment need despair of obtaining an experimental licence, and it is thought that very few people who take up wireless will be content to turn knobs on the outside of closed boxes. Many a smart mechanic has "found himself" owing to the breakdown of some simple mechanical contrivance which he has had to try to put right himself. If you have no amateur wireless organisation in your town or village, endeavour to start one. The writer had occasion to spend a few weeks this spring in a provincial town in which perhaps six people were interested in wireless reception. Within a month a strong association was formed, and a list of forty names of club applicants for experimental licences was sent in to the Secretary of the General Post Office. These applicants were all vouched for by the Secretary and Committee of the Association as being of British nationality, and as having undertaken to carry out a scheme of instruction and construction which had been mapped out. There was no licence difficulty other than that imposed by the fact that the General Post Office staff was inundated with applications. The Secretary of the Association in question, however, made matters so straightforward that the applicants had very little trouble indeed, and obtained their licences with remarkable promptitude. It is no time to endeavour to apportion any blame for the present confusion. All who are interested must work together to get the tangled skein unravelled. Without in any way taking up the duties of police officers, the members of an Association can combine to keep the ether clear of interference in the neighbourhood of their town. Many offenders are unaware of the extent of the interference caused, and in most cases are glad to amend their ways when the matter is explained to them.



Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

We begin in this issue the first instalment of a complete course on the valve. The nature of the course will be such that it should be readily understood by every reader.

What is a Valve?

THE word "valve," as ordinarily applied to engineering, means a device which will allow a fluid to pass through it in one direction only. The wireless valve is an electric device which acts in a somewhat similar manner towards electric currents; it only allows current to flow through it in one direction. The name "valve" was given to a special tube (somewhat similar to an ordinary electric lamp, but containing in addition a small metal plate) by Dr. J. A. Fleming, who, in 1904, was the first to apply this sort of a lamp to the detection of wireless signals.

Fig. 1.

The modern valve (an example of which is illustrated in Fig. 1) has enabled broadcasting to be accomplished; it has enabled long-distance reception to become a practical proposition; it has placed long-distance transmission by wireless on a satisfactory basis. And yet, although its capabilities are so great, it is a relatively simple device with an outward appearance not unlike that of an ordinary incandescent lamp as used for electric lighting. Other names for valves include: vacuum tubes, tubes, thermionic tubes, thermionic valves, vacuum valves.

What is Meant by the Terms "Electrode," "Filament," "Cathode," "Grid," "Anode," "Plate"?

If two wires are taken, one from each terminal of a battery, and the ends dipped into a glass of water, an electric current will flow from one wire to the other through the water. The wires under the water are said to be "electrodes." The wire, or electrode, connected to the negative terminal of the battery is called the "cathode" and the positive electrode is called the "anode."

If we used a battery of very high voltage and placed the two wires, not in water, but simply close to each other without actually touching, we would get a "spark" owing to the electricity flowing from one wire to the other through the air. The two wires would be called electrodes, the end of the wire connected to the positive side of the battery being called the anode, and the end of the other wire connected to the negative side of the battery being called the cathode.

In the case of a wireless valve, we also have a cathode and an anode. The cathode is normally a metal filament (i.e., a fine metal wire) which is heated to a very high temperature by means of an electric current which is passed through it. The anode is either a small metal plate placed near to the filament or a cylinder surrounding the filament. Owing to the fact that in the earlier types of valves the anode was a flat plate, the term "plate" has come to mean the same as "anode" in a wireless valve, although the term is not an accurate one. The filament and anode are usually placed in a glass tube or bulb, which is exhausted of air by special pumps. The filament is usually made of the metal tungsten, which may be heated up to a very high temperature without melting.

The modern valve, in addition to having a filament and an anode, is also provided with what is called a "grid." In most cases this grid is a spiral of wire surrounding the filament, the anode then surrounding the whole. The grid does not touch either the anode or the filament, and a separate wire is taken from it to the outside of the glass bulb. The term "electrode" is also used in connection with the grid, so that we sometimes call a valve of this type a *three-electrode* valve. As already stated, the word "valve" is sometimes replaced by such expressions as "thermionic valve," "thermionic tube," "thermionic vacuum tube," "vacuum tube," "vacuum valve," etc. Some of these names are more accurate than the word "valve," but the latter term has now come into general use in this country, although in America it is very rarely employed.

What is a Two-electrode Valve, and What are its Uses?

A two-electrode valve is a glass bulb containing a filament which may be heated by passing a current through it (this current being derived from a battery outside the bulb), and a plate or anode near to, or surrounding, the filament. The two-electrode valve was applied in 1904 to the rectification of wireless signals. The two-electrode or "Fleming" valve, as it was called, was about as sensitive as a crystal detector and worked in very much the same way.

The two-electrode valve is not used for receiving wireless signals, although its principle is still employed. For transmission purposes, however, the two-electrode valve is still used for changing high voltage alternating currents into high voltage direct currents. The two-electrode valve cannot be used as an amplifier.

Fig. 2 shows a two-electrode valve of an early type.

What is a Three-electrode Valve, and for What Purposes is it Used?

A three-electrode valve is a bulb exhausted of air and containing a filament, a grid, and an anode.

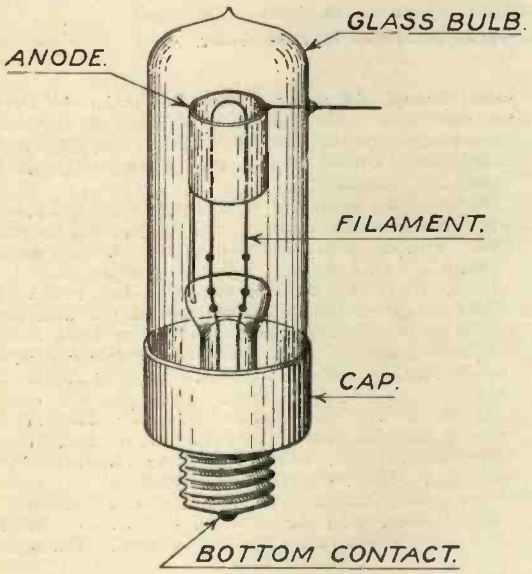


Fig. 2.

The grid is, in nearly all cases, between the filament and the anode. It takes many forms, according to the nature and position of the anode. When the anode is a cylinder surrounding the filament, the grid is sometimes in the form of a smaller cylinder with a large number of holes punched through it. More often the grid is in the form of a spiral of wire with distinct spacing between the turns. Again, we have valves in which the grid is made out of a wire mesh. When the anode is in the form of a flat plate the grid may be in the form of a flat plate with holes in it or a kind of grid-iron of wire. Frequently the grid in this case looks like a miniature riddle. Typical forms of three-electrode valves are shown in Figs. 3 and 4. Fig. 3 shows the earliest form the three-electrode valve took.

The three-electrode valve may be used as a detector in the place of a crystal, but its chief use is as an amplifier or magnifier of electric currents. It may be used, for example, to strengthen the currents which would ordinarily flow through the telephone receivers. By strengthening them it may make them capable of working a loud-speaker. The three-electrode valve may also be used to amplify the aerial currents before they are applied to a crystal or other form of detector. Several of these three-electrode valves may be used together to produce still greater amplification.

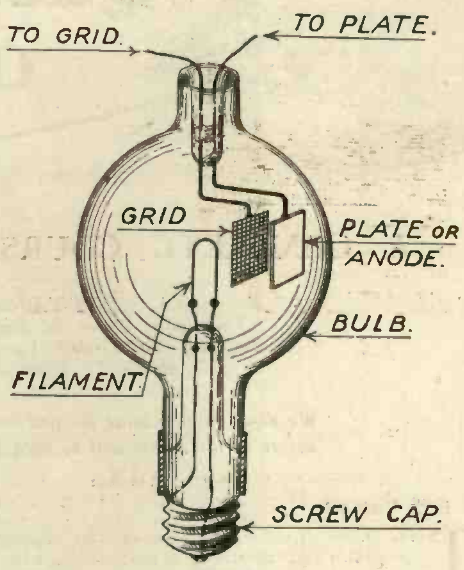


Fig. 3.

The three-electrode valve may also be used for transmitting wireless waves, but we are not concerned with this use of the valve at the moment.

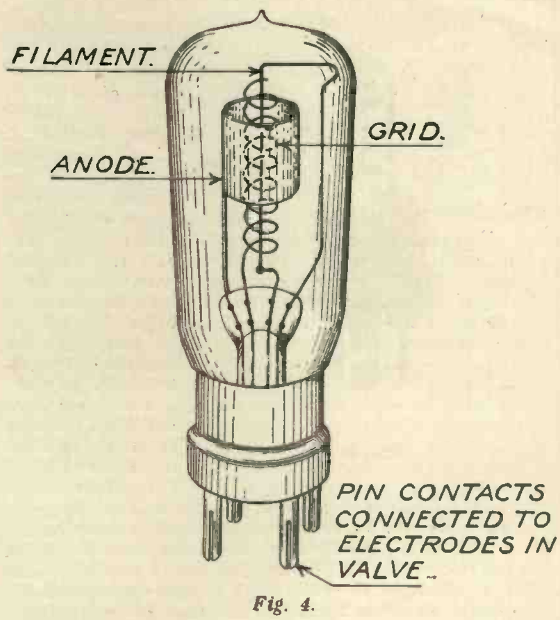


Fig. 4.

Compare the Functions of a Crystal Detector and Those of a Valve.

A crystal detector is used for changing the high-frequency currents which are set up in the aerial circuit into low-frequency currents capable of operating the telephones and causing them to give forth sounds.

The two-electrode valve may be used for this purpose, but otherwise it has no extensive applications in connection with receiving apparatus.

The three-electrode valve, however, may be used, not only as a detector, but also to amplify wireless signals, a function which the crystal detector cannot carry out.

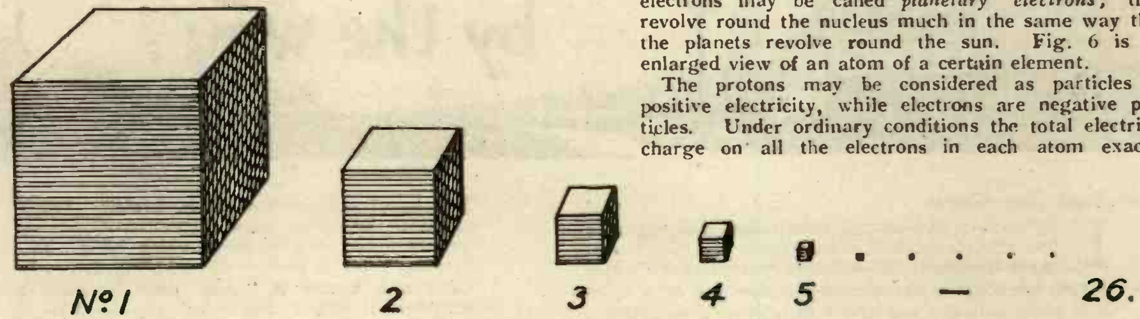


Fig. 5.

smaller than the electrons) and several *fixed* electrons. How exactly the protons and electrons are arranged in the nucleus or core is not certain, but the fact remains that they are all near the centre of the system, whereas there are several other electrons which revolve round the nucleus at a comparatively great distance. These electrons may be called *planetary electrons;* they revolve round the nucleus much in the same way that the planets revolve round the sun. Fig. 6 is an enlarged view of an atom of a certain element.

The protons may be considered as particles of positive electricity, while electrons are negative particles. Under ordinary conditions the total electrical charge on all the electrons in each atom exactly balances the total charge of the positive protons. The result is that a complete atom under ordinary conditions has no electrical charge at all, but is *neutral.*

Sketch One Form of Two-electrode Valve.

Fig. 2 shows a simple Fleming valve as originally used for wireless reception purposes. It is to be noted that the filament is in the form of a loop, the anode being in the shape of a cylinder surrounding the filament. The two ends of the filament are connected to the cap, which is similar to that of certain electric lights, such as pocket flash-lamps. A separate connection is taken from the anode through the glass of the bulb.

What Metal is a Filament made of, and What Happens when it is Heated to Incandescence?

Valve filaments are, in practically every case, made of fine tungsten wire. Tungsten is one of the rarer metals. It is extremely hard and melts at very high temperatures only. If a piece of tungsten wire is heated to incandescence in a vacuum so that it glows brightly, millions of small particles of electricity are shot off from the wire or filament. These particles of electricity are called "electrons."

What are "Electrons"?

Electrons are extraordinarily small (and, of course, invisible) particles of negative electricity. To understand what electrons are it is necessary to know something about the constitution of matter. If we take a piece of lead and keep on chopping it up into little bits, we will finally get particles which can only just be seen under the microscope. If we could possibly go on cutting up the microscopic particles we would ultimately reach the point where any further sub-division would result in a particle which would no longer retain the chemical properties of lead. Just before this stage is reached the particle would be an *atom,* which may be defined as the smallest particle of an element which still retains the natural chemical properties of that element. Fig. 5 shows a cube of lead having a side of 1 inch. If, by cutting, we keep on halving the side of the cube, about the twenty-sixth "cube" will be an atom.

Each atom, although in itself very minute, is built up of smaller particles called electrons and *protons.* The atom is not unlike a small solar system. We have in the centre of this system a nucleus or core which consists of several protons (which are even

What is the Difference between Free and Fixed Electrons?

Free electrons are the planetary electrons which revolve round the central nucleus of fixed electrons and protons.

If the central nucleus is represented by a large pea the planetary electrons would be represented by several peas revolving round the central one, but at a distance of *a quarter of a mile* from the nucleus pea.

The electrons in the nucleus are *fixed* electrons and they govern the chemical nature of the complete atom. If we alter the number of the fixed electrons we will change the atom into some other substance; for example, an atom of lead, if some of its fixed electrons were taken from it, would be changed into another metal. The planetary, or *free,* electrons, however, may be removed from the atom without altering its chemical nature. Similarly, we can add planetary electrons without producing any chemical change.

If we take one or more planetary electrons from an atom the atom will become *positive* electrically because the positive protons will now more than balance the

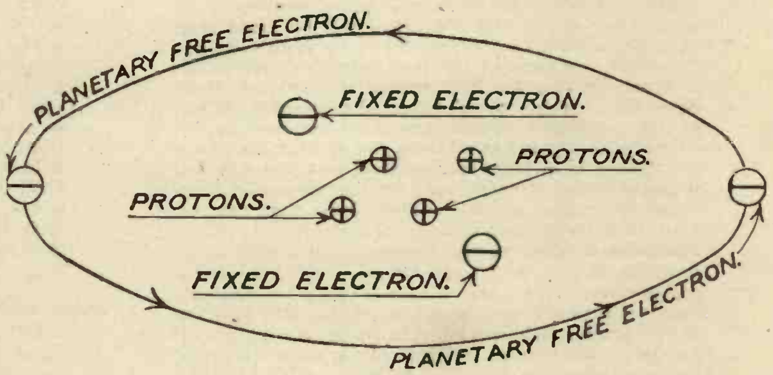
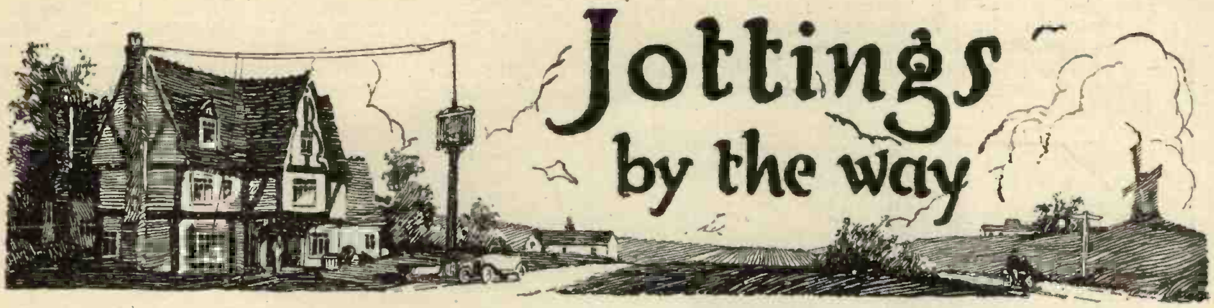


Fig. 6.

negative electrons. When a substance is said to be *positively* charged, the condition really is a shortage of free electrons. If, on the other hand, we add free or planetary electrons to an atom, that atom becomes *negatively* charged.

(*To be Continued.*)



See How they Grow.

If you notice that one of your fellow passengers in the train, tram or 'bus that takes you each morning to business is keeping his eyes not on his paper but on the roofs of the houses you need not be a Sherlock Holmes to put him down as a wireless enthusiast. Why? Well, my dear Watson, he is engaged in the fascinating pastime of counting and criticising aerials. It is marvellous to see how they grow. At the end of last year, for instance, there were only twelve visible on one side of the line on the ten minutes' run between a certain suburban station and the City. Last week the number had increased to 43. They are of all shapes, sizes, and designs. Some would do credit to the most professional erector; others appear to have been inspired by the drawings of Mr. Heath Robinson. One that I noticed in particular consisted of several sections spliced together with odds and ends of rope and cord in the artist's most approved style. The main mast, so to speak, was a stout clothes-prop, the top mast was a flag pole—probably a relic of Armistice day—and the "top gallant" was an old broom which proudly flaunted its ancient bristles to the breezes.

A Suspension Tip.

Most people use rope for slinging their aerials, and though it is satisfactory up to a point, it has certain serious drawbacks. A new rope is very susceptible to atmospheric changes, lengthening in dry weather and shortening to an amazing extent when mist or rain is about. This means that unless one is prepared to let the wire down a little whenever the set is not in use it must always be left slack enough to allow for the possible contraction of the suspending ropes, otherwise the strain will prove too much on some rainy night, and the aerial will be found next morning coiled in tangles (worthy of Laocöon's snakes) round the remnants of the best geranium bed. Rope is expensive too, for it is useless to buy poor stuff, especially if it has to withstand the corrosive effects of the soot deposit always generously provided by the chimneys of big towns. If you are rigging up a new aerial, or refurbishing your existing one, you will find it better to use stranded wire for the purpose. Army telephone cable, which was specially designed to withstand great strains and sudden jerks, is ideal. Hundreds of miles of this material, which consists of a great many thin steel strands cabled round a copper core, were sold by the Disposal authorities, and it can be obtained in small quantities from many of the firms which specialise in Army surplus goods. As the breaking strain of this wire is something over five hundredweight one need have no fears about the aerial's solidity once it is up. It can be hauled up quite tight and left so.

Interference and Broadcasting.

Most of those who listen nightly to the transmissions of Broadcasting stations will have had considerable experience of interference of various kinds. The bulk of it comes from broadly tuned spark stations, or from Government installations using powerful arc transmitters which seem to scatter harmonics on a variety of wave-lengths. In many cases it is a case of "what can't be cured must be endured"; still, a good deal can be done by those who care to tackle the problem. The most satisfactory anti-interference device is the frame aerial, which, owing to its directional qualities, enables a great deal of the interfering "hash" to be cut out. Its chief drawback is that it considerably reduces the range of the set unless one or more high-frequency valves are added to compensate for its inferior qualities as a "wave-trap." Another way of coping with the nuisance is to make the set as selective as possible, using a closed circuit coupled to the A.T.I., and tuning the H.F. transformers by means of .0002 μF variable condensers. Sharply tuned transformers, however, are very liable to fall into oscillation of their own accord, and even when a potentiometer is fitted it is not always easy to control the antics of two or three in series. Probably tuned-plate coupling will be found best by those who are troubled by interference; it is exceedingly selective, and it gives a higher degree of amplification than transformers, but it requires careful handling if oscillation is to be avoided. If interference comes from induction effects due to the presence of high-voltage cables in the neighbourhood an improvement can usually be effected by fitting a counterpoise instead of the usual earth.

A Valve Suggestion.

I wonder when we shall see the double-filamented valve as the standard article of commerce in this country. The filament is one of the smallest parts of the valve, yet if we, in an absent-minded moment, mistake H.T. for L.T. in making our connections the ensuing flash, though it does no damage to plate, grid, or glass, reduces the value of a fifteen-shilling valve by about fourteen and ninepence in a fraction of a second. In America, Australia, and even Japan (that queer mixture of ancient and modern), valves with two filaments are rapidly becoming general. Only one is used at a time, of course, but if it burns out the other can be brought into play in a moment and the valve has a new lease of life. Let us hope that some of our makers will take up the idea before long.

Repaired Valves.

It has been possible for some years now to have burnt out household electric lamps repaired. The process consists in cutting the bulb in two, fitting a new filament, re-sealing the glass, and then pumping out the air through a small tube welded into the glass. Several firms have recently applied the process to valves, charging about half the price of a new valve for effecting the repairs. The results obtained vary considerably. Some of the valves are quite efficient on their return from hospital, but others will not function as amplifiers since they have not been pumped to a sufficient degree of hardness. The commonest fault, however, is to be found in the size and nature of the filament used; as a rule it allows far too much current to pass. Tests made with a batch of half a dozen valves that were sent up for repair in order to see what could be done showed an average consumption of .85 ampere, which, as the Americans would say, is "going some." The process will doubtless be improved as time goes on, and even as it is it is something to be able to turn three penn'orth of scrap into a valve that will work after a fashion.

High-tension Batteries.

It is a great mistake to fit a high-tension battery of small size to a set with several stages of amplification. The current per valve works out at from 1 to 3 milliamperes only, but when four or five are in use for long periods continuously this rate of discharge is more than the tiny cells will stand and the voltage begins to fluctuate, causing a variety of unpleasant noises in loud-speaker or head phones. Matters may be remedied to some extent by using a very large bridging condenser with a capacity of two or even three μF. Any breakdown in the paper dielectric generally used in these condensers will allow the battery's charge to leak away in a very short time. It is a good plan, therefore, to test the condenser occasionally by connecting a *shorted* milliammeter or galvo in one of the condenser leads to the battery. Upon removing the shorting wire no current flow should be indicated if the insulation of the condenser is up to standard. By the way, a run down dry cell may be given a new lease of life by punching several holes through the zinc container with a hammer and a nail, and then standing it in a solution of sal ammonia. This tip comes in useful sometimes when a breakdown occurs on Sunday, or at a time at which no shops are open.

The Wireless Voice.

You have probably noticed what a vast difference there is in the quality of the voices that make wireless transmissions. Some people whose speaking or singing voices are quite pleasant when heard in the ordinary way do not broadcast at all well; with others just the reverse is the case. Certain voices seem to suit the microphone exactly, whilst others don't—why, no one can say. A curious point is that the slightest imperfection in pitch is intensified by wireless, probably owing to the enormous amount of magnification to which the sounds are submitted at both transmitting and receiving ends. Of all singers the contralto has the hardest task when broadcasting; any notes that are at all forced or imperfectly produced sound "puddingy." Wireless is, in fact, an automatic and keen critic, most unkind to faults of any kind.

Amateur Transmissions.

One does not hear so much of the amateur transmitter nowadays owing to the hours at which he has to work. But if you use your set on Sunday mornings or on week nights after broadcasting has ceased you will find that he is still very much in evidence. 2KT, 2ON, 5BC and many others are always to be picked up, and their transmissions are excellent. Many of our amateurs are heard regularly by experimenters in the South of France with quite small receiving sets. Considering the smallness of the power radiated this is a really remarkable achievement.

Hearing U.S.A. Telephony.

Anyone who has an efficient set fitted with a couple of stages of radio-frequency amplification can probably succeed in hearing American broadcasting, provided that his aerial is neither very low nor badly screened. The trouble is that it takes place at such an unearthly hour. Those who live near London will find it of very little use to listen-in until after 2 a.m., by which time Northolt and Leafield have usually finished their press transmissions. Whilst they are working the "hash" that prevails on short wave-lengths is so bad that one cannot hope for anything in the way of results. The main requirements for the would-be hearer of W.J.Z. and W.D.Y. are (*a*) patience and (*b*) the ability to keep awake, and (*c*) some skill in making fine tuning adjustments. Whenever I have managed to "stick it out" for an hour or two, weather conditions being favourable, I have generally managed to pick up one or other of these stations, sometimes on as few as two valves. Conditions (*b*) and (*c*) one can manage; hot coffee is an aid to the former, and the latter comes by practice. But (*a*) is a different matter; in fact, I know of no pastime so likely to ruin an otherwise sunny temper. You have just managed to tune in faint sounds of music when down comes a flood of "hash" and drowns everything. Even strong, silent men are moved to bitter words on these occasions, so let us hope that the Recording Angel is not too hard on such ordinary mortals as

WAYFARER.

We shall be pleased to hear from readers in the larger towns, who could act as correspondents and submit regular weekly reports of about 250-350 words dealing with the reception of broadcasting and local wireless developments. These reports should be written in an interesting manner and would be paid for. Application should be made at once to the Editor.

SOME EXPERIMENTS WITH AN ARMSTRONG SUPER-REGENERATIVE RECEIVER

By J. CROYSDALE.

Owing to the great difficulty experienced in getting this circuit to function, the following description of a regenerative receiver which actually works successfully will be of great interest.

LAST year, in common, I suppose, with most wireless experimenters, my interest was aroused by the many wonderful accounts of the super-regenerative circuit devised by Major E. H. Armstrong. The results claimed for this circuit offered me sufficient inducement to scrap my existing set and construct an Armstrong "super."

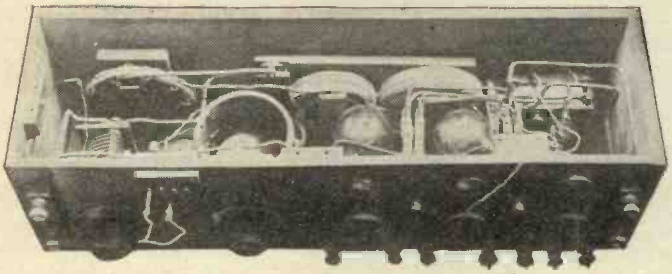


Fig. 1.—Internal arrangement of the receiver.

Though I apologise for adding yet another article on this circuit to the already long list of those which have appeared in the radio journals in this country and America, I feel there is, perhaps, some justification in my attempt to add a little further practical information which will render the use of this circuit more widespread.

Major Armstrong claims great things for his invention, and in his paper cites one or two examples of its powers of amplification. Many experimenters have tried to emulate these performances but have been disappointed; consequently, there seems to me to be a sort of general belief that the circuit is far too tricky as yet to replace the orthodox valve amplifier such as we now use. However, since I have had a certain measure of success with the circuit, I have come to regard it as the thing for amplification, and already I feel that ordinary high frequency amplification (reactance capacity, etc.) is out of date.

The photographs, Figs. 1 and 2, show the complete apparatus.

There are many points, naturally, which need careful attention in the construction of an Armstrong super-regenerative receiver.

The particular circuit with which I have experimented most is shown in Fig. 3. I will describe in some detail the alterations and refinements which I find necessary for its successful operation.

Some writers state that the relative disposition of the various components of the set is somewhat critical, and has an influence on the working. I have found myself that this is hardly true, and in my first experiments I had the coils and condensers lying about all over the bench; yet, when I came to box things up, everything worked as before.

I will now deal with Fig. 3.

A.—The A.T.I. consists of 70 turns of 24 S.W.G. on an ebonite tube 3¼in. diam. 3in. long. A tapping is taken at each 10 turns.

B.—The reaction variometer. This is mounted close up to the end of the A.T.I. The stator of this variometer is ebonite tube of same diameter as the A.T.I., and wound with 80 turns, 28 S.W.G. The rotor is a wooden ball 2⅝in. diam. wound with 70 turns, 28 S.W.G.

C.—Variable condenser of .0005 μF maximum.

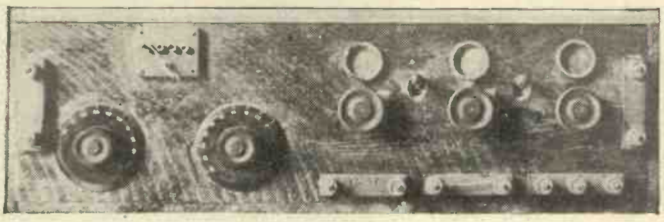


Fig. 2.—Complete instrument.

D.—Grid condenser .0003 μF.

E.—A multilayer coil of the duolateral type having 750 turns.

F.—A radio frequency choke coil of 1,500 to 2,000 turns approx. This may be a slab coil of 34 S.W.G. or any other form of multilayer coil.

G.—A radio frequency choke coil, approx. 300 turns. This serves to keep the high frequency oscillations in the circuit A C D from passing through condenser H.

H.—A variable condenser of .0015 μF. is used here by others, but I have found a fixed condenser of .006 μF. capacity better, and this eliminates the variable.

I.—Blocking condenser .002 μF.

J.—H.T. by-pass condenser 1 μF.

K.—Gridleak variable from 0-7 megohms.

L.—Condenser .002 μF.

P.—Pin plugs for extra A.T.I. and reaction.

Notes on Constructional Details

The A.T.I. coil is placed end-on over the reaction variometer. This ensures closest reaction coupling. The right-hand dial controls the reaction spindle.

As regards the wiring up, no special care was taken, except in the matter of insulation. The valves I am using are French (Mètal) R valves for detector and low frequency, and a B.T.H.-B. valve for the oscillator valve.

High tension supply is about 120 volts and low tension 6 volts.

I have made provision for the addition of extra A.T.I. or reaction if required; and the two plug sockets will be noticed in the photograph. These, of course, are shorted if not in use.

Two Dewar switches are shown (Fig. 2), which cut the low frequency valve in or out.

Notes on Manipulation

It is useless trying to give much detail with regard to the manipulation of this set, but

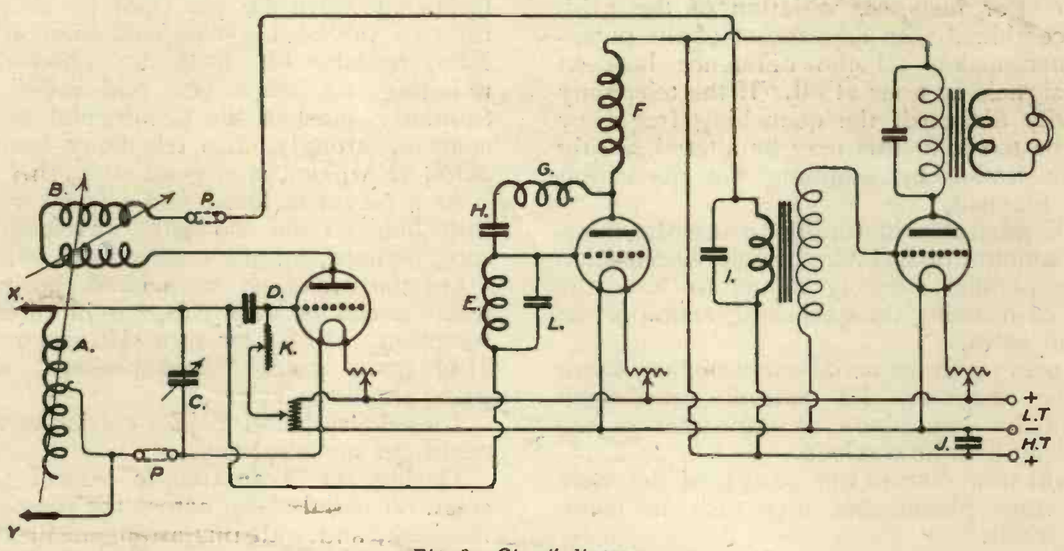


Fig. 3.—Circuit diagram.

The coils E, F, G are best mounted against the back of the instrument cabinet; in this way they take up least room. The blocking condensers L and H are also screwed to the back of the cabinet.

It is advisable to use vernier filament resistances for the oscillator and detector valves; suitable types are now on the market.

One of the most important points in connection with this circuit, at any rate when using ordinary R valves, is the use of gridleak rectification instead of the negative grid volts method. I have carried out many tests with various combinations of leaks and potentiometers, and have found that it is necessary to have a variable gridleak combined with a potentiometer, as in the diagram. I generally use a positive bias on the gridleak.

what I give is intended to serve as a starting-point from which to work and learn the meaning of each noise. The niceties of adjustment are gained by experience only.

When the whole is assembled the best thing to do is to attach the set to an aerial and earth. The detector valve is lighted, the set tuned to 600 metres, and the gridleak, etc., adjusted. One can then determine whether the detector part of the circuit is functioning properly.

Now disconnect the aerial and earth and connect the frame aerial at X and Y. The first valve should be made to oscillate vigorously on the broadcasting wave band; the quenching valve is next brought into action by simply lighting the filament and gradually brightening it up. A very high-pitched whistle should at once be heard. If not, something is wrong, and circuits should be tested for breaks.

As the filament of the quenching valve is brightened a point is reached where the first valve is "quenched," that is, stops oscillating. Now leave the filament of the quenching valve at this setting and increase the reaction coupling a little more, so that there is just sufficient to overcome the quenching action of the second valve. With the set in this state, by just varying the A.T.C. and reaction one can search round for carrier waves. Having found one, decrease the reaction to just off oscillation point. The telephony should now be heard, horribly distorted perhaps, but this is remedied by minor adjustments which one learns by trial and error. For instance, variation of the grid-leak combined with adjustment of the potentiometer makes all the difference between loud signals or none at all. If the telephony is badly distorted, the quenching frequency may be too low; this may be altered, within certain limits, by dimming the quenching valve filament.

It is advisable in tuning to use the minimum amount of A.T.C. possible, because too much parallel capacity seems to have the effect of resisting the quenching action of the second valve.

In using a frame aerial connected as shown in the diagram, its natural wavelength should be somewhere of the order of the wavelength to be received.

I will now discuss one or two of the more interesting phenomena met with in using this circuit.

Those who have followed previous literature on this circuit will know that the condenser H is given generally as having a capacity of .0015-.002 μF. This, I find, is not sufficient capacity if one is working with ordinary valves, and for the following reason, the object in this circuit is to get a sufficient variation of potential on the grid of the detector valve, therefore it is necessary to get as much energy as possible into the grid circuit of the quenching valve. The condenser of .0015-.002 μF is too small a by-pass for ordinary valves, and therefore by increasing the capacity to .006 this condition is more easily fulfilled and better results obtained.

As to the actual results I have had in the way of reception on the instrument described, I would like to quote one or two instances which will give an idea of the relative power of amplification obtainable.

Using no aerial, earth, or frame, simply the set as it stands on the bench in my workshop in the basement of the house, I get splendid signals on 200 metres. With the low frequency valve cut out (that is, using just the two valves) I get signals from 8AB, of Nice, readable 6ft. from the 'phones—8AB radiating 1.5 amps 900 odd miles away. Similarly, most of the Continental amateurs come in strongly, also telephony from 2JZ, 2ON, 2NM, etc., is of good strength.

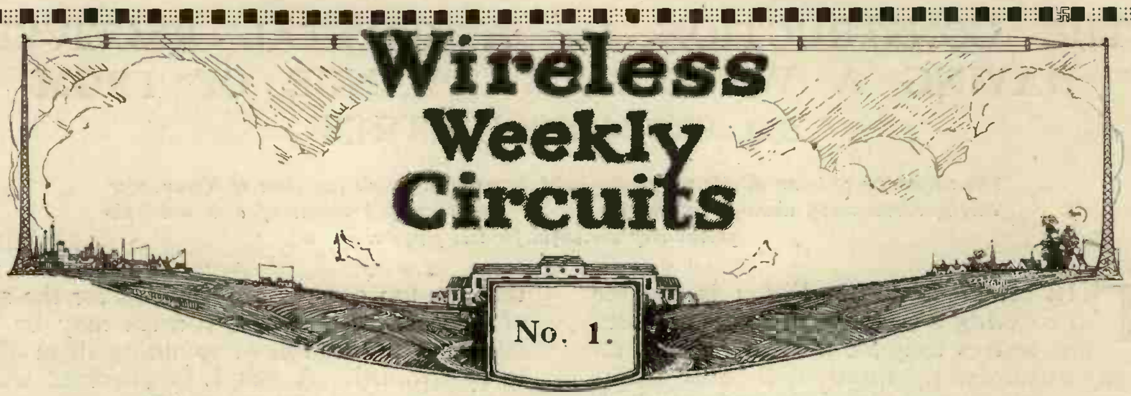
As a matter of fact I find a frame aerial of little help on the 200-metre wavelength, except, perhaps, for slight directional effect.

On the broadcast wave band, however, a frame aerial is very effective in directional reception. With a ten-turn 4½ft. square frame 2LO gives good "loud-speaker" signals using the three valves.

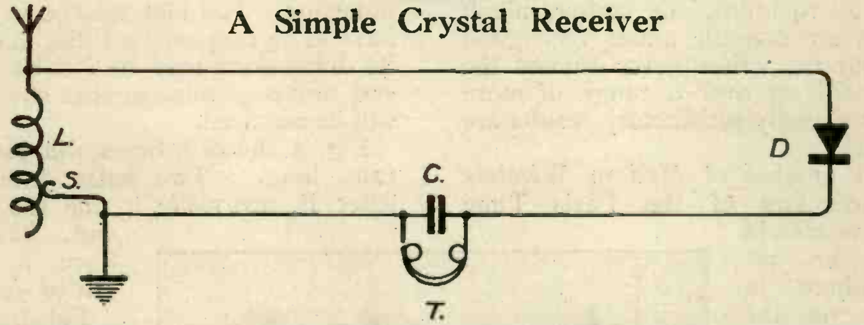
I have also heard WJZ's carrier wave, but could get no telephony.

During the Transatlantic tests I tried a small 8ft aerial slung across the room, using no earth, and with this arrangement I heard 8AQO and one or two other American amateurs, all of fair strength.

In conclusion, I consider that there is undoubtedly great scope for the British experimenter in the development of this principle of super-regeneration devised by Major Armstrong.



A Simple Crystal Receiver



COMPONENTS REQUIRED.

This is the simplest form of crystal receiver circuit. It will be seen that there are four pieces of apparatus required :

- L, an inductance coil fitted with a slider.
- D, a crystal detector.
- T, a pair of telephone receivers.
- C, a blocking or telephone condenser.

GENERAL REMARKS.

This circuit is suitable for the reception of broadcasting and experimental telephony transmission, the reception of Morse signals from ship and shore stations (particularly at night) and the reception of the Paris (FL) time signals. The circuit is easy to operate and is an excellent one for the beginner to try out first.

VALUES OF COMPONENTS.

The variable inductance will depend for its size on the range of wavelengths to be covered. The distance of reception has nothing whatever to do with the size of the coil, of course. If the wavelength to be covered is from about 200 to 1,000 metres, the inductance L might be wound with No. 22 gauge double cotton covered wire for a distance of about 8in. on a 3½in. cardboard tube. If the range of wavelength is to include 2,600 metres (the wavelength of the Paris time signals transmission) the inductance L might be wound with No. 24 enamelled copper wire wound for a distance of 10½in. on a cardboard tube 4in. in diameter.

The condenser C is fixed, and is known as the telephone condenser. Its value is usually about 0.002 μF, although this is not very important. It might be made up of sheets of tinfoil measuring 3in. by 2in., separated by slightly larger sheets of thin paper which has been soaked in paraffin wax. Five sheets on one side might be joined together and the other four, which are sandwiched between them, are also joined together in a similar manner.

The detector D might be of any of the usual types with the point of a fine spring made of No. 36 bare copper wire pressing on a small piece of Hertzite crystal.

The telephones T should be of high resistance, not less than 1,000 ohms.

NOTES ON OPERATION.

See that the sliding contact S makes good contact with every turn on the inductance L as it passes over it. With the metal point touching the Hertzite crystal, move the slider S up and down the coil L until signals are heard. Re-adjust the detector by trying different points on the crystal and varying the pressure ; then carefully adjust the slider until the desired signals are obtained. The final position of the slider should be such that a movement to either side of the selected point will cause the signals to fade off.

POSSIBLE VARIATIONS.

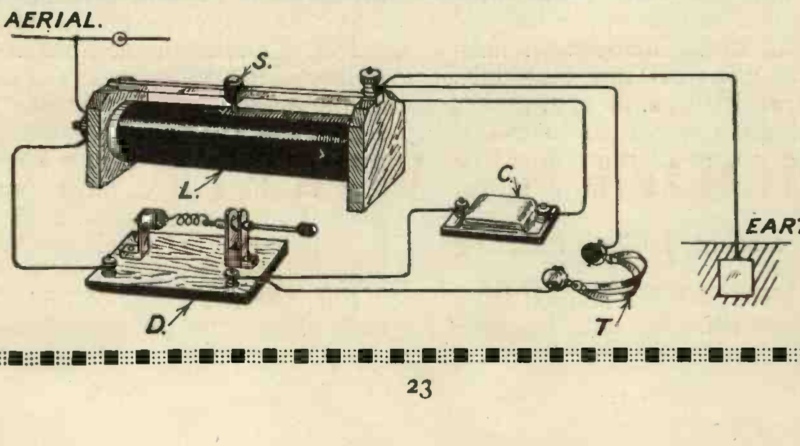
In most cases it will be found that no telephone condenser will be necessary. This varies with different circumstances and different telephone receivers.

RANGE OBTAINABLE.

Broadcasting stations should be heard up to 10 miles comfortably. Such a circuit has been known to receive Broadcasting up to 20 miles regularly, but signals are not loud. Much longer ranges are occasionally received. Paris time signals should be obtained all over Great Britain on a crystal detector. Ship and shore stations may frequently be heard up to a range as much as 600 miles at night, but 60 miles is a better average.

METHOD OF CONNECTING UP.

The lower figure shows pictorially how the different components may be connected up according to the circuit No. 1.

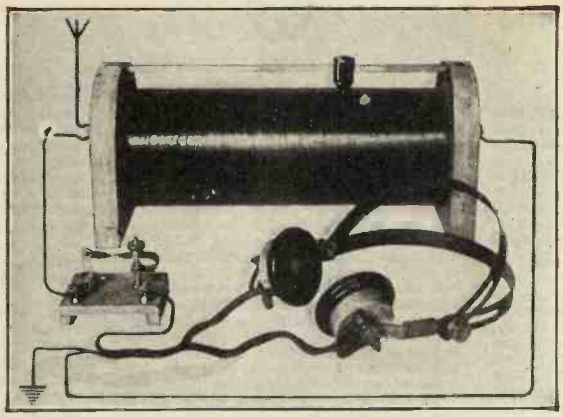


THE CONSTRUCTION OF A CRYSTAL RECEIVER HAVING A WAVELENGTH RANGE OF FROM 200 TO 4,000 METRES

The advantages of being able to receive the Eiffel Tower time signals and those of Nauen, near Berlin, attract many would-be listeners-in, and we give below full details of a set which has proved very successful for this purpose.

THE set illustrated in Fig. 1 is capable of covering a wavelength range of about 200 metres to 4,000 metres. It will receive broadcasting quite well over short ranges, such as 10 miles. Of course, much longer ranges are possible under very good conditions, but the writer never advises the use of a crystal set over a range of more than 10 miles if really satisfactory results are to be expected.

In the first number of *Modern Wireless* appeared particulars of the Paris Time Signals. These should undoubtedly be received anywhere in this country on the crystal set described here, and the reception of Nauen time signals should also be possible.



The Complete Receiving Set.

The receiving apparatus comprises three parts, the variable inductance, the crystal detector, and the telephone receivers. These are connected together by copper wire in the manner shown in Fig. 1.

Let us consider these various items in turn.

The Variable Inductance

The variable inductance is of the type having a slider which moves along the coil and enables contact to be made with individual turns. The principal raw materials, as it were, are shown in Figs. 2, 3, 5, and 6.

Fig. 2 shows a bobbin of No. 26 enamelled copper wire. One pound of this should be purchased. It will always come in useful for different purposes.

Fig. 3 shows a cardboard tube measuring 4in. by 12in. long.

Fig. 4 shows a piece of wood shaped from a board 6in. × 5¼in. × 1in. It will be seen that the top corners are rounded for the sake of appearance. These corners may be left square if the trouble of rounding them off is to be avoided. A slot L is provided where indicated. The slot will perhaps afterwards have to be deepened a little, but at this stage its dimensions may be left as shown. Two end pieces, similar to that shown in Fig. 4, will be required.

Fig. 5 shows a brass rod ¼in. square and 12in. long. Two holes, indicated by the letter E, are made in the rod, one at each end. These two holes have a diameter of ⅛th or $\frac{3}{16}$th in.

Fig. 6 shows a slider which should preferably be bought. The slider should have a ¼in. hole through it and is provided with a small rod H and a spring G. The slider will ultimately be slipped on to the rod of Fig. 5.

Fig. 7 shows a piece of wood measuring about 3¾in. × 1in. × 1in. Two of these pieces of wood will be required.

Having provided these different parts, or made them, the assembly of the inductance may be proceeded with, and the first step is to complete the end pieces which support the coil, by screwing the pieces of wood shown in Fig. 7 on to the end pieces shown in Fig. 4.

Fig. 8 shows the completed end piece and indicates the position on the wooden piece C of the small piece J. Screws K are used to secure the piece J to the piece C. M is the nut which helps to secure a terminal, preferably of the 4 B.A. army type, to the end piece C. A cross section of the end piece is shown in Fig. 9, which clearly shows the terminal.

Fig. 10 shows the two end pieces required, each constructed in accordance with Figs. 8

and 9, together with the completed inductance coil marked N. This coil is wound on a cardboard tube measuring 12in. × 4in. On this tube is wound a single layer of No. 26 enamelled wire for a length of 11in., care being taken to see that the turns are wound very close together, and the wire pulled tight at each turn.

The winding of this coil is somewhat laborious, but this is unavoidable. The cardboard tube N may be enamelled after the wire has been wound on it.

It is, of course, very important that the wire should be kept taut as it is wound, as otherwise it may come undone with serious results. The whole art in preparing an inductance coil of this kind, is in preventing the turns coming undone. One end of the coil of wire is passed several times through the holes Q at the end of the cardboard tube N, a length, P, being left over. The end of P is bared and secured to the nut M of the terminal going through the left-hand end piece. The other end of the inductance coil is secured to holes, and no lead is taken from this end. A short length of wire, however, is connected to the nut which is part of the terminal passing through the right-hand end piece C, which is similar in all respects to the end piece C at the left-hand side. The end of this wire is bared and connected to the brass rod which is fixed into position in the two slots in the end pieces in the manner shown in Fig. 12. Details are shown in Fig. 11.

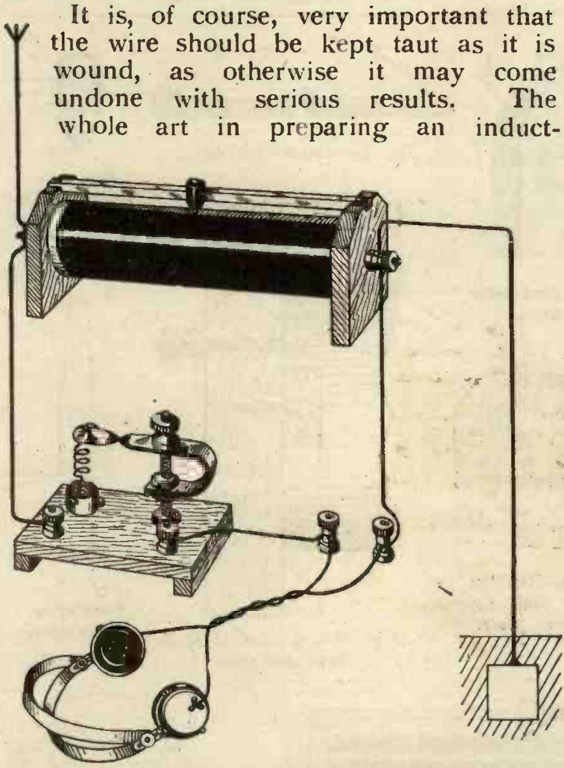


Fig. 1.—Pictorial diagram of connections.

Before fixing the slider in position the two end pieces shown in Fig. 10 are pressed against the ends of the cardboard tube, the ends of the wooden pieces J being smeared with seccotine so that when the cardboard tube is pressed over these pieces the whole will hold together. Screws may be passed through the cardboard tube into the ends of the pieces J if desired, to strengthen the whole inductance.

Having secured the end pieces, the slider is now slipped on to the brass rod, which is then fitted into the slots in the end pieces of C and C2 in Fig. 12. Screws S1 and S2 secure the brass rod to the end pieces. Having roughly fixed the slider in position, a pencil line may be drawn on the enamelled wire where the slider will move along it. Having made a longitudinal line along the coil the slider and brass rod may be removed for the time being, and a strip ¾in. wide of the coil may be bared by rubbing it with emery paper until the bare copper shows. The enamelling will still remain in between the individual turns and will prevent any short circuiting. When the wire has been carefully bared, and this must be done very thoroughly, the brass rod and slider may be replaced and care should be taken to see that the slider is pressing fairly firmly on the bare portion of the coil. The spring between the plunger in the slider and the brass rod should be compressed to about half its length, and the brass rod, of course, should be absolutely parallel with the coil. This is the most difficult adjustment in making a good variable inductance of this kind, and it may be necessary to deepen the slots in the two end pieces C and C2 until the slider moves smoothly and yet makes effective contact with each turn of wire as it passes over it.

Fig. 11 shows a cross section of the right-hand end piece, showing the terminal to which is connected a wire going to the screw supporting one end of the brass rod.

Having made the inductance, the next piece of apparatus is the crystal detector, which may be constructed as follows:

The Crystal Detector

In constructing the detector which has the finished appearance shown in Fig. 15 it is necessary to construct a baseboard A, having two little ledges D, and fitted with two terminals B and C. The dimensions of this baseboard are 3in. × 2in., although they are not of very great importance.

Fig. 14 shows a cross-section of the detector. It will be seen that the spring contact is a spiral of copper wire which may be bent round a diary pencil or something similar. The copper wire should be bare, and may consist of a small piece of No. 36 gauge wire. This spiral is attached at the top end to a strip of brass K, which should be springy. rod E by means of two nuts H and J, which, of course, are 2 B.A. brass nuts.

The hole marked R is really a longitudinal slit, which is provided to allow for the spring M to move up and down by turning the terminal head L, which may be from an ordinary terminal. By turning L in a clockwise direction until it presses down on K the spring may be lowered on to the crystal which is contained in a cup P, a screw Q being provided to secure the cup to the baseboard.

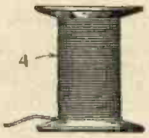


Fig. 2.—Showing bobbin of enamelled wire.

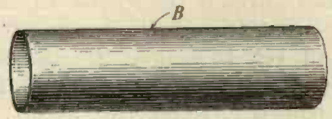


Fig. 3.—Cardboard tube for winding inductance coil.

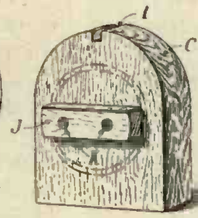


Fig. 4.—End piece for tube.

Fig. 5.—Brass slider bar.

Fig. 6.—Showing construction of slider.

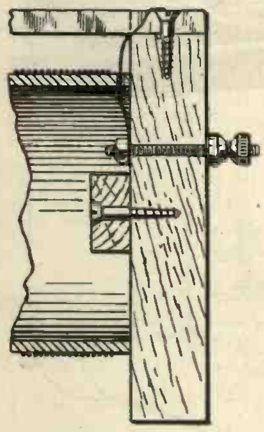


Fig. 11.—Section of right-hand end-piece.

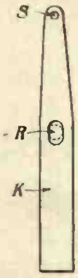


Fig. 13.—Plan of detector arm.

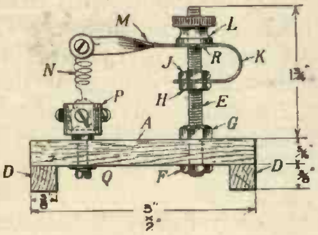


Fig. 14.—Elevation of detector.

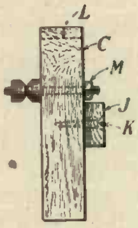


Fig. 9.—Section of end piece.

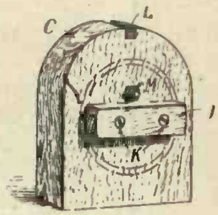


Fig. 8.—Position of terminal and support on end piece.

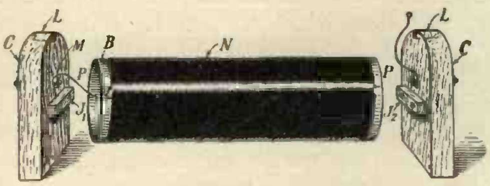


Fig. 10.—Complete inductance in parts.

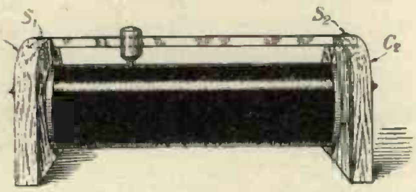


Fig. 12.—Complete inductance assembled.

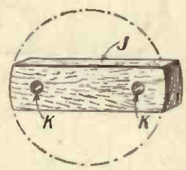


Fig. 7.—Support for tube.

An ordinary piece of thin brass strip will do, and springiness may be imparted to it by hammering it. The strip K, before being bent, has the appearance shown in Fig. 13. The hole S, and the cut-out portion R, are arranged as shown. The bent strip is mounted on a piece of 2 B.A. brass studding marked E, and dimensioned as shown. This piece of studding is secured by means of two nuts F and G to the baseboard of the detector. The bent strip K is fixed to the vertical

This crystal cup may be purchased, and the crystal in it is retained in position by means of three screws. This will generally be found more convenient than soldering the crystal in the cup.

It will be noticed that the strip K is bent at right angles at the point M. Care should be taken that the crystal comes directly under the spring end. Connection should be made from the cup P to the terminal B, and a similar connection is made between the vertical standard E and the terminal C. These connections can conveniently be made under the baseboard, the ledges D serving to keep the wiring off the level of the table.

The finished crystal detector presents the appearance of Fig. 15 and will be found to work excellently.

Wiring of the Apparatus

The apparatus is wired up as follows:—The aerial wire is connected to one terminal of the variable inductance. This terminal is also connected to the terminal of the crystal detector, which is connected to the crystal cup. The other terminal of the crystal detector is connected to one side of a pair of high-resistance 'phones, having a resistance, preferably, of not less than 2,000 ohms; the other side of the telephones is connected to the other terminal of the variable inductance, which terminal is connected to the earth lead. (See Fig. 1.)

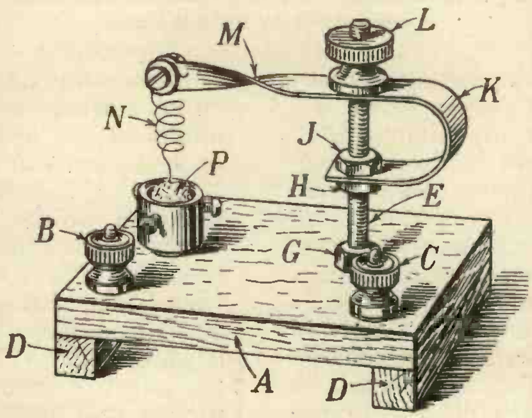


Fig. 15.—The crystal detector.

Operation of the Set

No difficulty presents itself in the operation of this set. The spring contact of the detector, which is preferably fitted with a piece of Hertzite crystal, should rest gently on a portion of the crystal, and the only other adjustment, is to move the slider very slowly up and down the inductance coil until signals are heard. When this occurs the slider should be left in the position which gives the loudest results, and the detector carefully re-adjusted. Probably different sorts of signals will be heard, including ship stations sending on the spark system. Broadcasting stations should be heard with the slider near the left-hand end of the coil, while FL (Paris) on 2,600 metres may be heard when the slider is near the right-hand end.

CORRESPONDENCE BETWEEN THE POSTMASTER-GENERAL AND THE HACKNEY AND DISTRICT RADIO SOCIETY

From the HACKNEY RADIO SOCIETY to the P.M.G.

16th Feb., 1923.

DEAR SIR,—I am instructed by my Executive to inform you that some doubt exists amongst the members of the Society as to the clause in their licences dealing with the removal of receiving sets.

They are puzzled as to whether they may take their apparatus to friends' houses or not, for the purpose of comparison and demonstration, and would be glad if you will give a definite ruling on the matter.—Yours faithfully,

(Signed) CHAS. C. PHILLIPS,
Hon. Sec., HACKNEY RADIO SOCIETY.

Reply from POSTMASTER-GENERAL to the HACKNEY RADIO SOCIETY.

*General Post Office, E.C.*1,
28th Feb., 1923.

Ref. 62652/23.

RECEPTION OF WIRELESS SIGNALS.

SIR,—With reference to your letter of the 16th February, I am directed by the Postmaster-General to say that he sees no objection to members of the Society taking their wireless receiving apparatus occasionally to other private houses for the purposes of comparison or demonstration.—I am, Your obedient servant, (Signed) T. W. WISSENDEN,
For the Secretary.

C. C. PHILLIPS, Esq.

ACCUMULATORS

By ALAN L. M. DOUGLAS, Associate Editor of "Wireless Weekly."

This article will give the experimenter an insight into the manufacture, care and use of accumulators for filament heating.

It is a common remark amongst many experimenters, "Oh, I never give my accumulators a thought; they don't require attention, you know." Now nothing could be further from the truth, because the useful life of an accumulator is almost entirely dependent upon the amount of care bestowed on it. The fact is that a great many enthusiasts have only had their cells for a comparatively short period, and in almost every case the careful first charge given them by an established accumulator charging station, together with acid of the correct specific gravity added by this station, has been sufficient to cause the battery to settle down and function regularly and reliably.

But how long is this state of affairs going to continue? There will be many who find after a time that their battery does not seem to hold the charge so well; others will notice a black deposit settling down upon the foot of the containing case; and yet others who find the plates, and especially the tops of the plates, becoming a white or yellowish-white colour. Any of these effects may manifest themselves within a period of a few months, but none of them, if due care be taken, should be present even after a few years service. Let us look further into the matter and obtain an insight into the principles underlying the use of accumulators. First of all it will be necessary to examine and understand the construction and principle of working of an accumulator. It is generally recognised that an accumulator forms a ready and convenient means of storing electricity of a certain kind. The exact process by means of which this is accomplished would not seem so clear to everyone though, and therefore we must first of all grasp this before the accumulator "instinct," so to speak, can be properly developed.

It will facilitate matters to glance at the diagrammatic sketch of an accumulator, Fig. 1. From this it will be seen that we have two sets of plates, as they are called, immersed in a solution of sulphuric acid and water and contained in a glass, celluloid or ebonite container.

There may be any number of plates on either side, as it were, depending upon the ability of the accumulator to store up more or less electrical energy; this we call the "capacity" of the cell. These plates are, although similar in size, by no means the same in construction. They both consist basically of a grid or framework of pure lead, this being for strength from a mechanical point of view where the filling is concerned. The plate or plates attached to the positive pole or *red* terminal have pressed into the grid formation spongy oxide of lead of a somewhat similar chemical constitution to ordinary red lead. The paste is

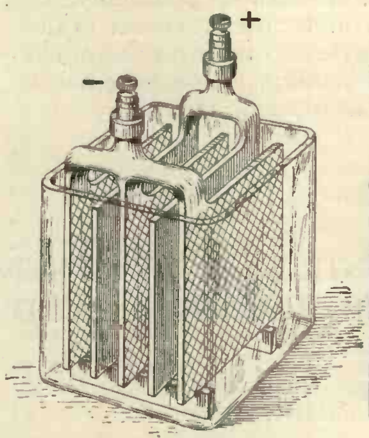


Fig. 1.—Showing arrangement of plates.

4-volt accumulator in carrying case.

pressed into the grid-like formation of the plates by hydraulic means, the holes in the plates taking many forms commercially with a view to retaining the paste for as long as possible.

Several factors may tend to dislodge the paste, but that most generally encountered is the too common tendency to charge or discharge the accumulator at a rate greatly in excess of that advised by the manufacturer. This will cause the plates to bend or buckle, and as a sure way of destroying the accumulator cannot be surpassed. These positive plates are joined at regular intervals to a lead busbar by burned joints, no other method of jointing lead being satisfactory.

The negative plates are formed into an open or diamond grid formation also, but are pasted with pure lead of a spongy or porous nature. The object of this is to offer as great a contact area to the acid (or electrolyte as it is called) as possible. This paste is also pressed in by hydraulic means, but is just as readily dislodged as the red positive paste is.

Referring to Fig. 1, we will see that a series of positive and negative plates alternately will present themselves to us, reading from one side of the cell to the other. These must all be kept separate, and yet the acid must circulate freely around and between them. This is best effected by means of corrugated perforated celluloid sheets, very similar in appearance to corrugated iron roofing with which we are all familiar. Another and superior arrangement is to have a number of little ⋂ shaped glass tubes hanging over the top edges of each other plate, and of such a length as to extend almost to the bottom of the plates. Yet another arrangement consists of creosoted wood strips separating the plates, and which certainly provides a more secure arrangement from a purely mechanical point of view.

These constitute the main features of the accumulator. The acid solution used should be of a specific gravity of 1.19 or 1.2, and should be made up with pure brimstone sulphuric acid in the proportion of four parts of water to one of acid. Cheap sulphuric acid often contains sulphur in excess quantities, and this is liable to deposit itself on the plates and prevent the proper circulation of the electrolyte. For this reason, also, pure water should be used, for tap water often contains carbonate of lime, which will behave in exactly the same manner, and cause the retaining powers of the accumulator to be impaired.

Now the accumulator does not really *store* electricity; what takes place when we apply a source of electrical supply to it is a chemical action, in which certain of the elements in the positive plates transfer themselves through the medium of the acid to the negative plates, and remain there in a state of suspended animation as it were until we call upon the accumulator to re-transfer the electricity with which we have charged it. Then the process is reversed, the positive plates assume their original formation, and the reversal of the chemical energy causes an electric current to flow through any circuit attached to the terminals of the accumulator.

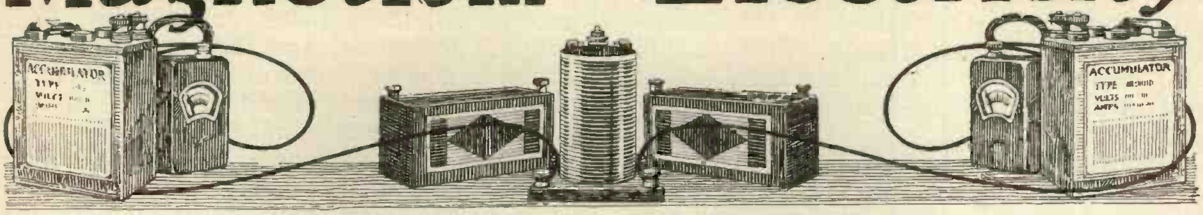
The difference between the action of a dry cell or primary battery and an accumulator or secondary battery is that with the former the process can be gone through once only, but with the latter it can be repeated time after time. Hence, of course, the enormous practical value of the accumulator is at once apparent.

Having now absorbed the principle upon which the battery works, the several reasons for the shortcomings indicated at the beginning of the article can receive attention. Firstly, the most common fault with the experimenter is that his battery does not appear to be holding the charge so well as when it was new. This may be due to several causes, and an examination of the accumulator is necessary. Should this reveal lack of acid, the falling-off may be attributed to that cause, provided the plates are of normal colour. If the plates are greyish-white or white with a yellow tinge, the trouble is rather more serious. To effectively treat this condition it should be tackled the moment it makes its appearance; but it may be remarked here that it never would have made its appearance were (*a*) the cell never allowed to stand in a discharged condition, and (*b*) the specific gravity of the electrolyte correct.

The only practicable method of eradicating this condition is to pour out all the acid, and repeatedly wash the cell out with hot 50 per cent. solutions of washing soda and water. Care should be taken not to shake the accumulator during this process, as it is liable to cause any deposit at the bottom of the cells to become wedged in the holes in the separators, whereby tending to shortcircuit the plates.

(To be continued.)

Magnetism & Electricity



By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART I

Introductory

WIRELESS has become so popular since the establishment of broadcasting that it has been necessary to provide receiving sets of the utmost simplicity, so that anyone purchasing a set and following the simple instructions may be able, without any technical knowledge, to take advantage of this new form of entertainment.

Although there are many thousands of people in this position, there is no doubt that an increasing number are desirous of learning something of the inner working of their sets. In wireless, as in many other matters, the interest and pleasure are greatly enhanced by the possession of a little technical knowledge.

For this reason, it is proposed in this series of articles to explain the fundamental facts of electricity and magnetism for the absolute beginner, that is to say, not the absolute beginner in wireless—for it is evident that you are already interested in wireless, or you would not be reading this—but for the listener-in who is beginning to take an interest in the workings of his set.

What is Electricity?

You would imagine that the first and simplest question to ask would be: What is electricity? The late Lord Kelvin (when Sir Wm. Thomson) during a lecture noticed one of his students falling asleep. The Professor called upon him: "Mr. So-and-So, will you kindly tell me what electricity is?" The student was momentarily confused and stammered: "I *did* know, Sir, but I have forgotten." "Gentlemen," said the Professor, addressing his class, "this is the saddest thing in my experience. Here is the only man who ever knew what electricity was—and he has forgotten!"

This little anecdote provides a suitable reply to the question. For it should be admitted at the outset that nobody knows what electricity is, except that it is one of the many forms which *energy* may take.

Although we do not know its ultimate nature, we do know a great deal about the properties and behaviour of electricity, and we have been able to employ it in a variety of useful ways, many of which are so familiar as hardly to need mention—the driving of tramcars, lighting, heating, the telephone, and so on.

Electricity is, of course, invisible and intangible, and one of the most practical ways to think of it, as we have said, is as a *form of energy*. It may be either at rest or in motion, just as the air may be at rest or in motion. If the air is moving from one place to another we have a *current* of air and this air in motion represents energy, since we can use it for doing work—for example, for turning a windmill. Similarly, when electricity is in motion we can employ it for doing work, and just as we speak of a current of air when the air is in motion, so we speak of a *current* of electricity when the electricity is in motion.

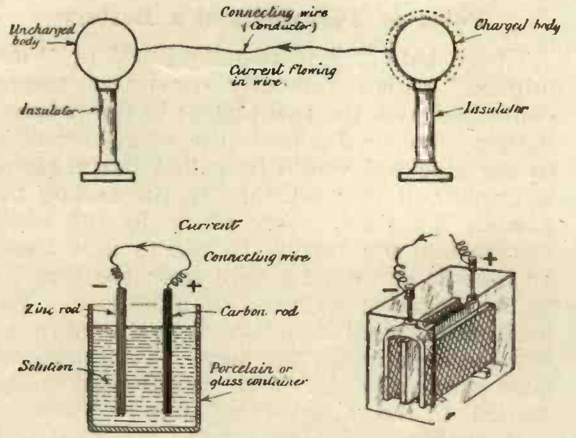
Electricity at Rest

When electricity is at rest, it is sometimes referred to as "*static*" electricity, and the study of electricity at rest is known as "*electrostatics.*" A quantity of electricity at rest is called an *electric charge*, or an electrostatic charge, and we usually only deal with electric charges when they are associated with material bodies. For example, it is well known that if a piece of ebonite be rubbed it acquires an electric charge which remains upon its surface.

To begin with, however, we shall find it more convenient to study electricity in motion rather than electricity at rest, and we shall therefore postpone the study of electrostatics until later on.

Electricity in Motion

Just as an electrostatic charge when it is at rest must be associated with a material body, so also must it remain in association with a material body when it moves from one place to another; that is to say, under ordinary circumstances electricity can only move from one place to another by means of a material connection. Such a connection, which is able to provide a path for electricity in motion, is known as an electrical conductor, or simply as a *conductor*. All substances are able to conduct electricity, but they differ so greatly in their ability to do so that they are generally divided into two main classes, namely, those which conduct electricity fairly easily and those which, for all practical purposes, do not conduct it at all. The former are known by the general name of *conductors*, and the latter as *insulators*. Most metals are extremely good conductors, and thus if two bodies are connected together by a metal wire an electric charge upon one of the bodies will be readily conducted along the wire to the other body, until the charge has distributed itself upon the two bodies. Whilst the electricity is flowing along the wire, there is said to be an *electric current* in the wire.



Figs. 1, 2 and 4.

Although conductors are extremely important, insulators are none the less so. Some commonly used insulating substances are glass, paraffin wax, ebonite, india rubber, mica, porcelain, dry cotton, and silk. When we use a wire for conveying electricity from one point to another the wire is sure to be in contact, at some point or other, with material substances, and if the electricity is to be prevented from escaping, the wire must only come in contact with insulating substances. For example, when telephone wires are supported upon poles, they are secured by porcelain insulators which prevent them from coming in contact with the wood of the telephone pole which, being usually damp, is a poor insulator and would allow some of the electricity in the wire to leak away into the ground.

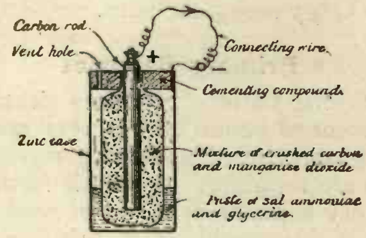


Fig. 3.

Wire which is to be used for indoor purposes, where it is likely to come into contact with surrounding objects, is usually covered over its entire length with insulating material such as cotton, silk, or enamel. It is then known as "insulated wire."

Sources of Electricity

Electricity may be obtained from various sources, but the two principal ones are the electric generator and the electric battery.

An electric generator, sometimes called a dynamo, is a machine (driven usually by a steam engine) which is able to convert the energy supplied to it by the engine into electrical energy in the form of electric current. This is the source of electricity which is used for all industrial purposes, such as for electric power, lighting, and so on. In an electric power station there are a number of generators producing the current, which is conveyed by means of insulated wires or cables to the various factories, houses, etc., on the system. We see here several transformations of energy. First of all the coal is burned in the furnaces and the chemical energy of the coal is changed into heat energy; this is transferred to the steam boilers and reappears as mechanical energy in the engine. This drives the generator producing electricity, which is conveyed (say) to a dwelling-house, where it is used to operate an electric fire, thereby giving back energy in the form of *heat*; or to light an electric lamp, thus giving its energy in the form of *light*. The energy supplied at the generating station has reappeared in the home, these two points being connected merely by a wire; we conclude that the flow of *electricity* along the wire represents the flow of *energy* along the wire.

Primary Batteries

The electric battery produces electricity by direct chemical action and is very convenient for many purposes where comparatively small currents are required. A simple form of electric battery consists of a rod of zinc and one of carbon immersed in a solution of sal-ammoniac. If the two rods are connected together, outside the battery, by a piece of copper wire, a current of electricity will flow from the carbon rod to the zinc, and chemical action will take place in the battery, resulting in the gradual destruction of the zinc rod.

This kind of battery is known as a "primary battery," and when the component parts (in this case the zinc rod and the solution) are exhausted, the battery is of no further use. It is then said to be "discharged" or "run down," and can only be re-conditioned by the replacement of the necessary parts. Batteries of this kind (called Leclanché batteries, after their inventor) are commonly used for ringing electric bells and such-like purposes, where the current is only required for short periods and at intervals. Used in this way, such batteries will last without attention for many months.

Dry Batteries.

Everyone is familiar with the so-called "dry" batteries used for pocket flash-lamps. As a matter of fact, these are Leclanché batteries, each unit consisting of a zinc container with a carbon rod in the centre and the sal-ammoniac solution, absorbed in a porous wrapping between the rod and the zinc. They are "dry" only in the sense of being unspillable, and if they become *really* dry they are useless. We shall see, later on, that this type of battery is largely used in wireless in connection with certain kinds of receiving sets.

Storage Batteries or Accumulators

We have said that a primary battery is useless when the active elements have been consumed. There is another type of battery, of great importance in electrical work, known as the secondary battery, storage battery, or accumulator. This consists of a number of lead plates immersed in sulphuric acid. The special feature of this battery is that the lead plates are not consumed in action, but a change takes place in them when current is drawn from the battery, and this change is reversible; when the battery is run down all we have to do is to pass current through it (from a generator, *e.g.*, the electric light mains) in the "wrong" direction and the lead plates are gradually restored to their original condition, the battery being then "charged" and ready for use as before. Owing to certain facts which we discuss later on, accumulators are able to supply much stronger currents than dry batteries. They are more expensive, however, and so we generally use dry batteries when we require very small currents and accumulators when we require large currents. Accumulators also need more attention than dry batteries, and should be recharged at least once a month.

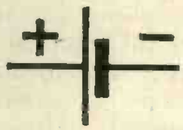


Fig. 5.

Poles or Terminals of a Battery

Every battery has two "poles" or "terminals," which generally consist of screws connected with the two plates; in the primary battery described above, the screw attached to the zinc rod would be called the *negative* terminal and that attached to the carbon the *positive* terminal. According to the older convention, the current is said to flow along an outside connecting wire from the positive to the negative terminal of a battery. The positive terminal is indicated by the sign +, and the negative by the sign −. An accumulator generally has the positive terminal marked in red, and the negative in black.

When we draw diagrams of electrical connections, a battery (or a "cell" as it is called if it is only one unit) is always represented as shown in Fig. 5. The terms "cell" and "battery" are used more or less indiscriminately, but strictly a battery is a group of cells.

In the next Article we will deal with some of the *effects* of the electric current.

(*To be continued.*)

News of the Week

SWEDEN is contemplating the establishment of broadcasting and their present intentions are that their plans should follow on much the same lines as those in this country. The Administration at Stockholm will probably grant a concession for a term of five or ten years to a Broadcasting Company which will receive licence fees.

It is prepared to establish Broadcasting stations in Stockholm, Gothenburg, and in a number of other towns.

A form of protection is to be introduced which will prevent foreign competition for a period of two years.

* * *

The London County Council has stipulated that a deposit of £1 is necessary before anyone renting one of their houses can instal a wireless set.

At a Meeting of the Council, Mr. Morrison desired to know whether this deposit was actually being enforced, and stated that the tenants regarded the imposition as frivolous and vexatious.

The Chairman of the Housing Committee said that the idea of the deposit was to compensate for any possible damage to property.

* * *

The Postmaster-General has appointed a Committee to consider the possibilities, from a technical standpoint, of transatlantic wireless telephony of sufficient reliability for commercial use, and to advise what practical steps, if any, can at present be taken to develop this means of communication.

The Committee is to be constituted as follows: Admiral of the Fleet, Sir Henry Jackson, K.C.B., K.C.V.O., R.N., Chairman; Major-General Sir F. H. Sykes, G.B.E., K.C.B., C.M.G.; R. A. Dalziel, C.B.E., Director of Telegraphs and Telephones, G.P.O.; W. H. Eccles, D.Sc., F.R.S.; F. Gill, O.B.E., M.I.E.E., President to the Institution of Electrical Engineers; E. H. Shaughnessy, O.B.E., M.I.E.E., Chief of the Wireless Section, G.P.O.; Major A. G. Lee, M.C., of the Engineer-in-Chief's Department will act as Secretary to the Committee.

The formation of this Committee is a sign of the times, and it is not unlikely that before long transatlantic radio telephony will become a commercial possibility.

* * *

2LO, the London Station of the British Broadcasting Co., will shortly move from Marconi House, Strand. The reason, however, is not as has been stated in certain sections of the press that interference has been caused with the Air Ministry Station a few hundred feet away. We hear that the current in the Air Ministry aerial, however, is in the neighbourhood of 150 milliamperes when 2LO is radiating.

No doubt, one of the reasons for obtaining a different site is that the British Broadcasting Co. is endeavouring as far as possible to keep the anonymity of its stations.

However much an individual company may have given of its best in the matter of the technical development of broadcasting, the company does not, as a fixed rule, desire that any firm should receive any direct or indirect advertisement.

* * *

There does not seem to be any truth in the rumour that the power of 2LO is to be increased.

* * *

The Broadcasting Co. have been carrying out experiments with a view to transmitting signals from a central studio in London to the different stations. They declare that they are not as yet satisfied with the results obtained, although the test recently struck us as being highly successful. In fact, many of our correspondents have declared that the Birmingham items which came through to London and were radiated from 2LO were even an improvement on 2LO.

* * *

A Wireless Club has been formed at Colombo in Ceylon, and considerable local interest is being taken in broadcasting. It is possible that a broadcasting station will be set up there, but the expenses which would have to be incurred would hardly be justified by the number of possible listeners-in.

* * *

The Westinghouse Co., of America, have been carrying out experiments with great success on the transmission of speech by wired wireless. Ordinary power lines are used and excellent results have been obtained over a distance of 30 miles between two power stations near Pittsburg.

The system is duplex and operates in a similar manner to an ordinary telephone line. The power lines are not interfered with in any way.

* * *

With regard to the broadcasting of plays, there seems to be some trouble on account of agreements between theatrical producers and the gramophone companies. These agreements prohibit artists from singing into "any other mechanical device." A broadcasting microphone is unquestionably a mechanical as well as an electrical device and an interesting legal point may arise if the gramophone companies care to dispute the matter.

The whole question of the rights of artists, authors, singers and others are involved, and when things settle down a little more these rights will probably be enforced more strictly.

* * *

The Austrian Parliament has passed a Bill permitting Marconi's Wireless Telegraph Co., Ltd., to establish a branch company in Austria with a capital of nearly £150,000.

* * *

It is quite possible that in the future we shall have broadcasting, not only through the ether, but along the electric light wires. Local news, for example, might easily be transmitted from a central power station, and the set would be connected up to the electric light mains. A correspondent suggests that we may ultimately be able to get different kinds of broadcasting not only from the electric light but from the gas mains and the water pipes!

* * *

Belfast enthusiasts are complaining that they are being interfered with by the transmissions from the Belfast-Heysham steamers. We gather that the wavelength of the Belfast-Heysham steamers is 400 metres and that when communication is carried on across the Irish Sea, it is practically impossible to tune out the interference with signals from the London station of the Broadcasting Co.

We understand from the Belfast *Evening Telegraph* that the Agent of the Heysham steamers in Belfast has taken up the matter. It is proposed to change from direct to inductive coupling at the transmitting land station. This, however, is not likely to result in much amelioration of the present condition, and it is proposed to place before the Postmaster-General a proposal that the wavelength of the Heysham steamers shall be altered to a wavelength which will not interfere with broadcasting.

* * *

We hear that Mr. Whitley, the Speaker of the House of Commons, has installed a wireless set. This is a promising sign. Let us hope that he becomes an enthusiast and uses his influence to allow the broadcasting of important debates. There is some suggestion that possibly the Budget announcements will be radiated. We do not propose to listen-in!

* * *

Mr. F. Laurie, the President of the Sheffield and District Wireless Society, has been making some strong remarks regarding reception in Sheffield.

The trouble regarding oscillating receivers is very severe there, and he estimates that there are about 60,000 experimenters in Sheffield alone, although the total number of experimenter licences granted in this country only amount to about 30,000.

* * *

The broadcasting of musical items between 11.30 a.m. and 12.30 p.m. is to become a permanent feature of the day's programme, and these times will be adhered to by all the broadcasting stations. No news, however, will be transmitted in order that the newspapers shall not be anticipated.

* * *

Outrageous demands are being made by certain landlords in the way of additional rent for houses fitted with aerials. Demands varying between 10s. and £2 are being made. Some tenants agree to these additional fees, while others are strongly protesting against this attempt to extort money. Many of those who have been blackmailed in this manner intend carrying the matter to the Courts.

* * *

A very powerful station is being fixed up an Antananarivo in Madagascar. Eight towers, each 800 feet high, are being erected.

* * *

We understand that the Air Ministry have opened up a wireless station for meteorological purposes in Guernsey.

Why "WIRELESS WEEKLY" should be your Choice

BEFORE you bought this copy, you no doubt were a little impatient at the idea of still another weekly. We hope that you have now changed your attitude of mind. Your first thought will now be: "Shall I continue with this new weekly or shall I continue with the one I have always bought up till now."

To some of our readers, the purchasing of several weekly wireless periodicals is not attractive financially. To these we would like to present the advantages obtained by becoming a regular reader of "WIRELESS WEEKLY."

(1) The paper is edited by a really technical staff experienced in every phase of the subject. The names appearing elsewhere in this issue are a guarantee in themselves.

(2) When reading "WIRELESS WEEKLY," you can experience that feeling of confidence which only comes as a result of knowing who is behind the paper. In the case of "WIRELESS WEEKLY," we are not largely in the hands of outside contributors.

Every article is checked by several editors who are primarily wireless engineers. Remember that their reputation depends upon the accuracy of the contents of "WIRELESS WEEKLY."

If you are a beginner, and cannot judge the relative value of a wireless periodical or its technical accuracy, ask an experimenter to confirm what we—in view of the great influx of new enthusiasts—have, unfortunately, to say for ourselves.

(3) May we remind you that Radio Press, Ltd.—the publishers of "MODERN WIRELESS," "WIRELESS WEEKLY," and numerous handbooks—are wireless publishers and nothing else. There is an obvious advantage to you in dealing with us rather than general publishers who run wireless as a profitable side-line.

(4) The price of "WIRELESS WEEKLY" is greater than that of other weekly radio publications for the simple reason that the ideal of excellence after which we strive necessarily increases the cost of production. We feel that very few will forego the luxury of a journal of this type merely for the sake of saving a penny or two.

(5) Sound constructional articles will appear every week.

(6) New developments will be fully described in these pages.

(7) "WIRELESS WEEKLY" is entirely unconnected with any Society or Association. Its views are its own and its policy entirely unfettered.

If you find "WIRELESS WEEKLY" to your liking, we trust you will buy it regularly every week, even if it means a sacrifice in other directions. The standard will be maintained and we intend to make this journal a worthy companion to "MODERN WIRELESS," the monthly Radio Press Magazine with over 100,000 readers.

A NEW MODULATION SYSTEM FOR WIRELESS TELEPHONY TRANSMISSION

By JOHN SCOTT-TAGGART, F.Inst.P.

This article explains a new modulation system recently patented by the author. The method has distinct possibilities for both broadcasting and general telephony transmission.

THE idea of using an electric discharge device or valve to absorb energy from an aerial circuit is by no means new. Previous investigators have, however, employed some form of relay device in which the microphone circuit is used to control the passage of an electric current through a vacuous space. An early example of the adoption of the general idea is the system of J. Schiessler, who in 1913 invented a wireless telephone transmission system (described in British Patent Specification 11708/14) in which a mercury vapour lamp acted as an absorbing element. The conductivity of this tube was varied by the microphone currents, which were used to produce a magnetic field acting on the current between the two electrodes in the lamp.

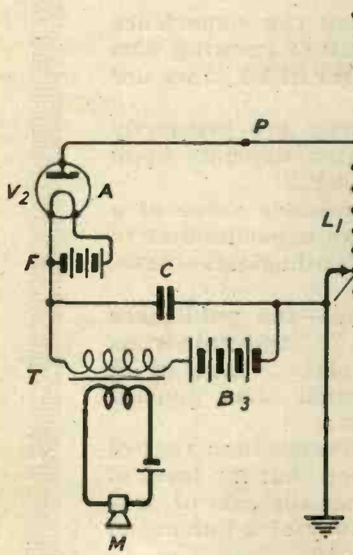


Fig. 1.—The basic circuit.

When the three-electrode valve became more generally used, the General Electric Company of America employed it in place of the vapour lamp. The anode and filament of the valve were connected across the aerial inductance and the microphone potentials were applied to the grid of the valve, and thereby controlled the conductivity of it, and hence the amount of energy diverted from the aerial. In this way the aerial current could be controlled or modulated by the microphone, and a very successful example of this kind of circuit was that used by the Marconi Company in 1920 when they broadcasted songs by Dame Nellie Melba.

The invention described here, however, differs from these previous methods in that only a two-electrode device is used and no relay action is employed. Any conductor which possesses a kink in its characteristic curve might be used, but an ordinary two-electrode valve forms one of the best absorption elements.

The Fundamental Circuit

Fig. 1 shows an aerial circuit which includes the usual aerial inductance L1, to which is coupled an inductance L2 carrying oscillatory current which is supplied by the generator S, which might be a valve, arc, or other source of high-frequency current. Varying amounts of energy are withdrawn

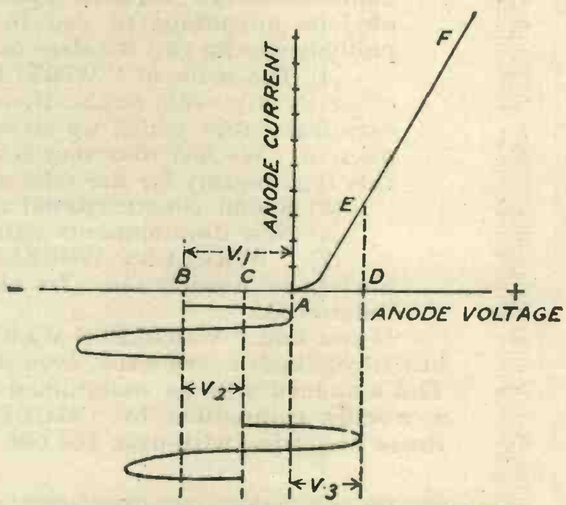


Fig. 2.—Graphical method of illustrating the action.

from the aerial circuit and dissipated in the valve V2, which is a two-electrode valve. In the anode circuit of this valve, if it may be so called, we have the secondary of a microphone transformer T and a battery B3; a by-path condenser C may be provided. Under ordinary conditions the battery B3 makes the anode A of the valve V2 highly negative. Its value might be adjusted to equal that of the E.M.F. across L1 due to the oscillatory current in the aerial circuit. Under these conditions there will be no leakage of current through the valve V2 because the anode A would never become positive; its potential would vary between zero and a high negative

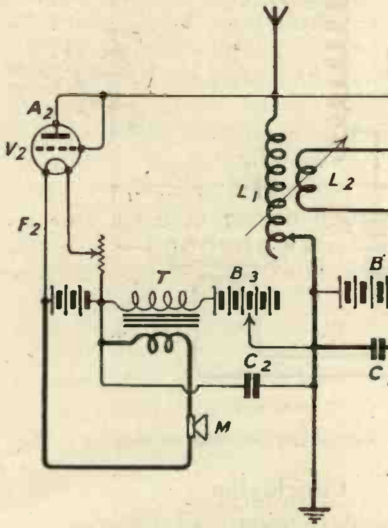


Fig. 3.—A practical arrangement.

value. If, however, we speak into the microphone M, the normal potential on the anode A would vary, and would, at times, become probably nearly zero. When this happens the high-frequency potentials supplied by L1 will add themselves to the modulating potentials, and the anode A will become considerably positive, thus causing a discharge through the valve V2 from filament to anode. This will cause considerable energy to be absorbed from the aerial circuit.

A Graphical Representation

Fig. 2 shows a graphical representation of what happens in the Fig. 1 circuit. This figure shows a characteristic curve of the two-electrode valve, the curve being represented by AEF. The letter B represents the normal high negative potential on the anode, and BA represents the greatest E.M.F. across L1, which is shown adjusted to equal the E.M.F. of the battery B3. It will be seen that even at the peak of the positive half-cycle of oscillating current the anode never becomes positive. If, however, we speak into the microphone the negative potential on the anode A becomes less, and takes up a value which is, say, C. The positive half-cycle of the oscillating current will now make the anode A go well over the positive mark, and V3 shows the positive voltage which the anode A attempts to reach. There is now, however, a heavy current flowing through the valve, and this has the effect of withdrawing energy from the aerial circuit. At the same time the length of the waves radiated will also be modified somewhat. This double effect, of course, takes place in the case of most modulation systems.

Some Practical Applications

Fig. 3 shows a practical circuit embodying the new method. This, and the succeeding circuits, may be tried by any experimenter. The valve V1 acts as an ordinary generator of oscillations, and no comment is needed on the subject. Across the aerial inductance L1 is connected the valve V2, which may be an ordinary three-electrode valve with the grid and anode connected together. It will be seen that a separate filament accumulator is

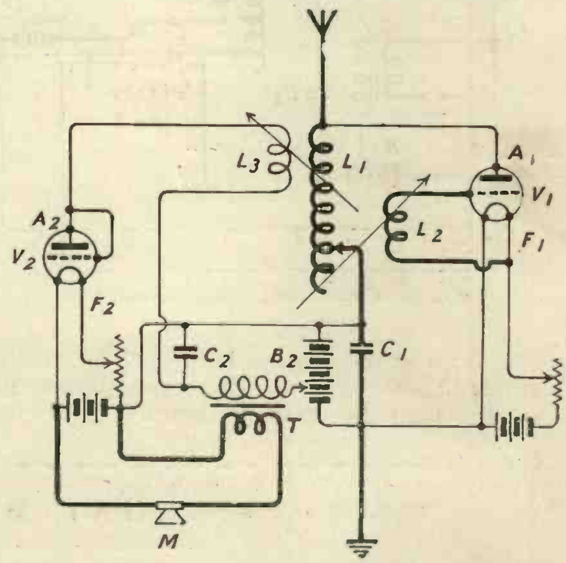


Fig. 4.—An arrangement using a common anode battery.

employed, and also a separate battery B3, which may have a value of 60 volts. This battery should be variable, and sometimes quite good results are obtainable even without it. The microphone is fed from the filament accumulator.

Fig. 4 shows another scheme in which a single high tension battery is used, but two filament accumulators. This time energy is not absorbed directly from the aerial inductance, but from a coil L3 coupled to it. Fig. 5 shows a modification of the Fig. 4 arrangement, a single filament accumulator being provided, but separate batteries B2 and B3.

An Interesting Suggestion

Mr. E. H. Robinson has used with considerable success, an Osglim lamp, whilst keeping to the general principles of the method. The resistance wire found in the cap of the Osglim lamp, which, by the way, costs only a nominal sum, is taken out, and it will generally be found to work best with a positive potential, which should be variable on one of the electrodes.

Fig. 6 shows a successful circuit. The tapping of the high tension battery B2 is such that the potential difference across the

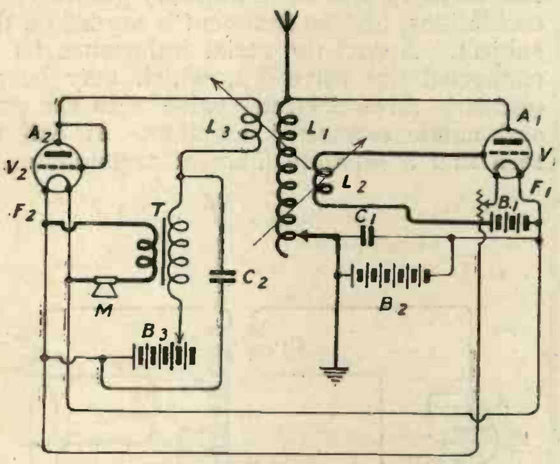


Fig. 5.—Circuit using a single accumulator.

electrodes in the Osglim lamp may be varied. When speaking into the microphone the Osglim lamp becomes illuminated to a varying extent, owing to the absorption of high frequency current through the lamp.

Use of a Crystal Detector

Even a crystal detector may be used as the absorption element. It is not, however, suggested that this is a practical system.

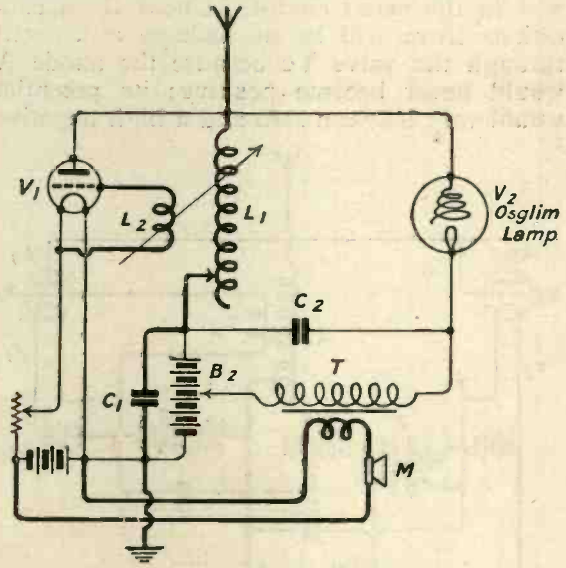


Fig. 6.—Use of Osglim lamp as absorber.

Conclusion

The circuits leave plenty of room for improvement for higher powers, and the microphone potentials would require to be amplified. The Osglim lamp arrangement has given perfect results up to 50 miles. Mr. Robinson has told the writer that he finds no difference between the results obtained by this method and those resulting from the use of a choke control circuit. We would be pleased to receive any results of tests carried out on these lines by experimenters.

NEXT WEEK'S ISSUE

The next issue of "WIRELESS WEEKLY" will contain several very interesting features. Readers must not imagine that No. 1 of "WIRELESS WEEKLY" is in any sense a special number.

The same regular features will appear next week, and in addition there will be an article by Sir Oliver Lodge, D.Sc., F.R.S., on "The Vast Range of Ether Vibrations." This article discusses in a very interesting manner the possibilities of ether vibrations. The author hints at the possibilities of psychic communications, and no one should miss this absorbing article.

There will also be the first of a series of articles by P. P. Eckersley, B.Sc., A.M.I.E.E., the Chief Engineer of the British Broadcasting Company. These articles will be of a technical character.

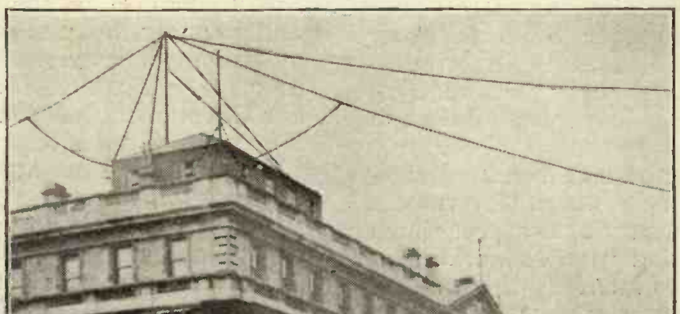
THE CONTROL OF WIRELESS

By Lt.-Col. C. G. CHETWODE CRAWLEY, R.M.A., M.I.E.E.,
Deputy Inspector of Wireless Telegraphy, G.P.O.

The following article deals with the control exercised by the G.P.O. over all commercial and experimental wireless activities.

MANY people, who are now for the first time becoming interested in wireless communication, are asking three very natural questions; firstly, why should wireless working be controlled; secondly, if control be necessary, why should it be State control; and, thirdly, if State control be necessary, why should it be exercised by the Post Office?

Now it is in the nature of things, in any free community, that the individual is at heart antagonistic to control of any kind, and is apt to be especially distrustful of Government control; in fact to many people such control has an effect like that of the proverbial red rag. This feeling may be less violent here than with our friends across the Irish Sea, but even in the selectest of million-sale circles on this side the feeling is clear and strong. After all, a policy of being "agin the Government" on all points is simple, saves much trouble, and is sure of many adherents. It might almost be said that some of our most popular newspapers seem to cater for people who won't think, or, as in the case of some of the illustrated papers, for those who not only won't think but won't read. However that may be, a good wireless journal can attract only those who both think and read, so that the championing here of a simple anti- or indeed, pro-Government policy on any matter without full discussion would be futile. Our first question was: "Why should wireless working be controlled?" and there is little difficulty in giving a satisfactory reply. In wireless telegraphy and telephony, energy is transferred from a sending to a receiving station by wave motions in the ether; and a receiving station can be adjusted to respond to wave motions of a definite wavelength, but can only receive intelligibly one message at a time on that particular wavelength. That is to say, that if two or more messages are being received simultaneously on waves of identical character, length and strength, they will be mixed up together, with the result that none of them can be read. But the number of different wavelengths available in practice for economical communication over any given distance is very limited, and control of some sort or another becomes, therefore, essential.



The G.P.O., London, showing wireless aerials.

Now for any particular country the control must be centralised in some one body, as wireless communication in any part of the country may obviously interfere with wireless communication in any other part, thus making divided control an impracticable proposition. The control must be exercised either by the Government or by private enterprise, and if the latter, it would have to be a monopoly for one company or combination of companies, thus suffering from all the usual disabilities of commercial monopolies; but in any case it would be impracticable to leave the control of wireless communications altogether in the hands of commercial companies, as the needs of the Fighting Services in this connection are obviously matters which can only be decided by the Government.

Hence we find that the State in every country in the world controls its wireless communications, though in some countries, of course, the control is less complete than in others.

There is another important aspect of wireless signalling which necessitates Government action, that is, the international aspect which arises from the fact that wireless working in one country is liable to interfere with wireless working in other countries for the reasons already mentioned. The most important reason of all, however, that first made wireless telegraphy appeal to every civilised Government, was its unique potentialities for assisting in the safety of life at sea.

This was first officially recognised by the drafting of an International Convention in 1906 for the regulation of ships' wireless communications throughout the world. By this Convention it was laid down that all ship stations were bound to intercommunicate on certain wavelengths in accordance with certain definite regulations, irrespective of ownership or of the system fitted.

In this country the Government had already taken over the general control of all our wireless communications by the Act of 1904, which made the Postmaster-General the Statutory Authority for wireless telegraphy and telephony. Later the Post Office purchased all our commercial stations which worked to ships, and thus acquired a monopoly of ship and shore communication so far as the shore end was concerned. This was regarded as a logical development of the Department's monopoly of the inland telegraphs, which had been provided for in the Act of 1869, the wireless transmission to ships being in the nature of an extension of the telegraph system of the country. This monopoly gave rise to little comment, possibly because its unremunerative nature at that time did not make the service very attractive to private enterprise.

Similar arrangements were made in most other countries, though in some, Government control was not so clearly defined, notably in the United States of America, where the telegraph and telephone systems were, and still are, in the hands of commercial companies.

As regards point-to-point wireless services, the position is rather different. Wireless, in its present state of development, is most unsuitable as compared with land lines for point-to-point communication in a small densely populated country like Great Britain; firstly, because of the interference trouble, and secondly, because of the ease with which messages can be overheard by people to whom they are not addressed. For these reasons our Government has consistently discouraged the use of wireless telegraphy and telephony where land lines are available, and there are, in fact, no internal point-to-point wireless services in the country. In some other countries, as in Germany and the United States of America, where the conditions are more favourable, the Governments are cautiously developing such services, and as selective and directional arrangements become more efficient, so must the possibilities of wireless for point-to-point internal communications increase.

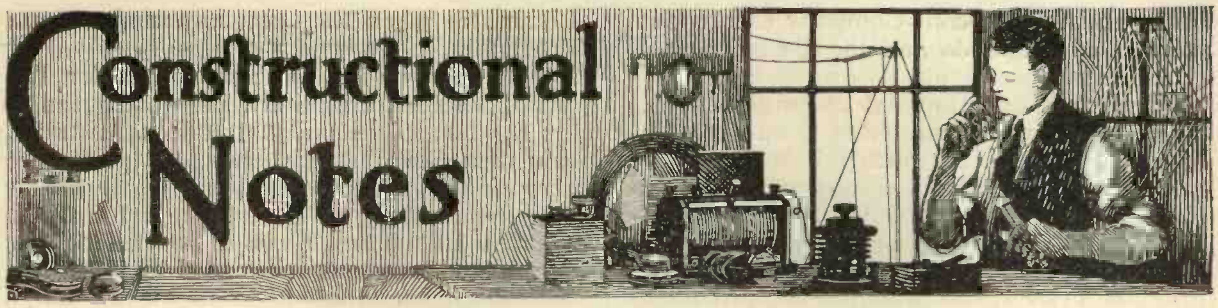
The possibilities of wireless for broadcast, as opposed to point-to-point communications are so obvious that the problem is to direct them into useful channels, while discountenancing any hasty and haphazard development which would only result in chaos, and the necessity for starting off all over again. In the United States of America, where scientific developments are received with more popular enthusiasm than on this side, the people dived wholeheartedly into these broadcasting possibilities, and it is for us, now that we too have taken the plunge, to profit by avoiding their mistakes and by improving on their successes.

Lastly, we must turn to the other aspect of point-to-point wireless signalling, the one which is of vital importance to our country as the centre of a world-wide Empire, that of long-range communications. At the moment in Great Britain some of the stations which work with Continental countries are in the hands of the Post Office, and the others are in the hands of the Marconi Company. The Post Office carries out a service with Egypt, and press services to Canada and

India, and the Marconi Company carries out services with Canada and the United States of America.

As regards our Imperial communications, the Government appointed a Committee in 1919 to prepare a complete scheme, and the report of this Committee was presented to Parliament in June, 1920. On the question of control, the Committee were of opinion that, "in order to secure efficient working, an Imperial system, by whomsoever provided, must be protected from interference from other sources, and must, therefore, be a practical monopoly"; and as they considered that a commercial monopoly would be probably prejudicial to research and progress, they recommended the alternative, a State monopoly. In 1913 the same problem had been considered from a technical point of view by a Committee under the chairmanship of Lord Parker, the famous patent lawyer, and this Committee, in their report, laid stress on the fact that the Government is not fettered by considerations arising out of patent rights, but can use any patent on fair terms; a fact which, no doubt, had weight with the 1920 Committee when they recommended a State monopoly.

This policy of a State monopoly for Imperial wireless communication was agreed to by the late Government, but first Australia, and then South Africa, showed a preference for private enterprise, and the whole matter was reviewed afresh by the present Government, with the result that a new policy was formulated, and was announced by the Prime Minister in the House of Commons on March 5th. This policy is to the effect that the Government are prepared to issue licences for the erection of stations in this country for communication with stations in the Dominions, Colonies, and foreign countries, subject to British control being ensured, and that, in addition, a station owned and operated by the State, and capable of communicating with the Dominions, is to be erected as soon as possible. We are thus on the eve of interesting developments in the control of our long-distance wireless communications, and now that we are turning from theory to practice, we are entitled, from past experience, to expect satisfactory results.



Take Care of the 'Phones

WE are a little apt to take the telephones rather too much for granted, giving them but a very poor share of the care that we expend in keeping the wireless set in a state of efficiency. The 'phones as a matter of fact, are very delicate instruments indeed for all their seeming robustness, and we cannot afford to neglect them if we wish them to continue to do good service.

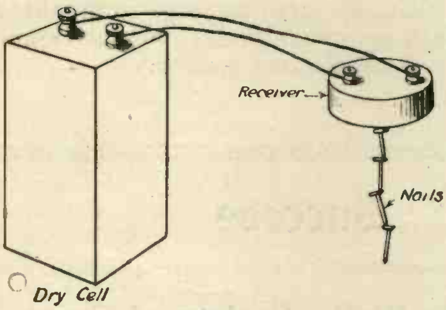


Fig. 1.

Yet how many people pay any attention to the direction in which current flows through their windings? This is a most important point, for if the flow is in the wrong way it is slowly weakening the permanent magnets, which means that when some time has elapsed their 'phones will become insensitive until they have been re-magnetised.

Some makes of telephones have one terminal marked +. The flex wire coming from it should be bound with red silk to distinguish it, and must always be attached to the terminal on the set that is directly connected to the positive of the high-tension battery.

Even if the 'phones are not marked it is quite easy to discover by means of a simple test which lead is which. Unscrew the cap of one ear-piece, and connect one lead to one terminal of a dry cell. Now hold the receiver upside down and load the magnets with a chain of small iron nails. If, upon connecting the remaining telephone lead to the dry cell, one or more nails fall off, the current flow is in the wrong direction.

Having found the positive lead, mark it as described with a binding of red silk, and be careful to connect rigidly when wiring the 'phones to the output terminals of the set.

Caps and diaphragms should be removed occasionally in order that all traces of dust or dampness may be done away with. When the 'phones are worn for long periods moisture from the skin condenses on the diaphragm. This may in time cause a skin of rust to form on the ends of the magnet poles; sometimes, if receivers are neglected, the rust is so extensive that it bridges the tiny gap between poles and diaphragm, causing the instrument to become insensitive.

The Slider Inductance in the Valve Set

A very large proportion of radio enthusiasts start their wireless careers by fixing up a crystal set of some kind, tuned by means of a long cylindrical inductance coil wound with from 400 to 800 turns of enamelled wire and

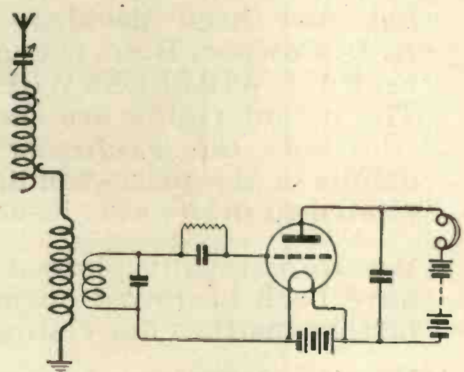


Fig. 2.

provided with a sliding contact. As progress is made the desire to possess a valve set becomes paramount, and eventually the crystal is discarded. As a rule the old inductance coil finds its way on to a dusty shelf, the handier and more selective double or triple holder with honeycomb coils taking its place on the wireless table. There is no apparent sphere of usefulness for the slider inductance in the valve set. Yet it is quite a mistake to regard the old tried friend as a back number, unable to serve any useful purpose. If you look at Fig. 2 you will see in a moment how the discarded coil may be employed in a most profitable way.

The slider upon the inductance coil, as will be seen, is wired in series with the primary of the A.T.I. The advantages of this arrangement will be obvious after a moment's thought. Tuning on the shorter wavelengths is always difficult, especially if the aerial tuning condenser has a large capacity value. Though we nearly always speak of wavelengths when referring to particular stations which we wish to receive, it is really their frequencies that matter in tuning, and on the short lengths the tiniest movement of the condenser knob makes a vast difference to the frequency of the circuit which it tunes.

At 300 metres, for example, the frequency is 1,000,000; that is, the waves picked up by the aerial are undulating at this almost incredible number of times in every second. If the wavelength is increased to only 305 metres the frequency drops to 983,607, a difference of 16,393 cycles a second. To take an instance from actual broadcasting transmissions, Glasgow's wavelength of 415 metres differs from Birmingham's 420 by a mere 5 metres, but their respective frequencies are 722,891 and 714,476. Here the merest touch of the condenser varies the frequency by 8,415. The shorter the wavelength the greater is the frequency change brought above by any variation of inductance or capacity.

It will be seen at once that if we are to obtain anything like sharp tuning on short wavelengths, we must have the means of making very delicate adjustments. By placing the despised slider coil in series with the honeycomb or basket inductance of the primary, as described, we are able to tune wonderfully finely, since we can take in a single turn more or less of the windings of the former.

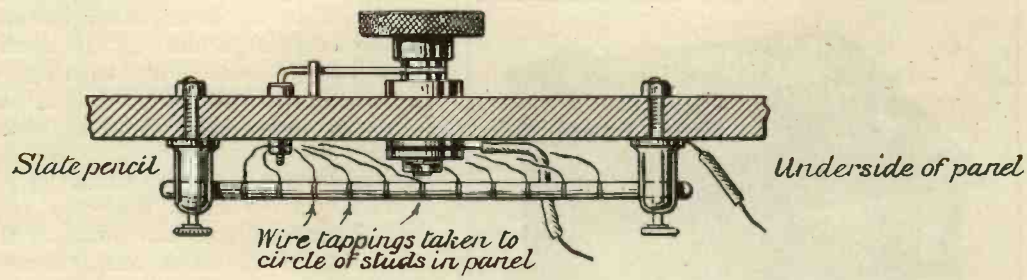
A further advantage is that having once found the desired transmission, we can go on gradually increasing the inductance value and decreasing the capacity of the circuit, working one against the other until the critical balance point is found. In this way we obtain much better signals on short wavelengths, where it is particularly undesirable to have large capacities in the aerial circuit.

□ □ □ □

A VARIABLE GRID LEAK

THE value of a grid leak is very important, especially when a loud speaker is used. It may make all the difference between muffled or clear results. The value of the required leak varies with practically every valve, and therefore an adjustable leak is very useful. The following leak may be mounted on the underside of a panel or used as a separate unit.

A piece of slate pencil three and a half inches long is fixed to the underside of the panel or on a piece of ebonite. This can be easily done by using what are sometimes called telephone or pillar type terminals. Two of these are screwed to the ebonite panel 3in. apart, and the slate pencil is pushed through them so that there is about ¼in. at each end under the terminal. The centre of each terminal is screwed down and will hold the pencil firmly. Tappings are taken from this by twisting bare copper wire tightly round the slate at intervals of, say, ½in., and leads from these tappings are taken to a multipoint switch. The tappings can be more frequent if required. The leak is connected in circuit by using one of the two terminals, and the arm of the tapping switch as the points of attachment. J. C.



Method of mounting leak.

Apparatus we have tested

Conducted by A. D. COWPER, B.Sc. (London), M.Sc.

In this section we will deal with apparatus which we have received for test. Ordinary trade notices in technical periodicals are of no real value to the reader as the opinion is in no way an impartial one, but usually has some subtle connection with advertising. In these columns the opinions will actually be those of this journal and may be treated as entirely impartial. The reader may purchase any apparatus commended in these columns with absolute confidence. If apparatus submitted has obvious defects, it is our intention to mention them, but manufacturers who have every confidence in their apparatus are invited to submit it for test and a report in these columns.

Variable Condenser

WE have received from Messrs. Burndept, Ltd., a variable condenser having a capacity of 0.001 μF which fulfils all the necessary conditions for a thoroughly reliable condenser.

The insulation resistance is infinity when tested on a Megger.

The two sets of plates are well spaced, and the construction of the condenser ensures that accidental short-circuiting is impossible.

Air dielectric is used and the connections to the moving plates are reliable and do not result in the scraping noises often heard on inferior apparatus.

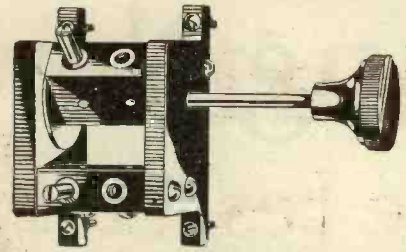
A Burndept condenser.

The condenser is of rather an unusually large size, but the robust construction has no doubt necessitated this. The workmanship, of course, is well up to the Burndept standard, and the design is equally representative of the best modern practice.

A Vernier Coil-holder

The Radio Communication Co., Ltd., have placed on the market a useful form of plug-in coil holder. It is possible with this "cam-vernier" arrangement to get a rough adjustment in the ordinary way and a vernier adjustment by turning the handle backwards. For example, the coils might normally be at right-angles to each other, and it might be desirable to obtain a careful adjustment with the coils at about 45° to each other. This would be done by turning the adjusting handle until the coils were at about 42° apart. This adjustment would be obtained by turning the handle through 48°. To arrive at the correct adjustment of 45°, the handle is now turned back and the coil, in moving backwards, does not move at the same speed as it went forward, but at a very much lower speed.

The chief criticism we have to make is that when two coils are made to approach each other for the purpose of reaction, the reaction has to be made too tight to begin with and then decreased in order to arrive at the critical point. This means, in other words, that the rough adjustment of the coupling between the coils makes the valve oscillate, and then it has to be brought out of the self-oscillating stage to the best reaction condition.

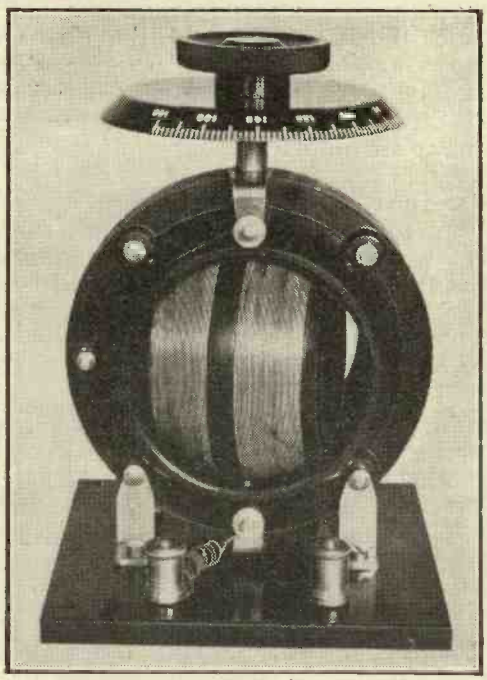


The Vernier two-coil holder.

Variometers

We have received two variometers from Messrs. McClelland & Co., and we made up a receiving set which gave excellent results, and which we propose to describe in next week's issue. The variometers are beautifully finished and work very well indeed. The inductance range is about 9 to 1, and we found that with the standard Post Office aerial the wavelength range varied between 250 metres and 750 metres.

The variometers may be employed either for aerial tuning or for tuned anode circuit use, in which case a small fixed condenser of about 0.0003 μF may be connected across it. A very wide range of wavelengths may be obtained by connecting different sizes of condensers across the variometer. A fine piece of workmanship and a component which may be mounted in any position and used wherever a variable inductance is desired.

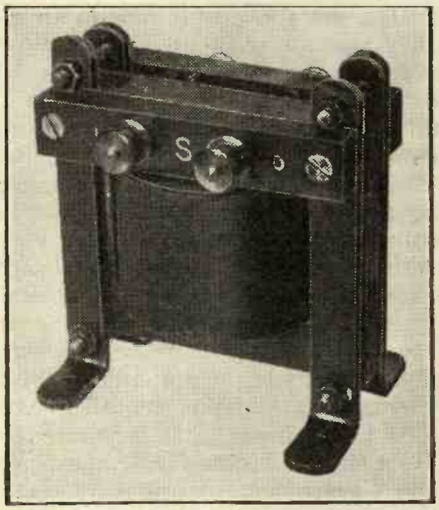


A McClelland variometer.

Intervalve Transformers

We have recently had occasion to test the intervalve transformers supplied at 25s. each by Messrs. Radio Instruments, Ltd. We find that their characteristics are very uniform and identical results were obtained with eight separate transformers. The finish is excellent and the construction sound in every respect.

The amplification obtained with these transformers is above the average, but there is no tendency to distortion or self-oscillation when several valves are used in series for low-frequency amplification. The iron work could do with an extra coat of preservative, as any damp is inclined to produce rust, which, however, does not in any way impair the effectiveness of the transformer.

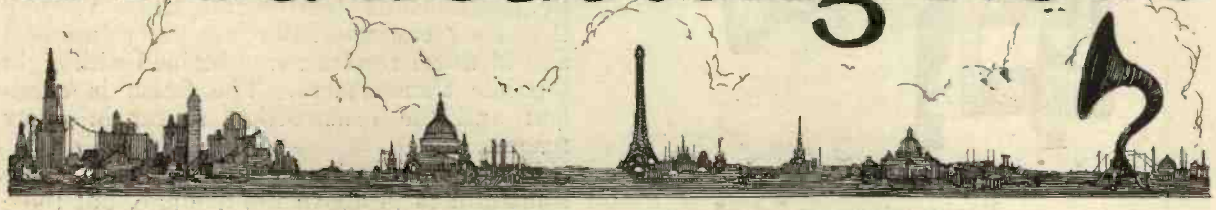


Intervalve transformer by Radio Instruments, Ltd.

Broadcast Major (a Two-valve Receiving Set)

This receiving set, made by Messrs. The Peto Scott Co., is a particularly well-finished piece of apparatus enclosed in a fumed oak cabinet with sloping front and double-hinged lid. Of the two valves, the first functions as a detector and the second as a low-frequency amplifier, separate filament rheostats being provided. The operation of the set is simplicity itself, there being only one tuning adjustment. The internal arrangements of the set are simple, but sufficient. All external connections, with the exception of the telephone receivers, are made to terminals mounted upon a strip of ebonite at the back of the set, and are therefore out of the way when the set is in use. Under test, the results obtained were fully satisfactory. The set represents very good value.

Broadcasting News



BY OUR SPECIAL CORRESPONDENTS.

THE immortal voice of Mr. Arthur Burrows has received much attention in both the technical and general press. I wonder how many of those who fondly believe that the announcements of musical items, etc., are those of Uncle Arthur know that they do not emanate from the popular Director of Programmes of the British Broadcasting Company.

I am sorry to disillusion the thousands of listeners-in who imagine that Mr. Burrows spends his spare time in the evenings in making announcements from 2LO.

Fortunately for him he has two very able lieutenants. One, by the way, is a captain—Capt. Lewis, while the other is Mr. Palmer.

* * *

Every day letters reach the offices of the British Broadcasting Company at 2, Savoy Hill, remarking on the beautiful voice of Uncle Arthur, whereas it is far more likely to have been that of Uncle Caractacus.

Uncle Caractacus, by the way, is a very cheerful and pleasing personality. His voice is undoubtedly an excellent one for broadcasting, but it only modulates the high frequency current in the aerial of 2LO on Tuesdays and Thursdays.

Mr. Palmer, however, apparently works a little harder, and does the announcing on Monday, Wednesday and Friday.

* * *

Mr. Burrows himself, one of the hardest-worked members of the Broadcasting Company, has very little time for keeping directly in touch with his admirers. On Sundays, however, he may be heard making the announcement. I hope we appreciate even this, for it is not all beer and skittles "announcing" from the upper room of 2LO up till 10.30 p.m.

* * *

Mr. Burrows himself is unquestionably admirably suited temperamentally for the work which he carries out. He strikes the interviewer as being not only a genial personality but a vigorous one. There is something decisive in his manner which augurs well for the programmes of the future. He is well aware of the public demand for good programmes, but he does not always get everything his own way.

He has in the first place to keep on friendly terms with the newspaper proprietors and to persuade officials to allow interesting items to be broadcasted.

* * *

One of his difficulties, for example, was in connection with the Boat Race recently. All the technical details had been arranged, but the newspaper proprietors declined to permit the broadcasting of the progress of the race. They stated that under the agreement of the Broadcasting Company with the Post Office no news was to be radiated before 7 o'clock. Hence the disappointment of tens of thousands of listeners-in who had hoped to receive the news red-hot.

* * *

Mr. Burrows has attempted to broadcast other exceedingly interesting items, but he meets with many obstacles which no one knows anything about. There was the trouble of the broadcasting of the King's Speech which we heard about, and there have been other occasions when the Broadcasting Company has been willing to provide very interesting items but has been prevented from doing so by circumstances outside their control.

Obviously public opinion must enable the facilities to be obtained for the Broadcasting Company which at present they cannot obtain for themselves.

* * *

Speaking of voices, and the way that listeners-in do not seem to be able to distinguish between some of the announcers, it is interesting to note that the ambiguity has been caused by what is really a great advance on the old microphone used at 2LO. Formerly a carbon microphone was used and Mr. Burrows' voice was peculiarly suitable for transmissions by means of this microphone. Now, however, four microphones are used which work on the magnetophone principle, and the result is that very much better speech is obtainable, and anyone with a fairly good voice is able to be understood clearly. About the microphone more will be said at another time.

* * *

Many people must wonder whether the announcers do any other work. On enquiry I discovered that announcing is more or less a spare-time—but arduous—occupation. The announcers during the day time work as hard as anyone else, if not more so. Uncle Caractacus, for example, is very busy preparing the programme for the children's entertainment. He is also going to assist in the arrangements for broadcasting items of interest to women.

* * *

There is considerable trouble at the moment owing to the proposed ban on broadcasting theatrical pieces. This, of course, is a very important matter, and it will be a great pity if the Broadcasting Company are unable to broadcast pieces from the theatres. Of course we can understand a poor piece getting the reverse of an advertisement, but a good play would undoubtedly be greatly helped.

* * *

CARDIFF.—Wireless has made considerable progress in South Wales, especially since the Cardiff station commenced operations, and the number of authorised stations in the vicinity of Cardiff is estimated at 1,000.

We understand that crystal sets have sold like hot cakes to residents within 10 miles of Cardiff, and, in general, satisfactory results are being obtained. More or less "blind" spots appear to exist, however, in some of the deep, narrow valleys, and only poor results are obtainable even with two- or three-valve receiving sets.

The broadcasting station itself is, at the moment, experiencing some little trouble, but the "voice" is that of an optimist, and no doubt the difficulty, whatever it is, will soon be overcome.

By the way, the "voice" is a new one, and in extending its owner a hearty welcome, we cannot do better than hope that he will prove as popular as his predecessor, who, we understand, has been recalled to London. The programmes radiated by the Cardiff station have in general been of a high standard and equal to those of other broadcasting stations.

* * *

BIRMINGHAM.—The recent experiments conducted by the B.B.C., in which a concert performed in Birmingham was transmitted to London by land-line and radiated from 2LO, proved a great success from the "listening-in" point of view. The first attempt was not very successful, but upon the second evening the musical items were exceptionally good and probably even better than when the concert was actually performed in the studio at 2LO.

There were, of course, certain periods when over-modulation was apparent, but this was no doubt due to alteration of adjustments made by the engineers conducting the experiments.

* * *

MANCHESTER.—In addition to the regular broadcasting programme which has been successfully carried on for some time at the Manchester station, we learn that a new feature is now being tried. The well-known Paris Time Signals, transmitted by means of the spark system from the Eiffel Tower, Paris, at 10.44 p.m., are received upon a separate aerial at the Manchester station, and by means of special apparatus are made to operate the C.W. transmitting set so that the actual Time Signals are re-transmitted upon the broadcasting wavelength.

The time involved is estimated to be about 1/300ths of a second only. We hope to publish some particulars of the method and apparatus employed in an early issue.

* * *

GLASGOW.—Great interest has been aroused in connection with the transmission of grand opera from the Glasgow broadcasting station 5SC. The apparatus used is identical with that which was employed for the transmissions from Covent Garden Opera House, with the exception that the cable used to convey the speech was of much greater length than in the case of the London station. Additional observation was introduced at the studio of 5SC in Bath Street, which is over a mile from the broadcasting transmitter, and in view of the 2½ miles of cable used in connecting the whole system further amplification was necessitated.

A PROGRESSIVE UNIT RECEIVING SYSTEM

Its Construction and Operation

PART I

A Variable Inductance Tapped at Every Turn

THIS is the first of a series of articles dealing with the construction of different wireless receiving units and the method of connecting them up and operating differently arranged sets. The writer has always favoured the use of component parts which may be interchanged according to the class of circuit in which they are to appear. Given a certain number of component parts, it is possible to arrange innumerable circuits and carry out real experimental work. This is not possible when a complete set is made up. Moreover, there is always a much greater chance of obtaining success with a set made up of components than with one which is mounted on a panel or in a cabinet or box. By the use of separate units it is possible to wire up the apparatus in an infinite number of ways, and many experimental tests may be carried out with great facility.

Tuning Apparatus

The first piece of apparatus to make, is a tuner which will cover the range of wave-lengths desired and one which is interchangeable. There are many different ways of tuning a circuit, but the one we are going to be concerned with involves only a variable inductance. The particular form of inductance it is proposed to describe is one provided with tappings at every turn. One provided with tappings at every 20 turns will be described next week.

Some variable inductances are provided with a switch which will give tappings at every turn up to, say, 10, and another switch which will enable the remainder of the inductance to be tapped off every 10 turns. After careful consideration, the writer has decided to have two variable inductances, each fitted with switches; the first will be called the "single turn" variable inductance and will consist of 20 turns of wire, the coils being tapped off at every turn, the tappings going to studs along which moves a selector switch arm.

If more inductance than 20 turns is required, another unit will be used, this unit consisting of a total of 100 turns, tapped at every 20 turns. By connecting these two inductances in series it will be possible to obtain

Editor's Note

HAVE you ever felt the need of a really progressive course of instruction in the construction of wireless receiving apparatus? There must be thousands of readers who have, at some time or other, wanted guidance from the very beginning regarding the construction of apparatus which will not be discarded the moment some new set is to be constructed; guidance which will be continued, not only until the apparatus is made, but which will be available while the apparatus is actually being used.

There have been so many articles written on the construction of different sets, that the reader is at a loss to know which to make, and if he makes, say, a crystal set, he will have to discard it if he wishes to construct a valve set described by some other author.

It has long been the ambition of the Editor to present a series of articles on the constructing of wireless receiving apparatus, this series to be of a different character from anything which has yet appeared. The reader will be able to start his constructional work to-day, and every week he will be able to construct some new piece of apparatus which will fit in with the other pieces he has already made. He will start with tuners which will first be used in a crystal receiver, but these same tuners which he has made will be used again later when he comes to make a valve set. Full instructions regarding the working, as well as the making, of the apparatus will be given. Standard sizes of wire will be used throughout, where possible, and the same will apply to the cardboard tubes, terminals and other parts employed.

Having very definite ideas on the question of a course of this kind, and to make sure that they will be carried out, the Editor has, in spite of much preoccupation, decided to conduct this section himself. Every piece of apparatus used will be designed and actually tested by himself, and the reader may proceed with the construction of the apparatus with the fullest confidence that excellent results will be obtainable.

Each piece of apparatus will be so designed as to minimise the skill required in constructing it. Moreover, the apparatus will be of a fool-proof character.

Lastly, the whole organisation of the Radio Press will be at your service should you have any difficulty in following the instructions given.

any value of inductance from 1 turn to 120 turns. Another advantage of having two separate variable inductances is that they will be more useful for interchanging in different arrangements of apparatus which we will be discussing later on.

An Inductance Tapped at Each Turn

Inductances may be wound either in a clockwise or anti-clockwise direction. The best way of designating an inductance coil is to say whether it has a right-hand screw or a left-hand screw. An ordinary corkscrew is called a right-hand screw, because to make the corkscrew enter the cork it is necessary to turn the handle round in a right-hand or clockwise direction. An inductance coil wound as a right-hand screw will be similar to a corkscrew. If we take the inductance coil, which we will presume is wound on a cylindrical cardboard tube, and if it is necessary to turn it to the right (*i.e.*, in a clockwise direction) to make it enter an imaginary cork, then the inductance is wound as a right-hand screw (see Fig. 1).

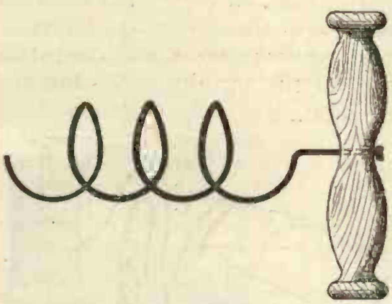


Fig. 1.—A right-hand screw.

If, on the other hand, the inductance coil is wound in such a manner that to make it enter the imaginary cork it is necessary to turn it to the left, or in an anti-clockwise direction, then the inductance is wound as a left-hand screw (see Fig. 2).

It is to be noticed that turning the inductance round the other way does not in any way affect it being a left-hand or right-hand screw. It will be necessary to turn it in the same direction as before to make it enter an imaginary cork.

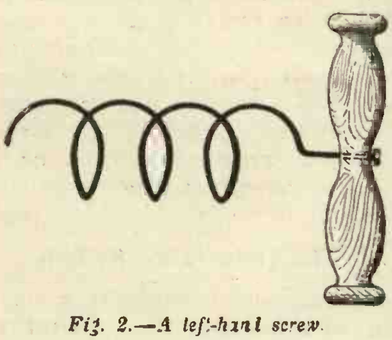


Fig. 2.—A left-hand screw.

Method of Winding the Inductance

The inductance coil is wound for a distance of $\frac{5}{8}$in. on a cardboard tube 5in. in diameter and $1\frac{3}{16}$in. long, and is tapped at every turn, there being 20 tappings altogether, these tappings going to studs over which moves a selector switch arm.

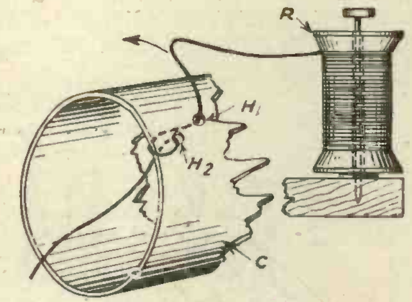


Fig. ... first step in winding the coil.

To the experienced constructor this conveys all the information which is really necessary, except as regards the size of wire, and this is No. 26 s.w.g. double cotton-covered copper wire, which is obtainable from many of the wireless dealers advertising in this journal.

For the benefit of the beginner, however, a detailed explanation of the way the variable inductance is wound and made will be of interest, as different kinds of inductance may be wound in a similar manner at any future date.

Fig. 3 shows the cardboard tube C measuring 5in. diameter by $1\frac{3}{16}$in. in length. About $\frac{1}{4}$in. from the left-hand side is made a hole H1, a similar hole H2 being made close to the edge of the tube and very slightly lower than the other hole. A reel of No. 26 double cotton-covered copper wire is now obtained; a half-pound reel will do, but it is better to obtain a full pound if much experimental work is to be done. The reel may be allowed to rest on the floor, or is preferably fixed to an old table by a nail which will allow the reel to rotate as the end of the wire is pulled.

The end of the wire is slipped through the hole H1, round the end of the tube at the left, and down through the hole H2 and out again, a loose end of about 12in. being left. The wire is pulled tight so that it is secured by the aid of the two holes. Any other method of fastening the wire to the tube will do, but this is sufficiently satisfactory for the purpose. The size of the holes has been exaggerated in order to show how the wire is threaded through them, but in practice they would fit the wire tightly. The wire is now wound round the tube for one turn. A hole, H3 (Fig. 4), is now pierced through the cardboard tube with the point of a pair of scissors or in any other manner. A similar hole, H4, is also made and is slightly below the level of H3 and placed close to the edge of the card-board tube. The hole H3 should be a little lower than the hole H1 and should be about the width of the wire to the right of H1. The wire is now formed into a loop L, and the pointed end of this loop is passed through the hole H3.

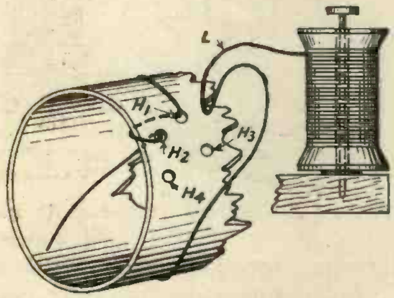


Fig. 4.—Completing the first turn.

Fig. 4 shows the construction of the inductance just prior to inserting the end of the loop L through the hole H3.

Fig. 5 shows the end L of the loop passed through the hole H3. The end of the loop L is now passed through the hole H4, and when this operation is completed the appearance of the inductance is as in Fig. 6. The loop should now extend beyond the cardboard tube for a distance of about 8 to 12in., and should

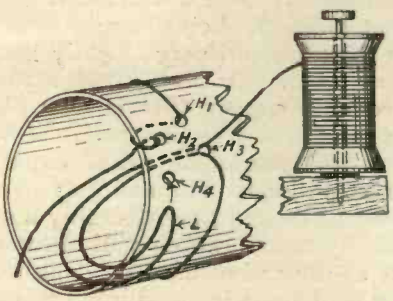


Fig. 5.—Taking the first tapping.

be pulled tight. Having pulled the loop tight, continue winding the wire round the coil, keeping the turns close together.

Another loop L (see Fig. 7) is now made and passes through another hole H6, and is then looped round the hole H5 in the same manner as before.

The same procedure is adopted until 20 tappings have been taken, excluding the wire going to the beginning of the winding, but including the connection to the end of the coil.

Fig. 8 shows the general manner in which each tapping is made.

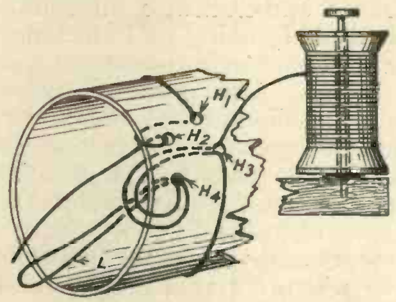


Fig. 6.—The first tapping completed.

Fig. 9 shows another view of the outside of the tube, and shows how the various tappings are taken.

Fig. 10 shows a view of a portion of the inner surface of the cardboard tube.

Fig. 11 shows the completed inductance tube with all the tappings coming out at the left-hand side.

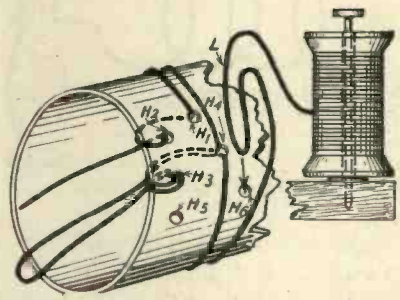


Fig. 7.—Completing the second turn.

The Base-board

The cardboard tube wound with its 20 turns of wire is mounted on a base-board fitted with terminals and a switch.

Two pieces of wood, measuring $3\frac{3}{4}$in. × $3\frac{1}{2}$in. × $\frac{3}{8}$in., are required, and one piece of wood as in Fig. 13, measuring $5\frac{3}{4}$in. × $3\frac{3}{4}$in. × $\frac{3}{8}$in. The Fig. 12 pieces are for the vertical supports, and the Fig. 13 is for the horizontal board on which the tube is actually mounted.

The Inductance Switch

The switch, which is for the purpose of selecting different numbers of turns of inductance, is arranged on a vertical piece of wood dimensioned as above. The vertical

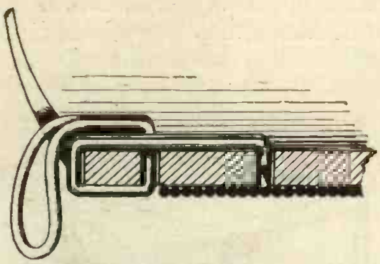


Fig. 8.—Method of taking tappings

piece of wood, with its switch and two terminals, is shown in Fig. 14, and is the next thing to make.

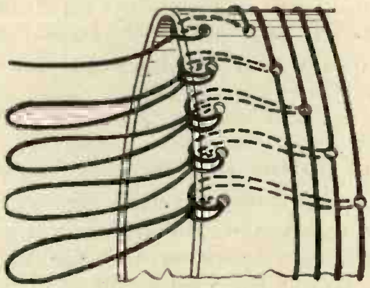


Fig. 9.—Appearance of finished tappings.

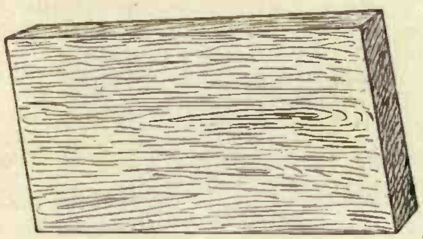


Fig. 12.—Vertical portion of base-board.

Two single "Army" terminals, T1 and T2, constitute the terminals of the inductance. The left-hand terminal T1 goes to the beginning of the coil direct, whereas the right-

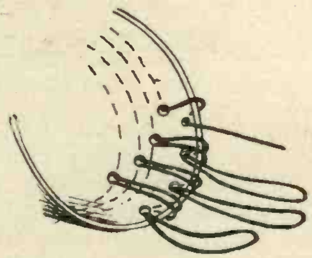


Fig. 10.—Inside of coil showing tappings.

hand terminal is connected to the switch arm. Fig. 15 shows the general lay-out of the vertical board carrying the rotary switch. The holes for the studs are drilled as shown, and the actual studs may measure ¼in. in diameter. The actual diameter of the circle round which the studs are arranged will depend upon the length of the switch arm. This, however, is more a matter of commonsense than anything else, but the reader is advised to separate the studs by a distance equal to about half their diameter.

Fig. 16 shows a side view of the board carrying the switch arm, and Fig. 17 shows the rear of the panel. The letters R and L indicate right and left, and correspond to the letters L and R of the front view of the panel

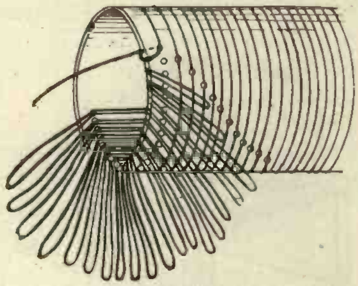


Fig. 11.—Another view showing tappings.

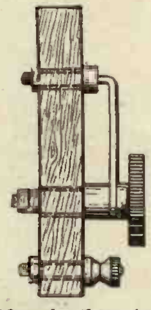


Fig. 16.—Another view of the selector switch.

shown in Fig. 15. It will be seen that the back of the terminal T2 is connected to the switch arm. The first stud (starting from the L side) is No. 0, and is connected to T1 and also the left-hand end of the inductance coil.

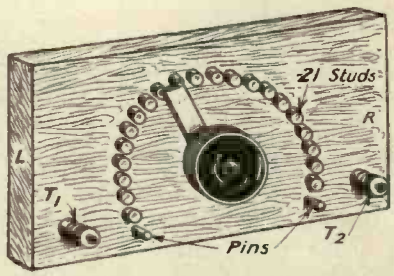


Fig. 14.—Arrangement of selector switch.

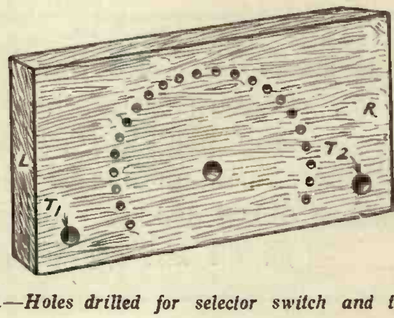


Fig. 15.—Holes drilled for selector switch and terminals.

Completing Base-board

Having constructed the three different boards, the two vertical ones and the horizontal one, they are assembled as shown in Fig. 18, screws or nails being used to secure the top board to the two vertical ones.

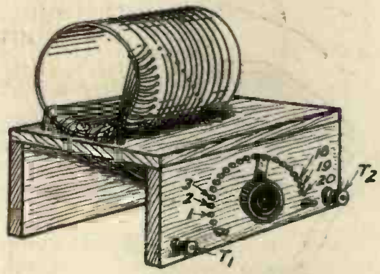


Fig. 19.—The finished inductance.

The only remaining operation is to screw the cardboard tube to the top board and to make connections between the tappings and the studs which correspond to them. There are altogether 21 studs, the one on the left (Fig. 19) being directly connected to the

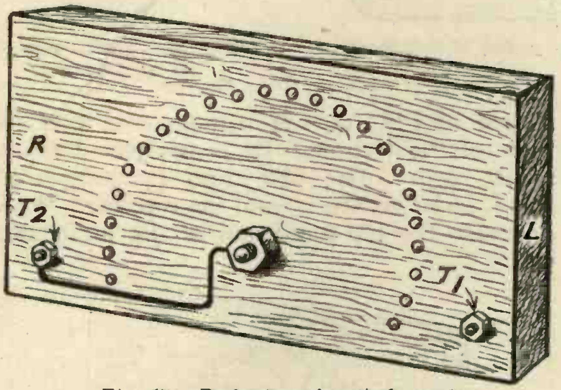


Fig. 17.—Back view of vertical panel.

terminal T_1 at the back of the panel. The terminal T_1 itself is connected to the left-hand side of the coil, in other words, to the beginning of the coil. Stud No. 1 goes to the first tapping, stud No. 2 goes to the second tapping, and so on, the final stud, No. 20, being connected to the right-hand end of the coil, *i.e.*, to the last turn.

The idea of having stud No. 0 is that the whole inductance may be cut out if so desired.

Screws or other projections should be fixed at the end of the arc formed by the studs. These screws should be placed in the same

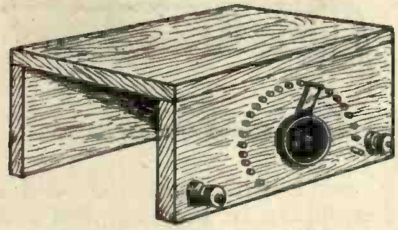


Fig. 18.—Completed base-board.

positions as would be occupied by an additional stud at each end, and they serve to prevent the switch arm from slipping off the last stud. They are merely stops, and no connections are made to them.

Wiring up the Inductance

The backs of the different studs are connected in strict rotation to the different tappings, the loops, which constitute the tappings, being bared at their ends for making

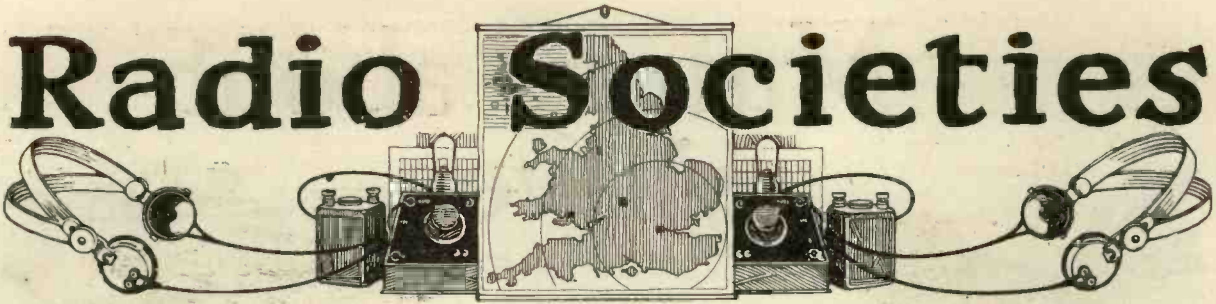
Fig. 13.—Horizontal portion of base-board.

connection to the studs, either by soldering or by means of nuts. Soldering is much to be preferred, and if the loop is too long it should be cut off where desired, the ends of both the wires being then bared, twisted together and soldered on to the back of the stud.

Fig. 19 shows how the completed inductance will look.

Next week's issue of "Wireless Weekly" will give full instructions for making another variable inductance and also a crystal detector. The constructor will then have sufficient apparatus to receive broadcasting, ship stations and experimental telephony transmissions. Further issues will contain full instructions for making combined crystal and valve sets and sets using valves alone. The reader is advised—for his own sake as well as ours—not to miss any instalments.

Radio Societies



THIS page will, in future issues, commence a section of this journal devoted to the needs and interests of British amateur radio societies. We believe that the publication of *suitable* reports will serve as a record of the progress of the society concerned, will enable all societies to know of and appreciate one another's activities and prove of great value to all readers who are members of a society.

The object of all amateur wireless societies may, for all practical purposes, be summarised as follows:—

" To assist and encourage members in the study of experimental wireless telegraphy and wireless telephony, and in the construction of the necessary apparatus."

Substitute the word *readers* for the word *members*, and it will be seen how closely allied are the objects of the amateur wireless societies and ourselves.

Now we well know that, for any society to make creditable progress both as regards its strength of membership and the technical work accomplished, a certain amount of publicity is very desirable, if not absolutely necessary.

But this publicity must be of the right kind. We consider that reports published should, firstly, indicate the *active* existence of the society concerned; secondly, should give technical details, carefully edited if necessary, of any interesting lectures, demonstrations or experiments which have taken place; and, lastly, invite suggestions and friendly criticisms from other societies.

Under these conditions, instead of reading that:

" Mr. John Jones occupied the chair . . . There was a good attendance of members and friends. . . . One new member was elected. . . . The Committee complained that the buzzer practice was not going well . . . (it seldom does) . . . A number of improvements to the Club's apparatus were discussed. . . . Mr. Tom Smith gave an instructive discourse on aerials and seems quite at home on the subject. . . . The evening concluded with a demonstration by Mr. Jim Brown, the apparatus being kindly loaned for the occasion, etc.,"

we should read:

" The Club station is now being equipped with a three-valve receiving set (1 H.F., Detector and 1 L.F., employing tuned-anode intervalve coupling) and a 4-ft. frame aerial wound with three complete turns of bell wire. This apparatus is to be used for directional work in conjunction with a portable small-power spark transmitting set, comprising an ex-Government aircraft transmitter worked from a 4-volt accumulator, 2 light, portable steel masts 20ft. high with a 40ft. 2-wire aerial and wire-netting earth. Preliminary tests will take place in about a fortnight's time, and during the coming summer it is hoped to put in some good work. The Secretary will be pleased to hear from any societies within a 10-mile radius who are agreeable to co-operate in the experiments."

or,

" A meeting of the Society was held on the 21st inst., the lecturer being Mr. John Smith, who spoke on " Methods of High-frequency Amplification." The lecturer stated that in his opinion the best method of amplifying high-frequency currents was to use a tuned-anode circuit, especially when several valves were used for high-frequency amplification. He gave a demonstration on broadcasting with a set in which the intervalve coupling unit consisted of inductance coils, wound for 4 inches with No. 26 gauge double cotton covered wire, on a cardboard tube 3½ inches in diameter; 6 equal tappings were taken from this coil, which was shunted by a variable condenser of 0.001 μF capacity; 2 high-frequency valves were used, and the last valve was used as a detector. On an aerial 20 ft. high and 80 ft. long broadcasting was received from both Cardiff and Newcastle with excellent results."

We cordially invite the secretaries of all amateur wireless societies to send us technical reports for publication in this journal. Literary effect need not be striven for; concise and accurate technical details (and a rough sketch or diagram if considered necessary) are all that we require. All reports should state clearly (1) the name of the society; (2) the name and address of the secretary; (3) the address of the club rooms; and (4) the day and time of regular meetings.

In this matter we do not propose to act as the official organ of any one, but prefer to remain the unofficial organ of all the societies.

Mainly about Valves

A causerie relating to the use of valves. This feature will appear every week and will be conducted by the Editor.

Connecting up the High Tension Battery

THERE are still many experimenters who connect the negative terminal of their high tension battery to the negative terminal of their accumulator. There is no reason why this should be continued, as it is highly desirable that some standard practice should be adopted, not only by manufacturers but also by experimenters.

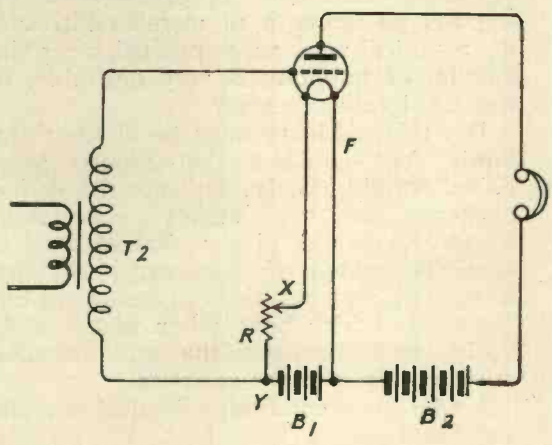
It is a very good plan, whenever more than one valve is used, to connect the high tension battery next to the low tension accumulator and to connect the negative terminal of the high tension battery to the positive terminal of the filament battery. The advantage of doing this is that the total voltage on the anode is increased by the voltage across the filament accumulator, which will usually be 6 volts. Thus, if we were to connect the negative terminal of the high tension battery to the negative terminal of the accumulator, and the high tension voltage were 60, the anode voltage would be 60. If, however, we connect the high tension battery negative terminal to the positive of the accumulator battery, the anode voltage would be 66 volts.

Apart from standardising practice, an economy of 6 volts is effected by doing this, and I know of no circumstances where any advantage attaches to the connection to the negative terminal of the filament accumulator, except, perhaps, when taking measurements of characteristics.

Whenever two pieces of apparatus employing valves are connected to the same batteries it is essential that the high tension battery should be next to the filament battery, and that in those cases the negative terminal of the high tension battery be connected to the same terminal of the accumulator, which terminal should, in my opinion, always be the positive terminal.

The Position of the Filament Rheostat

Another common fault on the part of the beginner is to pay no attention to the position of his filament rheostat. Many who use valve-holder panels do not trouble to look under the panel to see which terminal the rheostat is connected to. The accompanying figure shows the rheostat connected next to the negative terminal of the 6-volt accumulator B1. The electron current from the accumulator B1 flows in the direction of the dotted arrow head, and heats the filament to incandescence. If we assume that the used portion of the resistance R has a value of 3 ohms, and that the current flowing round the filament circuit is 0.7 amp., the voltage drop across the points XY will be 2.1 volts. This means that the point Y is at a potential of – 2.1 volts with respect to the negative side of the filament F.



The circuit shown is a simple low frequency amplifier, and it will be seen that one end of the secondary T2 is connected to the grid and the other to the point Y. It will therefore be seen that the grid has normally a negative potential of 2.1 volts, and this is usually a distinct advantage, because if the grid were connected through T2 to the negative side of the filament F, instead of to the point Y, its normal potential would be zero, and positive half-cycles of alternating current in P2 would cause the grid potential to rise well above zero in a positive direction, and so set up an appreciable grid current due to the flow of electrons from the filament to the grid and round the grid circuit. This grid current would damp out, to a certain extent, the positive half-cycles and distortion would result, also a certain loss of amplification.

Provided there is no tendency to self-oscillation, it is always better to connect the bottom end of the grid circuit of an amplifying valve to the negative terminal of the accumulator, the filament rheostat being connected in the position shown. Care must be taken to see that the high tension voltage is of the right value.

A Note Regarding the ST 45 Circuit

This circuit is one employing a tuned anode circuit with reaction from the anode circuit of the second valve. It sometimes happens that the first valve will oscillate when the reaction is applied, even though this reaction only takes place on the anode circuit of the first valve. This is due to the increasing of the natural retroaction between the anode circuit of the first valve and the grid circuit of the first valve. The effect may be lessened by connecting the bottom of the grid circuit of the first valve to the positive terminal of the filament accumulator, or to a point on a potentiometer across the filament accumulator. This introduces damping into the grid circuit, and should counteract the tendency to self-oscillation.

The effect may also be decreased by connecting a filament rheostat as a convenient form of variable resistance in the grid oscillation circuit in one of the leads to the variable condenser, if such is used.

Variable Gridleaks

It is interesting to note that as the number of people interested in wireless increases, the greater is the variety of the apparatus placed upon the market. For years we have been satisfied with ordinary gridleaks, but now there are several types which are stated to give greatly improved results.

I have tried several of these myself, and am not very happy with the results obtained. This is due to the irregularity of some of the commercial products. A home-made variable gridleak of the kind described in No. 2 of *Modern Wireless* is much more likely to give good results. The trouble about the type of variable gridleak which employs a pencil-line running in a groove is that it is very difficult, in the first place, to get an effective contact with the end of the pencil line, and, owing to the exposure of the leak to the atmosphere and the uncertainty of the contact with the graphite in the groove, this is a difficult problem. Some of the variable gridleaks, moreover, have a very long path, in the form of a groove, along which the electrons apparently have to find their way. Some have to go through veritable mazes before completing their leaky journey, and the road is not infrequently a very rough one.

There is no doubt that a really reliable variable gridleak is required. Considerable advantages result from its use, and much of the distortion in a valve receiver may be traced to the rectifying valve. Let us hope that such a good variable gridleak will be placed on the market. Manufacturers who read these lines might take the hint.

High or Low Frequency Amplification on a Two-Valve Set?

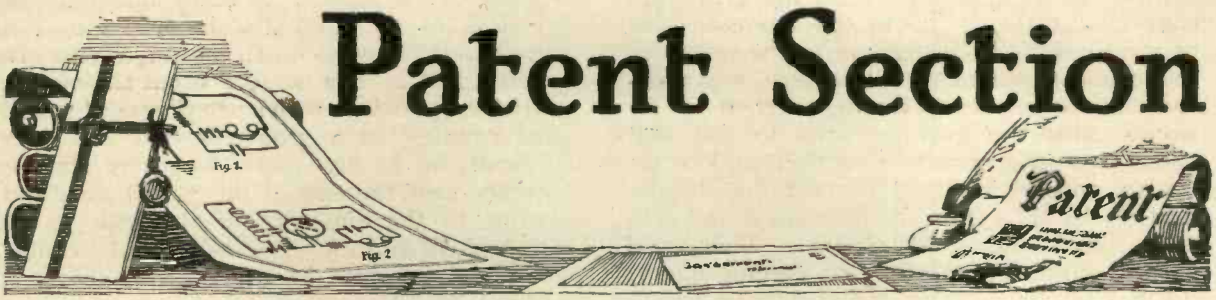
A question frequently asked is: "When using two valves, is it better to use the first as a rectifier and the second as a low frequency amplifier, or the first as a high frequency amplifier and the second as a detector?"

Except in certain cases where long or particularly short ranges have to be covered, there is practically no difference between the results obtained between a "straight" high frequency amplifier valve followed by a detector valve and a detector valve followed by a low frequency amplifier.

If, however, we obtain reaction from the anode circuit of the first valve to the grid circuit of the first valve (which is not permissible in the case of a broadcast receiver), or the anode circuit of the second valve to the inter-valve coupling, provided the latter is tunable, this arrangement is greatly preferable to the ordinary circuit using the valve as a detector followed by a low frequency amplifying valve.

The latter arrangement, however, may be greatly improved by introducing reaction from the anode circuit of the first valve into the grid circuit of the first valve, but this is not permissible for the reception of broadcasting, owing to the danger of self-oscillation.

Patent Section



The following list has been specially compiled for "Wireless Weekly," by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, London, W.C.2, from whom copies of the full specifications published may be obtained post free on payment of the official charge of 1s. each.

APPLICATIONS FOR PATENTS.

7752. AIREY, H. MORRIS.—Generation of waves for wireless telegraphy, etc. March 17th.

7192. ANGUS, A. R.—Devices for charging accumulator cells. March 13th.

7606. BOLITHO, J. B.—Receiving-apparatus for wireless telegraphy, etc. March 16th.

7056. BONELLA, E.—Wireless receiver. March 12th.

7691. BURTON, DELINGPOLE & CO., LTD.—Crystal detectors for wireless telephony, etc. March 17th.

7222. CADETT, E. E.—Means for amplification of audible waves or vibrations in wireless receiving-apparatus. March 13th.

7637. CHAWAY, L.—Inductance coils for wireless receiving-apparatus. March 16th.

7651. DEAN, H.—Electric accumulators. March 16th.

7565. DEAN, H. J.—Electrostatic condensers. March 16th.

7293. GROVES, H. H.—Crystal detectors for wireless reception. March 13th.

7051. HALE, G. W.—Receiving broadcasted signals. March 12th.

7028. HEADLEY, S. T.—Aerials for wireless telegraphy, etc. March 12th.

7072. HEATH, R. J. W.—Combined filament rheostat and holder for wireless valves. March 12th.

7405. HINE, J. J.—Loud-speaking and sound-collecting, etc., apparatus. March 14th.

7413. HYNES, E. W.—Wireless aerials. March 14th.

7052. JOANES, J.—Telephone or headphone terminal board. March 12th.

7075. JONES, T. L.—Switches for variable electric resistances, etc. March 12th.

7610. KIMPTON, W.—Wireless telegraph, etc., apparatus. March 16th.

7562. LEIGH, C.—Loud-speaking telephones. March 16th.

7752. MATTHEWS, C.—Generation of waves for wireless telegraphy, etc. March 17th.

7682. MING, H. E.—Slider and contact bar for wireless tuning-coils. March 17th.

7222. NEALL, J. E.—Means for amplification of audible waves or vibrations in wireless receiving-apparatus. March 13th.

7405. PALMER, G.—Loud-speaking and sound-collecting, etc., apparatus. March 14th.

7579. PARSONS, I. H.—Electric terminals. March 16th.

7071. PHILLIPS, H. C.—Wireless valves. March 12th.

7235. POULTON, G.—Wireless receiving-apparatus. March 13th.

7493. QUAIN, J. R.—Transmitting, recording, or reproducing sound electrically. March 15th.

7372. ROBERTS, V. S.—Wireless telegraphy, etc. March 14th.

7515. ROBINSON, E. Y.—Vacuum electric tubes. March 15th.

7093. ROUND, J. C.—Aerials for wireless telegraphy, etc. March 12th.

7117. SANFTLEBEN, E. A. V.—Crystal detectors. March 12th.

7752. SEYMOUR, C.—Generation of waves for wireless telegraphy, etc. March 17th.

7752. SHEARING, G.—Generation of waves for wireless telegraphy, etc. March 17th.

7622. SHURLOCK, H. H. M.—Telephone, etc., receivers. March 16th.

7028. TEE, J.—Aerials for wireless telegraphy, etc. March 12th.

7117. TELEPHONE MANUFACTURING CO., LTD.—Crystal detectors. March 12th.

7691. TILLEY, J. T.—Crystal detectors for wireless telephony, etc. March 17th.

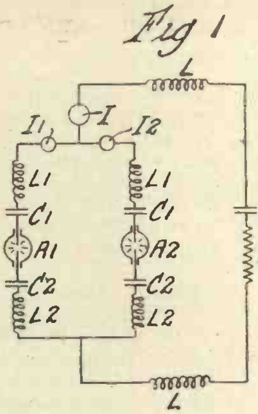
7159. WATSON, A. E.—Variable condensers for wireless telegraphy, etc. March 13th.

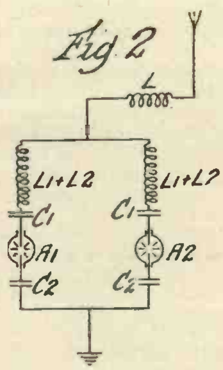
7343. WHITEHEAD, W.—Electric accumulators. March 14th.

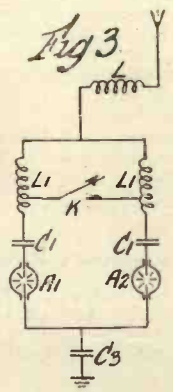
ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED.

192,090. WESTINGHOUSE ELECTRIC & MANUFACTURING CO.—Relates to receiving-apparatus for wireless and like signals employing a back-coupled valve which is set into oscillation by a received impulse and is choked into quiescence immediately afterwards by a negative charge accumulating on its grid; and consists in providing means for controlling the choking effect in accordance with the intensity of the received impulses. (January 22nd, 1923. Convention date, January 20th, 1922.)

192,133. BRITISH THOMSON-HOUSTON CO., LTD.—Duplex wireless signalling apparatus comprises an aerial which is made resonant for two different frequencies by coupling to it a closed oscillatory circuit, one of which frequencies is used for transmission by a generator, and the other for reception by a tuned circuit and detector. In order that the transmission currents may not affect the receiver, a balancing connection is provided between the generator source and the detector, comprising a transformer and phase adjustor, the oscillatory current transmitted thereby being adjusted to neutralise that transmitted from the generator through the aerial circuit and the tuned circuit. (October 20th, 1921.)







Illustrating Patent No. 192,171.

192,140. Donisthorpe, H. St. J. de A.—In thermionic valves, a helical grid, interposed between a filament cathode and an anode, is energised by passage of current, so as to produce magnetic fields which counteract the effect of mutual repulsion on the electrons emitted from the ends of the filament, and prevent the escape of these electrons through the open ends of the anode. In one arrangement both ends of a grid are connected to the positive terminal of a battery, and the middle point is connected through a resistance with the negative terminal, so that each half of the helix produces a magnetic field. In another arrangement one half of the grid is wound in one direction, and the other half in the other direction, the ends of the grid being connected with a battery through a resistance. (October 24th, 1921.)

192,111. British Thomson-Houston Co., Ltd.—In wireless transmission systems of the kind in which oscillations are continuously supplied to a divided aerial system, and signalling is effected by varying the relative phase of the oscillations supplied to the aerials or aerial sections, such phase variations are produced by magnetic controlling devices. The aerials are set apart so that the phase variation produces a displacement of the direction of maximum propagation, and consequently a variation of the strength of radiation in any given direction. (October 24th, 1921.)

192,171. Dowsett, H. M.—In methods of generating oscillations employing more than one arc and in which two condensers are arranged between like electrodes, the output circuit being connected between these condensers, each of the inter-arc condensers is made large compared with the condenser in the output circuit. Preferably inductances are also included, the two arc circuits being electrically equivalent. (October 28th, 1921.)

192,185. Three Star Accumulators, Ltd., and Kendall, C.—A tight joint is made between the lid of a storage battery and the container by means of a rubber washer which is held in a rectangular groove in the lid and bears on the flat upper end of the container. The lid is pressed down by means of a ring which bears on the upper surface of the lid, the lower surface being of a smaller diameter so as to enter the mouth of the container. (November 2nd, 1921.)

Fig 1

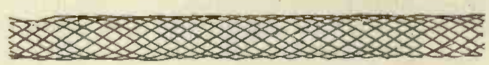


Fig.2

Illustrating Patent No. 192,272.

192,272. Sutton, J. F.—Electric inductance coils of insulated wire for wireless telegraphy or other purposes, of the kind wound in superimposed layers with the turns spaced apart and crossing at an angle to give the coil a latticed or cellular structure, are wound so that the wire describes a semi-wave form on the periphery of the coil. In the case of narrow coils, the spacing of the turns and the angle at which they cross are thus increased. The wire may describe about 50 complete cycles of a semi-wave in every 24 turns of the coil. The coil may be wound on the machine described in Specification 189,376. (January 21st, 1922.)

192,285. British L. M. Ericsson Manufacturing Co., Ltd., and Crowe, W. M.—In an electromagnetic relay having two or more electromagnets, with corresponding armatures and contacts, mounted on a common yoke forming part of the magnetic circuit of each of the magnets, the magnets are arranged alternately on opposite sides of the yoke. The contacts and armatures (which may be of pivoted or knife-edge type) are also alternately arranged, the contacts proper to one magnet being adjacent to and on the same side of the yoke as the next magnet. (February 3rd, 1922.)

The Practical Electrician's Pocket Book, 1923. (S. Rentell & Co., Ltd. 3s. net.)

This is the twenty-fifth annual issue of this red-coated manual, and the editor appears to have celebrated the quarter century by making the book, if possible, more valuable than ever to its numerous readers. Various sections have been most carefully re-written. For instance, the chapters on Steam Boilers, Motor Control Gear, Portable Electric Tools, Flexibles, Railway Signalling, and Fuses, have all received attention, and more Special Wiring Systems have been added in order to keep pace with the times. The most recent developments in Electric Welding are treated by an expert, and an entirely new chapter has been added on Wireless Broadcasting. Further, the useful set of Central Station Tables now includes the commencement of a new table showing the average number of units used per annum by consumers taking supply under rateable value tariffs. This, we believe, is information nowhere else obtainable, and is distinctly useful to central station engineers. Absolute reliability is essential in any work which gains a place in the City and Guilds list of "Works of Reference," as has been done by this hardy annual, and the publishers aim at maintaining that reputation to the best of their ability. The book is compact and well printed, and covers a very wide ground in a concise and practical way which should ensure it an ever-increasing sale throughout the whole electrical profession.

"How to Erect Your Own Wireless Aerial." By B. E. G. Mittell, A.M.I.E.E. (London: Radio Press Limited. Price 1s. net.)

This is No. 4 of the Radio Press Wireless Series, and deals in a complete manner with the erection of aerials for experimental work. Details are given regarding numerous different kinds of aerials, and the author speaks with some authority, as his experience is based on many years association with the firm that has erected probably more aerials in various parts of the world than any other.

Although more at home with, or, rather, on, 400-ft. masts, the author applies scientific principles to the erection of the experimenter's aerial.

There is more in erecting an aerial than meets the eye. Some of the vital parts of the aerial-earth system never meet the eye at all, with the result that they are often neglected. Mr. Mittell unearths these facts, if such a term may be used in this instance.

"Small Lathes — Making and Using." (London: Cassell & Co., Ltd. Price 1s. 6d. net.)

This is one of the well-known "Work" handbooks which relate to different handicrafts. Anyone who wishes to make really presentable wireless apparatus will, sooner or later, want to use a lathe. Those who wish to construct a serviceable tool, either a simple type of wood-bed or a 2½-inch centre lathe with back-gear and slide rest, will be well advised to buy this admirable little book, which is one of a series edited by Mr. Bernard Jones, whose long experience in this class of literature enables him to bring to bear an unerring judgment in supplying just that information which is wanted.

Please Mention Ye Paper

This is what Caxton printed at the foot of each advertisement page of the first periodical printed in this country.

The same formula is used to-day. Some even go so far as to say that you get better service by mentioning the paper when replying to advertisements. Don't you believe it! It doesn't matter a brass farthing whether you mention the paper or not.

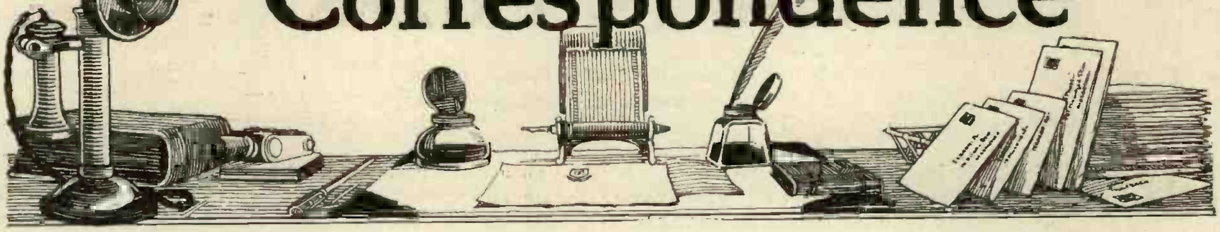
What does matter is the hard commercial fact that without advertisements the whole quality of a periodical must fall off. If "Wireless Weekly" does not become the premier weekly advertising medium we will not be able to keep up its standard. *You* can help by "mentioning ye paper."

We ask this favour but do not try to beguile you into thinking you'll benefit from the advertiser. It is simply the sporting thing to do and we are confident that, if you like our paper, you will oblige us by a little act of courtesy which will be to our ultimate mutual advantage.

We will see to it that ample text pages are provided every week.

We respectfully ask you to ORDER YOUR REQUIREMENTS from Advertisers in "Wireless Weekly."

Correspondence



EFFECTS OF NEIGHBOURING AERIALS

To the Editor, Radio Press, Ltd.

SIR,—I have noticed an effect which, whilst very annoying to myself, has a certain technical interest, and it would be interesting to know whether any other of your readers have experienced the same trouble.

My house adjoins that of a neighbour who has also fitted up an aerial which runs parallel to my own and very close to it.

At times, when receiving signals, they have become very much feebler, and thinking that this was due to fading, it was not until recently that I discovered that the trouble occurred when my friend—or friend that was —also listened-in at the same time. It seems that when the two aerial circuits are both tuned in to a signal, one aerial deprives the other of a considerable portion of its energy, and, on enquiry, I discovered that my neighbour had also noticed a similar effect.

I would like to know whether there is any method of preventing this trouble, and whether the experience I have related is something unusual or whether other listeners-in have met with the same phenomenon.

I am, etc.,

Basingstoke. SNOOKS.

SHOULD THEATRE BROADCASTING BE BANNED ?

To the Editor, Radio Press, Ltd.

SIR,—I have read with interest in the daily Press that a Committee of Theatre Managers are proposing to discourage the broadcasting of plays.

Allow me, as the father of a family, to add my protest to those of the theatrical managers.

Not only has the apparatus cost me a considerable sum, but after "The Lady of the Rose" my wife insisted on my taking her to see it. The real trouble, however, arose through us listening-in to "Cinderella." The whole family, especially the younger members, were so delighted that they simply had to be taken to see the actual piece. Listening to loud laughter when nothing humorous had been said, apparently was too tantalising, and it was obvious that half the humour lay in what was done rather than in what was said.

I hope you will do what you can to back up the theatrical managers.—Good luck to them!

I am, etc.,

Gouldburn. DEFLATED.

CARBORUNDUM WITHOUT A POTENTIOMETER

To the Editor, Radio Press, Ltd.

SIR,—Most experimenters with crystal receiving sets have tried various crystals and many appear to have arrived at the conclusion that Hertzite, Galena, or Silicon cannot be surpassed. Certainly these crystals are very sensitive and yield excellent results, but being most unstable cannot be considered really satisfactory. As a genuine experimenter I wilfully depart from all rules and the conventions laid down by experts who invariably say that the carborundum crystal will not work without an applied potential. I purchased several carborundum crystals at different shops, soldered them firmly into crystal cups, and have had better results with them *without* any applied potential than I have had with any other crystal. Upon first obtaining such results I suspected that my particular crystal was an unusual sample, but have since bought other crystals and obtained similar results.

I find that a piece of filament-resistance wire making firm contact at almost any part of the crystal gives excellent results, and, moreover, is quite stable and will withstand even rough or careless handling. I reside about six miles from 2LO, and the music etc., is very loud indeed. I shall be pleased to learn whether any other readers have experimented along these lines.

I am, etc.,

C. MULCH.

Hornsey, N.8.

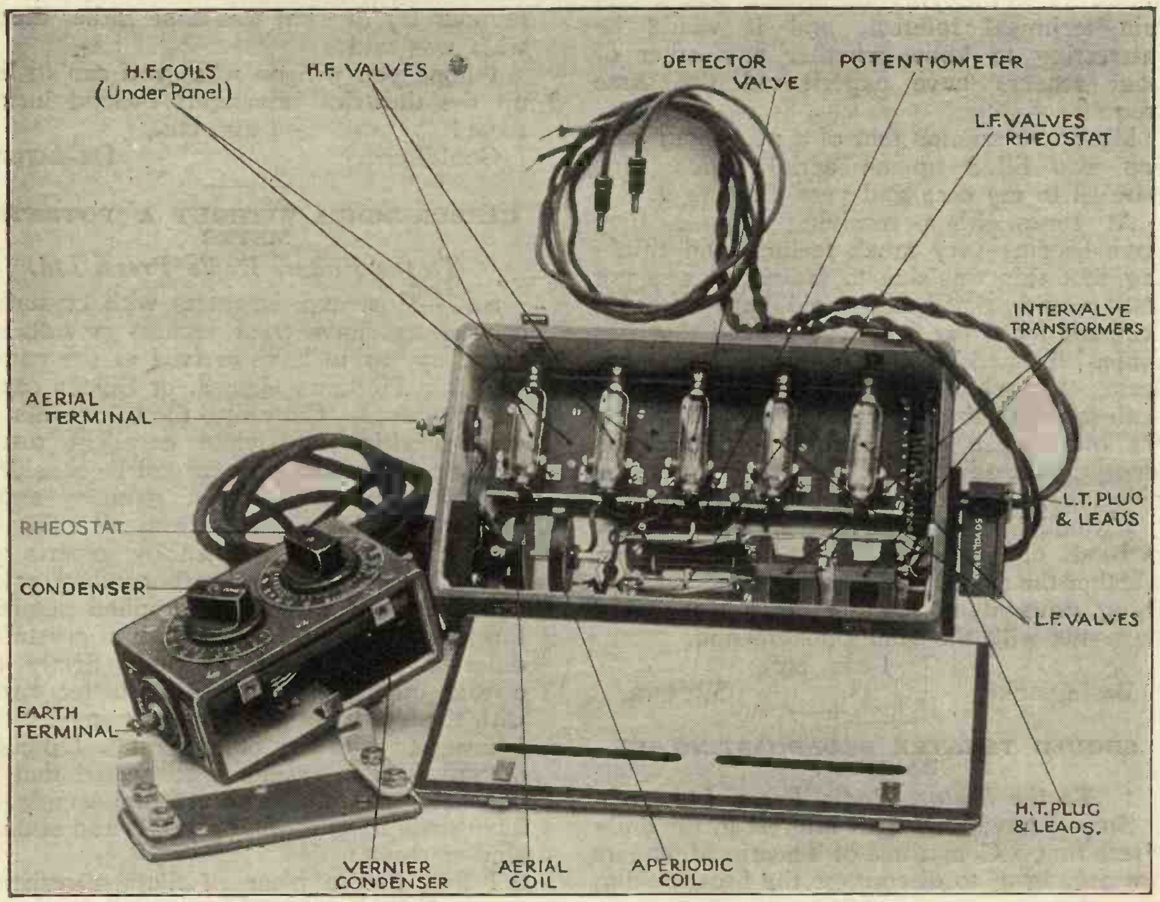
£250 IN PRIZES

A competition of particular interest to the genuine amateur experimenter.

READERS of this Journal will be interested to note in our business pages particulars of a competition organised by the City Accumulator Company in connection with the R.A.F. Type 10 Aircraft Receiver. This receiver, although never actually used, was designed at the close of the war for use on aeroplanes. The apparatus was intended for the reception of wireless telephony signals on a wavelength of 440 metres.

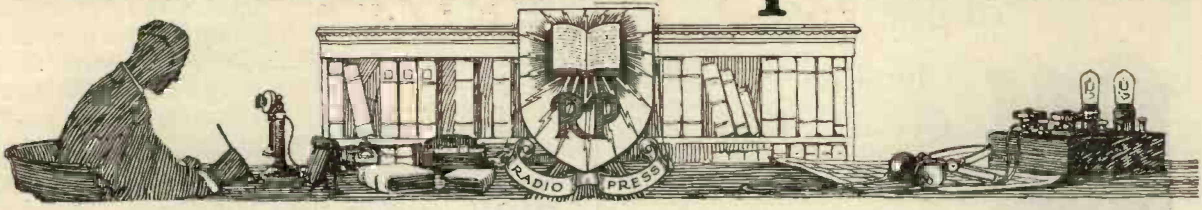
The instrument is a five-valve set, the first two valves acting as high-frequency amplifiers, the third as a detector, and the last two as low frequency amplifiers. A number of these instruments are now being placed on the market, the actual number, however, being only 400. The City Accumulator Company are offering prizes to the total value of £250 for the best suggestions for converting these instruments so that they will work on a wavelength range of between 300 and 3,000 metres. In other words, the apparatus should be capable of receiving not only the British broadcasting stations, but also the Eiffel Tower transmissions on 2,600 metres.

We hope in our next issue to give fuller technical details of the set, showing the present circuit diagrams. Those of our readers who propose entering for this competition will be able to exercise their ingenuity in re-designing the apparatus, as much of the original instrument being used as possible. The chief alterations, of course, will be those relating to the high-frequency amplification circuit.



We may state here that we are at all times willing to place our columns at the disposal of manufacturers who desire to encourage design work amongst genuine experimenters.

Information Department



Conducted by J. H. T. ROBERTS, D.Sc., assisted by A. L. M. DOUGLAS.

In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query" and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed. As this is our first issue, we have used questions which Radio Press had on hand.

W. A. B. (EASTFIELD) asks for a good receiving circuit employing one high-frequency valve, a rectifier and two low-frequency valves. He wishes to obtain reaction either into the high-frequency transformer or the aerial circuit.

Suitable circuits are Nos. ST. 48 and S.T. 49 in "Practical Wireless Valve Circuits" (Radio Press, Ltd.).

J. M. T. A. (NEWCASTLE) asks what a potentiometer is.

A potentiometer is a resistance usually connected across a source of small E.M.F., such as 2 or 3 dry cells or a 6-volt accumulator, in order to supply a very small potential to a point connected to the sliding contact of the potentiometer in such a way that a wide range of adjustment, although only over a small total electrical pressure, can be secured. This device is of particular use for controlling the potential upon the grids of valves amplifying at radio frequency.

D. B. (BIRMINGHAM) asks what the purpose of a telephone transformer is.

A telephone transformer is inserted in the circuit of a receiver in place of high resistance telephones so that, firstly, the telephones may be isolated from direct contact with the high-voltage circuit; and, secondly, so that low resistance receivers may be used which have considerably greater strength and consequently immunity from breakdown, both mechanical and electrical, than high resistance 'phones have. This point is especially of value where a loud speaker is connected in the anode circuit of a valve receiver operating with a high potential on the plate of the last magnifying valve. Low resistance telephones cannot be connected directly in the detector circuit, because there are so few turns of wire upon the magnet poles that a sufficiently intense field is not produced to energise the diaphragm by the current rectified by the detector.

E. G. G. (EDINBURGH) asks whether basket, honeycomb or single layer coils are most efficient for reception of short waves on a crystal receiver.

There is very little to choose between any of the three types of coil mentioned. Honeycomb or single layer coils should be used in preference to the basket pattern, but frequently the basket type is more suitable where space is restricted. The difference in their electrical efficiency is negligible.

H. C. V. (HOLLEYWOOD) asks whether it is better to use magnetic reaction or capacity reaction on wavelengths above the broadcasting band, and also the lowest wavelength on which it is possible to obtain satisfactory reaction by the electrostatic method.

Magnetic reaction and capacity reaction are both equally efficacious. The advantage of magnetic reaction is that it is very much more easily controlled than electrostatic or capacity reaction, and also that it is more suitable for short wavelengths. On the other hand, capacity reaction is very handy over the upper wavelength, as a small condenser will cover any value between about 1,000 and 30,000 metres.

BEGINNER (ACTON) asks if he can erect an aerial across a public road.

We believe that provided the aerial is over 30ft. from the ground and that the permission of the local surveyor is obtained, there is no restriction on the erection of such an aerial. It is not, as a rule, difficult to obtain permission of this nature where the aerial is to be erected over a side road or quiet thoroughfare, but where there are electric tram wires or telephone wires running along the street, it is most likely that permission would be refused. The aerial should be as high as possible, as it will probably be badly screened.

HUGH (BEXHILL-ON-SEA) asks whether better signals would be obtained if he used 2 crystal detectors than 1 detector.

It is not a practical proposition to use two crystal detectors as rectifiers together. One detector may be arranged to act as a stand-by to the other, and with careful adjustment good results might be obtained by two detectors working in parallel; but generally speaking, the results would be very disappointing, and much better signals would be obtained from one rectifier alone.

E. Q. (WOOLWICH) asks whether it is better to use a variometer, or a coil and condenser for aerial tuning.

The variometer method is the more efficient for aerial circuit tuning. The reason for this is that all the wire in the tuner is constantly in circuit and there are no losses due to either dead-end or series capacity effect. Variometers are, as a rule, only used for short wave reception on account of the difficulty of winding a sufficient amount of wire on to the formers, whilst at the same time keeping them to a reasonable size. The wire on the variometer should not be so fine as to offer appreciable high-frequency resistance. A series condenser inserted between a tuning coil and the aerial or earth side of the circuit generally gives about the same results.

ANXIOUS (BELFAST) asks whether the life of a valve is shortened by using a higher plate voltage than the normal.

The use of a plate voltage higher than the normal, provided this increase does not exceed too much the normal working voltage, will not appreciably shorten the life of the valve. It is increase in filament current which reduces the life of a valve to a considerable extent, because the filament becomes attenuated in course of time owing to oxidisation taking place, and in consequence it becomes less and less able to withstand the current flowing through it as more and more is required to obtain the same electronic emission. The plate voltage will, of course, vary in the case of every individual valve, and the correct value should be found by experiment. The novice is advised to adhere to the instructions furnished by the maker with the valves.

A. M. O. (ILFRACOMBE) asks what the natural wavelength of a standard P.M.G. aerial is.

The natural wavelength of an aerial is practically four times its length in metres. It should thus be sufficiently obvious how to calculate the length of one's own individual aerial.

A. D. (DOVER) asks what the capacity of a condenser for electrostatic reaction should be.

This depends on the range of wavelengths which it is desired to cover. If the reaction condenser is .000005 μF in value, it will react down to about 100 metres and up to about 12,000. If it is .00001 μF in capacity it will react down to about 1,000 metres and up to 30,000, and would, of course, react above that wavelength. Whatever pattern of condenser is used it should have a micrometer adjustment for very fine regulation of the capacity.

N. V. P. (LINCOLN) asks what is meant by saying that a valve is soft or hard.

A valve is said to be hard, generally speaking, if the vacuum is high; conversely, the valve is soft if the vacuum is low. These two types of valves work on entirely different principles when used, for instance, as rectifiers, but we may state that in general a soft valve is the best rectifier and the hard valve is the best type for high and low frequency amplification. A soft valve can readily be distinguished from a hard valve because it requires a lower anode voltage to function efficiently, and if the anode voltage is raised much above the normal, its amplifying powers cease to increase. A hard valve, on the other hand, will increase the amplification by a considerable extent after the normal anode voltage has been exceeded. Soft valves will also glow with a pale blue light inside when the anode voltage is too great owing to ionisation taking place, whereas a hard valve will not exhibit these symptoms.

R. D. K. (CALAIS) asks for particulars of the aerial circuit coil and grid coil for a C.W. and telephone transmitter working on 180 metres wavelength.

The aerial circuit coil for this transmitter should consist of 30 turns of either $\frac{3}{16}$th brass strip or 14 gauge copper wire used in duplicate on a former 6in. in diameter, the turns being spaced apart by a distance equal to their own diameter. The grid coil which will react into this may consist of a winding of 40 turns of a No. 20 or 22 gauge D.C.C. wire wound upon a cardboard tube 4in. in diameter, sliding into the aerial coil. It will not be necessary to have tappings on this grid coil. If the aerial used for this short wave transmission is very long, it may be necessary to insert a series condenser to reduce the wavelength. This may be of a value of about .0005 μF.

AMPLIFIER (WALTON-ON-THE-NAZE) asks how he can calculate the frequency corresponding to a given wavelength.

The frequency of a given wavelength is found by dividing the wavelength in metres into 300,000,000.

M. L. (FOREST GATE) asks whether he could use a sparking plug as a lightning arrester.

This proposal is quite a sound one. The aerial should be connected to the centre electrode of the plug and the earth to the outside point, that is, the metal casing. Care should be taken that the points of the sparking plug are nearly closed, so that there is only a very small gap between them. To avoid any ambiguity on the subject, it may be stated that the gap between the points should be just sufficiently great to allow a piece of thin writing paper to pass through it.

C. H. E. (LEEDS) asks how he can find out the correct charging rate for an accumulator of a certain capacity.

The charging rates for accumulators may be taken to be based upon an allowance of 10 amperes rate for every 100 amperes actual capacity of the cell. That means that an ordinary ignition accumulator (which has a rated capacity of 100 ampere hours and of 50 ampere hours continuous) would have a charging rate of 5 amperes. This will be found to be a safe rate to allow. We may point out that nothing puts an end to the useful life of an accumulator so quickly as excessive charging and discharging, and if any further information on this subject is desired we shall be very glad to answer it through these columns.

S. O. S. (BIRMINGHAM) asks the approximate internal plate-filament resistance of a V.24 valve.

The internal resistance, so far as the current flowing through the plate circuit is concerned, varies slightly according to the part of the characteristic curve on which the valve is worked. The average resistance of a V.24 valve may be taken to be from 20,000 to 50,000 ohms.

SPARKS (BARROW-IN-FURNESS) asks whether a 2-electrode Fleming valve is any improvement on a crystal for reception.

The Fleming valve is not really an improvement on the crystal as far as sensitivity goes, but, of course, the valve is much more stable and does not require constant adjustment like a crystal. We would advise you not to attempt the use of a two-electrode Fleming valve, but to use a good crystal in your receiver as a rectifier.

ENQUIRER (TEXAS) asks whether he can wind simple inductances for crystal reception on tins, such as cocoa tins.

It is useless to attempt to wind an inductance upon an iron former such as the tins you suggest. The effect of the metal is to form a closed metallic circuit which will reduce the inductance effect of the windings to a negligible quantity. You should make your formers out of cardboard well shellaced.

B. R. (DEVIZES) asks for the simplest possible winding for an efficient inter-valve transformer for a single stage of low-frequency magnification which will give him the maximum signal strength.

On an iron core $\frac{3}{8}$ of an inch in diameter, formed of soft iron wire bound tightly together, wind half an ounce of No. 44 gauge single silk-covered wire for the primary winding, and $1\frac{1}{2}$ ounces of the same wire for the secondary winding. These windings must be well insulated from each other and from the core. This transformer will be found to give a good magnification ratio, but should not be used for more than one stage, owing to the thin wire with which it is wound.

H. V. (HULL) asks whether he can use a valve to magnify the speech from an ordinary land line telephone, and if so could we give him an idea of the circuit required.

This is quite a feasible plan, and can be done in two different ways. In both cases a two-valve low frequency amplifier should be used. In the first case the two leads to the ordinary telephone receivers should be connected to the input terminals of the low frequency magnifier, and in the second case an ordinary microphone and battery is connected in series with the input transformer of the amplifier, and the microphone placed against the ear-piece of the telephone receiver. The second arrangement is the better of the two, as there is not then so much magnification of other noises in the line besides the speech.

N.B.—The Post Office do not allow any alteration to be made to their instruments.

H. S. W. (LOWESTOFT) asks what is a "Jigger."

A "jigger" is the name sometimes given to a loose-coupled tuning inductance, either for transmission or reception of wireless messages. The term is almost obsolete nowadays, and is probably only used still in connection with spark transmitters.

Printed for the Proprietors, Radio Press, Ltd., Devereux Court, Strand, W.C.2, by The Cornwall Press, Ltd., Paris Garden, Stamford Street, London, S.E.1. Published on Wednesday of each week at 3, Bolt Court, Fleet Street, London, E.C.4. Address for Subscriptions and Editorial communications:—Devereux Court, Strand, London, W.C.2. Advertisement Managers:—The Scheff Publicity Organisation, Ltd., 125, Pall Mall, London, S.W.1. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates:—[illegible] per annum, [illegible] for six months, post free. Sole Agents for Australasia:—Gordon & Gotch (Australasia), Ltd. For Canada:—Imperial News, Ltd. For South Africa:—Central News Agency, Ltd.

Wednesday Vol. 1. No. 2. April 18th, 1923

Wireless Weekly

SIXPENCE
NET

Edited by
John Scott-Taggart F.Inst.P.

Wireless Weekly

Vol. 1. No. 2.
April 18, 1923

CONTENTS

Editor: JOHN SCOTT-TAGGART, F.Inst.P.
Assistant Editor: E. REDPATH.

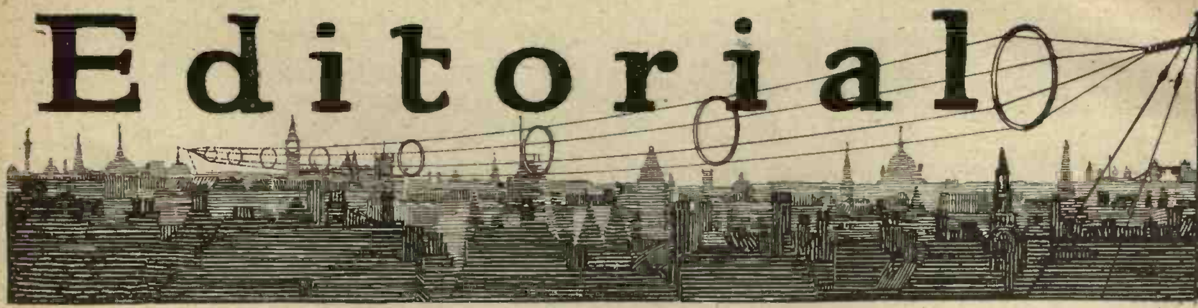
Scientific Adviser:
Prof. G. W. O. HOWE, D.Sc., M.I.E.E.
Advisory Editors:
Prof. R. WHIDDINGTON, M.A., D.Sc.
Prof. C. L. FORTESCUE, M.A., M.I.E.E.

Radio Press, Ltd.
Publishers of Authoritative Wireless Literature.
DEVEREUX COURT, STRAND, W.C.2.

Staff Editors:
J. H. T. ROBERTS, D.Sc.
E. H. CHAPMAN, M.A., D.Sc.
A. D. COWPER, M.Sc.
G. P. KENDALL, B.Sc.
A. L. M. DOUGLAS.
R. W. HALLOWS, M.A.

RADIO PRESS

All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."



CANNOT SOMEONE *ACT?*

At the moment of going to press, the licence position remains unchanged.

SOMETHING must be done at once. The licence position is a great deal more acute than the great majority of those in authority know. There are at least 200,000 would-be experimenters who are furious at the present state of affairs. Perhaps it is only the Press that appreciates fully the present position, and certain sections of the Press, in their endeavour to expedite matters, only make them worse.

Recently an influential daily paper went so far as to suggest scrapping the British Broadcasting Company altogether. They stated that the programmes were poor and the monopoly of the B.B.C. pernicious. That such an attitude should be taken up by a large daily paper is due solely to the impossible situation which has arisen with regard to the issue of licences to would-be experimenters.

The threatening clouds bode no good, either to the B.B.C., the manufacturer, or, in the end, the listener-in himself. To talk of disbanding the B.B.C. is, of course, sheer rubbish. Those who are in favour of throwing open the ether to a number of organisations, obviously have given the matter only cursory attention. The present position, however, which by some is attributed to the B.B.C., is enough to make even clear-headed people talk wildly.

Why has nothing already been done? The position is not a new one. It has been in existence for months and months. Over four months ago the Wireless Society of London sent a deputation to the Post Office to recommend the free granting of experimental licences at a figure which would enable the Broadcasting Company to derive revenue. It is all very well for those in authority to say: "These matters cannot be dealt with in a day." Apparently they cannot be decided within a year. It is a pity that someone at the Post Office cannot cut the Gordian knot and say: "This shall be done." The present position apparently is that for months they have been receiving all sorts of different opinions from different quarters. It is for the British Post Office to make a decision, and make it quickly. If they wait for all the opposed interests to compromise amongst themselves, they will have to wait till Doomsday.

State-aided broadcasting is something unprecedented and there are, no doubt, many constitutional purists who will seize on this fact with alacrity.

The unfortunate position is that, instead of all the wireless interests getting together and settling the matter, a position has arisen which has been developing over a long period, and it is inflaming not only the constitutional purists, but hundreds of thousands of those interested in wireless. The result of this strong feeling is reflected in the lay press, in which all sorts of impossible remedies are advocated.

We, at least, cannot be considered as not knowing the inner history of the whole position, and we know that something must be done at once, and *that* something is the immediate granting of constructional licences.

The time has gone when we smugly remarked that these applications for experimental licences did not come from people who wished to carry out research work of national importance. Of course, they do not. They want to listen-in to broadcasting, and then later, probably, do more valuable work. Ninety-nine per cent. of those at present interested in wireless are interested in it merely as a hobby. The whole business has for a long time been a farce, and farces can never continue when those clamouring for a remedy are numbered in six figures.

Unless we get this matter settled immediately, the Broadcasting Company and the manufacturers, and also the experimenters, will lose all the advantages which they have already gained. Awkward questions will be asked in Parliament, the daily press will seize on this as an excuse for flaming headlines, and the whole progress of organised broadcasting will receive a severe check.

All of us know that from a constitutional standpoint, State-aided broadcasting raises the gravest issues. We all want good broadcasting, and we all need the British Broadcasting Company, provided it carries out its duties adequately. Whether we want sets marked "B.B.C." or not, raises another important question which we will not discuss here; the main matter is the issue of constructional licences. This licence will go to alleviate eighty per cent. of the present discontent.

There is always a section which is apt to smile in a self-satisfied manner at the declamations of the press. "Sitting tight" is an art at which some people are adept, and they are supercilious at attempts to get them to *do* something. Three Postmasters-General have considered this matter in turn, but this is not sufficient excuse to justify the delay. Unless something were said about the matter, probably half a dozen more Postmasters-General would consider the whole subject.

The Radio Society, a large section of the manufacturers, and the B.B.C., have agreed on the general issues, and there is no excuse for any further delay. Let the Post Office *act.*

THE VAST RANGE OF ETHER VIBRATIONS

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

In the following exclusive article the famous scientist deals with this most fascinating subject in a masterly way.

IT is of interest to call attention to the fact that what is called the spectrum—that is to say, the known range of vibrations in the ether—is now nearly complete. By different methods it is now possible to detect and obtain rates of vibration ranging from those of quite low frequency, expressed by such small figures as 1, or even a fraction, per second, up to those which are so immensely rapid as to be almost uncountable.

To deal with the slow ones first, the capacity of a farad joined to an inductance of a henry would have an oscillation period of 6 seconds, which is about the same as the oscillation period of a charge upon the sun. On the earth a charge would complete an oscillation in the seventeenth part of a second. A μF connected to a henry of inductance would oscillate a thousand times in six seconds, and so generate a feeble wave 1,800 kilometres long. To get anything like strong radiation we must quicken the rate of vibration, and shorten the wave; but a very practical wave, 1,800 metres long, with a frequency of vibration about 170,000 per second, can be got by coupling a milli-micro-farad, or 9 metres capacity, to a milli-henry, or 10 kilometres inductance. It is still easier to get waves of great intensity only a few metres long. A wave of 300 metres has an oscillation frequency of a million per second; and with care and precautions these so-called wireless waves can be shortened in the laboratory down to something like a centimetre, which would correspond to thirty thousand million vibrations per second.

So already the electrical rates of vibration are getting considerable, but still nothing like those which we have learnt to associate with ordinary light.

The range of luminous vibrations, that is, those which can affect the eye, and therefore are popularly called light, is, as is well known, limited to "an octave" ranging from about 400 to 800 millions of millions per second. But below the visible range we have the infra-red, sometimes called "heat" waves, extending downwards without anything but an experimental limit, till they almost reach a range of extremely high electrical vibrations, such as those above mentioned, rising up to meet them. Electrical vibrations go on extending downwards, through the great range of wireless waves, with frequencies of anything from a million to, say, ten thousand per second, to the slow oscillation of large capacities joined to great inductances, such as one might have in a transformer station, or with alternating dynamos; it being understood that the radiation from these slower things is insignificant, and that the radiating power increases—other things being equal—with the fourth power of the frequency of the vibration.

At the other end of the scale, above the visible range, we have ultra-violet radiation, extending into the photographic region without obvious limit. There has been a practical limit till lately, but now the range has been extended, by photo-electric devices, until it overtakes and begins to overlap the soft *X*-rays. And these rise, through ordinary *X*-rays of excessively high frequency, up to the gamma rays emitted by radium, which at present constitute the highest terrestrially known rate of vibration, some hundreds of thousands of millions of millions per second.

It is possible that in the sun, or especially in the interior of some of the hotter stars, there may be rates of vibration even higher than that, due to the disintegration of atoms and the excessive temperatures which would be there encountered.

All these higher rates of vibration would be very deleterious to us; but fortunately they are easily stopped by a thin layer of matter, so that from the stars they hardly emerge, while those from the sun are screened from us by the earth's atmosphere. We only encounter a few of them when we ascend to great heights, and then we do experience their blistering effect.

It is beginning to seem probable now that the earth is kept warm by the absorbing power of a layer of ozone in the upper regions of the atmosphere, which has the power of stopping a good deal of radiation and of becoming warmed by it, thus constituting a sort of blanket, and preventing us from ever feeling the full intensity of the dread cold of space, which must be a close approximation

TABLE SHOWING THE KNOWN RANGE OF ETHER VIBRATIONS.

Wave Spectrum.	Frequency (vibrations per second).	Wavelength	Method by which Waves are produced.	Remarks.	Investigated by
			Charge on Sun ? Charge on Earth ?		
	10^2	10^6 metres.	Electric generator.	Radiation extremely feeble.	
	10^3	10^5 metres.	Long distance wireless transmitters.	Not easily absorbed. Travel round earth.	
	10^4	10^4 metres.			
	10^5	10^3 metres.	Amateur transmitters.	Fairly easily absorbed.	
	10^6	10^2 metres.	Broadcast Stations. Amateur transmitters.		Many experimenters (1888 up to present time). Hertz 1888.
	10^7	10 metres.	Large oscillator.		
	10^8	1 metre.	Small oscillator.	Used for Directional Wireless.	
	10^9	10 cms.			Righi 1890. Righi 1892.
	10^{10}	1 cm.			Bose 1897. Lebedew 1899. Bayer 1909.
	10^{11}	1 mm.	Undiscovered.*		
	10^{12}	10^{-1} mm.		Heating effect.	Rubens 1913.
	10^{13}	10^{-2} mm.	Sunlight (infra-red).		Rubens and Nichols 1897. Langley 1895. Herschel 1800.
	10^{14}	1 μ.	Sun. Incandescent solids. Sunlight (violet).	Luminous rays.	
	10^{15}	$10^{-1}\mu$.		Strong photographic action.	Schuman 1900.
	10^{16}	$10^{-2}\mu$.	Ultraviolet. Undiscovered.	Possibly absorbed by all known substances.	Stokes.
	10^{17}	1 $\mu\mu$.	Characteristic *X*-radiations. *X*-rays.		Moseley 1914.
	10^{18}	1 A°u (10^{-10} metres).	Gamma rays from radioactive substances.	Pass through most substances. Still more penetrating.	Röntgen 1895. Becquerel.
	10^{19}		High temperature ionisation in some stars.	Properties unknown.	

* At the date of going to press it is announced by Drs. Nichols and Tear, of the Nela Research Laboratories at Cleveland, in a paper read before the American Physical Society, that wireless waves have now been generated down to ½ mm. wavelength and that long heat-waves (infra-red rays) of the same wavelength have been received by wireless methods.

to absolute zero. When the sky is clear and the sun is set, we do feel some traces of this cold, and that is what gives us our hard frosts. But for the most part the earth as a whole is mercifully screened from the more violent ranges of temperature. Otherwise life could not have persisted and attained the approach to perfection which in the course of millions of centuries it has attained. Presumably there is some kind of similar provision on most of the other planets; and accordingly it appears probable that life of some kind—though not necessarily human life—would be found on them also.

By the planets here mentioned we mean the planets of the solar system, the only planets of which we have anything like adequate knowledge. What may be happening on the innumerable other planets which may be circulating round the infinitude of stars in space we have at present no conception. But the universe is so majestic, and its possibilities so immense, that no one with any wisdom would venture to put a limit to the possibilities and variety of existence.

We seem to have travelled far afield from the more or less practical considerations with which we began. But now that we are beginning to deal in an intelligible and practical manner with the ether—that universal medium which unites all the worlds—no one can say what may be the ultimate outcome. The ether has already brought us much information as to the chemical constitution and other details of what are called the heavenly bodies; though it should always be remembered that the earth is one of them, though a small one, yet just as much a heavenly body as the others, difficult as it may be occasionally to believe it, or to reconcile that fact with some of the doings of humanity—the ether, I say, has already brought us so much information about the heavenly bodies that it may by the progress of science bring us more; and so in due time we may receive quite unexpected information about them.

For science is as yet in its infancy. Our methods of exploration are continually enlarging; and we have already found that we are not as isolated and disconnected from the rest of the universe as we used to think, and as in old time for all practical purposes and by the methods of science we were. Though it should always be remembered and admitted that, by methods other than those of science, men have always believed themselves to be in touch—at first awe-stricken, but afterwards a reverent and even affectionate touch—with a higher order of existence. Things half known and but dimly glimpsed by the ancients may in process of time became known to us, through the accumulation and handing on of laboriously acquired knowledge.

And just as the higher and lower regions of the spectrum have gradually united, so that some approach to continuity is established through the whole range, so it may be hoped, and even confidently expected, that in the long run the regions of knowledge and of faith will approach each other by gradual extension, and merge into a comprehensive unity.

A FEW APPRECIATIONS

To the Editor, WIRELESS WEEKLY.

SIR,—I congratulate you on the quality of WIRELESS WEEKLY No. 1, and wish it every success.

Up to the present the most popular magazine amongst our members has been *Modern Wireless*, and I expect WIRELESS WEEKLY will be equally popular.

I shall be pleased to collaborate with a view to making the Radio Societies Section a success, and will send a report at an early date.

I am etc.,
W. F. NEAL,
Hon. Sec., Luton Wireless Society.

To the Editor, WIRELESS WEEKLY.

SIR,—I thank you for your letter and copy of No. 1 of your new weekly journal.

This is undoubtedly a thoroughly good weekly, and I am requesting the local newsagent to send it to me regularly.

I will pass the copy you sent me round at our meeting to-morrow night, and shall be pleased to co-operate in a matter of club reports.

I am, etc.
E. A. PYWELL,
Hon. Sec., Oxford and District Society.

To the Editor, WIRELESS WEEKLY.

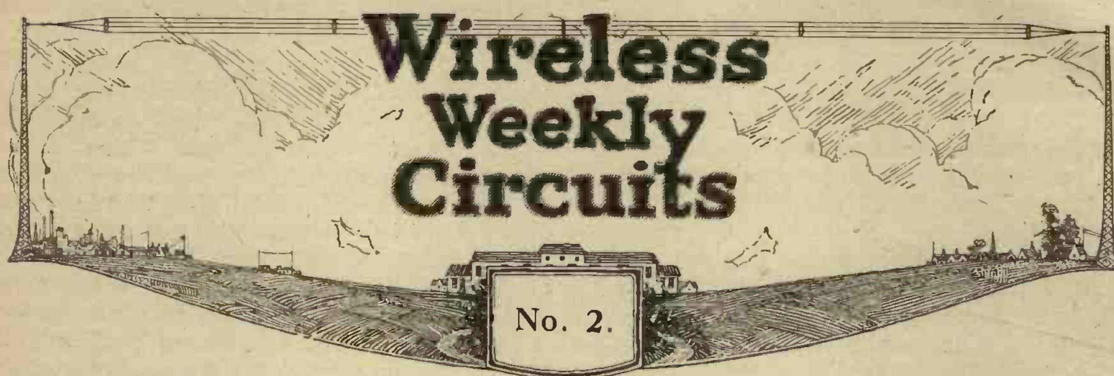
SIR,—As an experimenter of three years' standing I have not been long in appreciating the sterling worth of your periodicals, *Modern Wireless* and WIRELESS WEEKLY, and am quite with you in your statement on page 35 of your first issue.

I am, etc.,
Leyton, E.10. R. BAKER.

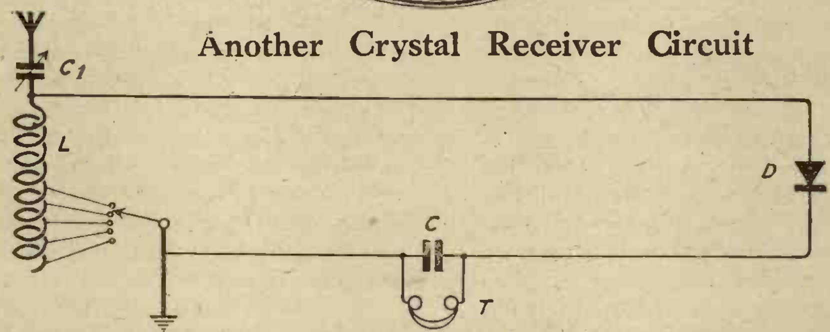
To the Editor, WIRELESS WEEKLY.

SIR,—Having read with great enjoyment No. 1 of your WIRELESS WEEKLY, I feel that I must offer congratulations upon your latest effort to bring wireless and the public together.

Plumstead, S.E.18. J. R. ALLISON.



Another Crystal Receiver Circuit



APPARATUS REQUIRED.

C_1 : A variable condenser having a capacity of not less than 0.0005 μF (microfarad). A preferable value is 0.001 μF.

L : A variable inductance having several tappings taken from it, a selector switch being provided.

C : A fixed telephone condenser of about 0.002 μF capacity.

T : High resistance telephone receivers.

D : Crystal detector.

GENERAL REMARKS.

In circuit No. 2 the tuning condenser C_1 is connected in series with the aerial. It might, however, be connected in parallel with the used portion of the aerial inductance L. The condenser C_1 is for the purpose of fine tuning, rough tuning being accomplished by means of the selector switch and tapped inductance.

Circuit No. 2 with the condenser C_1 in series is specially suitable for receiving the shorter wavelengths, and may be used with advantage when the aerial consists of a number of wires.

The parallel arrangement is more suitable for receiving wavelengths above 600 metres, such as Paris time signals (2,600 metres).

VALUES OF DIFFERENT COMPONENTS.

The tuning condenser C_1 in both circuits should have a value of about 0.001 μF, but a capacity of 0.0005 μF may be used if sufficient tappings are provided. The crystal detector may be of any of the well-known types. The telephone receivers should be of high resistance (not less than 1,000 ohms) and the telephone condenser C may have a value of 0.002 μF. Particulars of a suitable condenser were given in the description of circuit No. 1.

The inductance L may consist of a cardboard tube 3½in. diameter wound with No. 26 gauge double cotton covered wire for a distance of 5in., twelve tappings being taken. This should give a wavelength range of about 200 metres to 3,000 metres when C_1 is in parallel. For the reception of broadcasting, a 3½in. cardboard tube wound for 3in. with six tappings will be satisfactory.

NOTES ON OPERATION.

Both these circuits should be tried when receiving shorter wavelengths to see which gives the best results. The procedure for tuning is to place the selector switch on the first stud nearest the aerial end of the coil and to adjust the variable condenser C_1 from zero to its maximum. If signals are not heard try stud 2 and repeat the operation. If nothing is heard try the various studs until the desired signal is obtained and then carefully adjust on the condenser. Sometimes the signals will be heard on two or three different studs with different values of the condenser. If so, select the stud which gives the loudest results.

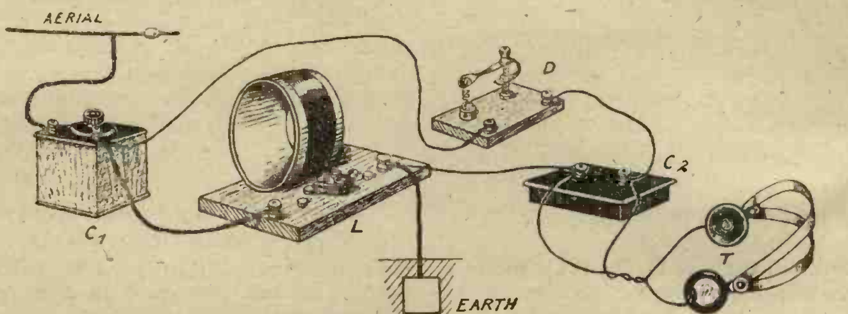
POSSIBLE VARIATIONS.

Sometimes the last stud is connected to the selective switch. This sometimes results in louder signals. The result of this is that a portion of the inductance is short-circuited. This portion, of course, is the unused portion.

The telephone condenser can, in most cases, be omitted without any disadvantage.

RESULTS OBTAINABLE.

The results obtainable with these circuits compare with those obtained with circuit No. 1, and similar ranges may be covered.



A FRENCH EXPERIMENTAL STATION

By M THOUVAIS.

The President of the Radio Club of Sologne gives a description of the apparatus with which he obtained excellent results during the last Transatlantic tests.

THE receiving set which I used during the Transatlantic tests was not at all designed in view of such long-distance work. In fact, it is not a short-wave receiver at all, but an all-round experimental set, with an all-wavelength tuner. The tuning is effected by means of interchangeable coils of various sizes covering the whole range 150 metres-24,000 metres. As it stands, I believed it far less efficient than a Grebe, a Paragon, or any standard variometer receiver, and I believed it was absolutely incapable of making such a performance. As time and material were lacking to build another especially designed set, I did not intend to enter the competition My aerial is not high, erected between the chimney of my house and a wooden mast in the garden. It is 27 ft. high at each end, and hardly 23 in the middle, as the wires stretched three years ago are slack and now form a graceful curve. It is a three-wire antennæ about 120 ft. long; the lead-in is shaped as Fig. 1. The ground connection consists of a wide zinc sheet buried 3 ft. deep in wet soil. The fundamental wavelength of the whole is something about 230 metres. This aerial, though nothing unusual, has proved rather efficient, as immediately after the war, when valves were not yet obtainable, I was able to read, regularly, on a crystal detector, many distant stations, such as Lisbon, Gibraltar, Bizerta, Malta, Vienna, Budapesth, Copenhagen, Karlsborg, etc., and I even picked up the first Chelmsford telephony in February and March, 1920 always on galena. My actual equipment—entirely home made, with the exception of valves and 'phones—consists of a single-valve receiver, a separate heterodyne, and a single stage low-frequency magnifier. The accompanying picture, Fig. 2, shows the three pieces of apparatus distinct. The single-valve receiver and the heterodyne unit have both the same appearance, as they are each housed within a similar wooden box. In fact, they differ but very little, only that the receiver is fitted with a grid leak and condenser for detection. Each box contains a standard 0.001 μF variable condenser, a small vernier condenser, and a filament rheostat. Both sets use either basket coils for short and medium waves, and flat pancake or honeycomb coils for longer ones. The heterodyne is used for long waves only, from 10,000 to 24,000 metres. It becomes unnecessary below 5,000 metres, and is practically useless for really short waves. While combined with the autodyne receiver it has allowed me to listen to long-wave, high-powered American stations practically without jamming . . . but this is quite a different story. This unit did not take part in the tests.

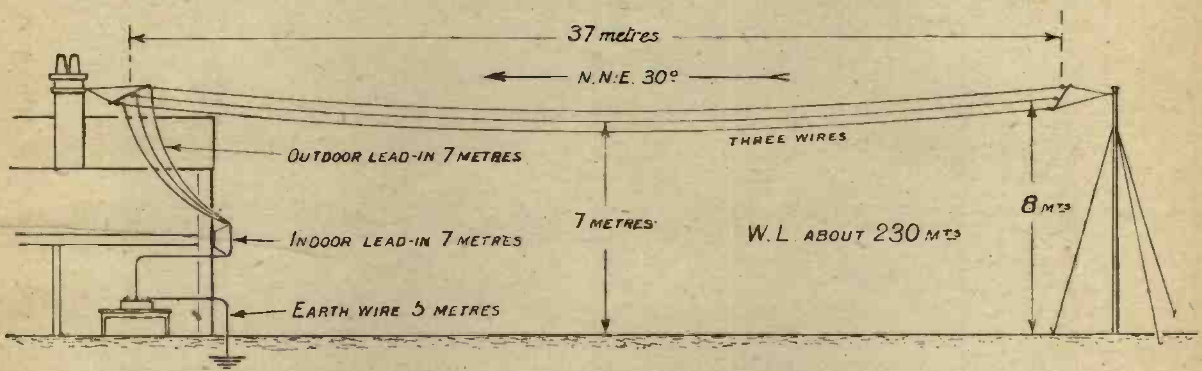


Fig. 1.—Showing the aerial arrangement.

The single-valve receiver is a usual single-circuit tuner with reaction. It has allowed me to receive with a fair intensity—sufficient for reading—all the high-power U.S. stations, such as NSS, WSO, WII, WGG, WQK, etc. The single stage low-frequency magnifier does not greatly increase the weak signals; in short, I believed this simple apparatus quite unable to receive the easiest "test."

Last year I had found some big difficulties in receiving the short waves, and only a month before the event did I get my set working really well down to 300 metres. On the W.L. band 350-450 I heard three British broadcasting stations with a very great intensity, both music and speech being often too loud to be comfortable when wearing the 'phones; and it could be almost continuously heard in the whole room without any loud-speaking device. A little while later, that is, hardly a week before the commencement of the tests, I at last succeeded in getting my receiver oscillating freely on as short a wave as 200 metres. I obtained this result by using a special type of winding for the inductances. My coils are somewhat like the well-known basket coils, but an improvement on them. The different manner in which they are wound gives a still lower capacity for a given inductance, thus making them especially efficient for short-wave work. As this method of my own is not yet covered by a patent, I am unable to describe it more fully now. As previously stated, I did not use a two-circuit tuner, but a much simpler single circuit—a fixed coil in series with the variable condenser. This method is doubtless less selective than using a vario-coupler, but it is really efficient, and is very much simpler to manage. With the aerial described and the variable condenser in series, a 30-turn coil tunes from 150 to 300 metres, while a 50-turn one covers the W.L. range 250-500. In either case a 50-turn inductance is quite suitable for reaction. Before the tests I had only heard two French amateurs, 8AG and 8AB, the latter extremely loud although located about 375 miles away, three British amateurs, 2AW, 2OD, and 2JZ, were also received with excellent intensity, as well as telephony from several British amateurs that I was unable to identify. These results decided me to spend one night listening-in to try if I could pick up anything during the tests. I was not at all confident, to tell the truth, and it was on the fifth day of the tests that I tried. During the first two nights (16th and 17th) I was only able to enjoy the concerts sent on 360 metres by several American broadcasting stations, among which is WJZ. It was on my third night (7th of the tests, 18th of December) that I picked up two American amateurs in addition to the usual broadcasting, and it was then that I realised that my set worked much worse on 200 metres than on 360. To

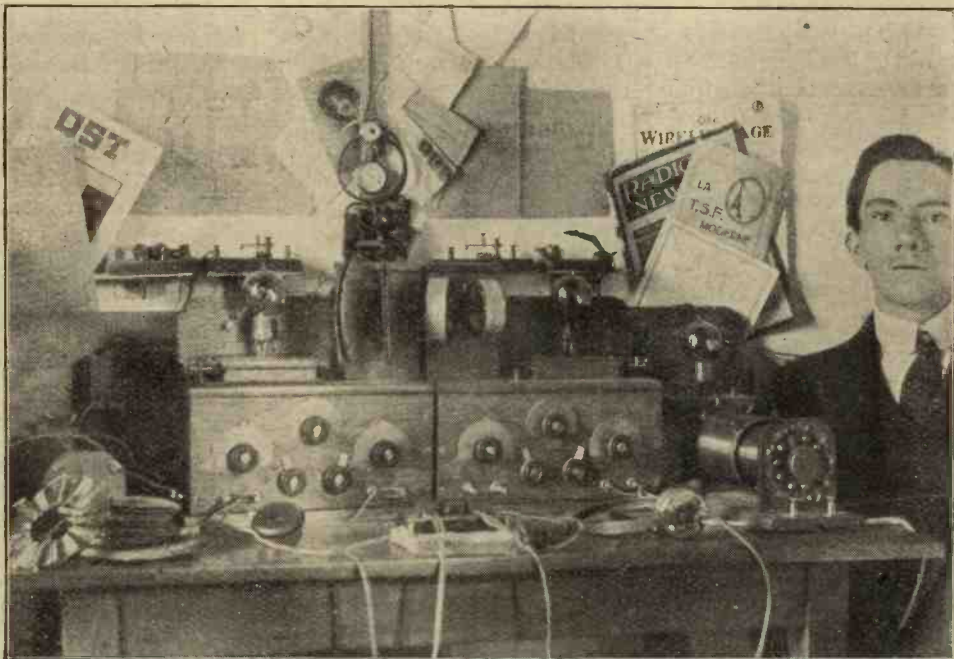


Fig. 2.—The complete installation; heterodyne on right.

remedy this, on the following days I built a new variable condenser, of the air dielectric type, to replace my unsuitable condenser insulated with paper, which I found really inefficient. Also, in view of lowering the high-frequency resistance of the whole, I tripled the single ground wire. Immediately my apparatus oscillated much more freely on as short a wavelength as 150 metres and the efficiency on the band 180-250 was very greatly increased. I was enabled to receive ten further call-letters on the following night, and the next day, having again found time to improve several details, increasing up to 80 volts my high tension battery and removing the lead-in a little further from the wall, I was quickly rewarded for my trouble by picking up no less than twenty-five calls from the

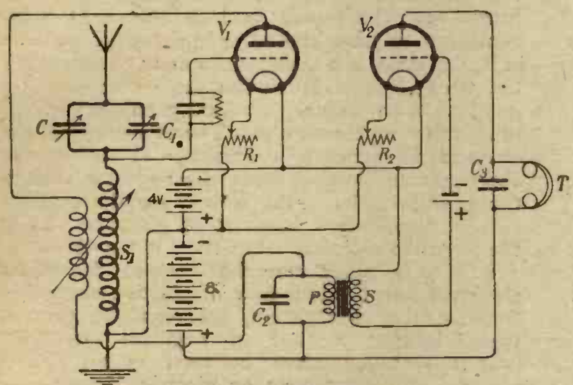


Fig. 3.—Circuit diagram.

American amateurs within a period of less than two hours (20th of December). For the last night, being no longer afraid of lack of filament current, I decided to listen-in up to the end, and fighting against sleep I worked continuously from midnight up to after 5 a.m. (G.M.T.). But this night—the last—was certainly among the worst on which I had experimented. The static was very bad throughout, the atmospherics extremely violent, and arcs caused considerable interference on some wavelengths, making these bands entirely useless. The usual jamming from ship and coast stations was yet more severe than ever and outweighed the rest, so that I could only pick up two or three calls during the free-for-all period. The second part of the night was a little better; the arc jamming having disappeared, I was enabled to register a dozen more call-letters, and at the last moment I was even successful enough to catch the call sign of a radiophone—2XAP—among the several ones that I had already heard almost each night on 200 and 275 metres.

In conclusion I wish to point out that I listened-in on six days only, and that on the first three my set worked badly on 200 metres. Further, it was only on the last night that I worked for as long as five hours; on all previous nights I had spent but three hours on account of my usual business throughout the day. Also, I daresay that if I had been more confident in my set and so had started to listen-in on the first night of the tests, and, above all, if my apparatus had been carefully prepared to work right down to as short a wave as 180 metres a little while before the outset of the tests, I believe that I should have been enabled to receive most of the stations heard throughout Europe: as most of the calls I heard were strong enough, and would have been received as well without the second valve, that is, with the detector valve alone. The second valve acting as a low-frequency magnifier, is by no means an element of sensitivity, but as it facilitates reading to some extent by giving body to the signals I did not dare to eliminate it, although I could have done so.

I will not introduce my set as a model, but as it stands it is, I think, one of the best among the simplest, and yet in spite of its simplicity it has proved quite efficient. It is certainly one of the easiest to operate, and can be confidently recommended to everyone, as it could be handled safely even by an absolute novice.

List of the 41 different American amateurs correctly received:—

1AJP, 1AWP, 1BDT, 1BES, 1BET, 1FB, 1II, 1OR, 1XM, 1ZE, 2AWF, 2CBX, 2CKR, 2CQZ, 2GI, 2GK, 2LO, 2FP, 2FW, 2GY, 2XAP, 2ZK, 3BG, 3AQR, 3BLF, 3BGT, 3HG, 3ZP, 8ADG, 8AQO, 8AGZ, 8AWP, 8BRK, 8BSS, 8AM, 8CJH, 8CYH, 8IB, 8SP, 8YD, 9OX. Several, such as 8AQO, 3HG, 1II, 1BDT, 1FB, have been received frequently. 8AQO seems to be the strongest and the steadiest. It was received regularly every night quite loudly.

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

PART II

(Continued from No. 1, page 17.)

What is an Electric Current Generally Supposed to be?

AN electric current is generally considered to be a flow of free electrons, whether through a vacuum or along a conducting wire. When the current flows through a vacuum it actually takes the form of electrons passing between the electrodes in the vacuum, but when a current is flowing along a wire each electron does not necessarily travel the whole length of the wire. What happens is that, if we imagine a row of atoms in the wire, a planetary electron from the first atom will proceed to the next atom and push out one of its free electrons. This free electron will now migrate to the next atom and push out one of its electrons and so the process goes on, the electrons migrating from atom to atom and in that way progressing along the wire. The moment an electron leaves the first atom to move forward, an electron from the last atom will also move forward, the passage of electricity being practically instantaneous.

The passage of an electric current through a wire is illustrated in Fig. 7. An analogy is shown in Fig. 8. Here we have represented seven bowls containing goldfish. Each bowl contains several goldfish which swim round in a circle in the water. A goldfish jumps out of the right-hand bowl into the next bowl; as it arrives, one of the goldfish in the second bowl jumps out into the third; one of the fish in the third bowl jumps into the fourth, and so on. Each bowl continues to have the same number of goldfish in it, but there is a steady movement of fish along the whole line. Much the same sort of thing happens in an ordinary wire when an electric current is flowing through it. The movement of the electrons is caused by the voltage of the battery, the electrons flowing from the negative side to the positive side. This is because the positive side of the battery is short of electrons, while the negative side has more than it wants.

Fig. 7.—To show movement of electrons along a wire.

Fig. 8.—Analogy of the goldfish

It is to be noted here that the old idea of an electric current was a flow of positive electricity from positive to negative, whereas the present theory is that a flow of negative electricity (electrons) takes place between negative and positive, and constitutes an electric current.

Upon What does the Rate of Emission of Electrons from a Hot Filament Depend?

When a metal wire is heated to incandescence, the internal vibration of the particles, due to the great heat, results in many of the free electrons shooting right outside the wire. The electrons which are thus shot off from the filament are said to be *emitted*, and the rate of emission of electrons depends on several different factors.

(1) The metal of which the filament is made.

(2) The temperature of the filament.

(3) The size of the filament.

(4) The nature and pressure of the surrounding gas.

Some metals emit electrons more readily than others. In all cases, as the temperature of the metal is increased, the rate at which the electrons are emitted is also increased. Obviously the area of the surface of the metal exposed has an important bearing on the emission. The thicker or longer the filament, the greater will be the emission from it at a given temperature. As regards the nature and pressure of the gas surrounding the filament, this will depend on the manufacture of the valve. Although we speak of producing a vacuum in the bulb, even the best vacuum which has ever been attained always contains a certain small quantity of gas, though it be highly rarefied. It is found that different gases affect the emission of electrons, water vapour, for example, having a great retarding effect on the emission of electrons from filaments.

The important point here for the student to notice is that in any given valve the number of electrons emitted per second depends solely on the temperature of the filament—in other words, on the amount of current passing through the filament. The greater the current from the accumulator, the brighter will be the filament, and the greater will be the number of electrons emitted from the filament per second.

What are Thermionic Currents?

These are the currents due to the emission of electrons from, in the case of a valve, the heated filament.

What are "Dull-emitter" Valves, and What are Coated Filaments?

Dull-emitter valves is the name often given to valves which are fitted with filaments which give off electrons in copious quantities, even when the temperature of the filament is relatively low. The advantage of using such valves is that only a very small filament current is necessary, with the result that dry batteries may be used for heating the filament. The method of manufacturing dull-emitter valves is more or less a secret process. Much can be done by decreasing the amount of water vapour left in the valve when pumping it. The addition of a small quantity of a substance called *thoria*, the oxide of a rare metal called "thorium," will greatly increase the emission from a tungsten filament.

Certain manufacturers coat their valve filaments with a special compound which readily gives off electrons. It is usual to employ lime or oxides of other alkaline metals, as these give off a copious supply of electrons even at comparatively low temperatures. Filaments which are treated by coating with some compound of this sort are called "coated filaments."

What is the Purpose of a Plate or Anode in a Two-electrode Valve?

If a filament is heated to incandescence in a vacuum, electrons are given off. The student will naturally wonder what happens to these electrons. Some of them travel to the inside of the glass bulb and stay there, charging it negatively, while most of them return again to the filament, just as a stone when thrown up into the air will descend again to the ground. If we insert a metal plate inside the bulb close to the filament, we are able to attract and collect the electrons shot off from the filament. In order to attract the electrons, however, we have to give to the plate a positive potential or voltage. If we connect a battery between the plate and one side of the filament and arrange that the positive terminal of the battery is connected to the plate and the negative side to the filament, we will make the plate positive and it will then attract the particles of negative electricity which are shot off from the filament. Fig. 9 shows the anode attracting some of the electrons emitted from the filament.

This is in accordance with the well-known electrical rule that positive and negative charges attract each other, whereas similar charges repel each other. The plate, which has now become an *anode* by virtue of being given a positive potential, is short of electrons, and the electrons which are shot off from the filament are anxious to make up the deficiency, and therefore flow to the plate and round the external *plate circuit* back to the filament.

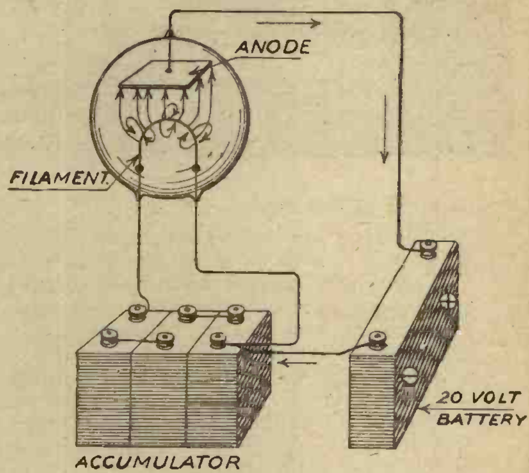


Fig. 9.—Electrons flowing to anode.

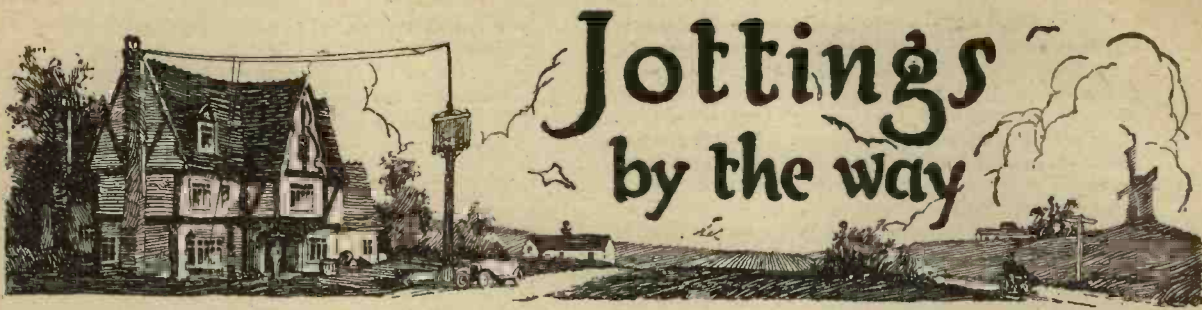
Why is a Vacuum Necessary in a Valve?

Partly because an incandescent filament would burn away in the air owing to oxidisation and partly because the emission from the filament would be much less. Moreover, the electrons could not travel far through air at ordinary pressure. They would collide with the atoms of the air.

What is Meant by the Terms "Unidirectional," "Unilateral," and "Asymmetric Conductivity"?

The conductivity of a valve is its ability to allow the passage of electricity through it. Unilateral conductivity means that electricity will only flow through the conductor in one direction. If we connect an ordinary piece of copper wire across a battery, a current will flow through the wire, and reversing the battery so as to make the current flow in the opposite direction will have no effect whatever on the strength of the current. Some conductors, however, like the two-electrode valve, will only allow the passage of current in one direction, and, if we reverse the battery, we will get no current whatever in the opposite direction. Such special conductors are called *unidirectional* or *unilateral* conductors. Sometimes a conductor will allow more current to flow in one direction than in the other. Such a conductor is said to have *asymmetric* conductivity.

(To be continued.)



Which Kind of 'Phones?

HIGH or low resistance 'phones: which shall it be? This is a problem with which the beginner is faced when he starts to lay in the gadgets necessary for fitting up a set. Each type has its own distinct advantages, and it is not always easy to come to a decision. Every transformer of the iron-cored kind must produce some small loss in efficiency, as well as a slight amount of distortion, owing to the presence of flux leakage, eddy currents, and various other undesirable little factors which cannot be eliminated entirely even in the best designed models. When using a crystal alone, we cannot afford to lose a fraction of the minute currents that are available; high resistance 'phones are therefore probably to be preferred in this case. When we come to valves, however, the problem is more difficult. Here we have much more current available, so that a very small loss will not be noticed. As far as purity of tone and clearness are concerned I would plump for high resistance 'phones every time; there are, however, two very strong points in favour of the other kind. The magnets of high resistance receivers are wound with very fine wire, and should a sudden great strain be thrown upon the windings a "burn-out" may occur; if a step-down transformer and low resistance 'phones are fitted there need be no fear on this score. Point number two is that the transformer acts to some extent as a filter towards parasitic noises and produces quieter working. What it all comes to is this: either arrangement will be found satisfactory so long as the instrument is well made and used with proper care. Personally, I use the high resistance kind as a rule, because the trouble of fitting another transformer is thereby saved.

Condenser Tip.

It happens sometimes that when you are experimenting with new circuits you need a variable condenser of a much larger capacity than any that you possess. Some of the much-talked-of Armstrong super-regenerators, for example, require as many as three of .001 μF apiece, a number which few of us possess. Here is a little tip that may be found useful, for it enables the capacity of any condenser to be doubled, temporarily or permanently. As a dielectric, good mineral oil is about twice as effective as air. If, therefore, the condenser is immersed in oil, its capacity will be twice what it was when air only was between the vanes. A .0005 μF variable condenser can thus be turned into a .001 μF by standing it in a jam-pot containing sufficient oil to cover the vanes.

On Soldering Wires.

If you have to make a soldered joint between two wires, don't scrape off the skin of tinning that covers them, for its presence will make the job a much easier one. The bared ends should be made bright, not by scraping them with a knife, but by giving them a rub with an old worn piece of the finest emery cloth. The tinning will thus be preserved intact. One of the most difficult pieces of work is to solder two pieces of such fine wire as is used for transformer windings, for if ordinary methods are used the wire will often be burnt up. A simple way of doing the job is to twist the leads together, and, after dressing with fluxite, to wrap a piece of tinfoil round the joint. If a lighted match is held under the tinfoil for a few moments, it will run like solder and make a very firm joint indeed. As the temperature necessary to make the tinfoil flow is much less than that required for solder, there is little risk of injuring the wires.

Annealing Hard Wire.

It is as well, when you are buying wire, to see that it has been sufficiently well annealed to stand the twisting to which it will be subjected when joints or loops for terminals are made. The easiest test is to bend the wire sharply two or three times in the same place. If it will stand this it will prove satisfactory, but if it breaks or cracks at the first or second time of bending, it will probably be found difficult to work with. When you are using stiff, bare wire for connections on the underside of a panel it may be an advantage to anneal the ends before making loops with your round-nosed pliers. This can be done by heating them red-hot and then plunging into water. Soft wire may be hardened by being heated and allowed to cool slowly. It will be noticed that for annealing brass or copper the process is just the reverse of that necessary for steel or iron. Another curious "oppositeness" applies to the drilling of these metals. Iron calls for lubrication with oil, but brass should be drilled "dry."

An Effective Earth.

An "earth" should be like the policeman's boots of tradition—it should make firm contact with a large area of ground. One that is as satisfactory as any—*experto crede*—consists of a disused galvanised iron bath or bucket, a few more holes being punched in it, in addition to those that have arrived through wear and tear in the scullery. Dig a hole three or four feet deep and plant the bath in it; the unstranded earth lead will, of course, have been already soldered to it in several places. Now fill the bath with finely powdered coke and complete its burial. Coke is strongly hygroscopic, attracting and retaining moisture to a remarkable extent; it will ensure the presence of dampness that is essential to a good earth contact; if the superfluous earth is piled up so as to form a kind of crater immediately over the buried bath, you may feel sure that a bucketful of water poured into the hollow in dry weather will get to the right place.

Lightning Switches.

Now that the season of thunderstorms is approaching, care should be taken to provide adequate means of earthing the aerial. There is little danger of the aerial being actually struck by lightning, but it is liable to become very highly charged during thundery weather, which may damage the set if it is left connected up. My own tip is to disconnect both aerial and earth wires from the outside terminals of their respective leading-in tubes. They are then hooked together and allowed to swing clear of the house. A piece of string kept fastened to one of them allows them to be hauled in again when they are required. If a lightning switch is used, it should be of a heavy type mounted on a glazed porcelain base, and it should be fitted outside the house. The switch must be arranged so that it actually breaks contact between the aerial and the set; it is of little use if it simply forms a shunt between aerial and earth leads. Those who are nervous about their aerials during thunderstorms should ask themselves how often they have heard of telephone and telegraph wires being struck. As a matter of fact a properly earthed aerial is a splendid protection from the effects of lightning.

The Paris Mystery.

Quite a storm in a teacup was raised by one paper over the story that a mysterious station (which could not be located in spite of the fact that it was using 8 kilowatts in the aerial) was anonymously broadcasting in competition with the Eiffel Tower. Efforts to track it down were described in breathless detail, and success was promised within a few days, since a committee of experts had undertaken the task of measuring the wavelength. Can you picture them, wrinkling their lofty brows and wagging their beards, as they struggle with the terribly complicated piece of apparatus, the heterodyne wavemeter? Truly, wireless offers wondrous opportunities for the journalist! The "mystery" transmission was apparently a harmonic of the Ecole Supèrieure.

An Experimental Concert.

Did you happen to hear the experimental concert transmitted late at night recently by the British Broadcasting Company? The first of them was a great surprise. Captain Eckersley announced, "We are going to experiment for a little," and there followed an excellent programme lasting until nearly midnight. He was quite in his old 2MT form when apologising for keeping us up so late, but how many were prepared for his statement that the concert had been transmitted from Birmingham? It was not one of his "spoofs," but an actual fact. The performers, including a largely augmented orchestra, were in Birmingham, where their strains were collected by microphones and transmitted *via* the "land-line," to 2LO. Save that there was a little over-modulation at times, the transmission was in every way a success. The idea is, I believe, that it may shortly be possible to broadcast simultaneously from both London and Birmingham, a performance being given at either station. This means, of course, that such things as Grand Opera, "Polly," and the "Lady of the Rose," will soon be within the range of crystal sets over quite a large portion of the country. In many broadcasting stations of other countries, the studio is at some distance from the transmitting plant. Performers in the justly famous Radiola concerts actually sing and play in a room at the Boulevard Haussmann in Paris, whilst the wireless apparatus is in the rather distant suburb of Levallois-Perret.

A Central Broadcasting Studio?

It is possible, I suppose, that in time there may be only one orchestra and one set of singers and instrumentalists for all the British Broadcasting Company's programmes. I do not know whether such a step is contemplated, but in view of the success of the London-Birmingham experiment, there seems to be no good reason why it should not eventually become possible. It would lessen one's choice, of course, for one would no longer be able to switch on to Manchester or Glasgow for a change, if Cardiff was transmitting an item that did not appeal. Still, it would lead to an immense improvement in the quality of the programme, since the very best could be given from a single studio.

WAYFARER.

PRINTER'S CERTIFICATE

This is to Certify that we have printed 110,000 copies of Vol. I., No. 1, of *Wireless Weekly*.

THE CORNWALL PRESS LIMITED.

(*Signed*) **CYRIL SMITH,**
Secretary.

AN EXPERIMENTAL FIVE-VALVE AMPLIFIER

By A. L. M. DOUGLAS, Associate Editor, "Wireless Weekly."

A constructional article of considerable interest to those whose means are limited, yet who require a sensitive and flexible receiver.

THE considerations governing the design of this amplifier were of an exacting nature; in a badly served area in Scotland it was decided that such a receiver as would intercept *all* existing telephony had to be erected, and the following constructional notes of the final design are published as being of interest. Although provision is made for the use of five valves and their associated circuits, yet reception was almost invariably carried out on four. With this combination there is no radio - telephone plant in Europe that cannot be heard in Scotland; a brief list of stations received is appended to the end of this article.

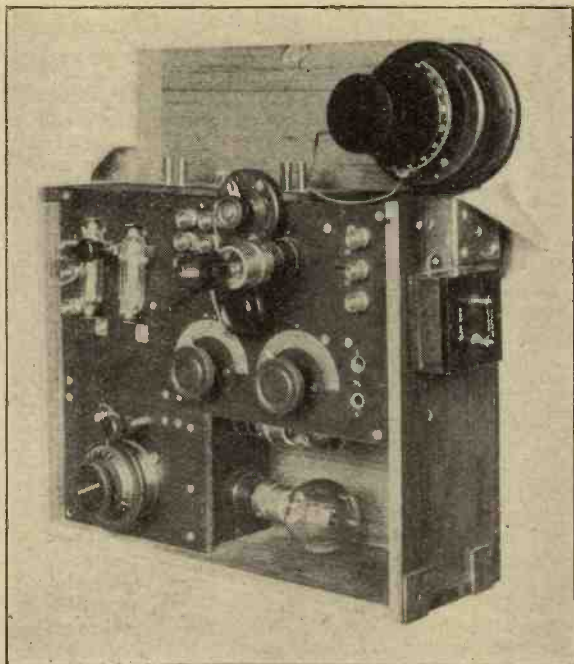


Fig. 1.—The complete amplifier.

Before investigating the construction proper of the receiver, a few remarks as to the combinations possible without switching will not be out of place. The set may be used as :—

1. A detector and two-stage radio frequency amplifier.
2. A high - frequency amplifier with anode reactance.
3. The same extended to two stages.
4. Reaction upon either H.F. stage, or on the aerial, or not at all.
5. H.F. coupling in one or two stages by means of air-core transformers, resistances or anode reactance coils; tuned or untuned.
6. Separate H.T. supply for H.F. and L.F. valves, or a common battery.
7. Grid leak or potentiometer control to the H.F. valves, and + or − control to the rectifying valve grid leak.
8. + or − control to the input side of the H.F. stages, whichever method of coupling is employed.
9. Telephone jacks arranged so that insertion of the plug in one or the other reverses the polarity of the output current.
10. Provision for using any pattern of grid leak for the rectifying valve, either fixed or variable.

In view of the number of possible arrangements, it is interesting to note that no switches are used, and only two single pole travelling plugs are introduced into the circuits. Let us now go more thoroughly into the actual construction of the amplifier.

The instrument measures overall 13½in. × 11in. × 5in. When the transformer or other method of high-frequency coupling is in position, the height is extended to 14½in. This now totals 13½in. × 14½in. × 5in. For the mounting of the components two ebonite panels will be required, one 12in. × 6in. × ¼in. and the other 4in. × 6in × ¼in. If desired one piece could be employed as illustrated in Fig. 2. If two separate panels are used, they must be attached as indicated in Fig. 2 by means of 4BA × ⅜in. brass cheese-head screws, nuts and a distance piece. The shape of this will be evident from Fig. 3A. The drilling of the panels must now be carried out, whilst two additional smaller panels are to be prepared as in Fig. 3B and 3C. These measure 4½in. × 2in. × ¼in. and 8½in. × 3in. × ¼in. respectively, and as shown in the figure. They require drilling also, the position and sizes of the holes being clear from the sketches.

The panel A, Fig. 3, is to be attached to the main front portion at the points marked for the purpose in Fig. 2, and B (Fig. 3) is also to be attached as indicated, so that the complete panel assembly will be as indicated in Fig. 4. This also illustrates the valveholders, etc., attached in their respective positions. The ebonite panels will, of course, have been rubbed down carefully prior to drilling, and for the benefit of those not accustomed to this kind of work, it may be said that, as the ebonite is cast in moulds lined with tinfoil, a certain proportion of this adheres to the surface of the sheets and is apt to act as a source of leakage, particularly to high-frequency currents. The bright surface must, therefore, be removed for electrical reasons, and the simplest way to carry this out is to rub the panel front and rear with reasonably fine emery cloth.

Coarse emery removes the surface more quickly, but it is a much more laborious process to remove the rough scratches afterwards. As the emery will probably leave a brownish surface on the ebonite, a very excellent and rather brilliant matt finish may be imparted to the panel by rubbing with powdered rottenstone and soapy water. The soap acts as a lubricant, and the more finely-divided the rottenstone is, the more brilliant will be the resulting finish. Very little effort is required to produce a good surface by this method.

Holes will be drilled and tapped 4BA in the places indicated in Figs. 2 and 3A respectively, so that screws may be used to attach the various portions of the frame, as it were, together. For the convenience of experimenters possessing a miscellaneous selection of tools, it may be mentioned that a ⅛in. Whitworth twist drill will make a hole of the correct size to tap out 4BA. No taper tap will be necessary in this instance. Four small wooden blocks, dimensioned as in Fig. 5, must be made in order to attach the amplifier when complete to the case; which may, however, vary under different circumstances, the case used in this instance being an ex-Government high-tension battery case which was bought with a number of plugs, sockets, and other devices for about five shillings. An excellent feature was the provision of a stout carrying handle made of canvas, which can be seen in Fig. 1.

Referring again to the little blocks shown in Fig. 5, no attempt should be made to attach these to the case until the amplifier itself is completely finished. As the construction of this device is rather unusual, a list of component parts will be of considerable assistance. We will need:—

14 terminals, Army pattern × 4BA.
5 valveholders (or the corresponding number of sockets).
4 additional sockets and 2 valve legs.
2 small ebonite heads or knobs for these valve legs.
2 filament rheostats.
2 contact studs.
1 switch arm and knob of small radius.
1 potentiometer, preferably of the rotary pattern.
1 grid leak in clips, 2 Ω.
2 telephone jacks and one plug.
2 intervalve L.F. transformers.

And the following condensers:—

1 0.0003 μF. 1 0.002 μF.
1 0.001 μF. 1 0.033 μF.
2 small variable condensers, 0.00025 μF, but in the case of the actual receiver described only one was used, of 0.00025 μF capacity.
8 V24 valve clips.

The condensers may be of the interchangeable pattern mounted in clips, or might be of the Mullard-Dubilier mica pat-

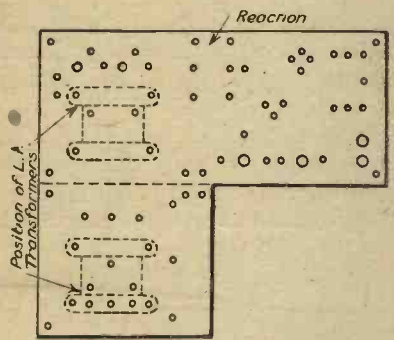


Fig. 2.—Drilling plan of the panel.

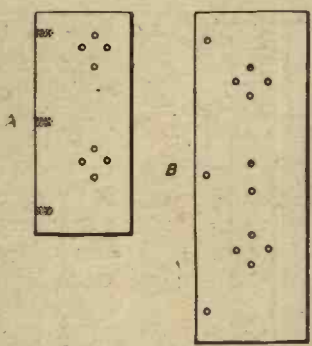


Fig. 3.—Drilling for valve panels.

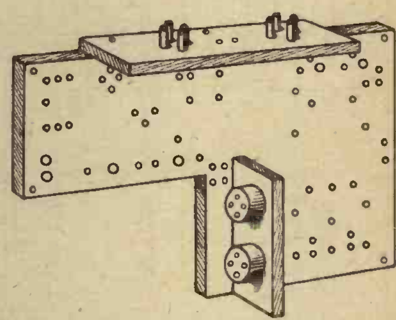


Fig. 4.—Back view of panels.

tern; it is of no importance which type is used, but the 0.033 μF condenser will naturally be large, and in this particular instance was attached to the outside of the case at the top right-hand corner (Fig. 1). This is the condenser affording a path for high-frequency current across the high-tension battery.

At this stage it may be as well to examine a circuit diagram of the complete arrangement. Fig. 6 indicates the various possible connections described at the beginning of the article and show the general scheme of wiring. The low-frequency transformers actually used were those made by Radio Instruments, Ltd., and which are no doubt familiar to all experimenters. They have proved so satisfactory for multi-stage amplification that they can be recommended with every confidence, and it will be observed that, owing to the almost entire absence of inter-action, they are placed near to each other and in the same plane; the coils are, however, reversed as regards their mutual positions, by way of an additional precaution.

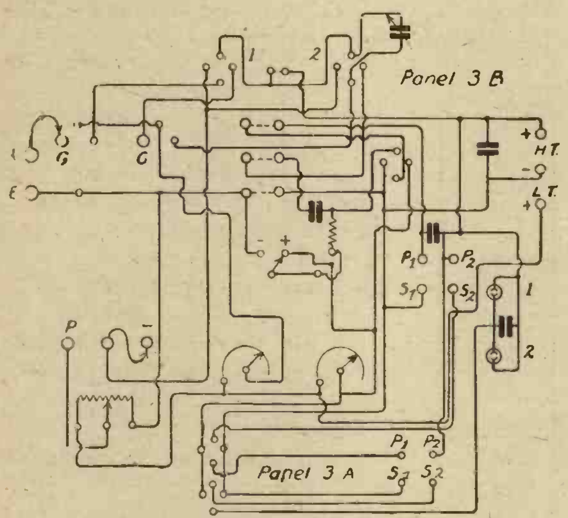


Fig. 6.—Circuit diagram.

When assembling this instrument, the terminals and filament rheostats should be mounted first. The basic wiring may then be carried out in a thorough manner, all conductors being enclosed in systoflex tubing by way of safety. No. 18 s.w.g. tinned copper wire is ideal to work with, and eminently suitable for connecting together the associated parts of the circuit. Care should be taken that no flux runs over the panel when soldering the connections, as it might be a possible source of leakage, and probably will also tend to corrode any metalwork it comes into contact with.. In this connection it should be mentioned that pure resin is unquestionably the best flux to use, but owing to the difficulty often experienced in working with it many of the patent fluxes now on the market may be used. The inexperienced are sure to leave some surplus

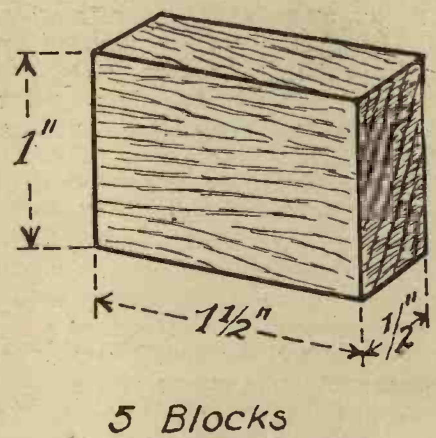


Fig 5.—Supports for panel

behind, so this should be carefully removed with a rag of linen or cotton; soft substances will simply become tangled up in the wiring and should not be used.

If the two telephone jacks are inserted, so that the larger springs of both point vertically upwards, and if the two adjacent springs are electrically connected (and the same with the outer springs), a reversal of the anode current will be obtained through any circuit

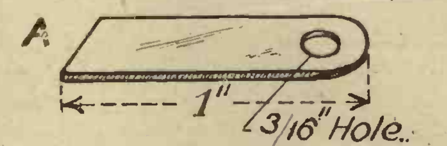


Fig. 7.—Connecting straps.

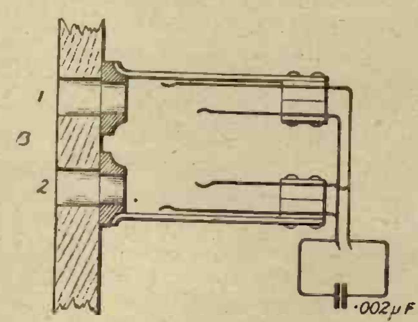
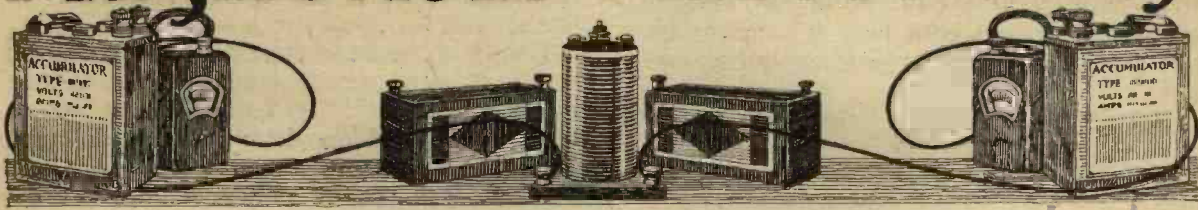


Fig. 8.—Telephone plug mounting.

attached to a telephone plug simply by changing it from the top to the bottom socket and *vice versa.* This will be clear from Fig. 7A, which shows the jacks.

(*To be continued.*)

Magnetism & Electricity



By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART II

(Continued from No. 1, page 32.)

The Flow of Electric Current

IN the first article of this series we explained how a body may be given a charge of electricity and how, if that body is connected to a second body by means of a conductor such as a metal wire, some of the charge will pass along the wire: whilst the electricity is actually flowing there is said to be an electric current in the wire. We also saw that this electric current represents *energy*, since it is capable of doing work, and that if we wish to maintain the flow of the current we must have a source of energy such as a generator to provide the energy in the form of current.

Potential Difference (P.D.)

Why should the electric charge upon one body flow along a wire to another body? We know from ordinary experience that if we wish to move anything from one place to another we must exert force. The same applies to an electric charge. When a body is electrically charged it is said to be at a different *potential* from its surroundings, and there is actually set up a " field of force " which tends to push the electric charge along any available conductor until it has distributed itself so as to bring the previously charged body to the same potential as its surroundings. The potential really refers to the "electrical state" or " condition " of the body, upon which depends its power of communicating electricity to surrounding bodies.

Electric potential may very well be compared to *temperature*. We know that if heat is communicated to a body its temperature is raised, and this rise of temperature causes a " back pressure," as it were, tending to make the heat flow out again. The higher the temperature the greater the " pressure " tending to make some of the heat flow away from the body until it has attained the same temperature as the surrounding bodies. As a matter of fact, the analogy between temperature and heat on the one hand and potential and electric charge on the other is a very close one and the reader will find it very helpful to keep it carefully in mind until he has become accustomed to the conception of potential.

Remember, temperature is the heat-condition which influences the flow of quantity of heat: potential is the electrical condition which influences the flow of quantity of electricity.

Now the moment the charge begins to leave the first body, the potential of that body begins to drop and the potential of the second body begins to rise: the difference of potential between the two, therefore, becomes gradually less and less. Since the rate at which the current flows between them depends upon the difference of potential (or electrical " pressure," as we have called it), the current will gradually become less and less as the two approach the final uniform potential, until, when the two bodies are at the same potential, the current becomes zero. Or, going back to the temperature analogy, if a red-hot body is connected (say by a metal bar) with a cold body, heat will flow along the bar, at first rapidly but gradually less and less rapidly, until, when the two bodies attain the same temperature, no further heat flows along the bar.

Electromotive Force (E.M.F.)

Thus, if we wish to *maintain* the current in a wire, we must find some means of *main-*

taining this potential difference between the two bodies which are connected by the wire. If we wish to maintain the flow of heat along a bar we must keep one end of the bar hot and the other end cold and this might be done by placing a gas burner under one end and immersing the other in running water.

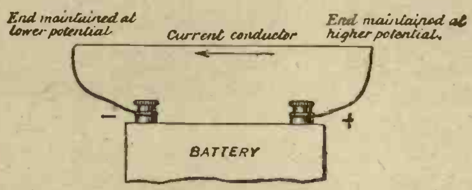


Fig. 6.—Diagrammatic representation of the potential differences existing between the elements of an electric cell.

But how are we to maintain an electrical potential difference between two bodies?

There are many methods of doing this, but we will deal here with only one, and that is by the use of certain chemical actions, namely, by the use of an electric battery. We described roughly in the first article how an electric battery was used, but we did not say how it maintained the potential difference at its terminals.

It has been found by experiment that if we take a solution of sal-ammoniac and immerse in it a piece of zinc, chemical action is set up which *creates* (nobody knows exactly how) a certain definite potential-difference between the zinc and the liquid, the zinc assuming a *lower* potential than the liquid. A piece of carbon immersed in the same liquid assumes a *higher* potential than the liquid. If the zinc and the carbon are not connected together, no further chemical action takes place.

Since the zinc is at a lower potential than the liquid and the carbon is at a higher potential than the liquid, there must be a potential difference between the carbon and the zinc, and if we connect them together by a piece of wire, current will flow from the carbon to the zinc in an endeavour to equalise the potentials; but the chemical nature of zinc and sal-ammoniac solution is such that they are only satisfied to be in contact when the necessary p.d. exists between them. So the moment the current begins to flow, thereby raising the potential of the zinc and upsetting their normal relationship, chemical action starts between the zinc and the solution and tries to maintain the proper p.d.: similarly with the carbon.

Thus the p.d. is maintained, the current continues to flow in the wire and chemical action continues in the battery. If the process goes on long enough the materials of the battery will be all consumed; the battery is then said to be "run down," and is of no further use for supplying current.

I want to make it clear that the chemical action between certain substances (there are innumerable examples besides those given here), which makes them assume different potentials when they are in contact with one another, is a natural phenomenon. We do not know why they do it. All we know is that they *do* it, and we take advantage of the fact to make up an electric battery.

We have said that the flow of current represents energy, and in the case just described the energy is produced at the expense of the materials of the battery, which are consumed by chemical action, just as heat is produced by burning coal with air or oxygen.

The p.d. between the battery terminals represents the force which drives the current through the wire—the greater the p.d. the greater the current. When this p.d. is maintained, as in the case of the battery, it is called electro-motive force, or E.M.F.

Resistance of a Conductor

If the connecting wire is very thick or is made of a very good conductor, such as copper, the current produced by a given E.M.F. will be greater than if the wire is thin or made of a poor conductor, such as iron. Thus the wire possesses the property of electrical *resistance*.

The unit of current is called the *ampere*, the unit of E.M.F. is the *volt*, and the unit of resistance the *ohm*, and we say that 1 volt is the E.M.F. necessary to be maintained at the ends of a conductor whose resistance is 1 ohm in order to maintain a current of 1 ampere strength along that conductor.

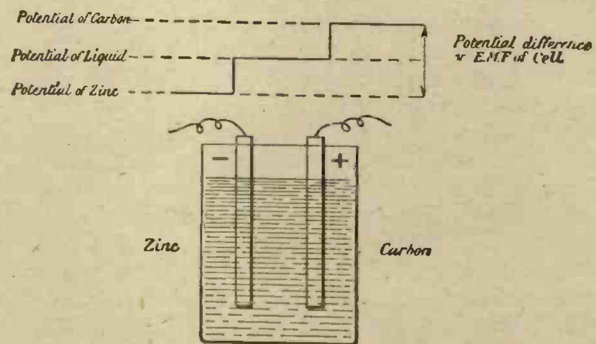


Fig. 7.—Potential difference between ends of conducting wire maintained by means of battery.

(*To be continued.*)

A GOOD EARTH

By E. REDPATH, Assistant Editor.

NEXT to the aerial itself, the permanent feature of a receiving station which has most effect upon the general efficiency, is the earth connection.

From the great number and variety of questions which the present writer has been called upon to answer, there are evidently many experimenters, especially beginners, who are not quite clear as to what does and what does not constitute a really satisfactory earth.

An illustration of this is given in a letter received only recently in which the question is asked whether a satisfactory earth connection can be made by burying a wire in the soil contained in a window-box.

Two Kinds of "Earth"

In connection with wireless there are two kinds of earth: one in which actual contact is made with as large an area as possible of the ground, preferably below or in the immediate vicinity of the aerial; and the other, known as a counterpoise earth, which does not make contact with the ground at all, but is deliberately insulated from it.

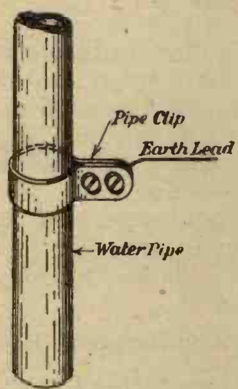


Fig. 1.—Clip on water pipe.

Of the former type, probably the most easily obtained and usually quite a satisfactory earth connection is the domestic main water-supply pipe.

If possible, the water pipe should be unearthed outside the house and as close as possible to the aerial lead-in point, which, of course, will in turn be as close to the instrument as possible. The pipe itself should be thoroughly cleaned by means of a file and glass paper, and the earth lead from the earth terminal of the receiving set should be secured to the pipe by one of the two methods illustrated in Figs. 1 and 2. It is important that the initial good electrical contact at the pipe should be maintained and, in order to prevent subsequent corrosion, the complete connection should be carefully wrapped with adhesive tape or canvas and be painted or tarred.

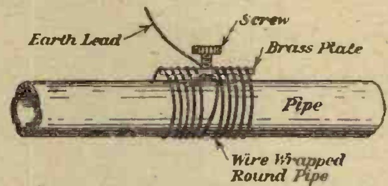


Fig. 2.—Method of tightening binding wire.

The Earth Lead

This should be as short as possible and of fairly stout gauge wire, not less than No. 16 s.w.g, if a single wire is used, or 7/22 stranded conductor as supplied for aerials. The object of these conditions is to keep the ohmic resistance of the earth-lead as low as possible so as not to waste any of the signal energy. There is another disadvantage in employing a long earth lead, apart from the question of resistance. In the case of a receiving set installed in an upper room of a house and having the earth lead taken through the lower portion of the window frame and down the side of the house to the water pipe, the long lead acts to some extent as another aerial and the receiving set itself is not at that point in the system where the greatest potential difference exists.

Fig. 3.—Metal plate earth.

Earth Resistance

In addition to the ohmic resistance of the earth lead, that of the earth connection itself must be considered. As already mentioned, good contact—and by this expression is meant good *electrical* contact—with as large an area of ground as possible is required. Practical experience proves that moist soil is a much better conductor than dry soil. Where an earth conductor is used (whether

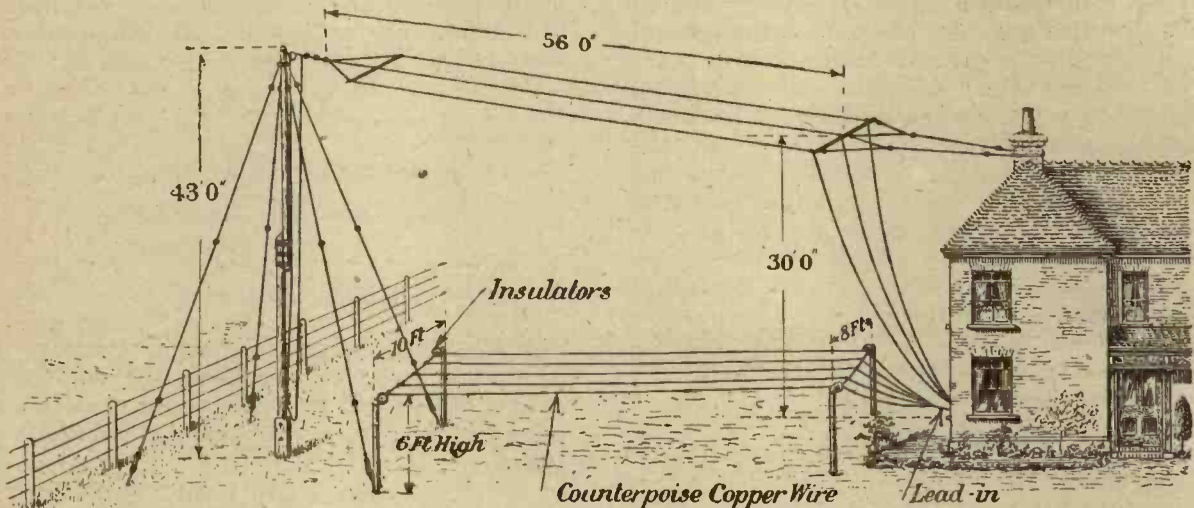


Fig. 5.—Complete aerial and counterpoise system.

the water pipe already mentioned, or copper wire or netting, as will be described presently), for which a hole has been dug in the soil, the hole should be partially filled with small coke or even cinders before the soil is replaced, and several bucketfuls of water should subsequently be poured over the surface.

The broken coke or cinders retains the moisture for a long period and greatly improves the conductivity of the earth. In fact, the method has been for years the standard practice for the earthing of lightning conductors.

Copper Wire and Plate Earth

Where the open space is available a very satisfactory earth connection may be made by digging one or two long, shallow trenches, anything from 10ft. to 20ft apart, parallel to and, if possible, immediately underneath the aerial, and laying in the bottom of each trench a long length of 7/22 bare copper wire.

The addition of a rectangular, galvanized iron plate (say, 2ft. square) soldered to the extremity of each wire and buried edgewise in a coke- or cinder-filled hole, as illustrated in Fig. 3, effects a considerable improvement, especially in the case of a transmitting station, where the question of earth resistance becomes exceedingly important.

A very effective earth, and one which is readily removable, should occasion require, consists of a long roll of galvanised wire netting, not necessarily new, simply unrolled along the ground immediately under the aerial and held in place by means of a number of heavy stones placed upon it at intervals, the lead to the earth terminal of the receiving set being carefully soldered to the nearest corner of the netting.

This netting arrangement, where the netting is laid upon very dry ground, becomes practically a "balanced-capacity" or counterpoise earth.

A Counterpoise Earth

This type of earth formed an essential feature of the original Lodge-Muirhead wire-

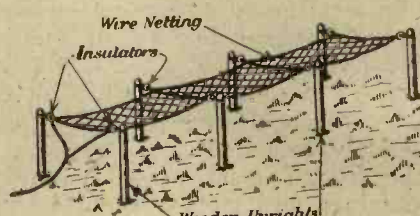


Fig. 4.—Counterpoise earth.

less system, in operation as long ago as 1897. The method, which consists essentially in the employment of a second aerial system, a reflection, as it were, of the aerial itself, but elevated only a few feet above the ground from which, however, it is carefully insulated, is receiving a good deal of attention just now at the hands of amateur experimenters, both in connection with transmitting and receiving work.

Improved selectivity is obtained by the use of a counterpoise instead of the more usual earth connection, and as many readers may care to experiment with the arrangement, two simple forms are illustrated in Figs. 4 and 5.

Fig. 4 shows the wire netting, already mentioned earlier in the present article, but now, instead of being spread out upon the ground itself, it is supported by (but insulated from) a double row of posts standing three or four feet out of the ground. Better results will be obtained if the height of the uprights can be increased to about 8ft., but, as this is not an easy matter, the arrangement shown in Fig. 5 should be tried.

Four light poles, each about 6ft. high, are erected as shown in Fig. 5, two being close to the down-lead end and two beneath the free end of the aerial, the two former being about 8ft. and the two latter about 12ft. apart. Between the respective pairs is suspended a cross wire having an insulator at each end, and between the two cross wires are four or five No. 18 s.w.g. bare copper wires, all brought to a common point as shown in Fig. 5 and soldered to an insulating leading-in wire as in the case of the down-lead from the aerial itself. This should be brought into the house some little distance from the aerial lead.

THE STAFF AT 2LO.

Left to right: Auntie Sophie (Miss Dixon), Uncle Jeff (Mr. Jefferies), Uncle Rex (Mr. Palmer), Uncle Arthur (Mr. Burrows), Uncle Caractacus (Capt. Lewis).

THE TESTING AND OPERATION OF CRYSTAL RECEIVING SETS

A few practical hints which will enable beginners to get good results without loss of time.

PROBABLY the greatest difficulty experienced in connection with a newly-made or newly-purchased crystal receiving set is the obtaining of the first signal. To the beginner there appear to be so many points which, if not in order, may account for failure to receive. This is particularly the case where the entire installation is new.

The aerial may be faulty; it may not be well insulated; not high enough; or badly screened by surrounding trees or buildings. Doubts may exist as to the effectiveness of the earth connection.

Adjusting the Detector.

The principal adjustments in the average crystal receiving set are two in number—namely, the tuning of the aerial circuit to resonance with the distant transmitting station and the adjustment of the crystal detector to give effective rectification of incoming signals. As, no matter how carefully the tuning may be carried out, no signals can be received unless the detector is in good working order, its adjustment should be the first point to receive attention. If a small signalling buzzer, or even an old electric bell with the gong and the hammer removed, and a single dry cell are provided, the adjustment of the detector can be carried out satisfactorily, quite apart from any considerations of tuning, or the effectiveness or otherwise of the aerial and earth system.

The buzzer itself should have leads attached to the proper terminals and then be muffled by being well wrapped up in cloth or soft felt and stowed into a small wooden box. It should then be connected up to the dry cell and placed at a distance of 2 or 3 feet from the receiving apparatus. The buzzer leads may now be connected to the dry cell and the crystal detector carefully adjusted, both as regards the point of contact and the mechanical pressure between the wire and crystal or the pair of crystals, according to the type of crystal fitted, until the loudest buzz is heard in the telephone receivers duly connected to the set.

Next, connect up the receiving set to the aerial and earth, and try the effect of removing the testing buzzer to a greater distance from the set. In most cases good results should be obtained when the buzzer is at a considerable distance from the set, but in close proximity to the earth lead. Satisfactory results thus obtained indicate that, in a general way, the aerial and earth system is in order.

Tuning the Receiving Set.

The usual arrangement for tuning a crystal receiving set consists of (*a*) a slider which moves over the wire on the tuning coils, (*b*) a tuning switch or switches moving over either one or two semi-circles of contact, with, in some cases, the addition of a variable condenser, either in series or parallel with the tuning coil. In the case of a tuning coil having a single slider, all that is necessary in order to cover the full range of wavelengths is that the slider be *slowly* moved from one end of the coil to the other. If two sliders are provided they should be moved along together in the first place, and, when signals are actually heard, results will no doubt be improved by increasing the number of turns included in the detector side of the coil.

In the case of a receiving set having one tuning switch moving over contacts, and a variable condenser, the latter should be rotated slowly through 180 degrees as the tuning switch makes contact upon each stud in turn. Where two tuning switches are provided the tappings from the coil will usually be arranged upon the "sub-multiple" system, in which one set of contacts includes either one or two turns and the other includes groups of ten or twenty turns.

If the main tuning switch only is operated the wavelength will be increased (or decreased) in jumps and the desired signals may easily be missed. It is necessary therefore that for each position of the main tuning switch the auxiliary tuning switch should be rotated over its full set of contact studs.

Searching for Signals.

Having connected the receiving set to the aerial and earth leads, donned the telephone receivers, and being satisfied by the "buzzer test" that the detector is in good working order, switch off the buzzer and bring the set to its minimum wavelength setting. Then proceed to tune the set through its complete range of wavelengths, proceeding slowly and listening intently throughout.

Upon hearing signals of any description pause a moment. Do not at this stage hastily attempt to improve the setting of the crystal detector. First make quite certain that the signals cannot be improved by any tuning adjustment. When the best possible tuning adjustment has been found, and not until then, attention should be given to improving the setting of the detector, which, although already adjusted to buzzer signals, may generally be made to give slightly better results by careful adjustment upon actual signals.

Failure to Receive Signals.

Although the foregoing instructions may have been carefully followed, failure to receive signals may still occur. If so, a process of careful elimination will generally show where the fault lies. Firstly, put the testing buzzer into operation, and, if good signals from it are heard in the telephone, the detector and the telephone receivers themselves may be considered satisfactory. Secondly, carefully examine the connections of the receiving set and the winding of the tuning coil and test the continuity of the latter by connecting it in series between the dry cell and the testing buzzer. The buzzer should certainly operate, though not so strongly as before.

If the set itself appears in order, examine carefully the aerial lead-in and the earth connection. Should these appear quite in order and further trials of the apparatus yield no better results, the best thing to do next is to ask some other experimenter to bring his apparatus along and endeavour to obtain results from your aerial. Should this test indicate that your aerial and earth system is satisfactory, the fault must lie in the winding, connections, or general tuning arrangement of your set or in your faulty manipulation of it.

Here, probably, your friend will be able to advise you, or you may be able to arrange to take your apparatus along and test it upon his aerial. As a means of obtaining friendly advice and assistance of this nature, membership of an amateur wireless society has very great advantages, and every beginner should make a point of becoming a member of his own local amateur association.

RADIUS.

A NEW SYSTEM FOR THE PRODUCTION OF CONTINUOUS OSCILLATIONS

By *JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E.*

The following is a description of a new negative resistance device, the chief application of which is in the production of continuous oscillations. A distinctly new principle is involved, the valve used having no grid.

At the time the writer was developing the Negatron valve, considerable attention was given to the development of various negative resistance devices capable of producing continuous oscillations. These were required for local oscillators for C.W. reception and transmission.

In this connection it may be of interest to readers to know that the Negatron valve, described in the current issue of *Modern Wireless*, is very extensively used in sets for the mercantile marine.

The arrangement described below proved equally as effective as the Negatron, and while there are features resembling those found in the Negatron, yet this new method of obtaining a negative resistance effect is distinctive in many ways. The most obvious difference is that no grid is used in the valve, which simply consists of a filament and two anodes, both of which may be at a potential of about +50 volts. The apparatus in no way involves secondary emission, and its theory of action is quite different from that of the Dynatron.

The Valve Used

The particular valve found most suitable for this invention is illustrated in Fig. 1. It consists of a filament F, a large anode A_1 in the form of a flat plate close to the filament, and a smaller anode A_2 at a considerable distance from the filament.

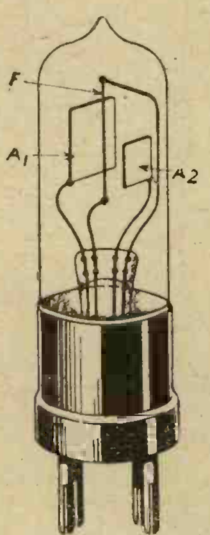


Fig. 1.—The valve.

The Characteristic Curve of the Valve

Fig. 2 shows a circuital arrangement enabling a characteristic curve of the valve to be made. It will be seen that by means of a battery B_1 of about 60 volts and a potentiometer resistance R_1 having a slider S moving along it, it is possible to vary the voltage on the anode A_1, the A_1 anode current being measured by the milliammeter M_1. In the anode circuit A_2 is a battery B_3 of about 25 volts, a milliammeter M_2 being included in the A_2 anode circuit to measure the anode current.

When this apparatus is connected up, some of the electrons emitted from the incandescent filament F will travel to the anode A_1, while some will travel to the anode A_2. The electron current is therefore distributed between the two anodes. If there is a copious emission of electrons from the filament F, an increase in the potential of the anode A_1 will produce an increase of electron current to the anode A_2, owing to a neutralisation of the space charge around the filament, this neutralisation favourably influencing the electron flow to both anodes. This result, which to some might be unexpected, was described in detail by the author in an article in the *Electrical Review* of February 27th, 1920.

If, however, the electron emission is reduced by increasing the value of the resistance R_2, a point will be reached when the valve will be saturated and all the electrons will be absorbed by the two anodes A_1 and A_2. Under these conditions, if we increase the voltage on the anode A_1, the latter will effectively compete with the anode A_2, and there will be an increase in the number of electrons travelling to A_1. These electrons are really those which would have gone to the anode A_2. Consequently, an increase of the voltage of A_1 produces an increase of A_1 anode current and a decrease of A_2 anode current. It is simply a case of the anode having the greater attractive force securing the major portion of the electrons.

In order that the anode A_1 may have the most effective control of the A_2 anode current, the plate A_1 is made large and placed very close to the filament F, while A_2 is kept fairly small and at a considerable distance from the filament.

Under these conditions a characteristic curve similar to that shown in Fig. 3 was obtained. It will be seen that the curve commences with an A_2 anode voltage at +30 volts. As this voltage is increased it will be seen that the A_2 anode current decreases and the valve is so constructed that the curve is as steep as possible.

The Two-Anode Valve as an Amplifier

The anode A_1, although an anode in the strict sense of the word, is also a controlling electrode, but its action is entirely different from that of the grid of an ordinary three-electrode valve. In the latter type of device the grid is an electrostatic control element, the current to which, under operating conditions, has no appreciable effect on its control action. A positive potential on the grid would produce an increase in the anode current, whereas in the two-anode valve operating at saturation an increase in the A_1 anode potential produces a decrease of the A_2 anode current, and this decrease is due

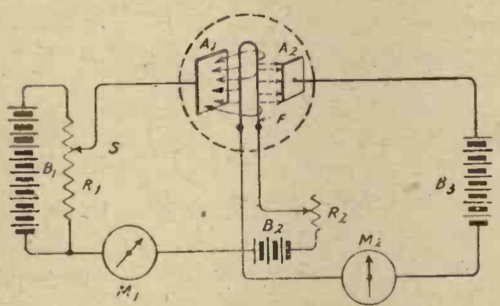


Fig. 2.—Obtaining characteristic curve.

to a heavy current flowing in the A_1 anode circuit.

The fact that the anode circuit connected to A_1 carries a heavy electron current prevents the valve being used as an amplifier in the ordinary way.

Use of a Subsidiary Three-Electrode Valve

By the use of a separate three-electrode valve it is possible to make the main valve act as an amplifier.

This is done by connecting a three-electrode valve in series with the A_1 anode circuit, as shown in Fig. 4. The anode A_1, it will be seen, is connected to the filament F_2 of an ordinary three-electrode valve V_2, the anode A_3 of which is connected through the battery B_4 to the filament F of V_1. The electron current passing to the anode A_1 now flows through the additional path between F_2 and A_3, and so round through the battery B_4 back to the filament F. The amount of this current may be varied by altering the potential of the grid G with respect to either the filament F_2 or the anode A_3.

In the circuit it will be seen that a potentiometer is connected across the grid and filament of V_2 for the purpose of demonstrating the action of the whole device as an amplifier. It is to be noted that the valve V_2 itself need not in any way be a voltage amplifier, provided that the valve V_1 is properly constructed. In fact, the ordinary three-electrode valve V_2 may be a voltage decreaser, and the potentials applied to the grid G may even be reduced when transferred to the anode A_1. This will not prevent the valve V_1 acting as an amplifier. The advantage of using the valve V_2 is that the input potentials are not damped out by the production of a heavy current, as would be the case if they were applied directly to the anode A_1.

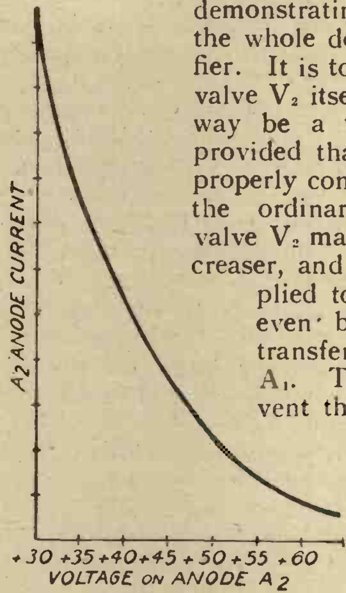


Fig. 3.—Characteristic curve of valve.

A Circuit having Static Negative Resistance Characteristics

Fig. 5 shows a complete circuit which will give a negative resistance characteristic curve.

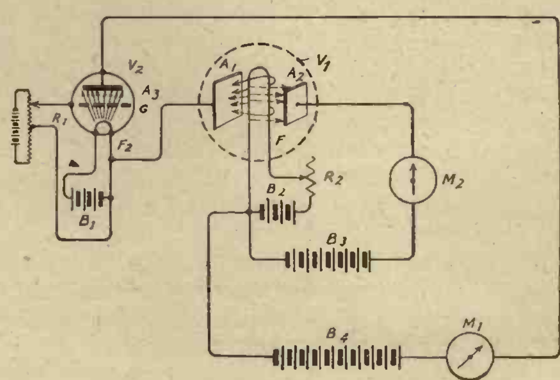


Fig. 4.—Special amplifier circuit.

The principle of the new system is briefly as follows:—Looking at Fig. 2, we will see that if an additional battery is included in the A_2 anode circuit so as to increase the voltage on the anode A_2, there would normally be an increase in the electron current flowing round the A_2 anode circuit. If we can so arrange matters that, when the A_2 anode voltage is increased, the A_2 anode current is decreased, a negative resistance effect will be obtained in the A_2 anode circuit.

The author produces this effect by applying the increased voltage not only to the anode A_2 but to the anode A_1. Owing to the anode A_1 being closer to the filament than A_2, the same increase of anode voltage will produce a larger effect on the anode current. For example, if we added 20 volts to the anode A_2 and 20 volts to the anode A_1, the current to A_2 would decrease. If, of course, we amplified the 20 volts before applying them to A_1, we would get a still greater effect, but this is not necessary if the double-anode valve is properly constructed.

The problem now resolves itself into a method of applying the increased voltage to the anode A_2 and also to A_1, but applying it in such a manner that the increased current flowing to A_1 shall not pass through the

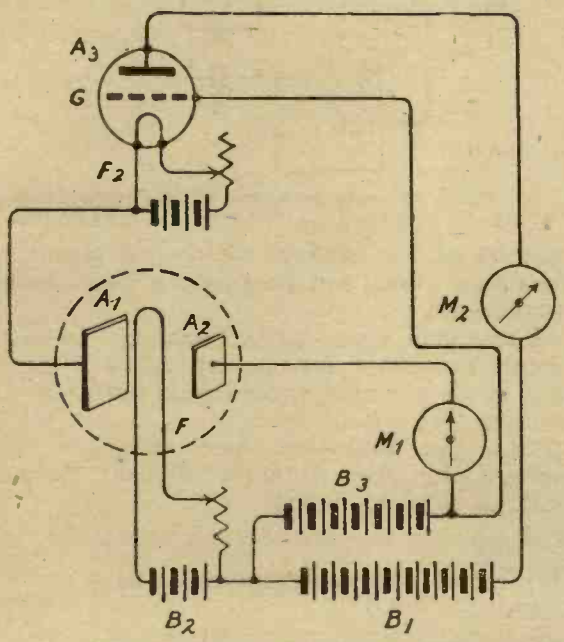


Fig. 5.—Static negative resistance device.

source of additional electromotive force influencing A_2 and A_1.

The desired effect is obtained in practice by making the A_1 anode circuit a separate shunt circuit which really acts as a suitable path for side-tracking unwanted electrons. To decrease the A_2 anode current we have to get rid of many of the electrons already flowing to the anode A_2, and they have to go *somewhere*.

Fig. 5 shows a complete circuit in which a subsidiary valve is used to prevent the A_1 anode current flowing through the source of potential which varies the voltage of A_2. It will be seen that the circuit F, A_1, F_2, A_3,

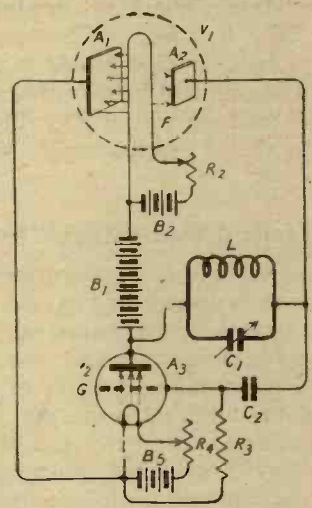


Fig. 6.—Circuit for producing oscillations.

B_1, F is quite a separate circuit, unconnected with the main circuit A_2, B_3, F.

Milliammeters M_1 and M_2 are connected as shown for the purpose of indicating the two respective anode currents. If the tapping on B_3 is so adjusted that the voltage on the anode A_2 is increased, we would normally expect an increase in the electron current flowing from F to A_2, round through M_1 and B_3 back to F. The directly opposite effect, however, is obtained by joining the anode A_2 to the grid G of the three-electrode valve. When A_2 becomes more positive, the grid G becomes more positive, and the three-electrode valve allows a stronger electron current to flow between F_2 and A_3. Put in other words, we can say that the voltage on A_1 has been increased perhaps to a greater (or a less) extent than that on the anode A_2. Whether the changes in voltage on A_1 are greater or less than those on A_2 does not matter very much within limits, provided the anode A_1 is closer to the filament than is A_2.

The action of the valve V_2, while a necessary one, is a very minor one, and the anode current through this valve does not itself form any useful function or flow through any material apparatus, such as an oscillatory circuit.

The increase in the voltage of A_1 occurring simultaneously with the increase of the voltage on A_2, causes the electrons emitted from F to make up their minds whether they will travel to A_1 or to A_2. Since A_1 is closer and is exercising a stronger attraction, the electrons prefer to go to A_1 and the A_2 anode current consequently decreases and a desired negative resistance effect is obtained in the circuit A_2, M_1, B_3, F. If we connect an oscillatory circuit in this anode circuit, continuous oscillations will be set up in that oscillatory circuit and we would then have a very useful method of generating alternating currents.

A Practical Generating Circuit

A practical circuit for generating continuous oscillations is shown in Fig. 6. It will be seen that we have now dispensed with separate high-tension batteries and that one, B_1, only is used. To prevent the grid G of the valve V_2 being at an unsuitable normal potential, a grid condenser C_2 and grid leak R_3 are provided. This grid condenser does not prevent the communication of high-frequency potentials from the oscillating circuit L, C_1 from affecting it, but it does prevent the grid being given a high undesirable positive potential due to the battery B_1.

If the circuit of Fig. 6 be connected up, continuous oscillations will be produced in the circuit L, C_1 and alternating currents of any frequency and of considerable power are capable of being generated in this manner.

A very important adjustment, of course, is that of the filament current flowing through F. The current through F is adjusted by altering the rheostat R_2 until saturation of the valve V_1 occurs. If the filament current is too great and there is a copious supply of electrons, the apparatus, of course, completely fails to work.

It is interesting to note the comparison between the oscillating three-electrode valve and the author's arrangement. In the latter case both the control electrode and the main anode potentials are in phase. When one is growing more positive, so is the other. In the case of the three-electrode oscillating valve, the grid and anode potential variations are usually 180 degrees out of phase, one being positive when the other is negative, and *vice-versa.*

An Arrangement Using Ordinary Three-Electrode Valves

Fig. 7 shows how an ordinary three-electrode valve, if operated at suitable potentials,

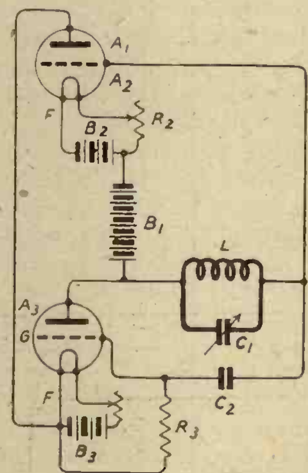


Fig. 7.—Showing use of two ordinary valves.

may be used to produce the desired negative resistance effect and so produce continuous oscillations.

The circuit needs no explanation. In this circuit the phase relationship between grid and anode potential variations is particularly striking.

(*N.B.—The invention here described is covered by the Author's British Patent* 174,134, *Sept.* 30, 1920.)

We desire to inform our readers that several of our contemporaries have refused to insert advertisements of this weekly.

We regret this narrow-minded attitude, as we ourselves have always *thrown our advertisement pages open* to all and even allowed our advertisers to declare that so-and-so is the best periodical. Readers must therefore look to our own publications for announcements. *Wireless Weekly* is published every Wednesday, and *Modern Wireless* (commencing with the next issue) on the 1st day of each month.

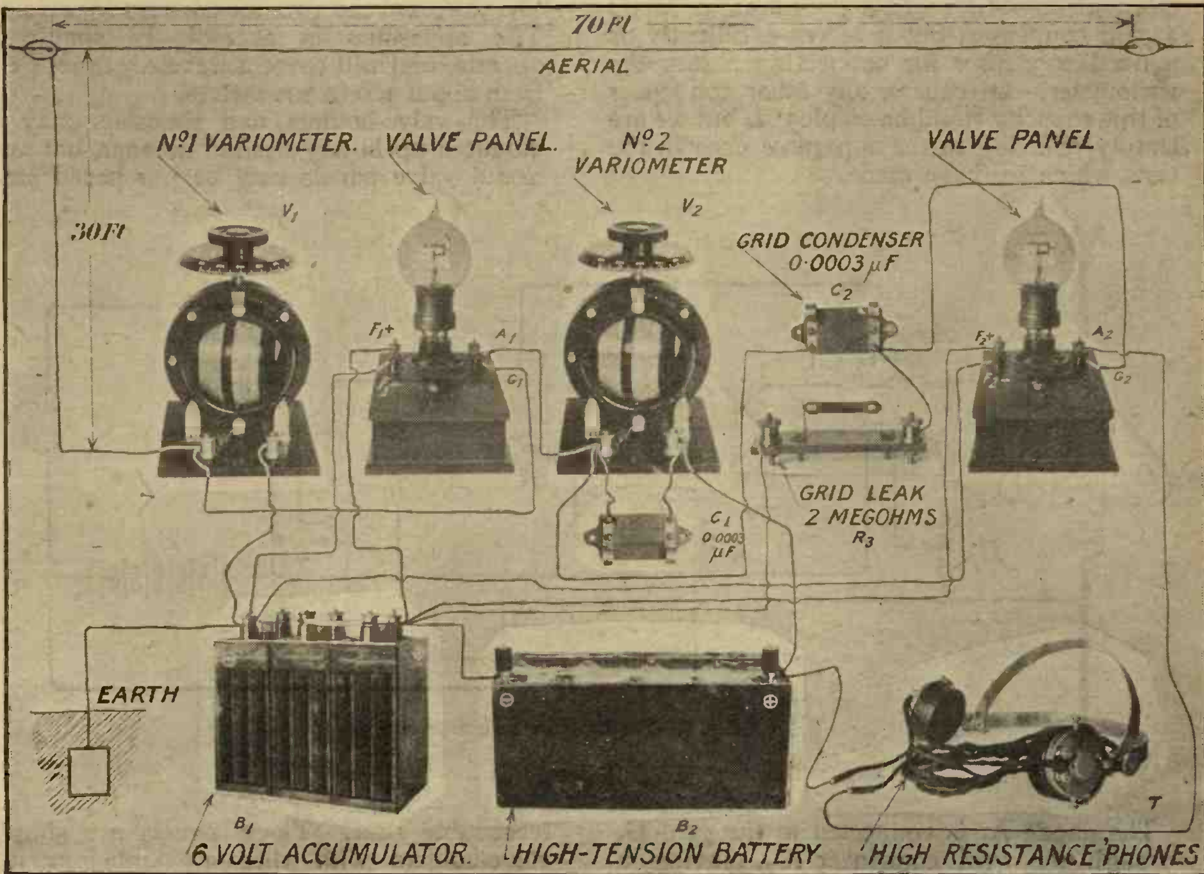


Fig. 2.—Showing how the different components are connected together

A VARIOMETER SET FOR BROADCAST RECEPTION

The following description covers the arrangement of a two-valve receiver which will receive broadcasting effectively by the use of two variometers. Variometers are very efficient for many purposes, and we have recently carried out tests with a type of variometer manufactured by the firm of McClelland & Company.

A VARIOMETER is particularly useful for aerial tuning, but it is not so successful generally for coupling valves in a receiver. This is largely because variometers are more or less aperiodic and a considerable amount of jamming is usually experienced. This defect, however, may be overcome by shunting the variometer by a fixed condenser, and in the apparatus described below the tuned anode circuit of the first valve consists, not of a fixed inductance and a variable condenser, as is usually the case, but a variometer and a fixed condenser.

Fig. 1 shows the type of circuit employed. It will be seen that the first variometer V_1 is connected in the aerial circuit, and that connections are taken from across it to the grid and filament of the first valve. It will be noticed that the connection from the bottom end of the variometer is connected to the negative terminal of the filament accumulator. This is for the purpose of giving the first grid a slight negative potential. In the anode circuit of the first valve we have the variometer V_2 shunted by a condenser C_1. The condenser C_1 is a Dubilier condenser of

0.003 μF capacity. This condenser is really a grid condenser, but it serves excellently as a fixed condenser for connecting across the variometer. Of course, any other condenser of this capacity could be employed, but we are simply referring to the apparatus used in the tests which we have made.

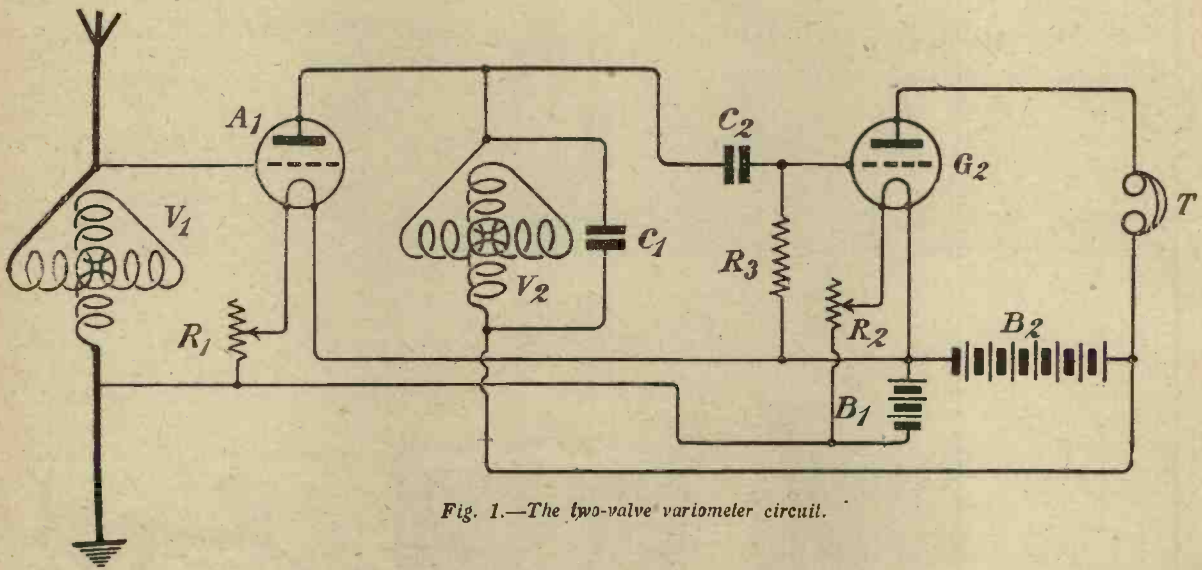


Fig. 1.—The two-valve variometer circuit.

The anode A_1 is connected to the grid G_2 through the grid condenser C_2, having a capacity of about 0.003 μF. A resistance R_3 of two megohms, or a variable gridleak, is connected across the grid and positive terminal of the filament battery B_1. The anode circuit of the second valve contains the telephones T and the high tension battery B_2 of about 70 volts, which also feeds the anode circuit of the first valve.

It will be found that a circuit of this kind will prove very satisfactory for the reception of broadcasting, and there is practically no tendency to self-oscillation.

The only adjustments necessary on a set of this kind are the two variometers V_1 and V_2. The apparatus is exceedingly simple to operate, and will cover a wavelength range of from about 200 to 700 metres.

The valve-holders and rheostats may be mounted up in any desired manner, but very useful valve panels may be purchased for a reasonable sum. These panels are simply valve-holders with rheostats and four terminals, two going to the filament and the other two going to the grid and anode respectively. These latter terminals are usually marked G and A or G and P, the letter "P" standing for plate or anode.

Fig. 2 shows the pictorial arrangement of the apparatus just described. The variometers may be mounted on panels if desired, but they may, on the other hand, be mounted as separate units on ebonite bases as shown.

In next week's issue we will show how these variometers may be used to make up a three- or four-valve receiver.

A GREAT SUCCESS !

No. 1 of *Wireless Weekly* has proved an extraordinary success. The actual sales amount to nearly 100,000 copies and we are informed that we have broken a record for a 6d. weekly periodical.

Letters of appreciation are pouring in and we are finding that tens of thousands are ready to pay 6d. for a really good paper.

THE TECHNICALITIES OF BROADCASTING

By P. P. ECKERSLEY, B.Sc., A.M.I.E.E., Chief Engineer of the British Broadcasting Co.

This is the first of an important and most interesting series of articles on the successful transmission and reception of broadcasting by the Engineer responsible for the technical arrangements in connection with British broadcasting.

PART I.—THE MICROPHONE

The Fundamental Principles

ONE of the greatest problems in Broadcasting is that of the conversion of sound as an air wave disturbance into an equivalent and undistorted electrical disturbance in the transmitter.

For ordinary commercial speech the common type of carbon microphone is excellent, but when it comes to really faithful reproduction, such an arrangement fails for various reasons.

First and foremost, the ordinary type of microphone depends for its action upon the movement of a diaphragm, and this diaphragm has a resonance point. That is to say, at about 1,000 cycles frequency the diaphragm is more sensitive than it is to disturbances of 200 or 3,000 cycles, say, and is infinitely more responsive to 1,000 than to 10,000. Now, it is wonderful what liberties one may take with speech without losing its "understandability," if I may coin a word; it is equally wonderful how much one has to do before one really reproduces the actual voice. Thus this resonant microphone does perfectly well for commercial purposes, but seeing that it gives such a large predominance to certain frequencies, it is fundamentally bad for really faithful reproduction.

Thus the first line of thought indicates that the microphone, whatever form it takes, must respond to all frequencies within the range of audibility equally; must be, in fact, aperiodic.

Something has got to be moved by the sound waves impinging on it, and that something must move in exact proportion to the intensity of these waves giving predominance to no particular frequency.

A very successful type of microphone used for broadcasting.

In practice, what is required is something that will respond to the lowest note of the organ (somewhere about 15 cycles a second) up to the youngest of bat's squeaks (about 6,000 a second), and give predominance to neither one nor the other, nor any other note in between.

The practical range of audibility will then be covered. It will be clear from this that a resonance somewhere above audibility will not matter as long as one can guarantee that no disturbances will take place at such frequencies.

For it is interesting to realise that if "loud" disturbances of, say, 20,000 a second took place, although quite inaudible, still the microphone, if it had a resonance of 20,000, would respond, and one would get the control circuits over-controlled by sounds not audible, provided, of course, no precautions were taken to do away with this possibility.

Much of the sensitivity of the ordinary microphone is given by the fact of its being resonant to about 1,000 cycles, which has been found to be the best resonant point for understandability.

Once do away with this quality of resonance and immediately the sensitivity of the arrangement is reduced tremendously.

Thanks, however, to the use of valves, this loss of sensitivity can be made up for by the use of an amplifier.

It might at first sight then seem perfectly easy to get a microphone movement absolutely aperiodic up to, say, 10,000 a second by relying upon having valve amplifiers and a very insensitive arrangement.

But here another trouble arises.

Every valve makes a slight hiss, and when tapped emits a "pong." Suppose, then, a 20-valve amplifier had to be used because the microphone was so insensitive (albeit perfectly aperiodic!) the result would be a Broadcast of Niagara Falls, the hiss drowning all other noises. Again, the slightest jar on the valves would produce terrible spurious noises. Thus, there is an insensitivity past which one cannot safely go at the moment.

Thus ideally we require this aperiodic movement with sufficient sensitivity to allow of practical amplification.

We wish to Broadcast from a theatre, and immediately the sensitivity problem presents itself.

If we have a reasonably sensitive arrangement, then this may give fair results if the disturbance is 5 feet or even 10 feet away. But in a theatre the actor may move from being a foot away and shouting to being 20 feet away and doing a stage whisper. Thus for a theatre a very sensitive microphone is required that can be placed well away in the auditorium. The difficulty, as before stated, is to get such an arrangement sensitive aperiodic and without spurious noise.

Thus fundamentally the basic problems are quite clear-cut, but obviously there are very great difficulties in the way of a practical solution.

In one type of microphone that has met with a good deal of success the natural period of the diaphragm is made to rise above audibility. Other arrangements have been tried in which the natural period is allowed to remain in the movement, but the effect of which is overcome later by electrical means. Many other methods have been tried, some with real success. The latest type in use is remarkably efficient.

What is really wanted is a substance that is affected in its electrical conductivity by the presence of sound waves—a sort of selenium cell for sound and not for light—then nothing would have to move, and the fundamental problems of resonance would be overcome.

This is a great trouble in Broadcasting, especially for theatre work.

In the theatre the microphone usually has to be placed at the footlights; place it back in the auditorium and the amplification required will be excessive, and a restive or coughing audience would predominate over the stage.

Thus the footlights is perhaps the best position, but the problem of controlling is awful. At one moment the leading lady is proclaiming her woes 5 feet from the microphone; at the next the hero whispers at the back of the stage, and to the mechanical microphone the difference is enormous. The man working the control has to sit somewhere in the dark underneath the stage, and unless he knows the play by heart, has to be a prophet and often gets badly let down by the rapid changes of intensity.

What we want is a sort of sound selenium cell which alters its resistance as the sound impinges upon it. This would solve a lot of the problems of resonance, and, of course, if it was really sensitive, would be all that could be desired.

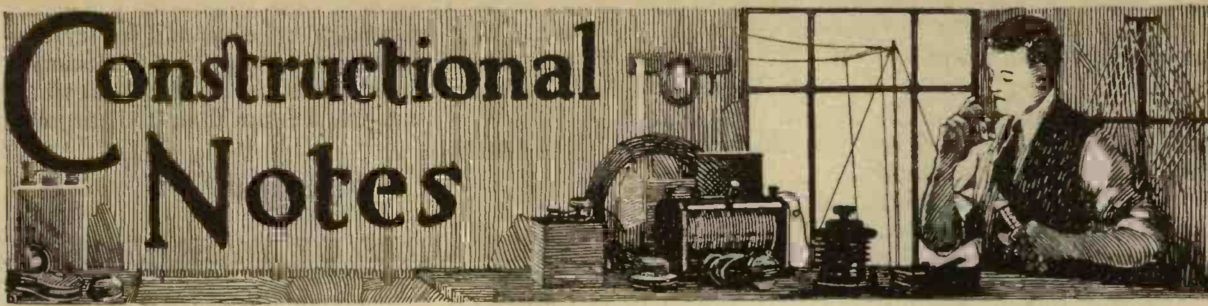
The microphone is our greatest problem, and I have dealt with it first, as it is the first link in the Broadcast chain. Later I shall deal with the various stages of Broadcasting, ending up with the loud speaker.

Now suppose a really aperiodic and a fairly sensitive microphone has been achieved, a microphone that responds equally and sympathetically to all the sounds that impinge upon it, one would think that troubles would come to an end. This is not so, however, because the ear has extraordinary qualities not given by the microphone.

In the first place, the ear to a certain extent adjusts itself to conditions, and if a loud shout, so loud as to be uncomfortable, impinges upon it, it closes up and rejects a certain part of the sound. On the other hand, a very weak sound can be given under favourable conditions, the ear automatically sensitising itself.

The microphone has no such power, and obeys the ordinary inverse square laws to a point, so that the loud shout is too loud, and the weak sound too weak.

Constructional Notes



IT is the small "gadgets" required for the wireless set that run away with one's money. Whether you are constructing a set, improving it, or conducting one of those frequent rebuildings with which all wireless enthusiasts are familiar, a whole host of small parts becomes necessary. Some can be made quite easily; others cannot, and that is where the money goes. Having recently adopted a novel system—which will be described later —calling for quite a number of non-inductive resistances, each with a value of about 100,000 ohms, I rather shied at paying from half a crown to three and sixpence apiece for

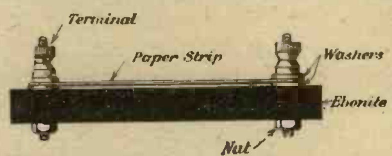


Fig. 1.—Elevation of grid leak.

them, especially as the scheme was still nothing but an idea, and might prove to be unsatisfactory in practice. No one wants to lay out thirty shillings or so on apparatus that may after all be of little or no use.

Was it possible to make resistances that would function properly? To be of any use they had to be compact and moderately robust; most important of all, they must be perfectly constant in action, remaining at their full value during the whole time that the set was in action. It was essential, too, that they should be easy and quick to make, and that they should not give rise to any parasitic noises in the set.

Numerous experiments were tried with indifferent success until the idea came of using the compound known as "Aquadag," which is made for the purpose of lubricating machinery. This, when mixed with graphite, gives a sticky paste which can be applied to paper with a stiff brush. When dry it forms a coating that will not easily rub off, and resistances made with its aid were found to be perfectly satisfactory.

Here is the recipe: Take 80 per cent. of graphite and 20 per cent. of Aquadag by *weight*. Powder the graphite and suspend it in absolute alcohol. Then evaporate the alcohol until a paste remains at the bottom of the test tube. Mix this paste with the Aquadag, working the two well together so that the graphite may be evenly distributed.

Now take a sheet of thin cartridge paper of good quality and, with a stencil brush, work the compound well into its surface. Allow the paper to dry hard and you have the material for a supply of resistances that will last you for years.

It is not possible to give definitely the dimensions of strips of the dressed paper that will have a given resistance, so much depends upon the way in which the coating mixture is mixed and the thickness and regularity of the film applied to the paper. If a resistance box is available, strips can be calibrated with ease; if not, the best method is to cut several strips all of the same length but of different breadths, and to test them until a size is found that gives the results desired. I found that strips $1\frac{1}{2}$in. in length and $\frac{1}{4}$in. broad gave a resistance of approximately 60,000 ohms, but these figures would probably be quite different for pieces cut from another treated sheet.

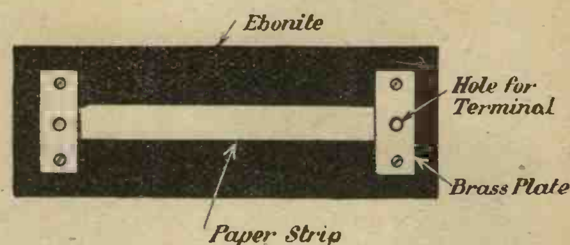


Fig. 2.—Plan of grid leak.

The strips can be mounted without great difficulty. Fig. 1 shows a method which will be found to answer well. A 4BA clearance hole is drilled near either end of a piece of ebonite measuring $2\frac{1}{4}$in. in length by 1in. wide and $\frac{3}{16}$in. thick. Holes are punched in the paper to correspond with those in the ebonite. Each end of the strip is sandwiched between two thin washers, the stems of the terminals being passed through these and through the ebonite. The nut on the underside must be tightened very carefully, otherwise the paper may be torn.

A rather better method is seen in Fig. 2. In this case the strip is secured by small brass plates which are screwed to the ebonite. The stems of the terminals are passed through the 4BA clearance holes seen in the drawing. Whichever mounting is used, a little of the graphite and Aquadag paste should be worked in round the washers or plates in order that there may be a good contact between the terminals and the strip.

A third method, which makes a neater and handier job, since resistances of different values can be inserted in a moment, is given in Fig. 3. Here a piece of undressed paper, rolled into a stiff tube, is inserted into the ends of a couple of used .22 bore rifle cartridges—these, by the way, should first be

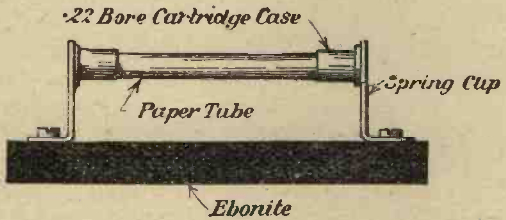


Fig. 3.—Another grid leak.

well cleaned inside. A resistance line is then painted on the tube, the compound being smeared fairly thickly over the joints between the copper cases and the paper. A small base made of ebonite supports a pair of spring clips spaced so as to grip the ends of the cartridge cases tightly.

Tests made with a Post Office resistance box showed that these improvised resistances were remarkably constant. When 100 volts was passed through them they showed a falling off after a few minutes under load of about 15 per cent. in value. Thus a strip that had a resistance of 80,000 ohms when first tested showed rather less than 70,000 at the end of half an hour, but after this it remained perfectly constant though left connected up for three hours on end. When used on the set the resistance proved to be satisfactory in every way, and no noises at all could be traced to them.

The method described serves excellently for making the resistances required for resistance-capacity coupling, and even for gridleaks, since any value can be obtained by cutting the strips sufficiently long and sufficiently narrow; but it has another application which will, it is thought, be novel to the majority of readers.

□ □ □ □

TAKE CARE OF YOUR VALVES.

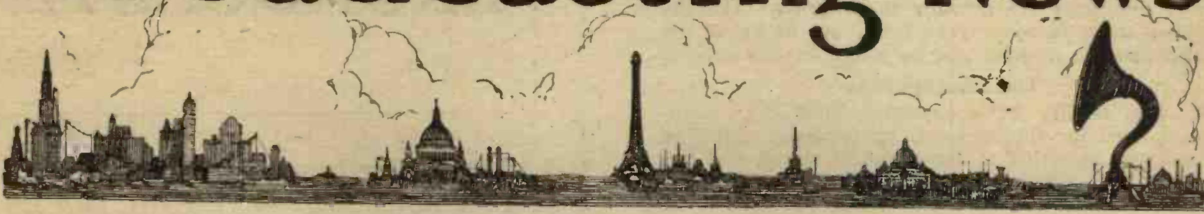
THOUGH valves are expensive things we often ill-treat them rather badly and so shorten their valuable lives. If it is carefully handled and never subjected to strains too great for it, an average valve should have a working life of quite 700 hours; that is to say, that if it is in use for two hours every evening it should continue to give good service for at least seven months. Many valves, however, last for longer than this; I have two on my set whose working life is already well over 1,000 hours, and they seem sound enough to do a good deal yet.

Here are some of the little points that make all the difference to the life of a valve. Never use too high a voltage or too much current on the filaments. It is, of course, best to use a 6-volt accumulator, for then you have plenty of power in hand; but with a battery of this kind your filament rheostats must have a fairly large resistance value if you are not going to overload such valves as the Mullard "Ora" or the Cossor "P.1," for these require only 3½ volts on the filament with a current of less than half an ampere. To give them more than this means simply that you are needlessly wearing out the delicate filaments. When using any valve, turn the rheostat knob only just far enough to make signals loud and clear; it is useless to give the valve more current than this.

In the same way cut down the anode voltage to the smallest amount that will give good results. An excessive anode potential has a very bad effect on many types of valve.

Handle your valves with care, remembering that, though filaments will stand a certain amount of jolting when new, they become very brittle indeed with age. Before you remove a valve from its holder disconnect the H.T.+ lead. If you make a rule of this you will never burn out a valve by accidentally touching "live" H.T. sockets with the filament prongs. When pulling a valve out of its holder grasp it by the metal cap, and not by the glass bulb, which is liable to become loose if continually strained.

Broadcasting News



BY OUR SPECIAL CORRESPONDENT.

THE B.B.C. has been basking in the glare of publicity of late, and has escaped the curse which falls upon those of whom everyone speaks well. Some aspects of the newspaper criticism have not been exactly fair, as, for instance, when the news bulletins are held up to ridicule. The company is compelled to transmit only such items as it receives from the news agency, and if there is any fault in the service it is the agencies who are to blame.

* * *

Glasgow is to fall into line with the other broadcasting stations and to have Sunday transmissions. The B.B.C. were afraid that the Sabbath-keeping Scot would object to Sunday programmes, but the demand for them has been so great that it cannot be long resisted. An unkind Sassenach has suggested that when the Scot realised that there would be no extra charge for the Sunday shows, he insisted on full value for his money.

* * *

2LO will be transferred to 2, Savoy Hill about the 1st of May. The new studio is built on the same principle as Carlyle's room at Chelsea—a room within a room—to be absolutely sound-proof. It is certain, however, that 2LO will be a greater success in this direction than Carlyle's room was. It will be big enough to accommodate a large orchestra, so that there should be no more complaints on this score.

* * *

It looks as if Captain Lewis, the accomplished young Deputy Director of Programmes of the B.B.C., and known to a host of children as Uncle Caractacus, were going to have a busy time of it. In addition to having charge of the children's hour, a women's hour is to be under his care, and he will also be responsible for certain features of the ordinary programmes. Of course, in the women's hour he will have some extremely competent ladies to assist him, but even with their help men of mature years will not envy him his job. If he is able to find out exactly what women want, he will rank with the great discoverers of the ages.

* * *

There are several Broadcasting officials who are very much in the public eye, but very little seems to have been written about the secretary, Major P. F. Anderson, who was the first official of the Company, and who was dumped down in temporary premises with nothing but four walls and a chair. In an incredibly short space of time he has organised the office on thoroughly business lines. He has a host of people to see every day, and while he is most anxious to meet everyone, it would be safer if people would fix an appointment with him beforehand.

* * *

Major Anderson is one of those fellows who obtrusively keeps himself in the background (to use a paradox), but he has had a most interesting career in various parts of the world. He was one of two or three officers who met in the basement of a house at Grantham during the Great War, and hammered the Machine Gun Corps into shape. It afterwards became one of the great sections of the Army, but it had its first lowly beginnings in that Grantham basement. By the way, some disgruntled manufacturers think that Major Anderson is responsible for the B.B.C. agreement, but it was formed before he entered the service of the company.

* * *

A great many artists and others interested in the programmes at 2LO do not seem to have realised that Mr. Stanton Jeffries is now Musical Director, and Mr. R. F. Palmer has been appointed Director of 2LO. Mr. Palmer is proving an efficient successor to Mr. Jeffries. He is the possessor of a very fine voice, which, we hope, will be heard over the microphone more frequently.

* * *

The statement has frequently been made that a good concert artist is not necessarily a good broadcasting artist. This is especially so in regard to humorous singers and entertainers. They are the most responsive of people and quickly sensitive to atmosphere. They depend for this effect so much on their facial play, and the microphone receives their funniest bits with such deadly, chilling silence that the poor humorist is quite discouraged.

* * *

It is usually found, however, that really great artists gifted with imagination broadcast very well. They forget the emptiness of the studio and the inartistic microphone, and see in their mind's eye a greater audience than was on shore or sea, and they pour out their heart to the unseen, but very real, audience.

* * *

There are some good voices, of course, which will never broadcast well, but in the long run it will be found that the presence or otherwise of imagination in an artist has almost everything to do with the success achieved. Some blind performers have been exceedingly successful because they are not accustomed to the inspiration which a crowd of people gives.

* * *

The B.B.C. is making a special effort to find out artists who by reason of physical infirmity cannot appear on ordinary platforms.

* * *

A high Broadcasting official.—Mr. J. C. W. Reith, general manager of the B.B.C., is six feet six inches in height.

* * *

2LO is frequently picked up in America now, and various amateurs are also being heard in the States.

BROADCASTING F

An article describing the actual a

WE give below the first practical description which has been published of how the broadcasting of grand opera, musical comedies, etc., is carried out directly from the stages of theatres and whilst the plays are actually in progress. The description must necessarily be brief, but many details of considerable interest will be found in this article.

The Microphones

It will readily be appreciated that the microphones used for this class of transmission must be exceedingly sensitive to the smallest sound and yet comparatively insensitive to mechanical vibration. The ordinary type of microphone does not fulfil these conditions, particularly as regards sensitivity to distant sounds. The special type of microphone employed has been evolved by one of the firms responsible for the design of a certain type of broadcasting transmitter, and is remarkably sensitive to distant sounds. One or two of these microphones are mounted in suitable positions behind the footlights. Here they are so disposed as to ensure a balance of tone between singers and performers on the stage, with their relatively weak voices, and the music of the orchestra, which has considerably more volume. This particular type of microphone is sensitive to sound impinging upon it from both sides, and is eminently adapted for this class of transmission.

The Speech Amplifier

Whilst, however, it is exceedingly sensitive to sound, the current output from it is very small and, in consequence, must be amplified electrically before it will be of sufficient intensity to impress speech upon the control circuits of the transmitter. A glance at the figure in the left hand corner of the page will explain how the microphones, placed behind the footlights, are connected to the speech amplifier, which is beneath the stage. The same firm who are responsible for the design of the microphone have evolved this type of speech amplifier. It is, of course, an audio-frequency amplifier, and employs three stages of magnification.

There are novel points which will be appreciated on examination of the circuit diagram shown in the pictorial representation of the stage. Observation is made on the transmissions from this amplifier by means of either a loud speaker or a pair of telephones worn by the person in charge of the amplifier. This enables him to pass on the correct volume of speech and music to the cable which is connected to the control circuits of the transmitter. The amplifier is a piece of apparatus upon which considerable time and care has been expended, and it is without doubt the most efficient instrument of its class in existence. High amplification without distortion is ensured by the careful and correct application of the necessary grid voltages to ensure the valves working at the proper points on their characteristic curves.

The Underground Cable

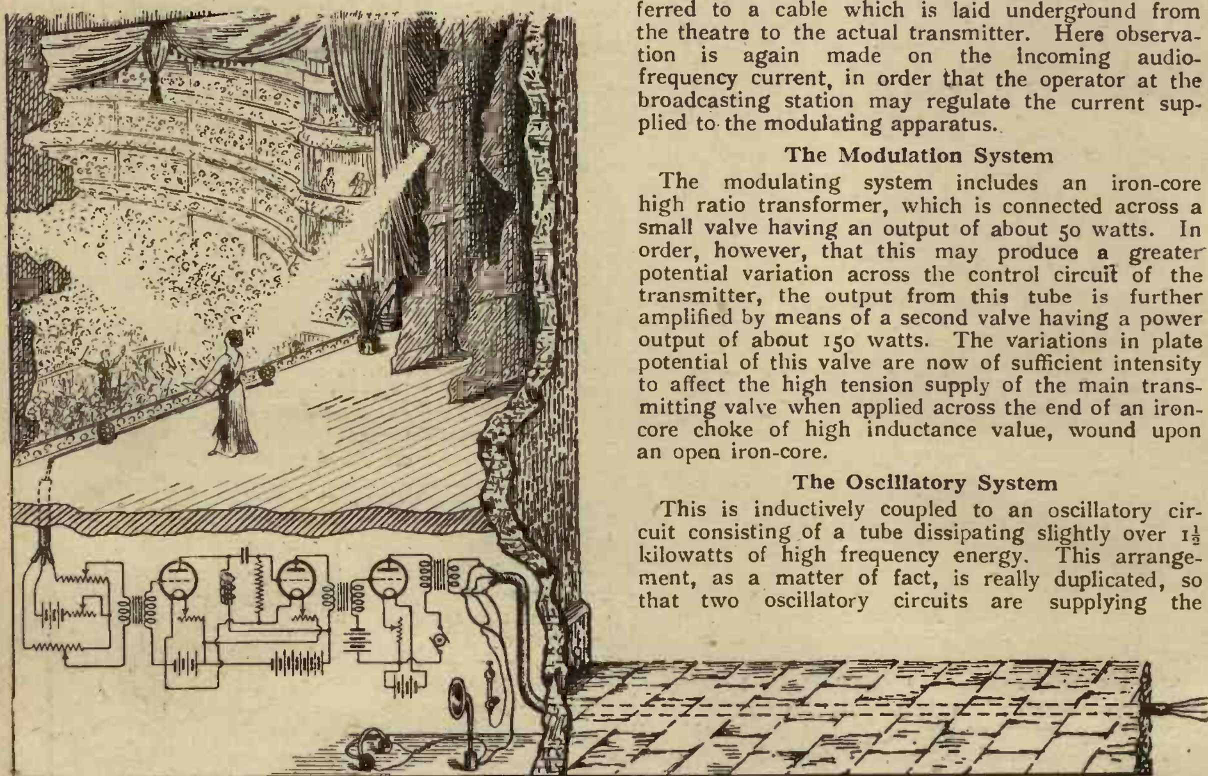
The amplified audio-frequency currents are transferred to a cable which is laid underground from the theatre to the actual transmitter. Here observation is again made on the incoming audio-frequency current, in order that the operator at the broadcasting station may regulate the current supplied to the modulating apparatus.

The Modulation System

The modulating system includes an iron-core high ratio transformer, which is connected across a small valve having an output of about 50 watts. In order, however, that this may produce a greater potential variation across the control circuit of the transmitter, the output from this tube is further amplified by means of a second valve having a power output of about 150 watts. The variations in plate potential of this valve are now of sufficient intensity to affect the high tension supply of the main transmitting valve when applied across the end of an iron-core choke of high inductance value, wound upon an open iron-core.

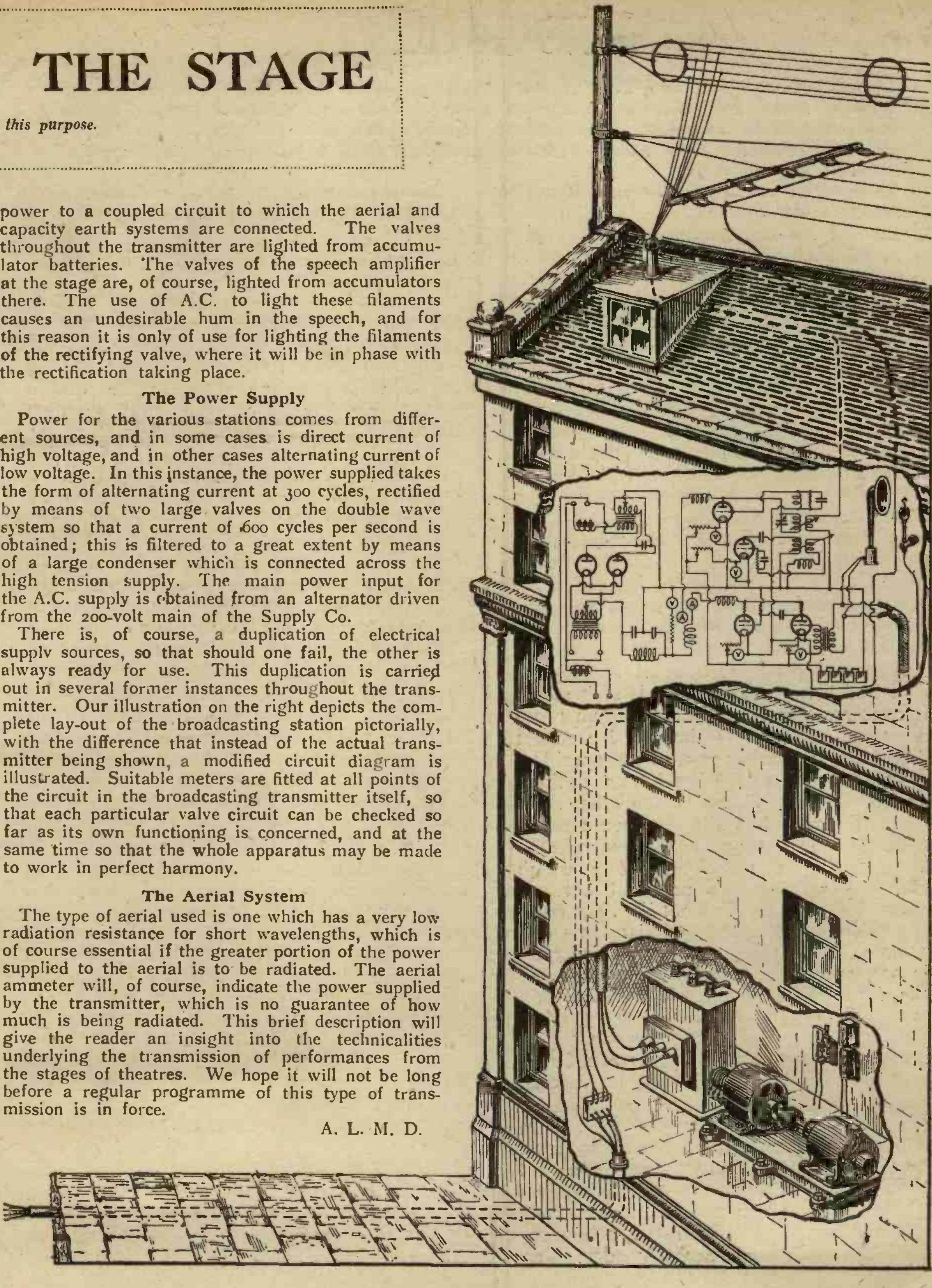
The Oscillatory System

This is inductively coupled to an oscillatory circuit consisting of a tube dissipating slightly over 1½ kilowatts of high frequency energy. This arrangement, as a matter of fact, is really duplicated, so that two oscillatory circuits are supplying the



ROM THE STAGE

paratus used for this purpose.



power to a coupled circuit to which the aerial and capacity earth systems are connected. The valves throughout the transmitter are lighted from accumulator batteries. The valves of the speech amplifier at the stage are, of course, lighted from accumulators there. The use of A.C. to light these filaments causes an undesirable hum in the speech, and for this reason it is only of use for lighting the filaments of the rectifying valve, where it will be in phase with the rectification taking place.

The Power Supply

Power for the various stations comes from different sources, and in some cases is direct current of high voltage, and in other cases alternating current of low voltage. In this instance, the power supplied takes the form of alternating current at 300 cycles, rectified by means of two large valves on the double wave system so that a current of 600 cycles per second is obtained; this is filtered to a great extent by means of a large condenser which is connected across the high tension supply. The main power input for the A.C. supply is obtained from an alternator driven from the 200-volt main of the Supply Co.

There is, of course, a duplication of electrical supplv sources, so that should one fail, the other is always ready for use. This duplication is carried out in several former instances throughout the transmitter. Our illustration on the right depicts the complete lay-out of the broadcasting station pictorially, with the difference that instead of the actual transmitter being shown, a modified circuit diagram is illustrated. Suitable meters are fitted at all points of the circuit in the broadcasting transmitter itself, so that each particular valve circuit can be checked so far as its own functioning is concerned, and at the same time so that the whole apparatus may be made to work in perfect harmony.

The Aerial System

The type of aerial used is one which has a very low radiation resistance for short wavelengths, which is of course essential if the greater portion of the power supplied to the aerial is to be radiated. The aerial ammeter will, of course, indicate the power supplied by the transmitter, which is no guarantee of how much is being radiated. This brief description will give the reader an insight into the technicalities underlying the transmission of performances from the stages of theatres. We hope it will not be long before a regular programme of this type of transmission is in force.

A. L. M. D.

JUDGMENT

The following is the first section of the Judgment of the Court of Appeal in the action of the Marconi Company against the Mullard Radio Valve Company, Limited. It will be remembered that the Marconi Company sued the Mullard Radio Valve Company, Limited, for alleged infringement of their two Patents 28,413/13 and 126,658. Mr. Justice Lawrence held that neither of the Patents was infringed by the Defendants, and Plaintiffs appealed against this decision.

The appeal was dismissed by the Court of Appeal with costs, and the reasons for the decision are given below.

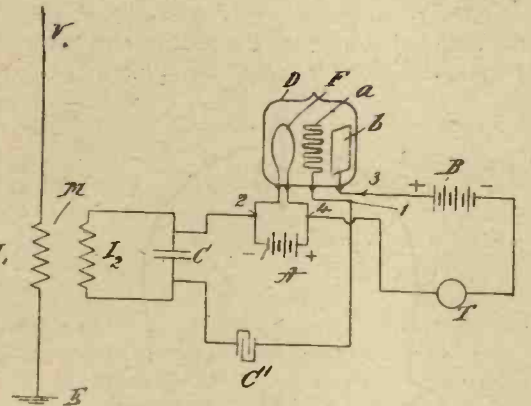
Mr. J. Hunter Gray, K.C., Mr. James Whitehead, K.C., and Mr. W. Trevor Watson (instructed by Messrs. Coward & Hawksley, Sons & Chance) appeared for the Appellants.

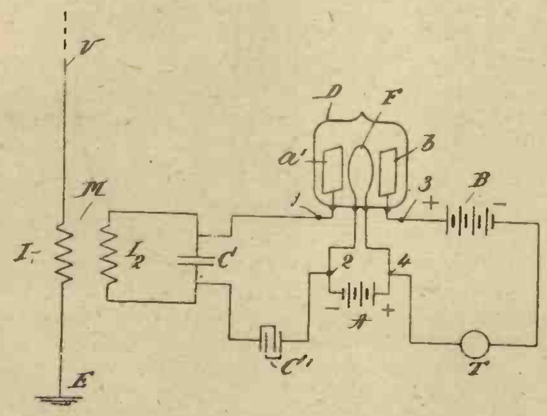
Sir Duncan M. Kerly, K.C., Mr. R. Moritz and Mr. Courtney Terrell (instructed by the Treasury Solicitor, Law Courts Branch) appeared for the Respondents.

THE MASTER OF THE ROLLS: This was an action in which the Plaintiffs alleged that the Defendants had infringed two patents of which they are the registered owners, one granted to the Plaintiffs and H. J. Round in 1913, No. 28,413, the other granted to Michel Péri and Jacques Biguet in 1916, No. 126,658. The Defendants deny infringement of either of the patents and also dispute the validity of both. The patents are quite distinct and require the consideration of different circumstances in each case. Round's patent is not only the earlier in date, but also far the more important, and I propose to deal with it first. It is a patent for "Improvements in receivers for use in wireless telegraphy," and as it is short, I think I had better read the whole of it so far as it concerns this case. "In vacuum tubes of this type, moreover"—the type I need not read, it is in the earlier part of the specification—"even where the grid has entirely separated the hot filament from the third electrode, the glass has hitherto been exposed to the cathode stream and has become electrified, producing a polarising effect which necessitated varying the potential between the electrodes and the filament." Now come the operative words: "To obviate this disadvantage, both the grid and the third electrode are, according to this invention, made in the form of cylinders which completely surround the hot filament. These cylinders effectively protect the glass from electrification, and possess the capacity above referred to as desirable." That is the provisional specification.

The complete specification is this: "In vacuum tubes of this type, moreover, even where the grid has entirely separated the hot filament from the third electrode, the glass has hitherto been exposed to the cathode stream, and has become electrified, producing a polarising effect which necessitated varying the potential between the electrodes and the filament. To obviate this disadvantage, both the grid and the third electrode are, according to this invention, made in the form of closed cylinders which completely surround the hot filament. These cylinders effectively protect the glass from electrification, and possess the capacity above referred to as desirable. Our invention is illustrated in the accompanying drawings." Then there is a description of the drawings. "In all these figures the filament, grid, and third electrode are shown in the conventional manner, but, as above stated, we find it advantageous to form the grid as a closed cylinder surrounding the filament, and to form the third electrode as a cylinder outside the grid." The third claim, which is the important one in this case, is, "A vacuum tube containing a hot filament, a grid formed as a closed cylinder completely surrounding the filament, and a third electrode in the form of a cylinder surrounding the grid substantially as described."

I agree with Mr. Justice Lawrence and the learned Counsel for the Appellants that, in order to appreciate the meaning of the specification and claims, it is necessary to look at the state of things prevailing in the industry at the time of the invention, and the kind of vacuum tubes in existence at the time which it was intended to improve, in order to see what meaning a person who knew these things would attach to the words used. To use an expression often employed with regard to other documents, these are the surrounding circumstances which it is legitimate to notice for the purpose of construction. They are so well described in the judgment of Mr. Justice Lawrence that I cannot do better than take them as they stand there. He says: "In order to appreciate the true meaning of the third claim in Round's patent, it is, in my judgment, essential to arrive at a clear understanding as to the type of valve which Round's invention was intended to improve. In 1904, Fleming invented a 2-electrode valve, consisting of an evacuated glass bulb which contained a filament and a metal cylinder. The metal cylinder was described as being open at the top and bottom, and as surrounding, but not touching, the filament. This valve operated to rectify or transform an alternating current into a continuous current capable of actuating a





Figs. 1 and 2.—Drawings accompanying De Forest's Patent 1427/08.

galvanometer by which signals could be read. In 1908, De Forest discovered that by introducing into a valve of the type invented by Fleming a third electrode in the shape of a grid interposed between the hot filament and the anode, the sensitiveness of the oscillation detector was increased. A perusal of the complete specification, in my opinion, shows that De Forest did not fully appreciate the great advantages of the introduction of this third electrode—indeed, I think it is very doubtful whether he even appreciated that his valve would act as an amplifier. What makes me doubt this is, in the first place, that he does not clearly state it in his specification and, in the second place, because the connections shown in the figures (although consistent with having a larger current in the anode surface than in the grid) are inconsistent with amplification without rectification, *i.e.*, with the relay part of the modern 3-electrode valves. However this may be, De Forest illustrates his invention by drawings in which the electrodes are shown in three parallel planes, the filament being represented as a hair-pin filament, the anode as a flat metal plate, and the third electrode as a flat grid. It is in this form that De Forest valves were put upon the market under the name of 'Audion.' In 1911 Von Lieben invented an improvement in the 3-electrode valve. This invention consisted of placing the grid in such a position as to effect an entire separation of the space occupied by the hot filament from the space occupied by the anode. According to this invention, the grid consisted of a flat round perforated metal disc which was fixed horizontally so as to fill up entirely the centre cross section of the bulb, thereby dividing the bulb into two compartments, the lower of which contained the filament and the upper the anode. The object of this arrangement was to make the grid form (and control the movement of) the boundary between the dark space near the cathode and the glow region near the anode. It was an essential element of the invention that the grid should effect a complete physical separation of the two compartments because the inventor desired to achieve two objects, the first object being to compel all the electrons which were going to reach the anode to pass through the grid, and the second object being to prevent any positive ions flowing round the edge of the grid out of the glow region into the dark space, which, if permitted, would have the effect of shunting the controlled boundary of ionisation. In Von Lieben's valve, no ionisation takes place in the lower compartment occupied by the filament, because of the comparatively low speed of the electrons, until after they have passed through the grid and have come under the attraction of the anode. Incidentally, therefore, Von Lieben's invention entirely shielded the filament from bombardment by positive ions. The invention, however, left the glass of the bulb very largely exposed to the cathode stream, with the result that the glass became charged with electrons and, when thus electrified, produced the polarising effect referred to by Round, which necessitated a frequent change of the potentiometer voltage. A further fact to be borne in mind when considering Round's invention is that at the date of that invention ionisation took place in all 3-electrode valves whenever high voltages were employed, owing to the high velocity at which the electron stream was then moving. In fact, at that date it was thought that ionisation was essential to the efficient working of these valves, and in some of the valves appliances were introduced in order to insure that ionisation should continue after the occluded gases had been extracted from the electrodes by long use."

The first improvement is that the grid and the anode are made in the form of cylinders, whereas in Von Lieben's patent they are of quite a different shape. The word "grid" is singularly inapplicable to what is called the grid by Round, for an ordinary person would not think of describing a piece of small mesh wire netting rolled into the form of a cylinder, whether opened or closed at the ends, as a grid. It is, however, the word used no doubt from the fact that the third electrode introduced by De Forest into Fleming's 2-electrode valve did somewhat resemble a grid, and the name was transferred to the electrode which in Round's patent took its place. I think it is clear that Round wished by this invention to improve Von Lieben's design, preserving the benefits of it, and in order to do so he intended to preserve the feature of a grid entirely separating the space occupied by the filament from that occupied by the anode, and he states that the grid must be in the form of a closed cylinder and completely surround the filament. He also states that the anode must completely surround the grid, and in one part of his specification he speaks of it as a closed cylinder, but in another and in the claim the word "closed" is omitted. The grid is, however, always described as closed in form. Mr. Justice Lawrence has held that although the grid must be in the form of a closed cylinder, whatever that may mean, the anode may be either in the form of a closed or an open cylinder, and I do not see any reason for differing from him. I also agree that the claim is a claim for an apparatus and not only of an apparatus that will produce a certain result, *i.e.*, the avoidance of varying the potential by adjustment of the potentiometer, but for an apparatus of a particular kind described in the specification which will produce that result, and that one of the essential elements in that apparatus is a grid in the form of a closed cylinder.

The deciding question, in my opinion, for the decision of the case so far as Round's patent is concerned is, What is the meaning of "in the form of" or "formed as a closed cylinder"? The Defendants say that it has the ordinary meaning of a cylinder closed at both ends, while the Plaintiffs say that it means electrically closed, an expression the

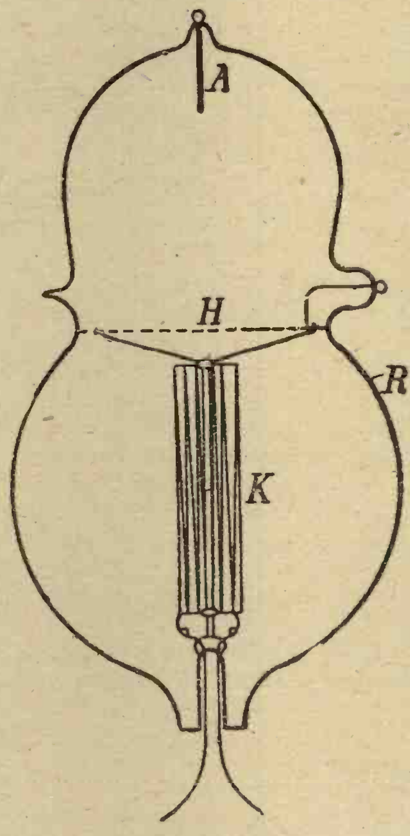


Fig. 3.—The Von Lieben valve described in his Patent 1482/11.

use of which cannot be traced further back than 1919, though, no doubt, what is meant by an electrically closed cylinder was known before that. There was a good deal of discussion during the case as to the meaning of "electrically closed," but the following was accepted by the learned Counsel for the Plaintiffs as not an unfair description. It is a question that I put to the learned Counsel myself. The question was this: "Is this a reasonable meaning of a closed cylinder in your sense; a grid in the form of a closed cylinder, a grid of cylindrical form of such dimensions relative to the filament or anode that it will avoid any variation of the potentiometer by reason of the action of the electrons or ions?" Mr. Hunter Gray said "Yes." Then I asked again, "It is rather a long definition of 'closed,' but that is what you say it means?" Mr. Hunter Gray said "Yes. One cannot get at what the definition of these words is unless one applies the knowledge at the time." Then I said, "I quite understand that; you think that is not an unfair description of what you said may be closed?" and Mr. Hunter Gray said, "It is not." It does not seem a very clear guide to anyone who wishes to make his grid in the form of a closed cylinder, but it might to an electrician convey the meaning of a certain form, and I therefore asked the learned Junior Counsel for the Plaintiffs what was the difference between the form of a grid which is electrically closed and one which is not electrically closed, and his answer was that there need not necessarily be any difference. The exact question and answer were, "Let me put this to you: you all talk as if the word 'closed' was the only word, it is not; it is a 'grid formed as a closed cylinder.' What is the difference in form between a grid which is electrically closed and a grid which is not electrically closed? What is the difference in form of the two?" Mr. Whitehead said: "There may be differences, but there need not necessarily be a difference." Then I asked: "There need be no difference in the form of an electrically closed and an electrically open cylinder; those are the words which we have to deal with, 'formed as a closed cylinder'; it is not only 'closed,' it is 'a grid formed as a closed cylinder.'" Mr. Whitehead said, "Yes." This seems to me to go a long way towards deciding the question. If there be no difference between the form of an electrically closed and an electrically open grid in the form of a cylinder, it is idle to specify that it must be in the form of a closed one; it would convey nothing to anybody more than the "form of a cylinder," whereas, if "closed" be read in the ordinary sense of the word there is a great difference in the form of a closed and an open cylinder. In ordinary language, a closed cylinder is one closed at the ends and an open cylinder is one open at the ends. Moreover, it is to be remembered that all valves in use at this time were what are called soft valves, *i.e.*, valves containing an appreciable amount of gas, and the filament in general use then was what is called a hair-pin filament, the hottest part of which is at the top. I do not say that Round's patent is confined to soft valves or to hair-pin filaments, but the fact that the previous inventions upon which Round meant to introduce an improvement were concerned with such valves and filaments is one of the circumstances to be considered.

I have already pointed out that one object of Von Lieben's invention was to separate completely the space occupied by the filament from that occupied by the anode, and this he did by making the grid physically separate the two spaces. Round's improvement was, in my opinion, meant to follow in the same path, but produced the result by a grid in the form of a closed cylinder in the ordinary sense, thereby creating the same physical separation between the two spaces. Moreover, the hottest part of the hair-pin filament being at the top, it was important that the top part should be the most closed in, and that was done by closing the top of the cylinder by what was called thimbling it. The closing at the bottom was not so important as the top. There was considerable difference of opinion as to the result of the introduction of hard valves, *i.e.*, valves from which the gas had been so far as possible extracted, as described in the judgment of Mr. Justice Lawrence, but I think it is a correct conclusion from the evidence that a physical separation of the spaces as contemplated by Von Lieben and effected by a grid in the form of a physically closed cylinder is much less important, if important at all, in a hard than in a soft valve. The filament also generally used in these valves is a straight filament, the hottest part of which is in the middle, and not at the top, and therefore the closing of the top of the cylinder is much less important. As a matter of fact, the valves manufactured under Round's patent at first, and, I think, until the introduction of the hard valve, were made with the top of the grid thimbled over. It is true that the bottom was not made in that way, but it was closed by being fastened down on a glass foot or bulb which completely closed it and produced the same effect. That is shown in Exhibits D. 12 and D. 13. I do not think that this can be used to construe the claim or specification, but it is consistent with the meaning which I put upon it, *i.e.*, that "in the form of a closed cylinder" means closed in the ordinary sense.

(To be continued.)

News of the Week

BROADCASTING reception in Canada has been used for some time past to receive tips and prices in connection with horse-racing, and this in spite of the present laws against the publication of betting items. This betting information comes from the broadcasting stations in the United States, and it is, of course, impossible for the Canadian authorities to prevent the waves passing the frontier.

* * *

The Sunday broadcasting programme commenced at Glasgow on Sunday last. The programme consisted of a sermon and various concert items.

* * *

On an average 150 letters a day from children and 350 from grown-up people are received by the head office of the British Broadcasting Company. These letters criticise the programmes and are welcomed by the company. Criticisms and suggestions should be written on postcards and addressed to the Company's new offices at 2, Savoy Hill, London, W.C.2, a photograph of whose "name-plate" appears elsewhere.

* * *

The Gramophone Company, who produce "His Master's Voice" records, have, we understand, served notice upon artists who are under contract with them not to take part in broadcasting without permission.

* * *

The question of broadcasting and the stage is an involved one, as not only are the different gramophone companies involved, but also the Performing Rights Society, the Variety Artists' Federation, the Actors' Association and the Musicians' Union.

There seems to be considerable doubt as to the legal position regarding the copyright of musical and other items. Does the broadcasting of a musical piece constitute a breach of the copyright? The Act of 1911, which deals with musical copyright, states that a performance is "any acoustic representation, including such a representation made by means of any mechanical instrument." This would, we think, probably include loud speakers and telephone receivers. The Act goes on to state that copyright includes "the sole right to perform the work or any substantial part thereof in public."

It could hardly be said that a broadcasting station is performing in public, nor could a receiver who simply listens-in, say, on his telephone receiver apparatus, be said to be reproducing the music in public. If, however, a loud speaker is being used to entertain an audience in, say, a cinematograph theatre, there seems to be a possibility that a copyright would be infringed.

* * *

It seems to us that if the different associations representing artists and others become unpleasant, the British Broadcasting Company could easily enlarge their present musical staff and be entirely independent of outside artists. We do not think that this would be desirable, but this is always a possible line of defence open to the Broadcasting Company. They have already their own orchestra, and a short-sighted attitude on the part of the Federations representing the artists would only result in a win on the part of the Company.

* * *

We hear that the Manchester Broadcasting Station is well supplied with singers and that no more applications can be considered for the present. It is surprising the number of artists who are ready to perform without a fee, presumably for the publicity afforded.

* * *

A correspondent at Kirkcudbright, on the East Coast of Scotland, about 70 miles from Glasgow, states that he can hear Cardiff better than Glasgow.

* * *

Numerous listeners-in to the Cardiff wireless station are expressing their appreciation of the programmes by sending gifts which vary from apples and cider to sweets.

* * *

The listeners-in in the London area appear to be the fondest of writing letters to the Station. In reply to the request of Major Corbett-Smith (of the Cardiff station) as to whether or not his audience would prefer the proportion of dance music to be reduced, four letters were received which were against the proposition, while one was in favour of a reduction.

* * *

The music to the film "Robin Hood" was beautifully reproduced by 2LO recently, and if this standard could always be maintained there would be nothing to grumble about. It is, of course, a very much simpler matter to broadcast music of this sort than to reproduce the utterances of people who are moving about on the stage.

* * *

A presentation of a handsome marble clock has been made to the retiring Secretary of the North Middlesex Wireless Club, Mr. E. M. Savage, on the occasion of his marriage. This society is one of the most flourishing in the South of England, and this is due in no small measure to the work of its late secretary.

* * *

We understand that the Marconi Company is proposing to erect a very high-power station in the Midlands to communicate with the Colonies. They are now awaiting a licence from the Government. It is expected that between two million and three million pounds will be expended in the erection of the station. The number of words per hour which it is expected to transmit is between 35,000 and 40,000.

* * *

There is no doubt that thousands of enthusiasts will fix up portable sets for use during the summer months. With a new circuit which has just been evolved by the Editor of this journal, it is possible to obtain broadcasting on a loud speaker with an aerial only a few feet long and one or two feet high. Only two valves are used and remarkable results are obtainable. The circuit is known as the ST 100, and full details will appear exclusively in No. 5 of *Modern Wireless.*

* * *

Two addresses were recently broadcasted from the Newcastle Station by Canon Newson, Vicar of Newcastle, and by the Rev. Collins respectively. The voices of both preachers were easily recognisable, and their addresses were received by an appreciative, if invisible, audience.

* * *

When the British steamer "City of Victoria" was on fire in mid-Atlantic, many New England listeners-in were enjoying an opera broadcast from a station in Boston. The S.O.S. calls which came from the burning ship interrupted the opera and broadcasting closed down for a quarter of an hour. Later messages indicated that the fire was under control and that the ship was proceeding to St. Michaels, the Azores, under her own steam.

* * *

There is much rubbish being published regarding wireless as a cure for the deaf. First of all wireless was stated to be good for promoting the growth of hair, then it was good for eyesight, and now it is good for hearing. There is no doubt that the concentration of sound results in people suffering form a certain form of deafness to hear more clearly, but to state that wireless is a cure for deafness is almost as bad as stating, as one titled lady recently did, that if birds got in a direct line with wireless waves (*sic*) they would fall dead.

* * *

Listeners-in in the Dundee area very much enjoyed the first act of "I Pagliacci" from the Glasgow Coliseum recently. As a matter of fact, the volume of sound was the greatest yet heard from the Glasgow station, and every part of the opera was received with success. Considerable jamming, however, was experienced. There seems to be a great deal of this in the Dundee area.

* * *

There are hundreds of demonstrations going on all over the country with loud speakers. Probably 90 per cent. of these demonstrations are unsuccessful and do far more harm than good. Unless really good results are obtainable it is much better to demonstrate on telephone receivers.

* * *

The Thanet Radio Society is experiencing trouble due to jamming from the local lightship sending telegraphy on 300 metres.

* * *

Many of our correspondents have suggested that instead of fiddling about with their apparatus it would be much better if those possessing valve sets using reaction were to content themselves with listening-in on a given adjustment. Most of the trouble is not due to radiating, but due to constant tuning which is generally quite unnecessary.

* * *

A statement in the Press to the effect that the Instone Air Liners, fitted with wireless telephony apparatus, do not employ an earth connection is rather good. The contractors supplying the Instone Air Liners with apparatus obviously do not intend the aircraft to be tied down to the ordinary methods of reception on the ground.

. Some excellent transmissions from the Oxford Picture House in Manchester have been taking place. The transmissions have been relayed by land-line to the Broadcasting Company's Manchester station.

* * *

In reply to a question by Sir Burton Chadwick, the Postmaster-General has written a reply stating that the total expenses of the Leafield and Cairo stations are estimated at about £36,000 and £49,000 per annum respectively. In addition to the Egyptian service, Leafield station is used for the transmission of press telegrams to Halifax, Nova Scotia, India, ships at sea and for the broadcasting of British official communiqués. The revenue derived by Leafield amounts to £24,000 for nine months, or £32,000 for the whole year. The Cairo station has collected £4,700 for nine months, which amounts to about £6,200 for the whole year. The whole revenue from the two stations therefore amounts to about £40,000, whereas the total expenditure is £85,000.

The loss on this service therefore amounts to about £46,000. This almost makes one wonder whether State-owned wireless is worth while, but of course the strategic situation has to be considered. Nevertheless, we would prefer to see organised services conducted by some British commercial organisation. For example, the Marconi Company could carry out the work and provide a desirable service without a loss to the State.

* * *

The Society of Authors, Composers and Publishers of America have decided to exact royalty payments in respect of musical, literary, dramatic and similar material broadcast by wireless.

OPULENCE !

The New Headquarters of the British Broadcasting Co.

A PROGRESSIVE UNIT RECEIVING SYSTEM

This forms the second part of our special series of articles on a complete wireless unit receiving system. All the component parts will be incorporated into different arrangements later on and great economy of time and trouble is thereby effected. By following this series closely the beginner, and also the more advanced experimenter, will be assured of success. The apparatus described is of the simplest character and has all been tested out very carefully by the Editor before being described.

PART II

(Continued from No. 1, page 52.)

A Variable Inductance Tapped at Every 20 Turns

IN last week's issue we described a variable inductance consisting of 20 turns of wire tapped at every turn. It is now proposed to describe a companion inductance, which is wound on a similar sized tube with similar wire that is tapped at every 20 turns. It is later proposed to connect these two inductances in series so that any number of turns of inductance between zero and 120 may be obtained. Accurate tuning may be effected in this manner and there is no necessity for the use of a variable condenser.

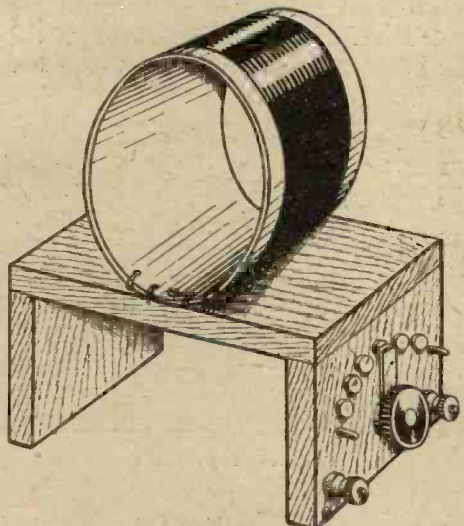


Fig. 1.—Showing the complete inductance.

Fig. 1 shows the completed variable inductance, and it will be seen that the method of construction is very similar indeed to that employed in the single stud inductance described in Part I. of this series.

Fig. 2 shows a cardboard tube on which the inductance is wound. It measures 5in. external diameter and 3¾in. long.

This tube is wound with 100 turns of No. 26 double cotton-covered copper wire, and tappings are taken at every 20 turns.

Fig. 3 shows the completed inductance with the tappings hanging out at the left-hand side. The method of taking these tappings is that described in the case of the single stud inductance, but if the reader has any preference for any other method he is, of course, at liberty to employ such method without interfering at all with the final operation of the apparatus.

The Baseboard

The baseboard is formed in exactly the same way as before, but the sizes are naturally not the same. Three pieces of wood are required; two of them measure 3¾in. by 3⅜in. by ½in., as shown in Fig. 4, and one piece measures 3¾in. by 5⅝in. by ½in., as shown in Fig. 5. Having made these pieces of wood to the right size, the next step is to mount the selector switch, stud and terminals on one of the pieces of wood dimensioned as in Fig. 4.

Fig. 6 shows the general arrangement of the studs and terminals. It will be seen that the right-hand terminal R is connected to the right-hand stud, which also goes to the right-hand end of the inductance coil. When the switch arm is on the last stud, which we will number zero, none of the inductance of the coil is included in the circuit, but if we move the switch arm so that it rests on the stud No. 1 we will include 20 turns of inductance, and if we move the switch over to stud 2 we will include 40 turns. If we move the switch over to studs 3, 4, and 5, we will get 60, 80, and 100 turns respectively connected in circuit. Two stops are provided, one at each end of the arc formed by the studs. These stops may be nails or screws, and their object is to prevent the switch arm from slipping off the end stud. A wire connection is taken from the selector switch to the left-hand terminal L.

Fig. 7 shows the end view of the completed variable inductance. It is very important to see that the right tappings go to the right studs, and it is desirable that these various studs should be numbered on the front of the panel in ink on the wood. There will then be no doubt as to how much inductance is in circuit at any adjustment.

The Crystal Detector

The crystal detector for use with this apparatus is illustrated in Fig. 8 and forms another unit in the system. This detector

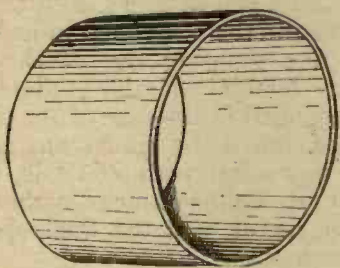


Fig. 2.—The inductance tube.

will be used on different occasions later on. It will be seen that it simply consists of a crystal cup containing a piece of Rectarite or Hertzite, on which presses a light spring S which is mounted in such a way that the pressure may be adjusted.

The detector is mounted on a baseboard B dimensioned as shown. It will be seen that two little ledges, L_1 and L_2, are provided in

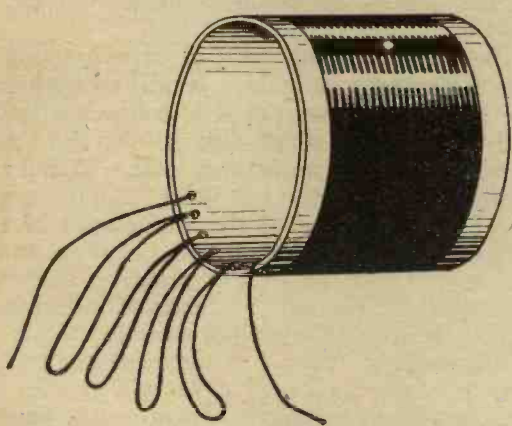


Fig. 3.—The complete inductance with tappings.

order to raise the underneath wiring above the surface of the table. The crystal cup C is connected to the terminal L by a wire underneath the board, while the spring S, which is a piece of No. 36 bare copper wire, is connected to the conducting strip of brass F and the other wire to the right-hand terminal R.

The strip of brass F is dimensioned in accordance with the figure and is screwed to a block of wood by means of a round-headed screw H. The block of wood V is screwed

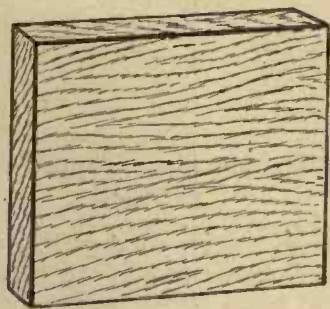


Fig. 4.—Sides of base.

down to the baseboard B by means of a screw let in from the bottom.

For a greater portion of its length, the brass strip F is flat, but just at the end, at the point K it is bent at right angles so as to be vertical. At its end is drilled a hole through which passes a small bolt M fitted with a nut. A convenient substitute is a small piece of threaded brass rod passing through the hole in the brass strip and having nuts fitted, one

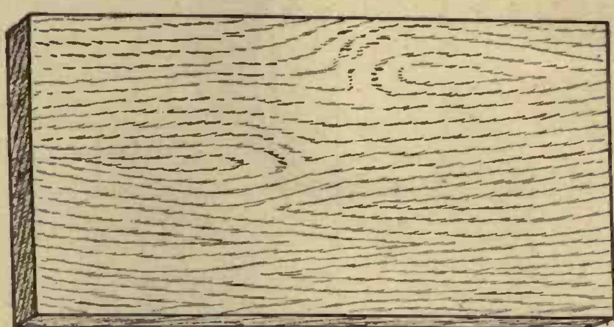


Fig. 5.—Top of base.

on each side of the brass strip. The nut and bolt, or equivalent arrangement, is for the purpose of securing the end of the brass spring S, the other end of which should lightly touch the surface of the crystal in the cup C.

In order that the pressure on the crystal may be varied, a piece of threaded brass rod N is made to pass through an oval slit in the brass strip F, and is secured to the base board by means of the two nuts Q and R. The head P of a brass terminal is screwed on to the piece of studding N, and by moving this terminal P round in an anti-clockwise or clockwise direction, the spring S may be moved up or down. The strip F should be of $\frac{1}{16}$in. thick brass, and it may be made springier by hammering before use. The process of hammering on an anvil or its equivalent adds considerable springiness to the metal, and the strip should be given a

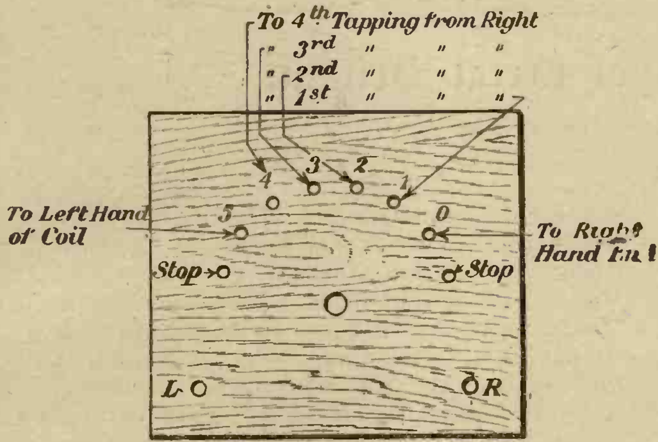


Fig. 6.—Arrangement of studs and terminals.

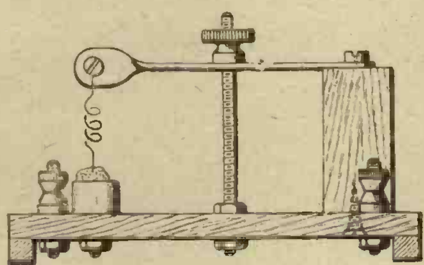


Fig. 9.—Elevation of crystal detector.

slight bend so that, under ordinary conditions, the point of the spring S is kept well clear of the crystal. When the terminal head P is rotated in a clockwise direction, the strip F is pressed downwards and the point of the metal spring S is lowered on to the crystal. When the terminal head is rotated in the opposite direction the springiness of the brass strip F lifts the point of the spring S off the crystal again.

Fig. 9 shows the elevation of the crystal detector.

Special Note

It is important when constructing these different component parts to ensure that the wood used is absolutely dry. It is preferable to bake the wood in an oven before using it, and, if it is then soaked in paraffin wax, so much the better.

As regards the inductances, these should be kept well dried and would probably be better if they were waxed. In order, however, to simplify the apparatus and to lessen

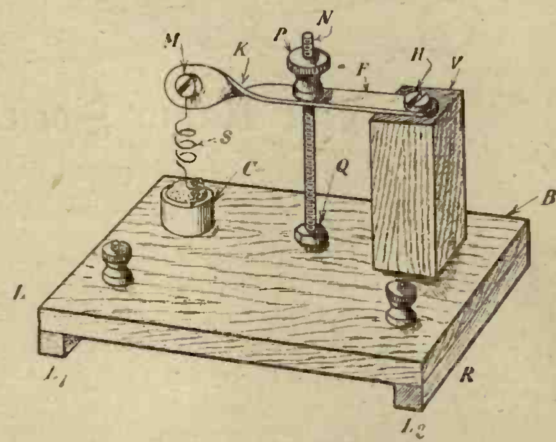


Fig. 8.—Showing the detector.

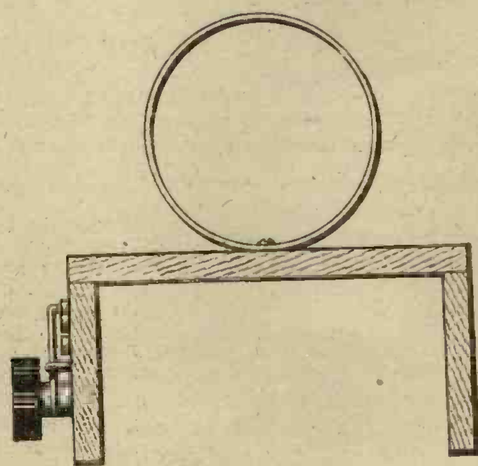
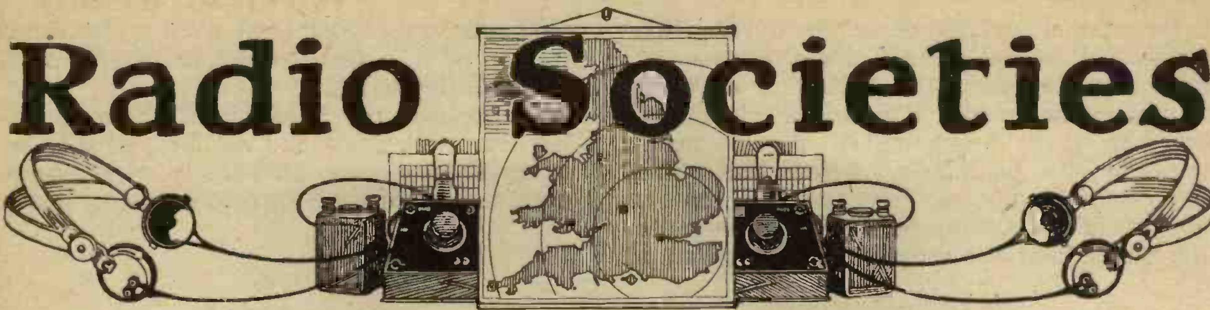


Fig. 7.—End view of completed inductance

the number of operations necessary, the inductance coils described here have not been so treated, and provided they are occasionally allowed to dry slowly before a fire there is no particular necessity for waxing the coils. If the inductances, however, are left out in a damp shed or tool house or similar place, they are liable to become less efficient owing to the absorption of moisture, which will result in leakage taking place.

(Next week: Receiver No. 1 using the two inductances and the crystal detector.)

Radio Societies



The Radio Society of Great Britain.

Patron—H.R.H. THE PRINCE OF WALES, K.G.
President.—W. H. ECCLES, F.R.S., D.Sc., A.R.C.S., M.I.E.E.

TWO lectures to Associate Members of the Radio Society of Great Britain are announced. One will be entitled the "Elementary Principles of the Valve," and will be given by Mr. E. Redpath, Assistant Editor of *Wireless Weekly* and *Modern Wireless*. This lecture is being given to-day, Wednesday, April 18th, at 6.30 p.m., at the Institution of Electrical Engineers, Victoria Embankment, London.

Another lecture which will prove very interesting is one by Mr. G. G. Blake, who will speak on "Some Notes on the History of Radio Telegraphy and Telephony," on Wednesday, April 25th. The lecture will commence at 6 p.m., and will also be held at the Institution of Electrical Engineers. A good deal of explanatory apparatus will be on view and experiments will be given.

MEMORANDUM UPON BROADCASTING

The following is a copy of a Memorandum upon broadcasting which has just been handed to the Postmaster-General by the Radio Society of Great Britain. This Memorandum has previously been sent all over the country to the Societies affiliated to the Radio Society, and has been discussed at their various meetings. All the main points set forth in the document have been accepted by the Societies which have reported up to this date, and nearly all the detailed suggestions have been supported by a large majority of the Societies.

THE Radio Society of Great Britain is an organisation representing about 160 of the Wireless Societies scattered throughout the British Isles and about 30,000 persons. The Society includes men of science who have worked upon the fundamentals of wireless, engineers and designers, artisans and operators, and an even larger number of non-professional students of the subject. All these meet with the common ideal of spreading the study of electricity in one of its most fascinating phases among all classes of the community and join hands in the public spirited endeavour to foster wireless science in the national interest.

The study of wireless is one of the best gateways to all electrical knowledge. The design and construction of wireless apparatus is a valuable part of electrical education. The practice obtained by actual use of the apparatus is an excellent way of acquiring skill in manipulation and makes the amateur a participator in the regulation of the world's wireless traffic. All this is immensely to the public advantage; for, in the first place, in our modern electrical civilisation our commercial survival depends upon the attention given to electrical subjects. In the second place, the existence of a nucleus of persons trained in wireless is an important contribution to the national security. In the third place, the wide dissemination of electrical thought produces an atmosphere that fosters electrical ability and facilitates the emergence of electrical genius. Unless this encouragement exists we shall become even more indebted than we are at present to foreign discovery and invention and we shall have to pay an even larger tribute as royalties on foreign patents than we do to-day.

The Radio Society of Great Britain can therefore claim that its activities are in the highest degree of national importance, and it need hardly be said that in spreading a love of the study and practice of wireless the Society is absolutely disinterested. In this spirit the Society has welcomed the advent of Broadcasting for at least two reasons. It appears probable that all those who listen-in frequently will gain information of the possibilities and of the limitations of wireless intercommunication, and it is probable that some of those who begin by listening-in for amusement may be led on to take a thoughtful interest in this branch of science. The Society, therefore, looked forward hopefully to the rapid multiplication of students, constructors and operators of wireless apparatus.

Three or four months' experience of Broadcasting has brought unexpected consequences. For instance, practice in the art of receiving signals with modern apparatus has been made difficult or physically impossible in certain areas at certain times. Again, many new restrictions have been imposed on old licence-holders, and the obtaining of new licences has been made less easy. All this is so clearly against the public interest and affects so many members of the Radio Society that the matter has been forced to the urgent attention of the Committee.

The principal ways in which members of the Society and others are affected adversely may be summarised as follows :—

(*a*) Experimental receiving stations within a few miles of a Broadcasting station are jammed so badly that practice in picking up other stations, in learning the Morse code, and in testing apparatus is impossible during the hours usually available to the experimenter. It is even impossible to calibrate a wavemeter for strictly scientific purposes.

(*b*) Experimental transmitting stations are greatly hampered because the co-operating station is jammed and because it is impossible to intercept before transmission on the licensed wavelength in the manner required by the permit. A branch of science with high potentialities is thus destroyed during a large portion of each day.

(*c*) The existing Broadcasting regulations prohibit an owner from studying or improving his own apparatus. This prohibition if it could be enforced would be an edict compelling ignorance, and would destroy the only chance that Broadcasting had of being of national educational value as well as an entertainment.

(*d*) The granting of experimental licences has been made more difficult rather than more easy, and serious would-be learners of wireless science are hindered in beginning their studies. This is quite contrary to the public interest and appears, besides, to be contrary to the intention of the Act of Parliament. It is said to have led to much evasion of the regulations and possibly to infraction of the law.

(*e*) The selling of apparatus in sealed cases is tending to lower the standard of manufacture, and the limiting of designs to certain standard types usable only in this country cannot but react most injuriously upon all attempts to build up an export trade in wireless apparatus.

The Committee collected a number of suggestions for the amelioration of the disadvantages enumerated above. The technical suggestions included the following :—

1. The Broadcasting stations should be prohibited from emitting high-frequency harmonics or overtones and should be restricted absolutely to their proper wavelengths.

2. The power to be employed should not be allowed to exceed the allotted figure.

3. Modern methods of modulation should be made compulsory.

4. More blank hours should be arranged for the use of students of wireless, especially on Sundays, and the hours fixed should be adhered to. It is stated that at present the blank hour is frequently filled illegitimately, and the Broadcasting station thereby becomes a permanent obstacle to the worker. For the benefit of the listener-in, the blank hours might be taken in rotation by the various Broadcasting stations.

The Committee also discussed a number of suggestions for the improvement of the present system of licences. As desirable guiding principles it was agreed that every competent British subject must retain his right to possess a licence for experimental work, must remain entitled to construct and to use his own apparatus under the licence, and must not be coerced into paying any sum or sums towards the Broadcasting Company if he does not use the entertainment they provide, always excepting any proportion of the usual licence fee which the Postmaster-General may allocate to the Company.

The following scheme of licensing was agreed upon as likely to be satisfactory to all parties concerned.

Three kinds of licence might be issued :—

(1) The broadcasting licence for use with apparatus marked B.B.C., fee 10s.

(2) The experimental licence at a low fee for qualified persons not listening-in to the broadcasting transmissions, say 10s.

(3) The listening-in licence allowing the use of any apparatus, bought or home-made, for the purpose of listening-in, fee 20s. The Broadcasting Company might supply holders of this licence with a neat badge, changed annually, as acknowledgment of payment of the fee. Such a badge suspended near the apparatus would serve as a guarantee of payment for the entertainment.

The Committee suggested that a fourth kind of licence might be issued to hotels, restaurants, cinemas, etc., costing £5 or £10.

It was agreed that the Society could not accept the suggestion that any form of licence should be endorsed with a requirement that any component parts purchased under the licence must be marked B.B.C. The Society would offer no objection to an endorsement limiting purchasers to components marked of British manufacture.

The Committee decided to put on record their demand that action taken on the above suggestions should not affect the enjoyment or issue of transmitting licences for experimental purposes.

We have had numerous letters from Secretaries of Radio Societies promising to support us in our endeavours to provide *useful* society reports. We aim at *Wireless Weekly* being the Unofficial Organ of ALL the Societies. Our next week's issue will contain the first set of reports.

ACCUMULATORS

By ALAN L. M. DOUGLAS, Associate Editor of "Wireless Weekly."

PART II

(Continued from No. 1, page 29.)

THIS treatment if persisted in, and if the sulphating is not too bad, will eventually restore the cell to its original freshness, although the plates will probably now be a little more fragile than before. It should be borne in mind that an accumulator is not robust at the best of times, and must be handled with care. Although large and heavy they are not strong mechanically, and a wooden container should always be used for their transport from place to place. Such an accumulator is shown in Fig. 2, which illustrates one of the latest patterns of filament heating batteries. It may be of interest to point out that a *cell* means a single primary unit, whether of the dry type or of the accumulator pattern; whereas a *battery* means the multiple of cell; i.e., one should speak of six cells as a battery and not six cells.

These terms apply equally to all types of cell, and there is often an erroneous impression that an accumulator and a battery are totally different things. It would be more correct to speak of a 2-volt accumulator as an accumulator cell, and of a 4-volt (and upwards) accumulator as an accumulator battery. There does not, however, appear to be much attention given to these points nowadays.

The next cause of trouble will probably be found to be due to buckling of the plates and consequent shedding of the paste. This is due either to charging the battery at a great rate, or discharging it in a like manner. The celebrated trick of some experimenters of drawing sparks from the terminals by closing contact across them with a file is responsible for much damage of this nature, and should not be persisted in. When the paste begins to drop out it is time to discard the battery altogether, as not only will it hold its charge now for a short time only, but if used in valve circuits will probably give rise to parasitic sounds in the receiver, and may produce "fading" effects.

A mysterious fault whereby an accumulator will often gas and indicate a full charge some hours after, but yet will fall off rapidly in use, is sometimes to be traced to a small portion of the paste having become dislodged and wedged in the separator holes, causing an almost complete short-circuit between the positive and negative elements when there is any demand from the accumulator. The only cure for this is to open up the cell and remove and clean the offending separator.

Another cause of falling-off in holding power, is occasionally due to sediment (which is metallic in composition) from the bottom of the cell having entered the holes in the separators, again causing a partial short-circuit; but this is unlikely unless the battery is subjected to much rough usage. For this last reason great care should be exercised in the choice of an accumulator; the following points should receive attention. The most important feature about an accumulator is the formation of the plates. These should be of the regulation straight pattern, and the thicker they are the better. They should have a heavy joint to the terminal bar, and this should be some distance above the top surface of the plates themselves, so as to allow plenty of acid space. The terminals should be long and project well above the case, passing through rubber collars inserted into the celluloid top. These and all the metal portions appearing on the outside of the

Fig. 2.—A common form of filament heating battery.

case must be kept well vaselined, because although no acid may be spilled on the case slight spraying takes place, both while charging and discharging, and will speedily corrode the metallic portions exterior to the case.

It is important to see that the plates are well supported at some considerable distance from the bottom of the case, and a point that should be insisted on is that each 2-volt cell should be built up as a separate unit and then assembled into a common case. All really good accumulators are so made, and attention to this point will prevent any possibility of leakage occurring should the cell receive a blow or even a fall.

When a leakage occurs, the faulty cell and its neighbour become one large cell, having the capacity in ampere-hours of the two but only the voltage of the one. It is never a source of satisfaction to patch a cell of the single-shell type, as celluloid patches rarely have any strength.

A few words as to the mixing of acid and water for the electrolyte may not be out of place. An enamelled metal container should be used for this purpose, as heat is generated and may even crack a glass or earthenware vessel.

The measured quantity of water should be put in first; then the acid may be added very slowly, almost drop by drop, the mixture being stirred constantly with a stick or glass rod. Great care must be exercised that the heat generated is not too great, and the acid must not be poured into the battery until it is cold. The specific gravity should be tested at this point, as it should be perfectly correct. When the acid has been poured into the accumulator in such a manner as to cover the tops of the plates by a quarter to half an inch, the initial charge may be commenced. It cannot be too strongly pointed out that this first charge really forms the battery—that is, causes it to settle down into a normal working state. To do this forming process correctly takes a considerable time, and it is as well to let the first charge be as long as possible. The maker will state a certain length of time and a definite charging rate on each separate battery, but this time should be extended, and the charging rate lowered somewhat if the very best results are to be obtained.

It is fatal to attempt to hurry the initial charge, and no one should do so. Vent plugs should be removed whilst charging, and if the level of the electrolyte sinks, then add water only to bring it back to the original level; remember that acid itself cannot evaporate, and therefore unless some of the mixture actually gets spilled nothing but distilled or rain water should be added.

These remarks will assist the experimenter to obtain the best possible results from his accumulators, and the methods of most use to him for charging them from sources of both direct and alternating currents, will be discussed in further issues of this journal.

FORTHCOMING EVENTS.

April

18th.	Wednesday, 6.30 p.m.	Radio Society of Great Britain. At the Institution of Electrical Engineers, Victoria Embankment. Lecture to Associate Members on "Elementary Principles of the Valve," by E. Redpath, Assistant Editor, *Wireless Weekly*.
18th.	Wednesday.	Swansea and District Radio Experimental Society. Mr. H. K. Benson, A.M.I.E.E., A.M.I.Mech.E., will lecture on "Alternating and Oscillating Currents." Y.M.C.A., St. Helen's Road.
18th.	Wednesday, 7.30 p.m.	Manchester Wireless Society, Houldsworth Hall. Lecture for Beginners, by the Secretary.
19th.	Thursday.	Ilford and District Radio Society. Lecture by Mr. A. Gwinn on "Short Wave Reception."
19th.	Thursday, 7.30 p.m.	Derby Wireless Club, Shaftesbury Restaurant. Lecture by Mr. Cowlishaw on "Radio Gadgets."
20th.	Friday, 7.30 p.m.	South Shields and District Radio Club, 34, King's Street, South Shields. Mr. R. J. Oliver will lecture on "Directive Transmission and Reception."
24th.	Tuesday (till 28th).	South Shields and District Radio Club open their Exhibition in Congregational Hall, Ocean Road, South Shields.
28th.	Saturday.	Luton Wireless Society, Hitchin Road Boys' School, Luton. 3rd Annual Exhibition.

A TELEPHONE TRANSFORMER MADE FROM A "FORD" COIL

As disused Ford ignition coils can be readily obtained, the following method of conversion to a telephone transformer will probably prove of use to wireless experimenters. The coil which actually underwent this transformation was, for ignition purposes, absolutely useless.

A few simple tests were carried out, chiefly with a dry cell and a telephone receiver, and

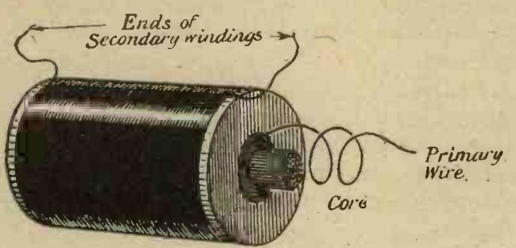


Fig. 1.—Showing original coil.

the following diagnosis completed. The secondary winding was quite in order, that is, there was no break in the wire. The condenser was hopelessly waterlogged and possibly punctured.

The outer wooden case was carefully removed, as well as most of the superfluous wax or pitch, taking care not to break any wires. The condenser was next removed, together with the slab of plate glass which insulates it from the secondary windings.

The two ends of the primary or thick wire winding were cleared of wax, etc., at the point where they entered the inside of the coil. Carefully pulling on one of these wires it began to come away in corkscrew fashion, as shown in the sketch, Fig. 1. This pulling was continued until all the wire was withdrawn and the iron core quite free. A few turns of the waxed paper from the inside of the secondary coil were removed to give more space. As the iron wire core was already covered with a layer of waxed paper, no special treatment was required beyond fitting a couple of fibre washers of such overall size that they would just slide inside the hole through the centre of the secondary coil. A winding of 36 s.w.g. s.s.c. copper wire was now put on to the core to fill up all the available space, that is, up to the outside of the fibre washers. About 6in. of wire was left free at the beginning and end of this winding for connecting-up purposes. Core and winding were now immersed in molten paraffin wax for a few minutes and then placed inside the old secondary winding.

A suitable box was made up to take the complete coil. Four terminals were fitted on two pieces of ¼in. ebonite sheet (*i.e.*, two terminals on each piece) and mounted at each end of the box in such a way that the terminals themselves were not in contact with the wood. The two wires from the old secondary winding were taken to one pair of terminals, and these terminals were marked "Primary." The ends of the 36-gauge winding were connected to the remaining terminals in the same way and marked "Telephones." The box was now filled up with molten wax and a suitable lid fitted.

Fig. 2.—Showing new primary winding.

On test, with a pair of 120 ohm telephones on a crystal set, the results were quite satisfactory, though not so good as on a professionally made transformer. This particular transformer has been in use for about a year on a crystal set, and continues to give quite good results; it has well repaid the time spent in converting. A. J.

Mainly about Valves

A causerie relating to the use of valves. This feature will appear every week and will be conducted by the Editor.

A Note on Reaction.

MANY experimenters will have noticed at some time or other that when they use reaction, either on an intervalve circuit or on to the grid circuit of the first valve, self-oscillation sometimes sets in at a point just a little to one side of the best tuning adjustment for the particular signals to be received.

For example, when using reaction on an intervalve oscillation circuit, such as a tuned anode circuit, it frequently occurs that although the valve will not oscillate on the actual wavelength of, say, the Broadcasting Station, if the tuning condenser is adjusted a little to either side self-oscillation sets in, the continuous oscillations will beat with the carrier wave of the Broadcasting Station and will produce the well-known howl.

Of course I am not alluding to the adjustment that some of the less experienced experimenters make; although their valves may be oscillating, by adjusting their condenser until the silent point is reached on the beat note between the local oscillations and the carrier wave of the Broadcasting Station, they imagine that their valve has stopped oscillating, which is often very far from being the case.

What I am referring to is the phenomenon which occurs when the condenser is varied and the valve starts oscillating on an adjustment of the condenser slightly different from that on which the loudest results are obtained from the Broadcasting Station.

For example, 2LO might come in best on 35° on the condenser of the tuned anode circuit. Signals might be strengthened by tightening the reaction on to the tuned anode circuit, and a slight readjustment of the condenser would usually be found necessary. It may often happen, however, that on this particular adjustment of the condenser the reaction may not be capable of being tightened sufficiently to produce self-oscillation and, therefore, it is impossible to say definitely that the best reaction has been obtained.

It frequently happens that under these conditions, if the value of the condenser be decreased, say, to 30°, self-oscillation immediately sets in, although the reaction has not been tightened. This may be due to the fact that valves always oscillate more readily when the condenser values are small, but the more usual reason is that the reaction coil has a natural frequency of its own, due to the self-capacity of the inductance coil and also the small capacity of the filament to anode space.

Effects of Different Sizes of Reaction Coils.

In the case of a reaction coil for receiving 2LO (369 metres), the reaction circuit might have a natural wavelength of 350. The fact that the reaction circuit has a natural frequency of its own does not generally matter, because the circuit for most purposes may be considered as more or less aperiodic. If, however, the grid circuit of the valve, whose anode circuit contains the reaction coil, has its wavelength reduced from 369 metres to 350, the valve immediately begins to oscillate. This is because the reaction effect between two circuits, one the grid circuit and the other the anode circuit—both tuned to the same frequency—is at a maximum when these frequencies are equal.

When the frequencies are different, a tighter coupling is necessary to produce reaction, but in the present case the fullest reaction could not be obtained on 2LO, yet when the condenser is reduced to 30° self-oscillation immediately sets in owing to the greater reaction effect between the reaction coil and the grid circuit. The reaction effect is enhanced by the capacity coupling between the two tuned circuits, the one being the tuned grid circuit and the other the semi-tuned circuit containing the reaction coil.

A similar effect is also often noticeable when too large a reaction coil is used. Full reaction may not be obtained on the desired wavelength, but if the wavelength of the grid circuit be increased, self-oscillation sets in. This time the natural wavelength of the reaction coil is greater than the wave-length to be received.

The moral to be drawn from these remarks is that the reaction coil should be designed carefully, and not allowed to have a natural oscillation frequency which approaches too closely to the wavelength to be received.

The trouble may be overcome by using smaller reaction coils than many people employ, and by using a tighter coupling. This, of course, is very difficult in the case of plug-in coils. When honeycomb and similar coils are used, it is very often difficult to get sufficient reaction without making the natural frequency of the reaction coil close to that of the signals to be received. That is why honeycomb coils used as reaction coils are usually larger than the grid circuit coils.

The difficulty may be overcome to a certain extent by winding the reaction coil with resistance wire, but the best remedy is to use fewer turns on the reaction coil and to get a tighter coupling.

DIRECT OR INDUCTIVE COUPLING?

By E. REDPATH, Assistant Editor.

A discussion of the advantages and disadvantages of these two methods of coupling as applied to crystal receiving sets.

THE usual form of crystal receiving sets employed for the reception of broadcasting, whether the set is home constructed or one purchased ready made, is of the single-circuit or direct-coupled type. The arrangement includes only one tuned circuit comprising the aerial, aerial tuning inductance and earth, with an aperiodic (or non-oscillatory) circuit comprising the detector, and telephone receivers.

The aerial tuning inductance itself may be a single- or two-slide inductance coil, a "tapped" coil or a variometer, whilst the detector in the aperiodic circuit may be either a crystal contact or a valve. A typical circuit diagram of such a set is given in Fig. 1, in which Æ represents the aerial; ATI the aerial tuning inductance; E the earth connection; S the slider of the inductance; D a crystal detector; and T the telephone receivers with a small fixed condenser C (shown dotted) which is optional.

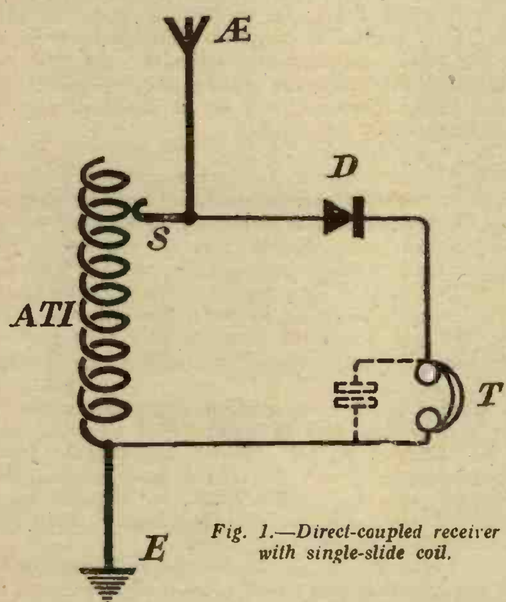


Fig. 1.—Direct-coupled receiver with single-slide coil.

The position of the slider (S) upon the inductance is determined by the wavelength to which the set is tuned, and in order to get the greatest potential difference applied to the detector D, the aperiodic circuit is shunted across the whole of the active turns of the inductance. On short wavelengths the number of turns is small and the total potential drop along them will also be small. All of these turns being common to both circuits, the coupling is exceedingly "tight" and the damping of the aerial circuit due to the rapid transfer of energy from it to the detector circuit, firstly, prevents selective tuning and, secondly, prevents persistent oscillation.

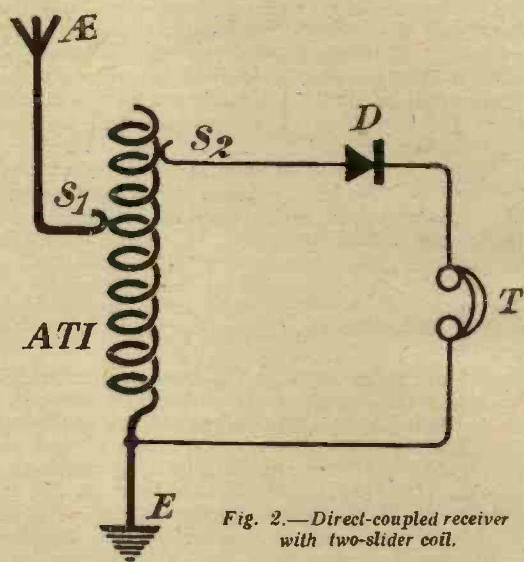


Fig. 2.—Direct-coupled receiver with two-slider coil.

Fig. 2 is a typical circuit diagram of a set in which the aerial tuning inductance is provided with two sliders shown at S_1 and S_2 respectively, the position of the former determining the number of coils included in the aerial circuit and consequently the wavelength to which the set is tuned, and the latter, the number of turns included in the aperiodic or detector circuit.

Note that the number of turns of the aerial tuning inductance included in the detector circuit is now greater than the number of turns in the aerial circuit; consequently, due to the auto-transformer action of the ATI, the potential differences set up between the point S_1 and the earth end of the coil are "stepped-up" and the higher potentials between the point S_2 and the earth end of the coil are applied to the detector, resulting in improved signal strength.

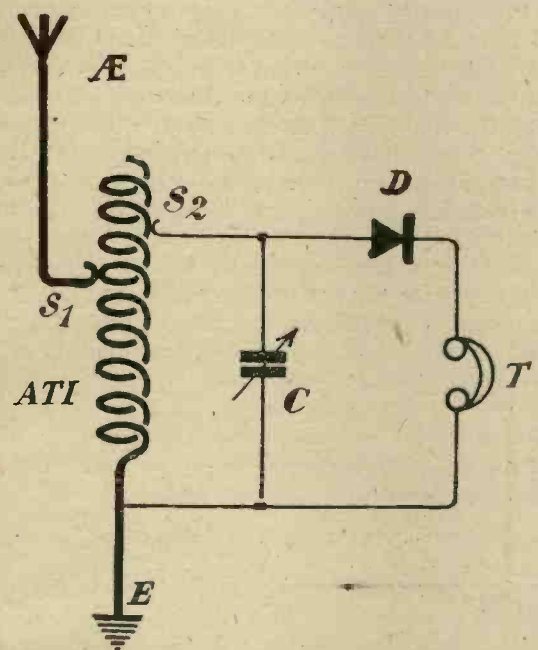


Fig. 3.—A two-circuit direct-coupled receiver.

The coupling, however, is, if anything, tighter than it was in the case of Fig. 1; consequently the damping in the aerial circuit is increased and this partially neutralises the gain just referred to. The arrangement shown in Fig. 3 is an improvement upon those shown in Figs. 1 and 2. By the introduction of the small variable condenser C between the slider S_2 and the earth end of the aerial tuning inductance, we now have *two* tuned circuits, and, provided the capacity of the condenser C is less than that of the aerial itself, more turns of the ATI can be included by the slider S_2 than by S_1, so that a certain "step-up" effect will remain.

Advantage may now be taken of the principle of resonance between the aerial circuit and this new secondary circuit. The coupling, however, is still *direct* and very tight, so that the damping in the aerial circuit will still be high.

All of the foregoing methods employ direct coupling. They possess certain advantages, such as comparative ease of adjustment and simplicity of construction or low cost to purchase. The disadvantages are that they are not at all selective (that is to say, the tuning is not exact and interfering signals cannot be cut out), and, on account of the excessive damping or dissipation of energy, persistence of oscillations is prevented and the principle of resonance is not made full use of.

Fig. 4 shows a typical circuit diagram of an inductively-coupled crystal receiving set in which the aerial circuit comprises the aerial itself, Æ; the aerial tuning inductance ATI, with slider S_1 and earth E. This circuit is also frequently termed the open oscillatory circuit. The tuned secondary circuit or closed oscillatory circuit consists of a second inductance coil L with slider S_2 and the variable condenser C.

The ATI forms the primary and the coil L the secondary winding of an air core high-frequency transformer (sometimes termed an oscillation transformer), and, as long as the capacity of the condenser C is very small, the number of turns of wire included between the slider S_2 and the opposite end of the coil L may be much greater than the number of turns in the ATI, so that an appreciable step-up effect is obtainable. This

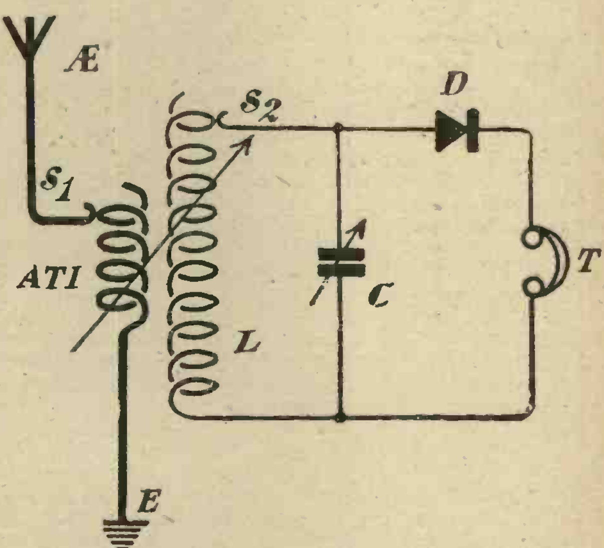


Fig. 4.—An inductively-coupled crystal receiver.

means, of course, that higher potentials are available to operate the detector D, and, as crystal detectors are essentially potential-operated, improved signals will result.

As the transfer of energy from the aerial is now made to a tuned circuit, and as the degree of coupling between the two coils may be made quite small by sliding one out of or away from the other, full advantage may be taken of the principle of resonance.

By operating the receiving set with a *loose* coupling between the inductance coils, the damping in the aerial circuit can be kept to a workable minimum. Consequently, the oscillations in that circuit are more persistent and cause the induced oscillatory currents in the closed circuit to build up to a comparatively high value.

Apart from the question of being able to have the largest possible number of turns of wire in the secondary coil L, there is another reason why the capacity of the variable condenser C should be as low as possible, namely, with any given and definite amount of electrical energy a small condenser will be charged to a higher potential than a large condenser. The smaller the value of this condenser, therefore (as long as it is large enough to effectively tune the secondary circuit), the higher will be the potential obtained to operate the detector D.

The fact that the degree of coupling between the two inductance coils is variable is indicated by the arrow drawn through the two coils.

The advantages of inductive coupling, as illustrated in Fig. 4, are, firstly, greatly increased selectivity (more accurate tuning and greater facility for tuning out unwanted signals); secondly, greater persistence of oscillation due to reduced damping; thirdly, persistent oscillations at higher potentials in the secondary circuit, capable of more effectively operating the detector D. The only disadvantages as compared to the circuit illustrated in Fig. 3 are that an additional inductance coil is required and there is one more adjustment to be made, namely, the coupling between the coils.

In the writer's opinion, however, the advantages far outweigh the disadvantages, and it is rather surprising that more universal use is not made of inductively-coupled crystal receivers for the reception of broadcasting. It is hoped to publish in an early issue of this journal full particulars of a serviceable inductively-coupled receiving set for broadcast reception.

TRADE NEWS

We note that the Western Electric Company, Limited, are now manufacturing a complete loud-speaking equipment, comprising a very businesslike loud-speaking telephone and a power amplifier. We have not yet had an opportunity of testing this equipment, but hope to do so in the near future, when we shall comment upon it in our "Apparatus Tested" page.

* * *

In order to meet increased demands, Radio Instruments, Ltd., have extended their works and announce that they are now in a position to give delivery of apparatus in two days from receipt of the order.

* * *

It is interesting to note that Messrs. Alfred Graham & Co., manufacturers of the Amplion loud-speakers, first demonstrated loud-speaking telephones in 1887. They were adopted by the British Admiralty in 1894 and, in the Navy, are called Navyphones. Up to the end of 1919, no less than 12,000 vessels were fitted with these loud-speaking telephones. To-day, more loud-speakers than ever are being produced in the Graham factory or under licence.

* * *

For eliminating interference, a receiving set having two tuned circuits has great advantages. The British L.M. Ericcson Manufacturing Co., Ltd., make a set of this description in which provision is made for the use of the utmost re-action allowed by the G.P.O.

* * *

From certain quarters we learn of a shortage of ebonite. No doubt this was only a temporary shortage, as we understand that the American Hard Rubber Co. (British), Ltd., who supply this material to the trade, have plenty of this material actually in stock.

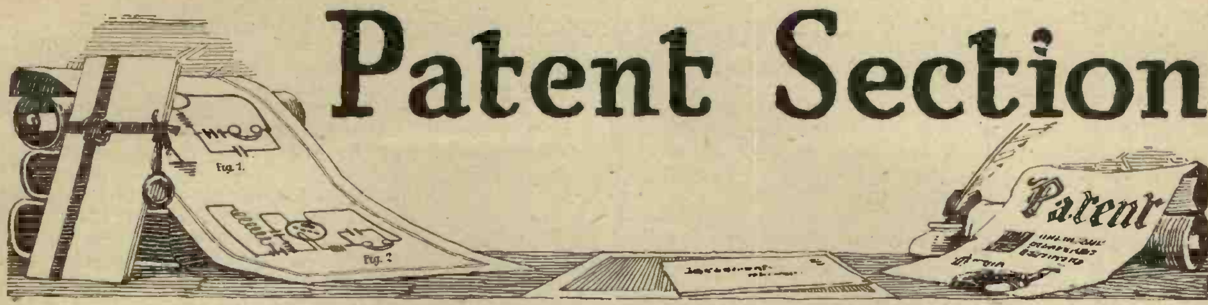
* * *

At their Stratford Works, the City Accumulator Co. are proceeding with the sorting, classifying and cataloguing of their huge stock of ex-Government apparatus. We understand that the apparatus includes practically everything from a receiving valve to a 5-kw. transmitting set, and that a complete list will be issued very shortly.

* * *

It is interesting to note the increased tendency of wireless firms to offer wireless service. As a rule, this service appears to include the supply of the desired set, together with free advice, presumably with regard to the operation of the set in question. We think there is a very good field open to firms who will undertake to supply the apparatus, erect the necessary aerial and put the complete installation into working order. A complete proposition of this nature, which obviates all necessity for the purchaser risking his neck by climbing upon the house-top, should find many willing subscribers.

Patent Section



The following list has been specially compiled, for "Wireless Weekly," by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, London, W.C.2, and at Croydon, from whom copies of the full specifications published may be obtained post free on payment of the official price of 1s. each. We have arranged for Mr. Gee to deal with questions relating to Patents, Designs and Trade Marks. All enquiries should be sent direct to him at the above address.

APPLICATIONS FOR PATENTS.

8331. ALLEN, A.—Headpieces for telephone receivers. March 23rd.

7892. ARROWSMITH, A. C. R.—Wireless receiving-apparatus. March 20th.

8106. BARBER, W. E.—Thermionic valves, etc. March 21st.

7858. BOWLEY, A. S.—Telephones, phonographs, etc. March 19th.

8266. BRITISH ELECTRICAL AND ALLIED INDUSTRIES RESEARCH ASSOCIATION.—Electric switches and circuit-breakers. March 23rd.

8113. BRITISH THOMSON-HOUSTON Co. LTD.—Electric battery boxes. March 21st.

8114. BRITISH THOMSON-HOUSTON Co., LTD.—Suspension devices for battery boxes, etc. March 21st.

8052. BROWN, F. A.—Electric switch. March 21st.

8020. BRYAN, B.—Wireless apparatus. March 21st.

8286. CAMERON, T. C.—Storage battery, etc. March 23rd. (Australia, March 8th, 1922.)

7911. CARLSON, W. L.—Telephone receiver circuits for radio telegraphy, etc. March 20th.

7911. CARPENTER, G. W.—Telephone receiver circuits for radio telegraphy, etc. March 20th.

8228. CHAPMAN, A. E., AND WADSWORTH, L. H.—Electric variable condensers. March 22nd.

8229. CHAPMAN, A. E., AND WADSWORTH, L. H.—Resistance-capacity devices for wireless telegraphy, etc. March 22nd.

8122. CREED, F. G., AND CREED & Co., LTD.—Translating wireless, etc., messages. March 21st.

8345. DAVIS, H. E.—Crystal detector. March 23rd.

8263. DAVENPORT, E.—Crystal detector. March 23rd.

7981. DEELEY, R. M.—Microphones, telephone receivers, etc. March 20th.

8253. DOWN, P. B.—Crystal detectors. March 23rd.

8239. DUBILIER, W.—Variable electric condensers. March 22nd. (United States, July 20th, 1922.)

8190. FOSTER, A. E.—Insulation of electric conductors. March 22nd.

8048. GARDNER, E. R.—Wireless detectors. March 21st.

8463. GATH, T. P.—Rectifiers for alternating electric current. March 24th.

8293. GIOSTI T.—Electric switch. March 23rd.

7928. GRACE, B. B.—Sockets for thermionic valves, electric lamps, etc. March 20th.

8341. GRACE, B. B.—Wireless receiving-apparatus. March 23rd.

7972. GRAHAM, E. A.—Cabinets for wireless receiving-apparatus. March 20th.

7973. GRAHAM, E. A.—Cabinets for sound-reproducers. March 20th.

8113. GRIFFITHS, L.—Electric battery boxes. March 21st.

8114. GRIFFITHS, L.—Suspension devices for battery boxes, etc. March 21st.

8248. GUEST, F. E.—Wireless receivers. March 22nd.

7943. HAMPSHIRE, F. W.—Telephone, etc., receivers. March 20th.

7945. HAYNES, F. H.—Signalling and amplifying systems employing electric oscillations. March 20th.

7935. HILTON, C. F.—Microphone relay. March 20th.

8366. HORTON, C. E., AND SEYMOUR, C.—Apparatus for direction-finding by wireless telegraphy. March 23rd.

7990. KATTINGER, F., AND REGER, F.—Foot for masts or poles. March 20th. (Austria, March 20th, 1922.)

8344. LEVY, S.—Reception apparatus for radio telephony, etc. March 23rd.

7839, 7840, 7841, 7842.—LEVY, L. A.—Thermionic valves. March 19th.

8198. LEVY, R. C.—Detectors for wireless telegraphy, etc. March 22nd.

7785. LOWTH, W. H.—Terminals for wireless telegraphy, etc. March 19th.

8075. McCLENAGHAN, H. S.—Crystal detectors. March 21st.

8039. MACHIN, F. R.—Locking-device for crystal detectors. March 21st.

8399. MALLETT, G. E.—Device for varying resistance or tuning inductance of coils. March 24th.

8369. MILLS, C.—Crystal detector. March 24th.

8340, 8341. NASH, G. H.—Wireless receiving-apparatus. March 23rd.

8250. NIXON, A.—Means for converting headphones, etc., into loud-speakers. March 22nd.

8154. PARSONS, I. H.—Electric switches. March 22nd.

7963. PHILLIPS, C. C.—Variable electric condensers, resistances, etc. March 20th.

7944. POCOCK, H. S.—Apparatus for winding electric inductance coils. March 20th.

8308. RICHARDS, W. E. WINDSOR.—Manufacture of electric insulators. March 23rd.

8426. RICHES, F. W.—Crystal detectors, and mounts therefor. March 24th.

8246. RICHES, V.—Electric fittings for wireless apparatus. March 22nd.

8254. SHANNON, D. S. B.—Receiving-apparatus for wireless telegraphy. March 23rd.

8054. SHURLOCK, H. H. M.—Ear cushions, etc., for telephone receivers. March 21st.

8190. SIEMENS BROS. & Co., LTD.—Insulation of electric conductors. March 22nd.

8308. SILUMINITE INSULATOR Co., LTD.—Manufacture of electric insulators. March 23rd.

7801. SNELL, C. E.—Electric condensers. March 19th.

8172. SNELL, C. E.—Electric insulators. March 22nd.

8389. TAYLOR, J. H., AND TAYLOR, W. E.—Electric batteries. March 24th.

8161. THOMAS, W. M. W.—Wired wireless telephone systems. March 22nd.

8283. VENABLES, T. A.—Receiver for wireless telephony. March 23rd.

8266. WEDMORE, E. B.—Electric switches and circuit-breakers. March 23rd.

7928. WESTERN ELECTRIC Co., LTD.—Sockets for thermionic valves, electric lamps, etc. March 20th.

8340, 8341.—WESTERN ELECTRIC Co., LTD.—Wireless receiving-apparatus. March 23rd.

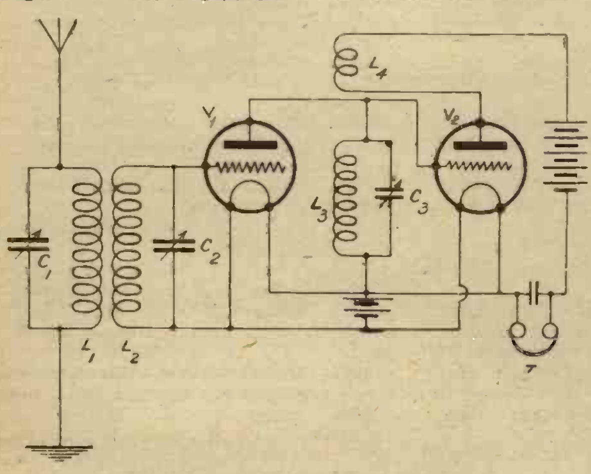
ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED.

192,346. British Thomson-Houston Co., Ltd.—Relates to horizontal directive receiving aerials of the kind described in Specification 175,315 wherein the received energy and the ether-wave energy build up cumulatively along the aerial, to reach a maximum at the end of the aerial furthest away from the transmitting station, and consists in an arrangement whereby the actual detecting-apparatus may be located at the end furthest away from the actual point of maximum aerial current or at any convenient distance from that end. (September 30th, 1921.)

192,382. Akt.-Ges. Kummler & Matter.—In electric resistances silicon carbide is heated in silicon vapour, produced at about 3,000° C. by heating a mixture of quartz and carbon, to form a resistance material having a small specific resistance compared with silicon carbide itself. January 19th, 1923. (Convention date, January 30th, 1922.)

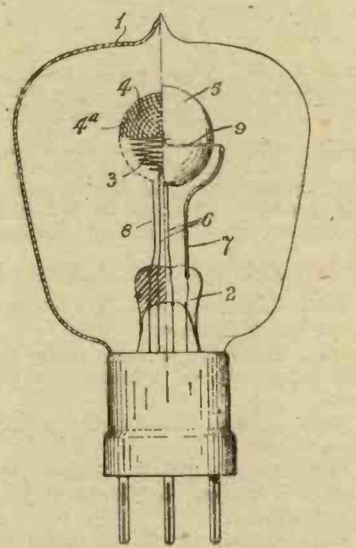
192,404. Signal Ges.—A diaphragm for use in telephone instruments, relays, gramophones, diaphragm horns, etc., is constructed to have an increased elasticity of movement in its own plane, so as to respond to temperature changes without bending, and so causing changes in tuning and air-gap. In one form the diaphragm has corrugations impressed upon its periphery, and may also have radial corrugations, in which case the diaphragm vibrates as a rigid structure. January 26th, 1923. (Convention date, January 26th, 1922.)

192,429. Taggart, J. Scott, and Radio Communication Co., Ltd.—In a wireless receiving arrangement for continuous waves the incoming signals are applied to a thermionic valve the normal steady anode potential of which is zero, negative or only slightly positive, and on which is also impressed a locally-produced current of an audible frequency or of a high frequency slightly different from that of the incoming signals. August 8th, 1921.



Illustrating Patent No. 192,429.

192,460. Jones, H. Sefton.—High-frequency oscillations are obtained from a low-frequency source by means of a transformer with a core arranged to be saturated with a small fraction of the maximum current strength developed in the low-frequency circuit. The transformer is preferably air-cooled. October 29th, 1921.



Illustrating Patent No. 192,464.

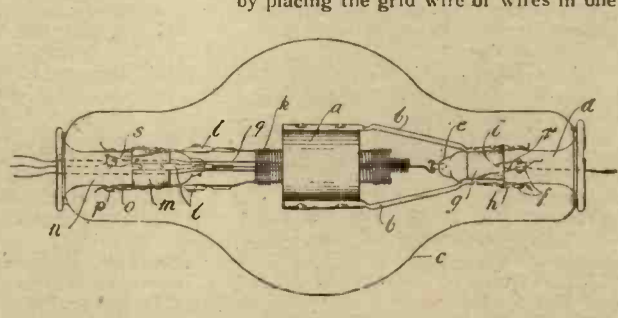
192,461. Jones, H. Sefton.—In an arrangement for multiplying the frequency of an alternating current by the aid of static frequency transformers, the winding of a transformer with a closed magnetic circuit adapted to become highly saturated is connected to the source of alternating current through a circuit which includes an inductance of a value considerably greater than the inductance of the transformer, this circuit being tuned to the frequency of the source. An oscillatory circuit, tuned to an even or odd harmonic of the frequency of the source is placed in parallel with the transformer winding, permanent direct-current magnetisation of the core of the transformer being employed when an even harmonic is desired. October 29th, 1921.

192,464. Bullimore, W. R.—In a thermionic valve a filament cathode of spherical or egg shape is enclosed in turn in a similarly shaped grid and anode in order to utilise fully the electron emission and to ensure even spacing of the electrodes. In a modification for use in beat reception of wireless signals the grid is formed in two parts. October 31st, 1921.

192,476. Bullimore, W. R.—An anode or other electrode of a thermionic valve, Röntgen-ray, or other vacuum tube, is carried on or secured by a conical ferrule seating over a re-entrant tube having a conical end, thereby ensuring axial alignment of the electrodes. In another arrangement the anode is formed with a tapering end by removing long V-shaped pieces from the end and closing in the remaining portions, the tapering end being secured directly to the ferrule. November 1st, 1921.

192,575. Mathieu, J. L., and Benoit, A.—A plastic material for sound-amplifying horns consists of 100 lbs. of pulverised wood, 42 lbs. of starch, and 33½ lbs. of colophony. The intimately-mixed ingredients are formed into a paste by sprinkling with starched water containing 2 lbs. of starch per gallon, the mixture being gathered into a pile so as to obtain uniform moistness. After standing for two hours the material is placed in a mould and baked at 200° F. for 20 minutes. January 6th, 1922.

192,592. Preston, L. G., Hodgson, B., and Hughes, H. G.—In thermionic valves a grid is secured to a support by placing the grid wire or wires in one or more slots in the support, the edges of the slots being burred over the wire by a blow from a tool. In a modification the slot is inclined, and one edge only is burred over. In another arrangement the grid wire is threaded through holes in a support, and the support is indented to clamp the wire. January 24th, 1922.



Illustrating Patent No. 192,476.

AERIAL CONSTRUCTION

To the Editor, WIRELESS WEEKLY.

SIR,—Judging by the aerials which I have observed, it appears a common practice for amateurs to insert insulators between the aerial wires themselves and the spreaders. This does not appear to be the best plan, as the insulators attached to one wire are in parallel with those attached to the other wire and, consequently, the total insulation resistance is halved. A further point I notice is that by this method the aerial is "open ended," whereas in pre-war days it was considered important that the two wires forming the aerial should be connected together at the end. Possibly you could let me have your views on this matter. What do our other pre-war readers think of this matter?

I am, etc.,
"PRE-WAR."

Weston-super-Mare.

[*This raises an old controversy. Perhaps readers who have views on this subject will write us.*—ED.]

FADING

To the Editor, WIRELESS WEEKLY.

SIR,—As the question of "fading" is receiving considerable attention just now, you will possibly be interested in my own experience, which was as follows. I was receiving quite good and clear signals (music) from 2LO upon my crystal set when suddenly the strength of signals increased to at least 1½ times its original value. I noted the time of this sudden increase in signal strength, and found that it coincided with the moment when my friend next door, whose aerial is parallel to and higher than mine, tuned in the same signals upon his two-valve non-reactive receiving set. I have always understood that a decrease in signal strength was to be expected upon such occasions, and am therefore at a loss to explain the phenomenon. I intend to investigate the matter further, and will let you know the results in due course.

I am, etc.,
Dartford. PUZZLED.

EFFECT OF NEIGHBOURING AERIALS

To the Editor, WIRELESS WEEKLY.

SIR,—With reference to the letter signed by "Snooks" in your first issue relating to the above subject, I would like to put forward my own experiences.

I use a crystal receiver and live next door to an experimenter using a valve set. I find that when he is listening-in I receive even louder signals. Our aerials are quite close together, and I am wondering whether I am getting stronger signals as a result of deriving some benefit through the reaction effects in my neighbour's set. If he is using reaction on to his aerial circuit, it might surely be possible that some of this reaction effect is being transferred to my own aerial circuit and making it more receptive to incoming waves.

It will be interesting to know whether other readers of your excellent periodical have met with the same effect, which is very noticeable in my own case.

For obvious reasons I do not desire my name published, but enclose my card.

I am, etc.,
BALHAM.

ANOTHER PIRATE

To the Editor, WIRELESS WEEKLY.

SIR,—I read with great interest your Editorial in the first number of your new weekly. I myself must confess that I am of the new "pirates" who are listening-in to broadcasting regularly every night and not paying a cent for it.

I am, however, not an intentional breaker of the law, if there is a law. I am neither a burglar, a pickpocket, or even an evader of the income-tax. I pay my dog licence regularly, and am not more than a month late with my rates. I greatly enjoy the present programmes of the British Broadcasting Company by the aid of a carefully concealed aerial under the roof of my house. Every evening I and my family listen-in without the least qualm, although occasionally we visit some friends, also pirates, who have a five-valve set—entirely devoid of stamps—made up from bought parts on the strength of a broadcasting licence. They themselves have modified their set in various ways by adding different units which they have made themselves.

We have all applied for experimental licences to the Post Office, but although it is three months ago since we first made application, nothing appears to happen. Our chief interest lies in constructing cur own sets and improving them, and generally learning all about the subject and then applying our knowledge.

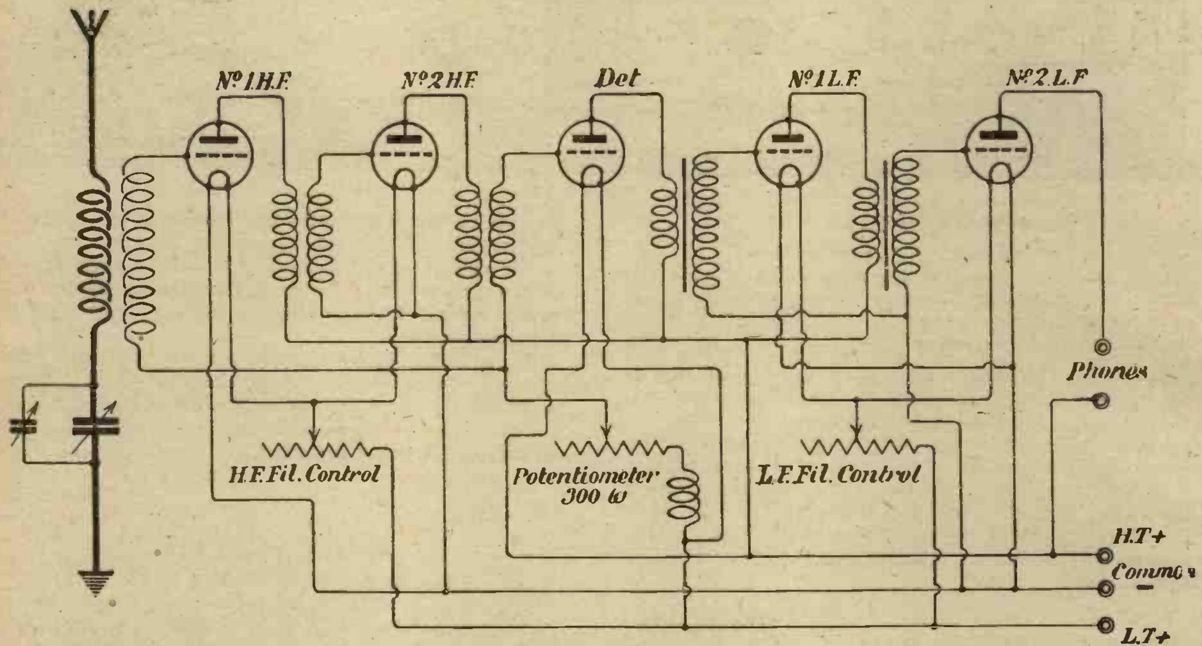
We are all willing to pay for a licence which will enable us to listen-in on home-made apparatus, but the only thing to do is to contravene the regulations and simply carry on.

With regard to the remarks about drawing a red herring across the path, I entirely agree that the first thing to do is to grant the constructor's licence. We are thoroughly satiated with meetings, conferences, and committees. Let *us* have the licence, and let the manufacturers fight out the B.B.C. stamp question afterwards.

I am, etc.,
A MANCHESTER PIRATE.

£250 IN PRIZES

A competition of particular interest to the genuine amateur experimenter.



The circuit diagram of the receiver.

THE above illustration shows the circuit diagram of the R.A.F. type 10 Aircraft Receiver which forms the subject of the competition mentioned last week.

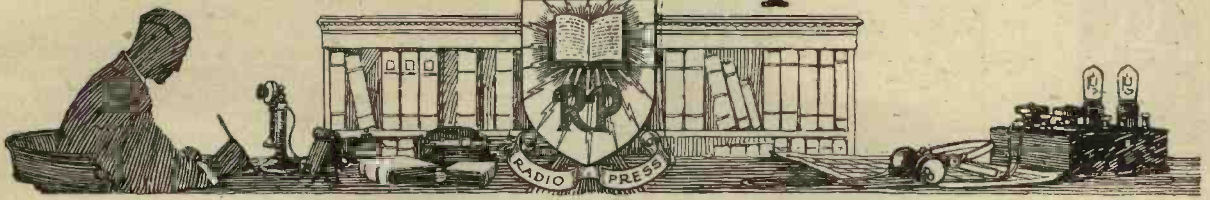
It will be seen that it consists of two high-frequency valves, followed by a detector valve, and then two stages of low-frequency amplification. In the original instrument the coils forming the high-frequency coupling consists of two small basket coils wound with resistance wire and embedded in paraffin wax. These are fixed so that there is a certain definite coupling between them, and there are two for each stage of high-frequency amplification. They lie immediately underneath the two high-frequency valves below the ebonite panel carrying the valve clips and are side-by-side in a flat ebonite case.

The detecting valve has neither a grid leak nor condenser, and one of the possible conversions is the substitution of the ordinary four-pin type of valve holder, with a grid condenser and leak for rectifying purposes. The low-frequency amplifying part of the apparatus consists of two army pattern low-frequency transformers connected in the usual manner and having the secondary connections so arranged that the grids of the low-frequency valves are given a slight negative potential with respect to the filaments. The filament temperature control for these valves is mounted on the small box forming the remote control unit, together with the tuning arrangement, which consists of two small variable condensers in parallel, one of which can be fixed at a definite point so that the other may be used to give more accurate tuning over a small range of wavelength.

The filament resistance for the high-frequency valve is fitted inside the case containing the rest of the instrument, and is only variable by opening the case and setting it at a definite point. These points have already been fixed, but it will be an advantage to have them variable for purposes of experiment.

The aerial tuning arrangement consists of a miniature loose coupler, in the form of two small basket coils wound with very fine wire, about No. 44 s.w.g. The relative positions of these two coils are also fixed. Connections to the high- and low-tension batteries are effected by means of multi-pin plugs, which are supplied with the instrument. The pins are so arranged that it is impossible to insert them in a wrong hole. These should be retained when converting this instrument for the purposes of the competition.

Information Department



Conducted by J. H. T. Roberts, D.Sc., assisted by A. L. M. DOUGLAS.

In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query," and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed.

J. M. (PLYMOUTH) asks (1) I live in rooms in Plymouth and cannot use an outside aerial. What is the minimum installation I must have to get the London Broadcasting with a frame aerial? (2) What would be useful dimensions for this frame aerial and number of turns of wire necessary? (3) Will any installation permit me to use a loud speaker?

We are afraid you will not have satisfactory results in Plymouth from a frame aerial even with a seven-valve high-frequency amplifier. The reason for this is that Plymouth appears to be in what is known as a "blind spot," quite apart from its distance from the London Broadcasting Station. A loud speaker could, of course, be used with an outdoor aerial, but probably no telephony would be heard at all with a frame.

B. M. W. (KILBIRNIE) asks: With reference to the Compact Broadcast Receiving Set by E. Redpath (described in the March issue of "MODERN WIRELESS"), whether he could use one of the variometers advertised in the April issue on pages iv. and xlvi., and what size of condenser is required with it.

The variometer which you mention will be quite suitable for the purpose. If anything, it slightly increases the range of wavelength of this set. No condenser is necessary, nor should one be used.

W. E. F. (HULL) wishes to build a six-valve broadcast receiver with two high-frequency valves, one detector and three low-frequency valves. The last valve is to be controlled by a switch so that it may be cut out if necessary. He asks for a circuit diagram of this arrangement, and also states that he cannot understand why a potentiometer is connected directly across the low-tension battery because, in his opinion, the battery would be constantly running down.

Circuit No. St. 51 in *Practical Wireless Valve Circuits* (Radio Press, Ltd.), would fulfil your requirements, with the addition of another stage of high- and low-frequency amplification. We would remind you that reaction on to the aerial circuit is not permitted on broadcast wavelengths under any circumstances. The potentiometer will not run down the low-tension battery because it has such a high resistance that the total amount of current passing through it is very, very low, and it would take some considerable number of weeks to exhaust the accumulator.

R. E. A. (TUFNALL PARK) states that he wishes to make a two- or three-valve set capable of receiving all the British Broadcasting Stations and possibly Continental telephony. He rather favours the set described on page 104 of the March issue of "MODERN WIRELESS," and asks whether it will be suitable.

The receiver you mention would prove exceedingly suitable for your purpose. If used in the district you mention, all Continental telephony should be audible upon it.

E. A. B. (LONDON) encloses a sketch of a double reaction circuit published in "MODERN WIRELESS" and asks certain questions regarding the value of various components he has on hand and whether they will be suitable for use in this circuit

The aerial circuit coil should, of course, be of the size required to tune to the wavelength you desire to receive. The reaction coils should be of just sufficient size to produce the necessary results and the correct values, for these must, of course, be determined by experiment. Referring to the valve, any good hard receiving valve will be suitable for this purpose. The H.T. battery should have a value of between 50 and 100 volts, the rheostat 6 or 7 ohms, the fixed condenser you mention may have a value of .003 μF., and the two variable condensers should have the same values, which may be .0005 μF.

K. C. G. (WREXHAM) asks whether the circuit diagram he encloses is correct and whether he may use it for the reception of British broadcasting.

The arrangement you indicate is quite correct, and forms a very suitable receiver for British broadcasting purposes.

A. E. B. (SOUTHAMPTON) asks in connection with circuit No. St 45 "PRACTICAL WIRELESS VALVE CIRCUITS" (Radio Press), whether the resistance R.4 is a standard valve grid leak and if not what its value should be.

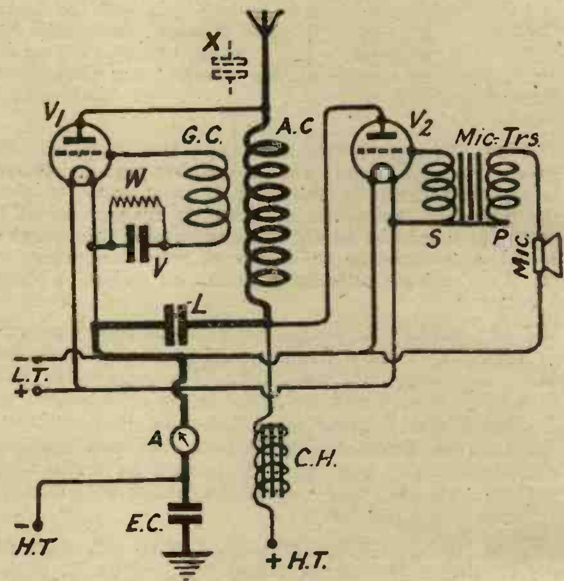
The resistance you indicate may have a value of from 1 to 2 megohms. A standard grid leak will therefore be quite suitable.

J. K. (EALING) asks where he may find a simple wiring diagram illustrating the use of dual amplification. He wishes to use this in connection with a crystal rectifier.

A suitable circuit for this purpose will be found on page 26 of *Modern Wireless* for February.

Jack (CRAYFORD) asks for a wiring diagram for the construction of a two-valve telephony transmitter, using about 30 watts, for either C.W. or telephony transmission. He wishes to know the necessary values for the different components of this circuit.

We give herewith a suitable circuit diagram for this transmitter; the values you require are indicated.



A.—Aerial ammeter, 0/0.5 amps. *E.C.*—Fixed condenser, 0.01 μF.
L.—Grid circuit condenser, 0.005 μF.
X.—Aerial circuit condenser, 0.01 μF. (If desired.)
G.C.—Grid coil, 40 turns, 22 s.w.g. d.c.c. wire, former 4 inches in diameter.
A.C.—Aerial circuit coil, 30 turns, 3/16th inch copper strip spaced 1/8th inch, former 6½ inch diameter. *W.*—Grid leak, 12,000 ohms.
V.—Grid condenser, 0.005 μF. *C.H.*—Speech choke, 20,000 turns, 40 s.w.g. s.s.c. wire, core ¾ inch diameter iron wires.
Mic. Trs.—Primary, 360 turns, 22 s.w.g. d.s.c. wire; Secondary, 20,000 turns, 40 s.w.g. s.s.c. wire; core, 20 mils., iron wires.
V_1.—0.20 Mullard valve. V_2—0.20 Mullard valve.
Mic.—Standard P.O. solid back type.

G. J. (HIGHGATE) proposes to build a low-frequency inter-valve transformer and asks whether windings of the following values would be suitable. Primary winding 10,000 turns 44 s.w.g. copper wire; secondary winding 15,000 turns 46 s.w.g. copper wire. He also asks whether if the secondary is used as the primary and vice versa it will form a suitable telephone transformer and wishes to know the number of laminations that should be used for the core of this transformer.

The windings you suggest will not give a very good ratio of magnification. We suggest a primary winding of 5,000 turns of 44 gauge d.s.c.c. wire and a secondary winding of 15,000 turns of the same wire. No. 46 is rather fine for this purpose. Quite satisfactory results will be obtained if this is wound upon an iron core ⅜in. in diameter, the wires of which may be bent round over the finished windings so as to form a closed core. You will probably find difficulty in obtaining laminations for this purpose from the average wireless dealer, and in any case considerable time has to be expended in preparing these so that they shall be insulated from contact with each other. These windings are unsuitable for use with a telephone transformer. For this purpose the 'phone winding might consist of 2,000 turns of No. 32 gauge d.s.c. wire, and the plate winding may consist of 15,000 turns of 44 gauge d.s.c. wire.

G. D. (INVERGORDON) is 600 miles from 2LO and wishes to know of a suitable circuit which will enable him to receive it satisfactorily. He wishes to know whether Ford coils would be of any use to him in the making of his set.

A suitable circuit for your purpose will be found on page 196 of the April issue of *Modern Wireless.* Ford coils are of no use as they are, in connection with receiving apparatus, although they make very good microphone transformers for transmission purposes.

R. V. R. (NORWOOD) asks the following questions with reference to "MODERN WIRELESS" No. 3. On page 175 details for the construction of an H.T. Safety Unit are given. He wishes to know a suitable number of foils for the condenser described in connection with this article. In the same No. of "MODERN WIRELESS" and on page 201 in connection with the inter-valve transformer, he wishes to know how much 38 gauge wire should be obtained to complete the winding.

Twelve foils each side will be sufficient for the condenser described on page 175, and a half a pound of 38 gauge wire should be obtained for the transformer, as, although there will be some left, it is always of use to the experimenter for odd jobs.

J. B. (EAST HAM) asks where he can procure books giving him details for the construction of experimental transmitting and receiving apparatus.

Practical Wireless Valve Circuits, Radio Press, Ltd., and *The Construction of Wireless Receiving Apparatus,* Radio Press, Ltd., will give you all the information you desire on the subject of reception. Complete details that should enable you to construct an efficient transmitter are given elsewhere in these columns.

J. P. G. (SHREWSBURY) wishes to make a frame aerial to receive on a fixed wavelength of 400 metres, and asks for details.

If the size of your frame is to be 3ft. square, then you should wind seven turns of your No. 16 gauge d.c.c. wire round it, spaced about ⅜in apart. A condenser of 0.0002 μF may be used to tune this.

P. S. (FORE STREET) wishes to construct three solenoid coils to function as primary, secondary and reaction to cover a wavelength of from 150 to 1,500 metres and wishes to know the size of former, number of turns, tappings, if any, and the gauge of wire for this purpose.

The winding of the primary coil should consist of 200 turns of No. 22 s.w.g. d.c.c. wire wound on a 4in. former; 10 tappings should be taken from this at equal intervals. The secondary winding should be 300 turns of No. 24 s.w.g. d.c.c. wire wound upon a tube which will slide comfortably inside the primary; 10 tappings should also be taken at equal intervals from this coil. Reaction on broadcast wavelengths is not permitted.

D. G. (WATFORD) asks how the Brown patent telephone works.

Detailed information is given in various text books, but, briefly speaking, a light steel reed is supported in the magnetic field close to the pole of a permanent magnet of, roughly, horse-shoe shape. To the centre of this reed is attached a light coned aluminium diaphragm, which is vibrated by the reed, and thus sets up sound waves in the same manner as any other pattern of telephone receiver.

A. D. (LONDON) asks how to make a transmitting condenser having a capacity of .0005 μF and using glass di-electric.

Five foils, each having an overlap of 25 square centimetres, should be used on each side, and they should be separated by a glass plate .1 cm. thick.

H. W. (SWANSEA) asks for particulars of a solenoid inductance to cover a wavelength range of from 150 to 650 metres.

A cardboard tube 4in. in diameter by 4½in. long, wound full with No. 20 s.w.g. d.c.c. wire, will cover this range. Five tappings should be taken from this at approximately equal intervals.

F. C. E. (YARMOUTH) asks for the numbers of plates required for variable condensers of 0.001 μF, 0.0005 μF and 0.0003 μF capacity.

The moving plates are 2½in. in diameter, .028in. thick, and the spacing washers .125in. thick. You will require 93 plates for the .001 μF condenser, 47 for the .0005 μF, and 29 for the .0003 μF condenser.

H. H. (MIDDLESEX) wishes to build a loose-coupled inductance having a considerable wavelength and wishes to know the size of formers and amount of wire required.

We suggest you use a former 4in. in diameter and 12in. long for the primary coil, wound full of No. 24 d.c.c. wire with 20 tappings at equal intervals. The secondary circuit coils should be 3½in. in diameter and the same length, and may be wound with No. 28 d.c.c. wire with 12 tappings. If variable condensers of .001 μF and .0005 μF be used for primary and secondary circuits respectively, the wavelength range with a series-parallel switch would be from 200 to 10,000 metres.

E. B. A. (DUMFRIES) is situated about 500 miles from the Hague and wishes to receive these transmissions, also the telephony from Paris. He asks what number of valves will be necessary to obtain satisfactory reception.

We suggest you use a four-valve receiver, consisting of one high-frequency valve on the tuned anode principle, one detector and two low-frequency valves. With a good aerial signal strength should be sufficient to almost operate a loud speaker if the set is carefully designed. If the aerial is lower or the screening is bad, you should use two high-frequency valves. They should be coupled by means of the tuned anode arrangement. A very good circuit for this purpose is given in *Practical Wireless Valve Circuits* (Radio Press, Ltd.).

G. H. P. (HUDDERSFIELD) asks whether it is the case that a fixed condenser should be connected across the primary winding of a low-frequency intervalve transformer and if so, what is the reason for this.

It is customary to by-pass the primary winding of the first low-frequency transformer by means of a fixed condenser having a value of .001 to .003 μF. The reason for this is that any high-frequency current which leaks past the rectifying valve will find its way across the condenser very much more easily than through the highly inductive windings of the transformer. If the condenser were not there, losses might be produced due to slight damping in the windings. It is, therefore, generally speaking, a distinct improvement to add such a condenser to a low-frequency amplifier. One very good low-frequency transformer now on the market is shielded by means of the bye-pass condenser which is actually wrapped round the winding.

W. H. R. (NORWAY) asks whether it is possible to charge accumulators from the A.C. mains.

It is not possible to charge accumulators directly from the alternating current main. If some form of chemical or valve rectifier or rotary converter arrangement is made use of, then the process may be conveniently carried out. A description of methods employed for charging accumulators from A.C. mains will appear in this paper in the near future.

M. E. S. (COLCHESTER) asks whether Siemens-Halske valves may be used for his receiver.

Siemens-Halske valves may be employed if desired, but we suggest the use of a hard valve such as " R " type. The Siemens-Halske valve is not a good rectifier, but is a very excellent low-frequency amplifier if many stages are to be used. It is possible to construct a six-valve low-frequency amplifier employing Siemens-Halske valves without the distortion which frequently accompanies a three-valve amplifier using the ordinary hard valve.

E. F. (SWANSEA) asks what is meant by a " stand-by " and " tune " switch.

A " stand-by " and " tune " switch is an arrangement by means of which either the aerial circuit coil or closed coil of a receiving tuner may be coupled to the detector or the first valve of the receiver at will. It is an advantage when rapid searching for stations is necessitated, as in the " stand-by " position tuning can be carried out on the aerial circuit coil and condenser only; and, when the desired station has been found, the secondary or detector circuit may then be tuned to the aerial circuit.

J. E. S. (BRISTOL) asks whether it will make any difference to his receiver if he has a number of telephones connected to cords about 30 feet long, attached to his set.

The length of wire in the telephone circuit will not make any difference to the signal strength in all probability. Low-resistance telephones with a transformer should be used for this purpose, otherwise there might be some slight upsetting of the receiver.

L. J. H. (NORFOLK) finds trouble from interference due to 50-cycle A.C. power lines and asks how he can reduce it.

A frame aerial will probably be found the most satisfactory solution of the trouble, although using high-frequency valves in place of low-frequency valves is generally a very effective method of reducing hum. Iron core transformers themselves pick up a considerable amount of L.F. energy due to the magnetic field set up by the transmission line. As a final precaution, the set may be completely screened with tinfoil, and the telephone and battery leads wrapped round with wire and earthed.

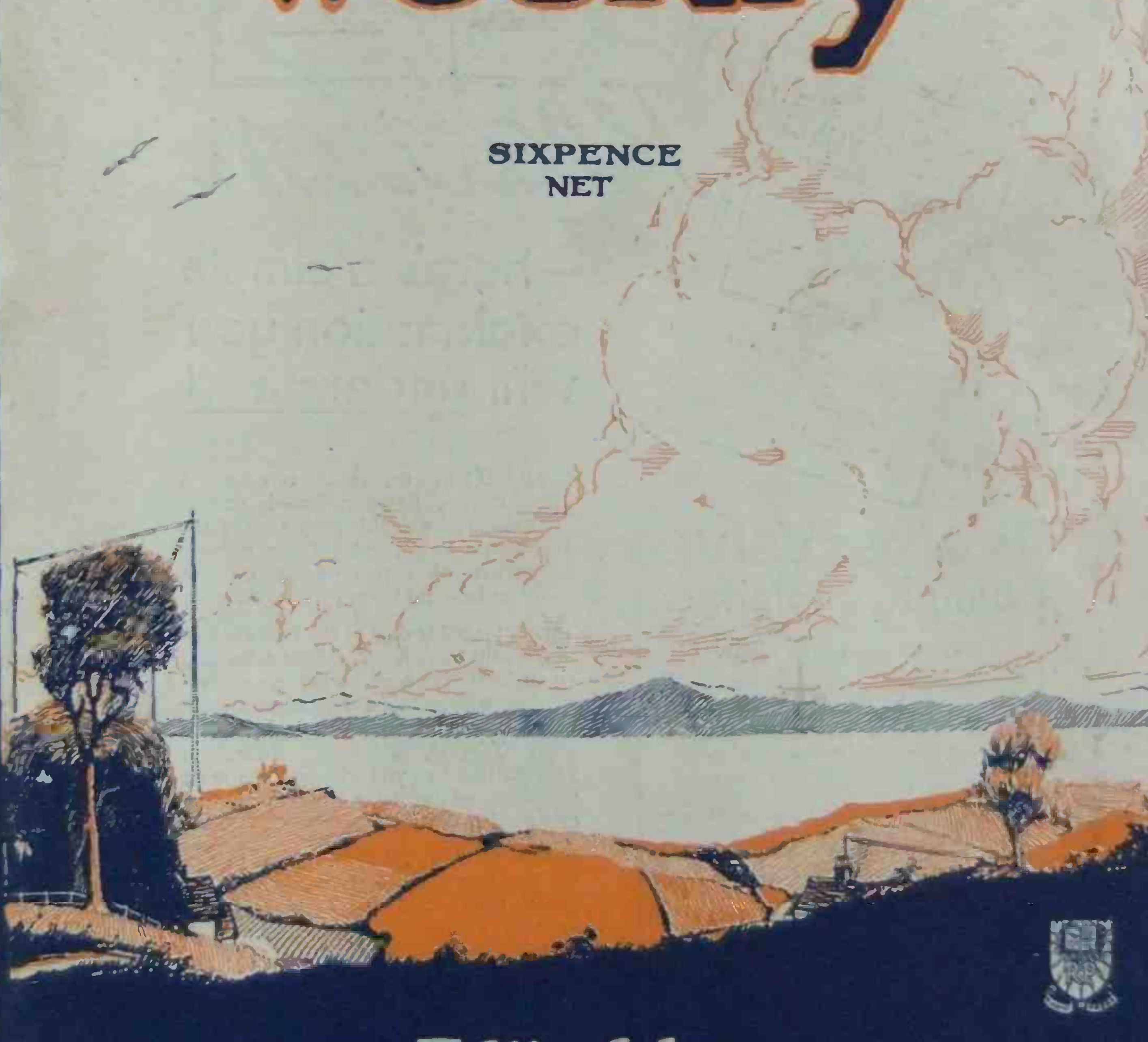
(continued from page vi.) *whether you mention the paper or not. What does matter*

Printed for the Proprietors, RADIO PRESS, LTD., Devereux Court, Strand, W.C.2, by THE CORNWALL PRESS LTD., Paris Garden, Stamford Street, London, S.E.1. Published on Wednesday of each week at 3, Bolt Court, Fleet Street, London, E.C.4. Address for Subscriptions and Editorial communications:—Devereux Court, Strand, London, W.C.2. Advertisement Managers:—THE SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates:—32/6 per annum, 16/3 for six months, post free. Sole Agents for Australasia:—GORDON & GOTCH (Australasia), LTD. For Canada:—IMPERIAL NEWS LTD. For South Africa:—CENTRAL NEWS AGENCY, LTD.

Wednesday Vol. 1 No. 3. April 25th, 1923

Wireless Weekly

SIXPENCE NET



Edited by
John Scott-Taggart F. Inst. P.

Wireless Weekly

Vol. 1. No. 3.
April 25, 1923

CONTENTS

Editor: John Scott-Taggart, F.Inst.P.
Assistant Editor: E. Redpath.

Scientific Adviser:
Prof. G. W. O. Howe, D.Sc., M.I.E.E.
Advisory Editors:
Prof. R. Whiddington, M.A., D.Sc.
Prof. C. L. Fortescue, M.A., M.I.E.E.

Radio Press, Ltd.
Publishers of Authoritative Wireless Literature.
DEVEREUX COURT, STRAND, W.C.2.

Staff Editors:
J. H. T. Roberts, D.Sc.
E. H. Chapman, M.A., D.Sc.
A. D. Cowper, M.Sc.
G. P. Kendall, B.Sc.
A. L. M. Douglas.
R. W. Hallows, M.A.

All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

The Licence Position

We hope by the time that this appears that the Postmaster-General will have taken some definite step to ease the licence situation. We are convinced that he will deal with the matter expeditiously, although his task is by no means an easy one.

He has surprised the great majority of those interested in wireless in this country by his stand against the licence fee for constructors being 20s. The most remarkable feature of this policy is that the Radio Society of Great Britain and other societies have all, or nearly all, agreed to the licence fee being £1. Apparently, the Postmaster-General believes that a licence fee of £1 would not quell the present unrest. This is no doubt quite true, as there are many who would consider that a £1 licence fee was much too high for the man who simply used a crystal receiver.

We only hope that the revenue to be derived from a 10s. licence fee will satisfy the Broadcasting Company. It is to the interests of all that this company should be supported, and destructive criticism is calculated only to cause unnecessary friction and unpleasantness.

Possibilities of Sub-Station Working

There are several parts of the country which are practically blind spots as regards wireless reception. Several of these exist in Wales.

There are two ways in which sub-stations might be worked: either sub-stations of small power might be connected to the main Broadcasting station by means of a land line, or else they might be operated by wireless. The latter idea has, in fact, been suggested in America for the benefit of outlying country districts, and while it does not appeal to us so effective a method as the use of a land line, it is possible that good results might be obtained.

A difficulty, of course, would be in connection with the prevention of the outgoing signals interfering with the incoming currents. Some sort of duplex circuit might, however, be employed, but the disadvantage of the wireless method would be that interference and atmospherics would become more prominent, as not only would there be the normal interference and atmospherics, but also that radiated by the sub-station.

There is great technical interest in the experiments which are being carried out by Mr. P. P. Eckersley, Chief Engineer of the Broadcasting Company, at Sheffield, and we are looking forward to having some technical details of any results obtained.

Provincial Programmes

We receive a number of complaints from provincial Broadcasting stations to the effect that their programmes are not up to the London standard. There is, of course, no particular reason why London should receive any preferential treatment. Many artists, of course, do not leave London, and consequently 2LO has an advantage in that it is able to broadcast items provided by certain artists.

Nevertheless, we must see that the other Broadcasting stations have adequate programmes provided. The tests which have been carried out recently in the direction of sending items by land line to provincial Broadcasting stations seem to provide a solution of the problem.

We do not consider that a Central Studio communicating with all the Broadcasting stations and giving only one programme would satisfy the needs of such diverse tastes as those of Scotland and Wales.

However, it would be a great advantage if, on special occasions, the best items on the London programme could be sent to all the stations simultaneously and radiated from them.

We cannot help but wonder how many listeners-in actually choose their programmes from the different Broadcasting stations. I do not suppose that more than one in every thousand listeners-in is able to select a distant Broadcasting station and to listen to it without interference from one or other of the remaining stations.

We cannot help but think that a listener-in should be in a position to listen to whichever station he desires, and to enable this to be done, we think that the power of the Broadcasting stations would have to be increased by at least 50 per cent., if not more. Moreover, the difference in kilocycles between the frequencies of the different stations is not at present sufficient to enable one to tune out the individual stations with the ease which one would desire.

We are communicating with the B.B.C. to see if there are any technical, political, or wavelength considerations which make it impossible to facilitate the reception at will of the signals from different Broadcasting stations.

New Amateur Wavelength

Readers of the "News of the Week" feature in this journal will see that the General Post Office have offered to reserve 720 metres for experimental transmission work. This is very good news, and the new wavelength should enable transmitters to proceed with experimental work.

THE TRANSATLANTIC TESTS IN FRANCE

By Dr. PIERRE CORRET

A very interesting and full account of the results obtained in France and Switzerland.

THE third series of Transatlantic tests organised in the United States by the American Radio Relay League, and in Europe by the Wireless Societies of France and Great Britain, include American transmissions heard in Europe from the 12th to the 21st December and the European transmissions heard in America from the 22nd to the 31st December. These transmissions were made at night from 0 till 6 hours Greenwich time, that is, from midnight until 6 a.m., on wavelengths of 200 metres and with a maximum power of 1 kilowatt.

The author, with a portable crystal receiver used by him during the war.

American Transmissions

The first preliminary trial took place from the 26th of October till the 4th November, with a view to making a selection from the best American amateur stations. To these were given a definite code word not known to the stations who were to receive the transmitters. The trial consisted of covering a distance of at least 1,920 kilometres over land. Almost 450 stations filled the required conditions. 324 of these were given a code word for transmission, the others and those who had not been able to cover minimum distance of 1,920 kilometres over land were allowed also to participate in the trial, but without any transmission code word. The receptions were made principally in Great Britain and in France. British amateurs allied themselves with Dutch amateurs, and the French allied themselves with the Swiss. Although no American stations had been heard with certainty in Europe before the first series of Transatlantic tests in February, 1921, and although only 30 had been heard at the time of the second trial in December of the same year, the total number of the different American amateur stations received with or without the code word by 26 French amateurs and two Swiss amateurs during the course of the third series of trials was no less than 246.

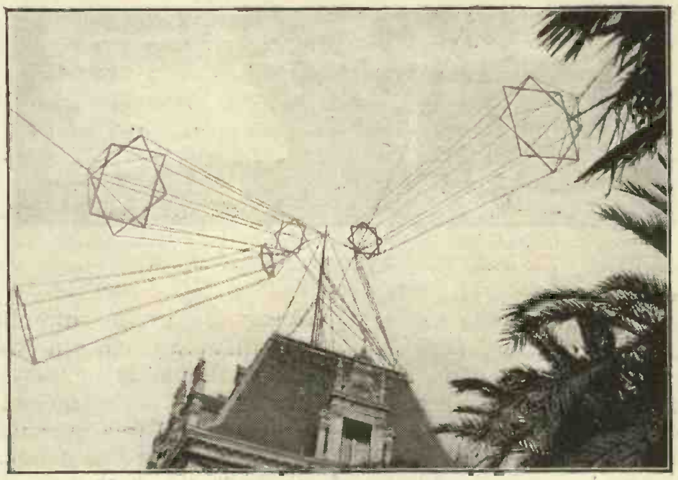
Very much better results were obtained in Great Britain by a much greater number of amateurs. These, however, have been used for a much greater length of time than the French amateurs to the reception of very short waves. A special committee was formed from the Radio Society of Great Britain to assist these amateurs. Enormous scientific interest attaches to these results when one considers that a great majority of American stations were using considerably less power than the maximum permissible, 1 kilowatt, and also when one bears in mind that their reception was often effected in Europe with a single valve on a very small aerial. [Note that the only one station which we know ourselves to have fulfilled certain conditions of operations, and which was heard in Switzerland, employed in parallel four 5-watt tubes having the following characteristics:—Filament current, 2.35 amps. at 7.5 volts; plate current, 45 milliamperes at 350 volts. In the test, however, the high tension employed was 750 volts.]

These trials were made, it is true, under the best possible conditions as regards time of day and period of year. It is easily seen that, under certain conditions and independent of certain obstacles to their propagation which are still open to investigation, these waves of short length have shown a remarkable aptitude, which one might almost call intrinsic, for reaching over great distances with very small power. Taking for instance the American station 8A.Q.O., notably, received by a large number of European amateurs, has been described by many as "excellent with one valve," and "heard with the head 'phones on the table" by a number of persons with a super-heterodyne; also "readable distinctly at 10 metres distance." This shows how regularly communications could be quite easily sent us across the Atlantic.

Another interesting fact noted was that of the extraordinarily easy reception of these very short waves on large aerials, and not only in the case of special arrangements, such as the Beverage antennæ, or with such a special tuner, for instance, as the Reinartz; but equally well with aerials of ordinary standard type. These Transatlantic tests have also confirmed the difficulties which seem to be associated with the regular employment of very short waves to traverse great distances, chiefly on account of the obstacles which they meet with during their propagation. There was no intention of effecting these tests during the day; on the contrary, an hour was chosen when it would be night not only in America, but in Europe. Even under these conditions great irregularities were always noticed in the intensity of reception even from the same station, the reception sometimes varying very quickly between excellent and unreadable, to come back again to the normal state a few moments afterwards. These rapid variations, which manifest themselves equally over long or short distances, are well known to American amateurs, who have given them the name of "fading," and for which they adopt the telegraphic abbreviation Q.S.S. They have made, on their part, a series of methodic trials in collaboration with the United States Bureau of Standards. The results obtained from these trials seem to indicate, without doubt, that the cause of the rapid variation of intensity of short-wave reception is due to absorption by the atmosphere. Another curious fact in connection with these Transatlantic transmissions has been the results obtained from stations disposed along the Atlantic Coast of the United States or its immediate neighbourhood. These stations furnished respectively 60, 50, 54, 30 and 20% of the stations heard, whilst the districts in the centre of America and on the Pacific Coast only formed about from 4.5 to 5%. These latter stations were, it is true, at a greater distance from Europe than those on the Atlantic Coast, but this factor alone does not seem to explain the inferiority in the quality of their signals. There is, therefore, no doubt that a considerable amount of absorption is due to the passing of the waves over a large area of ground. The first Transatlantic transmission made by Marconi nearly 20 years ago with a power and a wavelength which seem to us nowadays only moderately great, introduced the question of the propagation of Hertzian waves round the globe. This problem has not yet been satisfactorily solved and different hypotheses have been put forward by various leading radio telegraph engineers. Possibly these latter have been able to make observations on the Transatlantic transmissions by amateurs of very short waves which allow them to confirm or otherwise one or the other of their original theories. Let us now examine with what type of receiver the best results have been obtained. To be candid, each particular result depends not only on the excellence of the apparatus used, but also on a number of other factors, such as the ability of the operators to make use of it; their good, or otherwise, knowledge of the Morse code; their numbers and their ability to listen for continual periods without fatigue; the quality of their aerial—whether it was more or less screened or more or less open; and a variety of other factors.

Method of reception.	Number of stations employing this method of reception.	Total No. of stations received by these groups.
Super Heterodyne.	2	158
1 Tuned anode H.F. stage.	7	153
No H.F. amplification.	8	102
H.F. amplification by air-core transformers.	4	59
Multi-stage H.F. amplification by anode reactance coupling.	3	9

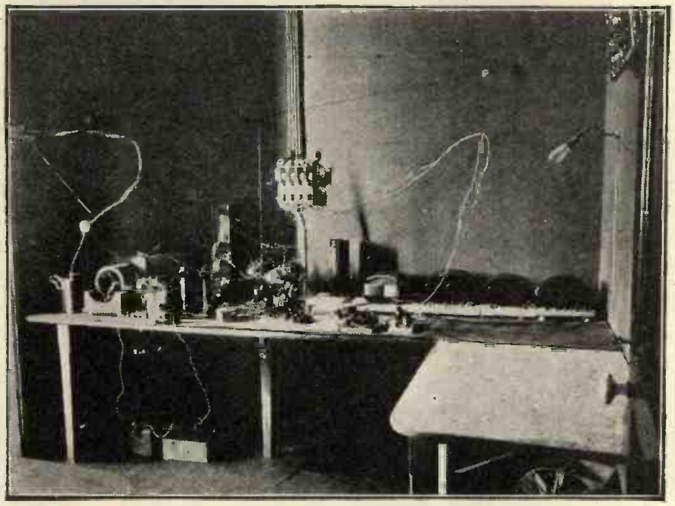
A brief classification of the different types of apparatus and the degree of amplification used gives the foregoing results. The best results during these tests were given by receivers using the super-heterodyne circuit of Mr. E. H. Armstrong. We have not mentioned the number of stages of low frequency amplifications used in different cases. The reception from a great distance of very short wave-lengths is to a great extent dependent on high frequency amplification. Again, a very large number of French amateurs have entirely suppressed the use of low frequency amplification in order to avoid the parasitic noises which often accompany it. In all cases a reaction coil directly coupled to the aerial circuit was made use of. Four stations used the Reinartz tuner, two of them utilising at the same time high frequency stages, the other two without high frequency amplification. Several amateur stations in France only used one valve, one of these stations having also received short-wave telephony from the American Broadcasting Station, Newark, New Jersey. This latter station was also received by numerous other amateurs in France with the apparatus which they used for the Transatlantic test.



The aerials at 8AB (Nice).

French Transmissions

Twenty-three French stations were registered to participate. One dozen only actually transmitted and, of those, one only was heard in America. Many of the French stations which transmitted did so in a very irregular manner on account of many different difficulties encountered. The great part of these stations were only authorised to transmit with a maximum power of 100 watts. Certain amateurs were allowed to increase their power to 1 kilowatt, but, owing to the short notice at which this authority was granted, they were not able to experiment with their circuits to a sufficient extent to justify the use of the full power. Again, although most amateurs refrained from transmitting during the period of the test, there was a considerable amount of interference from this source, especially in France. The only French station which was heard in America was one which had been authorised before the period of the test to use a power of 1 kilowatt. The apparatus employed consisted of four 250 watt tubes working in parallel with the ordinary arrangement of a grid coil coupled to a plate coil in the aerial-earth circuit. Alternating current of several thousand volts was directly applied to the plate, with a frequency of 25 periods per second. Under these conditions a maximum aerial radiation of 4.8 amperes was obtained with a wavelength of 195 metres, and this in an aerial whose constants had not been exactly measured, owing to lack of time. The aerial consisted of eight wires 60ft. long arranged in the form of an inverted umbrella, with a maximum height of 35 metres (a mast of 10 metres upon the top of the house 25 metres high). The wire used in the construction of this aerial consisted of eight strands of enamel copper of 22 s.w.g The natural wavelength of this aerial was in the neighbourhood of 200 metres, which was brought down to 195 metres by a series condenser. The earth circuits consisted of a connection to the water-supply pipe, the gas-pipes of the central heating, also to a lightning conductor and to 20 metres of wire buried underneath the aerial. The whole of this was joined together by a copper wire 3 centimetres in diameter. A counterpoise earth consisting of twelve wires arranged underneath the aerial was introduced in the middle of the test with the intention of trying the counterpoise arrangement, but the local conditions did not seem favourable to its use and for this reason it was abandoned. The transmissions from this station were made in such a manner as to ensure almost complete success. Very slow operation and, at the same time, frequent repetition of the code word, in addition to operating during the whole of the hours allotted to the French stations, was found to draw attention to 8 A.B from the American amateurs. The reception of the station in America was rendered rather difficult on account of the interrupted nature of the waves which the alternating current at 25 periods produced. It was, however, received on the 23rd and 25th of December by an American amateur using one detector valve and one low frequency stage; on the 30th December with great regularity, and signals readable for a period greater than an hour by another American amateur with one single-valve detector and two low frequency stages of amplification. On the 26th and the 28th December this station was also received by the telegraphist on the French steamer "Janus," who was at the moment just off the American coast.

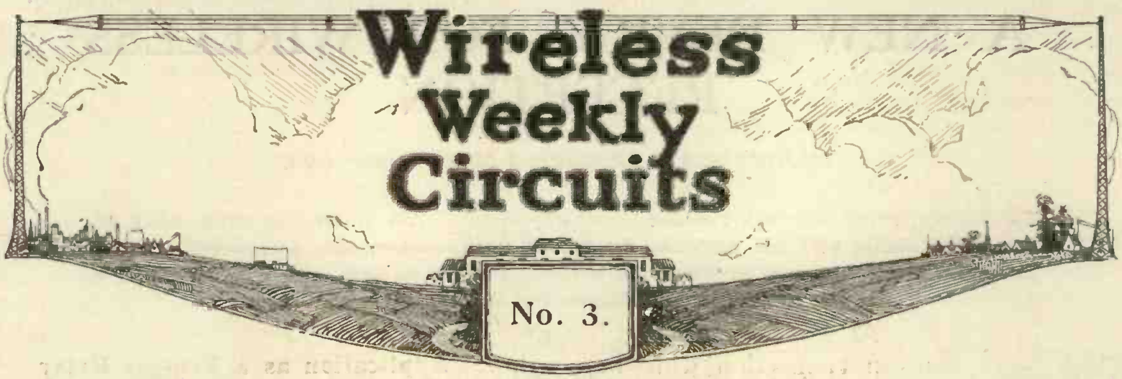


The transmitting apparatus employed at 8A.B

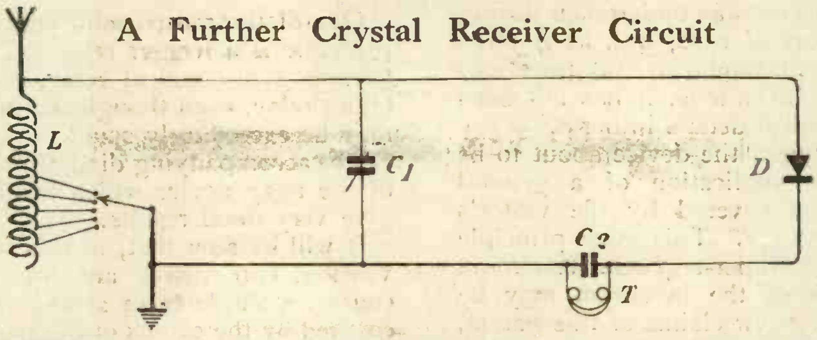
He also received 8A.B. with one detector valve and two stages of low frequency amplifications. From Great Britain two stations altogether were heard, one belonging to the Radio Society of Great Britain in London and the other in Manchester. Possibly there was also a third station, the identity of which has not been verified at the moment. By way of termination of this account the French Committee of the Society T.S.F. wishes to express its congratulations to amateurs who received the American transmissions and who were able to make themselves heard in America. These interesting experiences tend to make a strong bond of fellowship between members of the French Radio Societies and their British confrères, and have shown for the first time the possibility of bridging great distances with very little power and on a comparatively short wavelength. They have attracted great attention from wireless scientists, and shown what a valuable contribution the modest experience of experimenters can make to the science of wireless telegraphy. In view of the very encouraging results obtained from these trials, the Committee of the Radio Society, T.S.F., propose to organise, if possible, tests of not only telegraphy but telephony on wavelengths of 200 metres and under. These will be announced in due course by the French radio telegraph reviews, but amateurs would do well to prepare their apparatus in the meantime for any further tests.

THE ST100 CIRCUIT

In response to many enquiries regarding this new 2-valve circuit, we desire to inform our readers that No. 5 of "Modern Wireless" will contain full details of the apparatus with which such remarkable results are obtainable.



A Further Crystal Receiver Circuit



APPARATUS REQUIRED.

C_1 : A variable condenser having a capacity of not less than 0.0005 μF (microfarad). A preferable value is 0.001 μF.

L : A variable inductance having several tappings taken from it, a selector switch being provided.

C_2 : A fixed telephone condenser of about 0.002 μF capacity.

T : High resistance telephone receivers.

D : Crystal detector.

GENERAL REMARKS.

In circuit No. 3 the tuning condenser C_1 is connected in parallel with the used portion of the aerial inductance L. The condenser C_1 is for the purpose of fine tuning, rough tuning being accomplished by means of the selector switch and tapped inductance.

Circuit No. 2 with the condenser C_1 in series (illustrated last week) is especially suitable for receiving the shorter wavelengths.

The present arrangement is more suitable for receiving wavelengths above 600 metres, such as Paris time signals (2,600 metres).

VALUES OF DIFFERENT COMPONENTS.

The tuning condenser C_1 should have a value of about 0.001 μF, but a capacity of 0.0005 μF may be used if sufficient tappings are provided. The crystal detector may be of any of the well-known types. The telephone receivers should be of high resistance (not less than 1,000 ohms) and the telephone condenser C_2 may have a value of 0.002 μF. Particulars of a suitable condenser were given in the description of Circuit No. 1.

The inductance L may consist of a cardboard tube 3½in. diameter wound with No. 26 gauge double cotton covered wire for a distance of 5in., twelve tappings being taken. This should give a wavelength range of about 200 metres to 3,000 metres when C_1 is in parallel. For the reception of broadcasting, a 3½in. cardboard tube wound for 3in. with six tappings will be satisfactory.

NOTES ON OPERATION.

Both circuits should be tried when receiving shorter wavelengths to see which gives the best results. The procedure for tuning is to place the selector switch on the first stud nearest the aerial end of the coil and to adjust the variable condenser C_1 from zero to its maximum. If signals are not heard try stud 2 and repeat the operation. If nothing is heard try all the various studs until the desired signal is obtained, and then carefully adjust on the condenser. Sometimes the signals will be heard on two or three different studs with different values of the condenser. If so, select the stud which gives the loudest results.

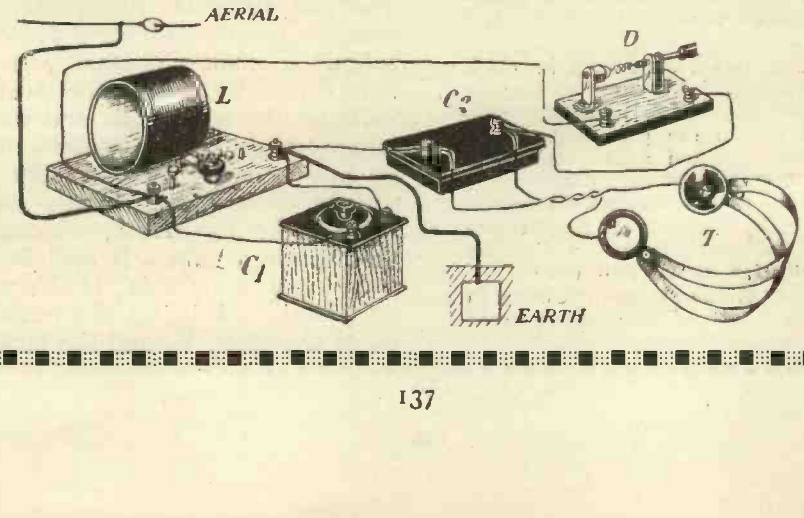
POSSIBLE VARIATIONS.

Sometimes the last stud is connected to the selector switch. This sometimes results in louder signals. By this method a portion of the inductance is short-circuited. This portion, of course, is the unused portion.

The telephone condenser can, in most cases, be omitted without any disadvantage.

RESULTS OBTAINABLE.

The results obtainable with Circuits 2 and 3 compare with those obtained with Circuit No. 1 and similar ranges may be covered.



A NEW DEVICE FOR WIRELESS RECEPTION

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E.

The following article deals with a method of receiving signals. This is the first article which has been written dealing with this particular development, which, however, dates back several years, no publication having been made for commercial reasons. Probably the chief interest of the patent at this date is that it is an anticipation of the super-regenerative circuit.

THE work done in connection with the following device was undertaken during the early part of 1920, but, as is often the case where commercial organisations have interests in inventions, it has not been convenient to publish details hitherto.

In the present case, the device about to be described is one application of a general principle which is covered by the writer's British Patent 170,377. This same principle is employed in the Super-regenerative circuit. The broad scope of the invention may be gauged by the first few claims of this patent, which read as follows:—

1. In apparatus particularly for use in wireless signalling system comprising a valve or electron discharge device having input or output sides which are connected in some manner so that there is a transference of energy or potentials from the output side to the input side, such transference being normally of such sense or magnitude that the condition is stable, the method of varying the extent of the transference during such stable condition which consists in varying by electrical as distinguished from mechanical means the damping or impedance of a circuit associated with the valve.
2. Apparatus as in Claim 1 in which the conductivity of a conductor associated with the valve is varied electrically.
3. Apparatus as in Claims 1 or 2 in which a valve is used to vary the damping or impedance.
4. Wireless receiving apparatus comprising a valve adjusted to a stage preceding self-oscillation and means for varying the tendency of the valve to oscillate comprising a valve which affects the damping of an oscillatory circuit associated with the first valve.
5. Apparatus according to Claims 2 or 3 in which the second valve is connected in shunt across one of the first valve circuits such as an inductance coil.
6. Apparatus as in any of the preceding Claims wherein the transference is varied by the application of an external impulse, current or potential.
7. Apparatus according to the previous Claims in which by the application of a signal, the transference of energy is increased sufficiently in such a direction as to produce self-oscillation of the first valve.
8. Apparatus as in any of the preceding Claims in which one or both valves are of the three-electrode type.

Application as a Trigger Relay

One of the most useful applications of the principle is a trigger relay device which will operate a mechanical relay, such as a Post Office relay, even though the incoming signal may be exceedingly small.

The accompanying diagram shows one form of the relay device which has been found to give very good results.

It will be seen that, in this form of the invention, two valves are used although, of course, a single-valve arrangement would be covered by the claims of the patent.

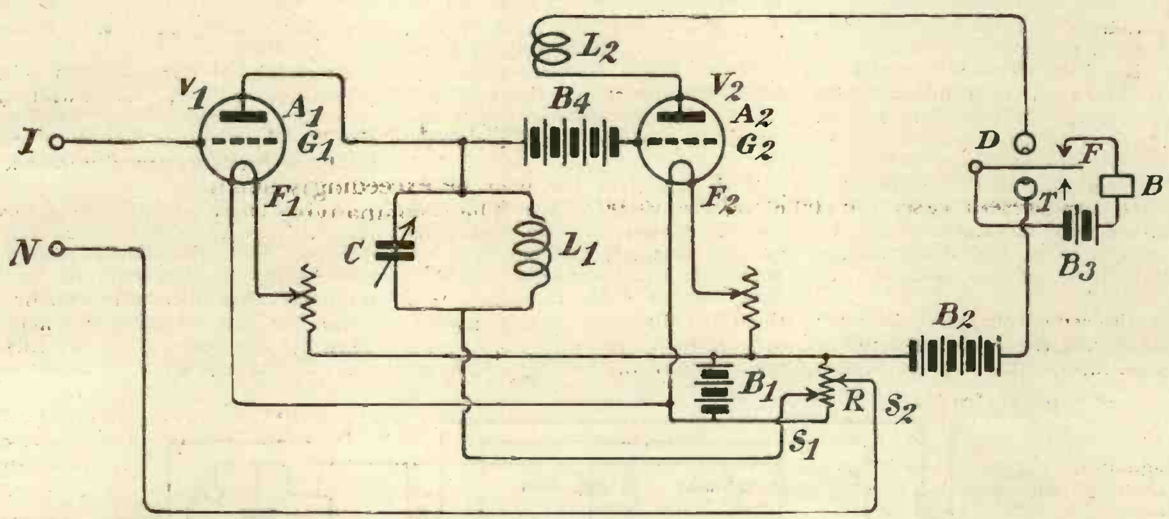
The valve V_2 is operated so that there is a reaction effect between the anode coil L_2 and the oscillatory circuit L_1C, which is included in the grid circuit of the valve V_2. In this grid circuit we have, in addition to the oscillatory circuit L_1C, a battery B_4 of about 7 volts so connected that the grid G_2 is given a negative potential. The bottom end of the grid circuit is connected to a slider S_1 which moves along the potentiometer resistance R connected across the filament accumulator B_1. The top end of the inductance L_1 is connected to the anode A_1 of a valve V_1, which valve is therefore shunted across the oscillatory circuit L_1C and acts as a means of regulating the damping of the oscillatory circuit L_1C. In the anode circuit of the valve V_2 we have not only the reaction coil L_2 but also the relay D, this relay, for example, being of the Post Office B pattern. A moving tongue T makes contact with the marking stud F thereby closing the local circuit which includes the battery B_2 and the indicator B, which might be a buzzer, tape machine, or any other device. Under normal conditions, when no signals are being received, the tongue T, of course, rests on the spacing stop. It will be noticed that two input terminals I, N, are provided, the terminal I being connected to the grid G_1 of the valve V_1 and the terminal N being connected to the slider S_2 of the potentiometer R connected across the filament accumulator. Two sparate potentiometers might be employed, but if a single potentiometer with two sliders is provided, separate potentiometers are not necessary.

The object of the slider S_2 is to enable a varying positive potential to be applied to the grid G_1 of the valve V_1, while the slider S_1 serves to vary the grid potential from about —1.5 volts and —7.5 volts.

two separate grid potentials, to make the whole device a very sensitive relay.

If we assume that the correct adjustments have been made and an incoming signal makes the grid G_1 not necessarily negative, but less positive than normally, the damping effect exercised by the valve V_1 is decreased, the damping of the circuit L_1C is decreased and the valve V_2 is set into self-oscillation.

When the valve V_2 oscillates, there is an immediate heavy flow of grid current which



Circuit diagram of the new relay device

Theory of Operation

The circuit described above may be used for recording wireless signals and for many other purposes.

Let us assume for the moment that the reaction between L_2 and L_1 has been adjusted to a critical value just preceding the self-oscillation stage. The valve V_1 acts as a damping device, the effect of which may be controlled by the grid G_1. The tendency for the valve V_2 to oscillate will depend very largely upon the potential of the grid G_1, which controls the conductivity of the valve V_1. If the grid G_1 were normally positive so that the valve V_1 would act as a substantial absorbing element if the valve V_2 were to oscillate, this latter tendency would only cause self-oscillation if the grid G_1 were given a relatively negative potential.

It is possible, by carefully adjusting the may amount to as much as 0.5 milliampere. At the same time there is a sudden jump in the anode current, and this sudden increase may be utilised to operate the relay D in the local circuit.

It will be obvious from these remarks that the relay might be included either in the anode circuit of the valve V_2 or in the grid circuit. If included in the grid circuit, the arrangement is considerably simplified, as it is not necessary to balance out the effect of the steady normal anode current. If the relay is connected in the grid circuit there is normally no grid current at all, and this, in many cases, simplifies the precautions which have to be taken.

The whole device is self-restoring, provided the incoming signals are not too weak. Under these conditions no external quenching device is necessary.

HOW TO RECEIVE THE AMERICAN BROADCASTING

By J. H. D. RIDLEY.

Mr. Ridley will doubtless be remembered as the first British amateur to receive music transmitted from WJZ, the Newark (U.S.A.) station.

TO lay down hard and fast rules for the successful reception of such low powered, long distance telephony transmissions as the American Broadcast would be undertaking a responsibility for which there is no feasible excuse. One has to take into consideration the atmospheric conditions, both local and over the Atlantic, location and efficiency of the receiving station, and last, but by no means least, the ability of the operator to get the best out of his set.

At the same time there is every possibility, given a certain amount of good luck, of the average experimenter experiencing the fascination of listening to a 3,000-miles-away radio concert.

It is with this point in view that I am going to give one or two hints which may prove useful to would-be listeners to the American Broadcast.

The aerial, needless to say, should be as high and open as possible, and all connections well soldered. A waterpipe earth can hardly be excelled.

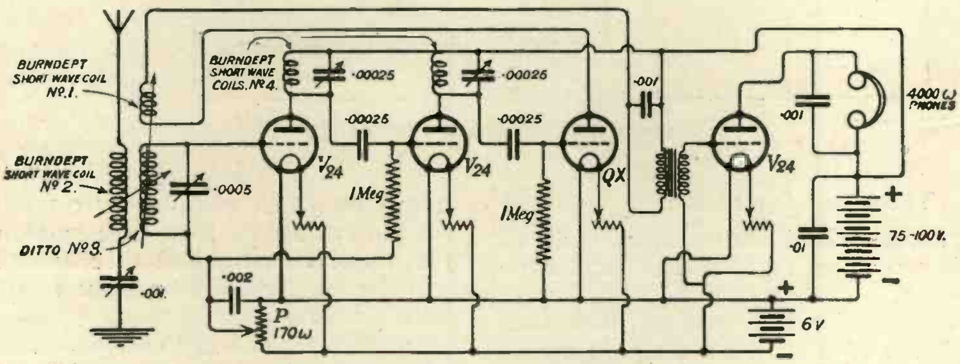
The tuning apparatus may consist of the usual type of triple circuit (Primary, Secondary, Reaction), and should at all costs be free from "Hand" effect. A vernier condenser is almost a necessity. From personal experience I prefer Burndept short wave coils for all purposes, i.e., Primary, Secondary, Reaction and Anode coils. These coils are single layered, and being taped are almost impervious to any change in atmospheric conditions, which in itself is a big consideration.

With regard to the arrangement of the receiving set, preferably this should consist of two high frequency, detector, and one low frequency valves. Reports have been given of one valve reception. Although I have done this myself, one cannot sit down at 3 a.m. with great hopes of hearing WJZ on such apparatus. The high frequency valves should be "reactance-capacity" coupled, this being, in my opinion, the best method of high frequency coupling. High resistance 'phones should be used, there being a certain amount of loss even with the best of telephone transformers. The use of high resistance 'phones may make the difference between hearing and understanding, and hearing only, the telephony of a distant station.

If it is possible for the reader to discriminate between the choice of valves, a Marconi Q.X. for rectifier and V. 24's for other purposes should be used in preference to the "R." type of valve. The low self-capacity of the V. 24 makes it ideal for high frequency work, and it should be used whenever possible.

Referring to the diagram, the potentiometer "P," is absolutely necessary to control "self-oscillation" which often occurs when using the reactance-capacity method of coupling.

In conclusion it may be stated that the writer has received four different U.S. Broadcast stations and during the Transatlantic tests no fewer than fifty-two amateurs, whilst the best reception was made when it was raining in torrents. The minimum number of valves recommended is three, one H.F., Detector, and one L.F., failing this, Detector and two L.F. Quite good work can be done with these combinations and reasonably good results expected. To those who wish to receive WJZ it may be helpful to state that the carrier wave of this station has a distinct ripple. This may be likened to an eighty cycle A.C. note, smoothed out until only just a faint ripple is audible. This note proves very useful when separating the "carrier" from waves radiated by experimenters who are allowing their valves to oscillate continuously instead of during the preliminary searching period only.



Circuit diagrams of the apparatus used.

AN EXPERIMENTAL FIVE-VALVE AMPLIFIER

By *ALAN L. M. DOUGLAS, Associate Editor of "Wireless Weekly."*

A constructional article of considerable interest to those whose means are limited, yet who require a sensitive and flexible receiver.

(Continued from No. 2, page 82.

THE clips for the V24 valves can be either purchased or made; it is very simple to bend springy brass or phosphor-bronze strip to the required shape, and a small hole (about $\frac{3}{16}$in.) should be drilled in each clip for the metal cap of the valve to project into. One clip of each set of four should preferably be rigid, and this can conveniently be the lower filament one. The grid clips will have to have a slightly larger hole in the panel beneath them than the others, as a valve socket is attached to them (Fig. 1) and holds them in place. This is for the grid selector plug, so that one or two high-frequency valves will be in use as required. The grid leak switch may now be firmly attached to the panel, and the contact finger of this must have a heavy and firm pressure on the studs. Any looseness of contact here will produce terrible noises in the telephones and absolutely prevent any reception being carried out. The position of the clips for the various condensers will be noticed, and this pattern of fitting will prove very handy for experimental purposes. For connecting the points where the detector and low-frequency amplifier are connected to the high-frequency circuit, and where the high-tension link also is so attached, three straps of brass or copper should be made. These should be 1in. long with a $\frac{3}{16}$in. centre hole, as in Fig. 7B. They may be lacquered at all points except the extreme ends, if a good appearance is desired, otherwise they will soon become dull. The arrangement of the grid selector and potential plugs will be evident from an examination of Fig. 1 in conjunction with Fig. 6, and no difficulties should be encountered in attaching these. Small ebonite knobs of the nature indicated are readily obtainable at accessory dealers for a modest sum, and add considerably to the appearance. The wiring up may now be proceeded with in accordance with Fig. 6, and all points of attachment should be soldered.

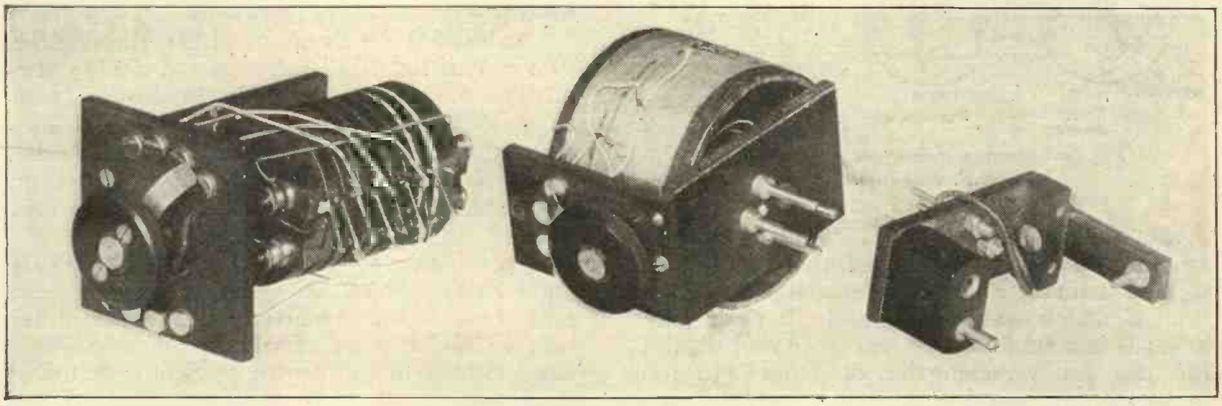


Fig. 8.—Photographs of different inter-valve H.F. couplings.

The various components may be attached by means of 4BA × ½in. cheese-head brass screws, and the heads of these may be lacquered if desired; they very soon become black and discoloured if left in their natural state, no matter how bright and shiny they may look when purchased. If Radio Instrument transformers are used, and supported as indicated in Fig. 2, it will be found that there is just sufficient clearance for the panel to fit into the case. This will be apparent from Fig. 1, and in consequence the small wooden blocks may be affixed in a suitable position on the inside of the case. From this same illustration the position of the variable condenser will be noticed, and the connections from this are made by flexible rubber-covered wires in accordance with Fig. 6. A condenser of $\cdot 001\mu F$ is connected across the primary winding of the low-frequency transformer, following the detector valve, and if this condenser is of the clip type it will be found that it can just be gripped under the top terminal nuts of a R.I. transformer; this will simplify the construction to a certain extent, as there is not too much room on the back of the panel.

When the amplifier has been carefully wired up, attention may be given to Fig. 8, which illustrates several different arrange-

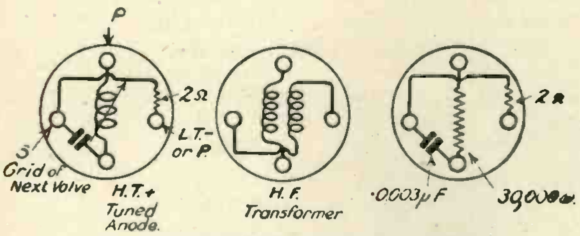


Fig. 9—Showing connections of inter-valve H.F. couplings.

ments for inter-valve H.F. coupling. 'A' is an air-core high-frequency transformer with tapped primary and secondary, the construction of which was not so difficult as it may look; B is a small anode reactance coil wound for use on wavelengths of from 150/400 metres in conjunction with the variable condenser; C is a plug-in unit to extend the anode reactance inductance to any required range; and D is a resistance-capacity coupling very suitable for the higher wavelengths right up to Bordeaux (LY. 23,450 metres). Any of these intervalve couplings may be selected for experimental purposes, as the valveholders in the top panel of the amplifier are for this purpose.

As considerable attention is now focused upon British and American broadcast wavelengths, particulars of the anode reactance coil B are given: length, 3in.; diameter, 3in.; winding, 70 turns 28 D.S.C. copper wire, tapped at 40, 50, 60, 70 turns. This is suitable for all British wavelengths under 400 metres, and will amplify up to 425 metres without much loss in signal strength. It is, however, very selective, and no difficulty is experienced in eliminating unwanted signals with this arrangement.

Particulars of the air-core transformer are: length 3½in.; diameter, 2in.; number of slots, 8; dimensions of slots, 1/32in. wide, ⅜in. deep. Winding, 400 turns number 40 S.W.G., S.S.C. wire in each slot. Primary and secondary wound in alternate slots. The connections of these various intervalve H.F. couplings are given in Fig. 9, and should be quite clear.

No mention is made of any tuner to accompany this amplifier, as experimenters generally have pet systems of their own; but to give a certain idea of the efficiency of the receiver, when using the standard three-coil experimental tuner with a single wire aerial 80ft. long, the following stations were extraordinarily well received in Scotland on four valves—many without reaction of any kind:—

Cardiff, 5WA; London, 2LO; Manchester, 2ZY; Writtle, 2MT; Newcastle, 5NO; Birmingham, 5IT; Nederlandische Radio Institute, PCGG; Tours, YG; Société Radio-éléctrique Français; Eiffel Tower (Paris), FL; Konigswusterhausen, LP; Croydon, Amsterdam, and Rotterdam; and Newark, WJZ.

Several amateur stations, especially 2OM and 2MG, have also given satisfaction; and such is the sensitivity of the amplifier that PCGG can be clearly heard, and every word copied in the centre of Scotland, using a rectifier and two low-frequency valves alone.

This circuit has been so successful that the experimenter who contemplates constructing it is urged to pay great attention in every way to its erection, his lasting satisfaction being ample compensation for any time spent in elaborating little details. The operation of the amplifier will be evident from a perusal of Figs. 1 and 6, and there are several technical points which the seeker after knowledge will appreciate in the design of this instrument.

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

By JOHN SCOTT-TAGGART, F.Inst.P., Member I.R.E. Author of "Thermionic Tubes in Radio Telegraphy and Telephony," "Elementary Text-book on Wireless Vacuum Tubes," "Wireless Valves Simply Explained," "Practical Wireless Valve Circuits," etc., etc.

PART III

(Continued from No. 2, page 77.)

Explain Why Two-Electrode Valves Act as Unilateral Conductors?

A two-electrode valve acts as a conductor because electrons pass between the two electrodes in the vacuum. If two metal plates were inserted in a bulb containing air at ordinary atmospheric pressure, it would be possible to pass a current between the two plates *in either direction*, provided very high voltages were applied to the plates. If we began pumping the air out of the bulb, we would find that, up to a certain point, the current would flow through the bulb very readily, even at low voltages. If we went on pumping the air out of the bulb until we had almost a perfect vacuum, we would find that no current whatever would pass through the space between the two plates however high the voltage of the battery. The flow of an electric current between two electrodes involves the passage of electrons and, in the case of a high vacuum containing two metal plates only, there is no source of supply of electrons. If we substitute an incandescent wire for one of the plates, the wire or filament will provide the electrons,

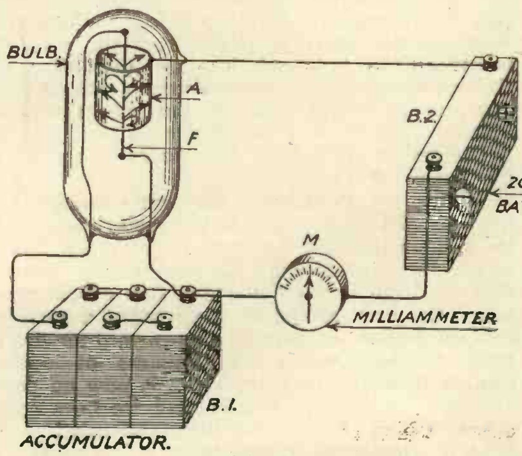


Fig. 10.—Positively-chargea plate attracting electrcns.

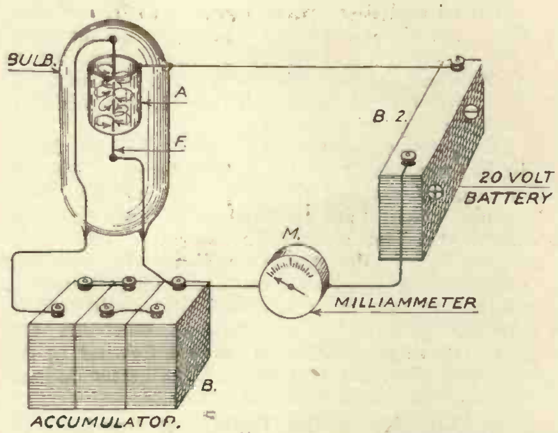


Fig. 11.—Negatively-charged plate repelling electrons.

but these can only flow from the filament to the plate. Electrons cannot flow from the plate to the filament, as the plate, being cold, does not emit any electrons.

A simple experiment to show that a two-electrode valve will only conduct electricity in one direction is illustrated in Figs. 10 and 11. In Fig. 10 it will be seen that a cylindrical anode A surrounds a filament F heated to incandescence by current from the six-volt accumulator B1. Across the anode A and one side of the accumulator is connected a battery B2 of, say, 20 volts. A milliammeter M is also included in the anode circuit for the purpose of measuring any anode current which, if it exists, will have a value of about 1 or 2 milliamperes (1 milliampere, or "milliamp," being 1/1,000th part of an ampere). As the anode A now has a voltage of +20 volts with respect to the filament, the electrons shot off from the filament, instead of all returning to the filament or going to the glass of the bulb, will now in a large measure go to the anode. All the electrons shot off from the filament will not go to the anode; some will remain near the filament and then return to it.

The reason for this is that it is only with the greatest reluctance that the electrons are forced out from the filament, and they are not all emitted with the same velocity. Some leave the filament slowly, others at a great speed. The speedier ones travel further away from the filament and are, therefore, more readily collected by the anode. Those which leave the filament slowly, travel only a very short distance and return to the filament before the anode has had an opportunity of drawing them away. Just imagine an ordinary magnet lying on a smooth table with a dozen small nails lying a couple of inches away from it. If some of the nails are pushed forward a distance of half an inch, nothing special will happen; they will not be attracted to the magnet. If, however, some of the other nails are pushed forward a distance of one inch, they will come into the field of the magnet which will immediately attract them to itself.

It is not possible here to go into the full details of what happens in the case of electrons, but suffice it to say that the more cautious ones, which only leave home (the filament) a short distance and then speedily return to it, are quite safe, but those electrons which go further afield are at once attracted by the anode and go to form what is called the *anode* current which will flow through the milliammeter M, and which is therefore easily measured.

If we now reverse the battery B2, as shown in Fig. 11, the cylinder A will be negative and instead of attracting any of the negative electrons it will tend to repel them back into the filament. The greater the negative voltage of the cylinder, the greater will be the repelling effect on the electrons, and there will, therefore, be no electron current round the anode circuit. As the cylinder is cold and no electrons can leave it, there will be no current flowing in the opposite direction and the milliammeter M will therefore indicate zero current.

Give an Analogy of the Unilateral Conductivity of the Two-Electrode Valve.

Fig. 12 shows a water analogy which gives quite a good idea of what is happening in a two-electrode valve.

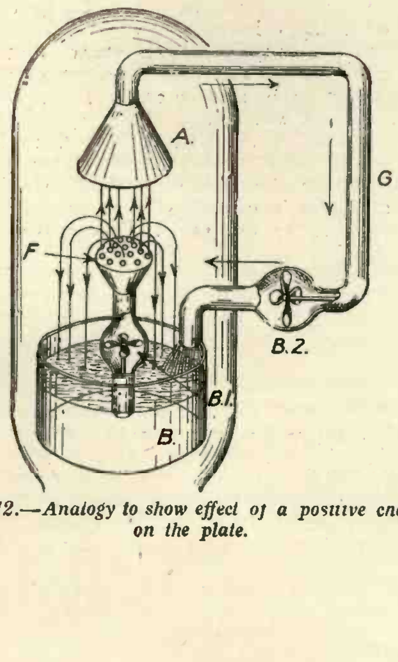


Fig. 12.—Analogy to show effect of a positive charge on the plate.

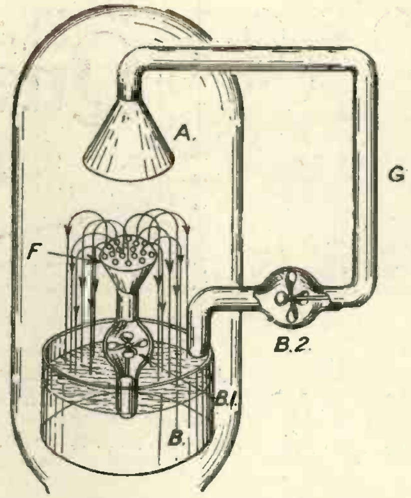


Fig. 13.—Water analogy corresponding to Fig. 11.

A basin B contains water. Into this water dips the end of a funnel F which is fitted at the top with a rose somewhat similar to that of a watering can. In the middle of the tube leading to the rose is a propeller B1 which revolves and sucks up water, which is then projected through the holes in the rose. Another funnel, inverted, is shown at A, a pipe G being connected to it. In the middle of this pipe is a propeller B2, the continuation of the pipe G entering the bowl B but not touching the surface of the water there. The propeller B2 is rotated in such a direction as to cause a draft of air in the direction of the arrow-heads. If the propeller B1, which represents the accumulator in an ordinary valve circuit, were not revolving, no water would be projected through the holes in the rose F, which corresponds to the filament of the valve. The result would be that even though the propeller B2 might be causing a strong air draft up into A, no water would be sucked up, and there would be no flow of water round the the circuit A G B2 B. If, however, the propeller B1 projects water through the holes in the rose F, some of the water will be sucked up into the funnel A, and will pass round the pipe circuit and flow back again into the bowl B. Some of the water projected from the rose F, however, will fall back into the bowl B, and this corresponds to those electrons which are shot out from the filament, but return to the filament instead of going to the anode.

The water analogy of Fig. 12 corresponds to the circuit of Fig. 10.

In Fig. 13 we have a different condition of affairs. Although water is still being projected in streams through the rose F, yet none flows round the pipe circuit for the simple reason that we have reversed the direction of the propeller B2, and instead of there being a suction into the funnel A, there is a downward air draft from A which repels the streams of water coming from the funnel. There is now no flow of water in the pipe circuit, and we have conditions which closely resemble those existing in a valve circuit when the battery is connected across plate and filament in such a direction as to make the plate negative. Just as the water is repelled, so are the electrons in the valve. This corresponds to the circuit of Fig. 11.

What Advantage is Taken of the Unilateral Conductivity of the Two-Electrode Valve?

The two-electrode valve has two principal uses. One is as a detector of wireless signals

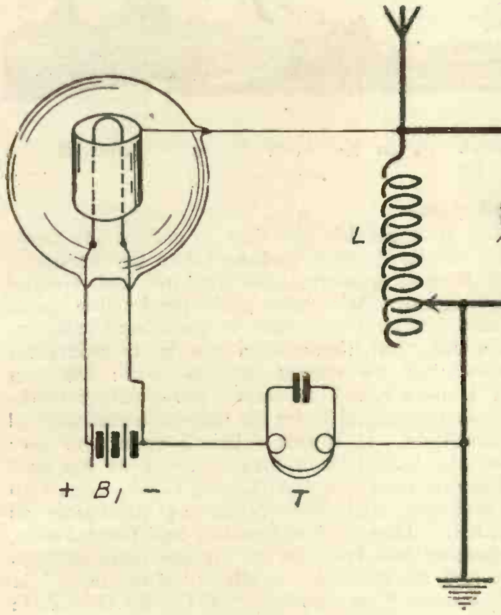


Fig. 14.—Circuit for use with 2-electrode valve.

and the other as a means of producing high voltage direct current. When used for the latter purpose, high voltage alternating current is obtained by the use of a step-up transformer and is then applied to a thermionic two-electrode valve which only allows current to flow when it is in a certain direction. The result is that we have pulses of current all in one direction, and these pulses are stored up in a large condenser which is then used in much the same way as a battery would be used for supplying high voltage direct current. By having a large condenser, it is possible to obtain a fairly steady high voltage current without the fluctuations which would otherwise result.

The two-electrode valve as a detector is no longer of much importance, but it is of technical interest.

Explain How a Two-Electrode Valve may be Used to Detect Wireless Signals.

Fig. 14 shows the type of circuit which was commonly used for detecting wireless signals. It will be seen that the circuit very closely resembles an ordinary crystal detector circuit, the only difference being that, instead of having the crystal in the circuit we have a two-electrode valve (the filament of which is heated by the accumulator B1). Now the currents in the aerial circuit are oscillating currents and change direction very rapidly. The result is that the cylinder is first of all positive for a fraction of a second and then negative, and so on. When the cylinder is positive, electrons will be attracted from the filament and will flow round through the inductance coil L, through the telephones T and so back to the filament. When the cylinder is made negative by the change in direction of the current in L, no electrons at all are attracted to the cylinder, and there is therefore no current through the telephones T. The result is that we have flowing through the telephones T small currents all in the same direction, the pulses varying in strength in accordance with the kind of signals which are being received.

For example, the kind of signals obtained when receiving broadcasting are shown in the top line of Fig. 15. It will be seen that the currents are oscillatory currents of high frequency but that their magnitude is continually varying in accordance with the speech which is being transmitted. When these currents are applied to the valve, only the positive half-cycles are allowed to pass through the valve and operate the telephones. Thus we get the currents shown in the second line of Fig. 15. As a matter of fact, the currents flowing through the telephones are not the very high-frequency unidirectional pulses which one might imagine, as all these

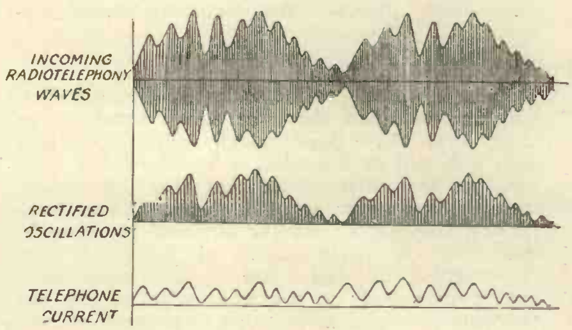
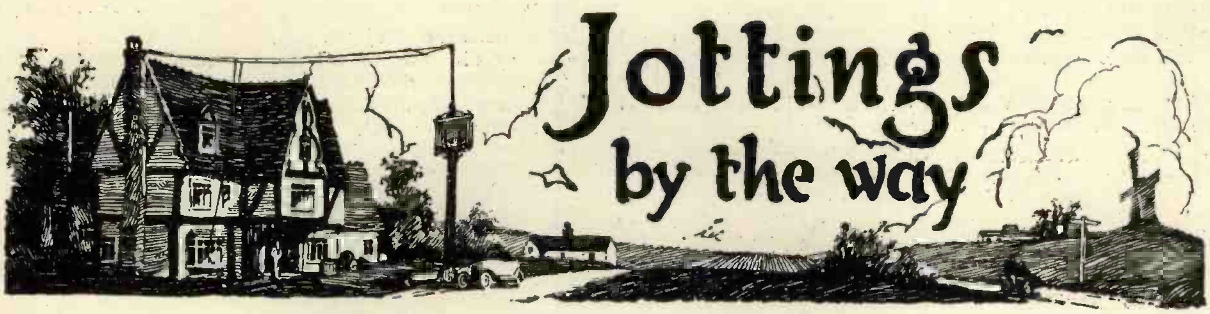


Fig. 15.—Graphic representation of the various currents in a broadcast receiver.

combine to form an average current which changes its strength at a low frequency. This form of current is shown in the third line of Fig. 15.

(To be continued.)



Railway "Atmospherics."

TRAVELLING up to one of London's southern termini a few nights ago, I was much impressed by the pyrotechnic displays gratuitously provided by those electric trains which use overhead collectors, shaped like a kind of inverted "U." As the horizontal bar of this collector swept along the cable there was an almost continuous flashing arc, and I fell a-wondering what the effect of these electrical fireworks must be upon reception in South London. It would be interesting to know if wireless men whose aerials sway in the breezes of those parts have more than their fair share of atmospheric crackles and fizzes. Every electric spark, of course, sets up oscillations: even the magneto of a car, or the motor of an underground train, if they are arcing a little, may produce waves powerful enough to be picked up by a sensitive set in their near neighbourhood. But these sparks from the overhead wires of the aforementioned railways cannot be classed with these small fry, and one imagines that they must make their presence felt for considerable distances.

Our Sure Shield.

Though we all profess to loathe atmospherics, and expend upon them at times words more biting even than those which follow the flight of a golf ball as it makes a bee-line for a bunker, yet we must admit that they have their uses. You know what I mean. You have pressed the Jones' and the Smiths' to come in and hear the performances of your new set. One evening they take you at your word, turning up in a body to see what wireless can do. Of course, the set misbehaves—for some at present unknown reason this is one of the few certainties of wireless. The tuning condenser that was working to perfection a few short hours ago develops an acute attack of touching plates. As you move its knob the assembled Jones' and Smiths', or at any rate such of them as are wearing head-phones, are deafened by clicks and scrapes. And do you tell them the truth? Do you admit that your apparatus is not in a condition of efficiency? You do not. You explain that those terrible atmospherics are at work and (this is true), that you have not known such a night for months. Or if the loud-speaker's usual full-throated tones are on this occasion a mere rasping whisper, a contingency which is sure to arise if some other even worse does not, do you not complain that reception is rendered almost impossible by the unprecedented violence of the storms in Northern Africa? Quite so: so do I!

The Radiananias.

The Radiananias bids fair to eclipse the finest feats of the Angliar and to make the hardened Golf Romancer seem more truthful than George Washington. We take such pardonable pride in our receiving sets that it goes hard with us to admit that there is a single broadcasting station that we cannot hear at will: but you and I, reader, are of course paragons of truthfulness and would scorn to utter the radiological inexactitude. It is that fellow Brown who *does* draw the long bow a little. He is at his best when demonstrating spark and C.W. signals to an audience, that finds Morse as intelligible as Sanskrit. Then he has Bombay and Cape Town, Melbourne and Panama on tap for their delectation and astonishment. His "'Mauretania' in mid-Atlantic" is sending "C.Q. de G.N.F.": Bombay seems to have borrowed for the moment the call letters of Ushant: Melbourne, for some reason, is speaking in German. But his listeners-in, knowing nothing of these things, are blissfully happy. And then there is Robinson, who revels in American broadcasting on every evening of the week save those when friends take him at his word and come round to share his joys. Robinson did it originally on three valves. Wilkins lowered his colours by reporting success on the like number with a frame aerial. Robinson lopped off a valve: Wilkins shed two. We are now waiting in feverish excitement for Robinson to win game and sett by achieving the feat with a crystal.

Foreign Telephony.

The worst of trying for broadcast transmissions from across the Herring Pond is that it entails sitting up till all hours of the morning. There are numerous transmissions from foreign parts to be heard at much more reasonable times, and though the distance from which they come is, of course, nothing like so great, they provide excellent tests for the sensitiveness and selectivity of the set, as well as of one's own ability in searching and tuning. On 900 metres there are the air stations at St. Inglevert, Le Bourget and Rotterdam which can be picked up at almost any time during the hours of daylight. Amsterdam, using 1,800 metres, transmits daily at 1.10 p.m. On 2,800 metres, Königswusterhausen, near Berlin, may be heard between 4 and 5.30 in the afternoon. This station is difficult to pick up in many places in the South of

England, but comes in very strongly further North.

The most distant of all the available European stations is Rome, which speaks each morning at 10 o'clock on a wavelength of 3,200 metres. Searching for the last two is comparatively easy, thanks to the Eiffel Tower, whose enormously powerful transmissions enable one to find the tuning for 2,600 metres without difficulty. From that point one simply goes gradually upwards until the others are found.

A Neat Accumulator.

One of the handiest low-tension batteries that I have seen is a new type placed on the market by a London firm. Each cell is provided with three little floats, which are free to move up and down in compartments contrived for them between one end of the plates and the transparent celluloid case. Their position indicates at a glance the exact condition of the cell. When the battery is fully charged the floats touch the surface of the acid. During discharge they sink gradually, and when each has reached the bottom of its compartment one knows that as much current as is good for it has been taken from the battery. This, of course, saves a world of trouble. The amount put into the battery by the charging station is automatically registered: and what is still more important, one knows exactly where one is as regards the supplies of "juice" available at any time. With such a battery you need have no fear—provided, that is, you look at the floats—of asking your friends round and then treating them to no better entertainment than the spectacle of a strong man battling with the emotions aroused by the discovery that his accumulator has "conked out."

Broadcasting Problems.

Not for anything in the world would I exchange places with those to whose lot it falls to arrange broadcasting programmes. If they put on light music they are attacked for pandering to depraved tastes and urged to educate the public to a liking for higher things. Programmes containing music alone are criticised because they lack lectures: when lecturers hold forth the critics proclaim that such things are quite unsuited for broadcasting purposes. In fact, whatever is done there is always somebody carping away for all that he is worth. The truth is that it is impossible to please every one: whatever kind of programme was put on, certain items would always fail to appeal to certain people.

The most that the broadcasting company can hope to do is to transmit such programmes that everybody will find something to his liking in them. In this they have certainly succeeded, and when the scheme has been working a little longer the results will be even better. After all, if there is any "turn" that you do not care about you need not listen to it. If your set is not powerful enough to bring in some other broadcasting station, for a change, you can always switch off for a few minutes. Such a course has an excellent effect on (*a*) the temper and (*b*) the batteries. The former is not roused by having to listen to uncongenial stuff: the latter are better for a short rest during a period of otherwise continuous working.

Appreciation.

But the broadcast programmes *are* appreciated: there can be no doubt about that. Those who have not sets are always ready to visit friends who have, and most of the wireless sets in the country are tuned in nightly as a matter of course. Several keen experimenters of my acquaintance, who swore roundly a few months ago that no broadcasting would ever woo them away from Morse, have even fitted loud-speakers for the express purpose of receiving speech and music, to the no small joy of their wives and families, to whom dots and dashes were never violently attractive. I notice, too, that those who are the bitterest critics show no signs of beating their wireless sets into fragments or consigning them to the lumber-room. On the contrary, their accumulators appear at the charging station as regularly as my own. 'Tis a queer world!

Improving Head Sets.

Some head-phones are far from comfortable to wear for a variety of reasons. They may seize your unfortunate head in a grip like that of a rat-trap: they may be heavy enough to cause considerable discomfort after they have been worn for a time: or they may be so constructed that they tear out little tufts of hair every time they are removed. Here are ways of dealing with instruments that offend. If the head-band fits too tightly, don't seize the receivers one in either hand and bend violently. Take hold of the head-band at its middle point and give it a very slight bend outwards: work right down one side until the receiver is reached, gently straightening the curve as you go. Then deal with the other side in the same way. By this means it is easy to secure a perfect fit. For heavy phones there is no cure, but a palliative can be contrived by fixing a little pad of leather, or cloth, under the middle of the head-band. The plucking of one's hair can be prevented by cutting a small piece from an old leather glove and sewing it round the junction of the bands so as to form a kind of shield.

Buying Valves.

Most people when purchasing a new valve take the precaution of having its filament tested by means of a flash lamp battery. This is an excellent precaution, but there are two others that should be taken. If the valve has a horizontal filament examine it carefully to see that it is not sagging down on to the grid. This may happen if the valve has been stored for some time in an unsuitable position, and it is a fault that should be looked for particularly in the case of ex-Army goods. The other important point is to see that the pins are not loose. Some valves are not too strongly put together, with the result that the pins may become wobbly. If they do so, a break in one of the fine leads running to them is sure to occur sooner or later, putting the valve entirely out of action. Whenever possible the valve should be tried in the shop, actually on a receiving set in the position in which you intend to use it. Though valves of various makes are fairly standardised one frequently comes across individuals that are better than others.

WAYFARER.

A LOW-FREQUENCY AMPLIFIER

By E. REDPATH, Assistant Editor.

The following description of a two-stage amplifier easily constructed from standard components is of particular interest to readers who desire to add to their existing crystal receiving set.

AMPLIFICATION, as applied to wireless signals, may be of two kinds—high-frequency or low-frequency. High-frequency amplification consists in applying the feeble oscillatory currents in the aerial circuit of a receiving set to the grid and filament of a suitably adjusted three-electrode valve, with the consequent production in the anode circuit of the valve of greatly amplified but *still oscillatory* currents. Subsequent rectification of the magnified oscillatory currents is necessary before the signals can be made audible in telephone receivers.

Low-frequency amplification consists in amplifying the audio-frequency impulses after they have passed the detector, either crystal or valve. In general this latter method gives the greater amplification, but it is to be particularly noted that it can only be employed where the original signals are of sufficient strength to actuate the detector.

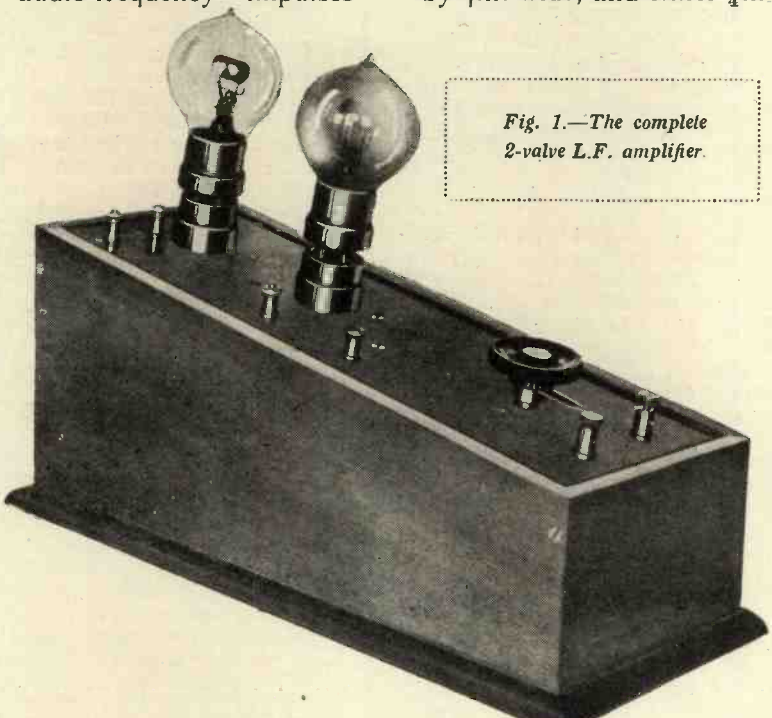


Fig. 1.—The complete 2-valve L.F. amplifier.

As the proper operation of the detector, whether a crystal or a valve, necessitates a certain minimum amount of energy in the aerial circuit, high-frequency amplification can most profitably be employed upon very weak incoming signals, which in themselves are unable, or scarcely able, to cause the detector to function.

Provided that signals can be heard upon a crystal receiving set alone, even though only faintly, low-frequency amplification can always be usefully applied, and the two-valve low-frequency amplifier now to be described, and illustrated in the photograph (Fig. 1), may readily be used in conjunction with a simple crystal receiving set or a single valve panel and will result in great increase in signal strength.

Components Required

The containing box is of wood, suitably stained and polished, the internal dimensions being 12in. long by 4in. wide by 5in. high at the back and 3in. high at the front.

The ebonite panel. This is to be 12in. long by 4in. wide, and either ¼in. or 3/16in. thick.

Two iron-core intervalve transformers.

Two valve-holders.

One filament rheostat capable of carrying about 1½ amps. without undue heating.

Eight brass terminals.

A supply of connecting wire, preferably No. 20 s.w.g. tinned copper, and about 2 yards of insulated sleeving.

The foregoing items will be clearly seen on reference to the photograph, Fig. 2, which shows the back of the panel with all components fitted in place and wired up complete.

Constructional Details

All the necessary particulars regarding the wooden containing box are given in Fig. 3. The actual arrangement of the joints and the general finish will, of course, depend upon the skill and taste of the individual reader. Note that suitable cross pieces are to be fitted inside the box either $\frac{3}{16}$in. or $\frac{1}{4}$in. below the edge of the opening, according to the thickness of the ebonite employed for the panel.

It is thought that the sloping containing box gives a rather smart appearance, but this, of course, is not necessary, and an ordinary flat type of box may be used if preferred or if already available.

The next item to receive attention is the ebonite panel. This should be carefully cut to size, be squared up and made a neat fit into the opening in the top of the containing box. In the final manufacturing processes of ebonite tinfoil is used in order to get a fine glossy surface. In wireless apparatus, however, especially where valves are employed, the presence of a fine polish upon *stock* ebonite should be regarded with suspicion as being very likely to give rise to serious leakages.

In order to prevent any possibility of leakage over the surface of the ebonite, the original polish should be entirely removed from both sides of the ebonite by brisk rubbing with the finest emery paper wrapped round a short piece of flat stick, finishing off with a piece of flannel and a few drops of sweet oil.

The panel should now be marked off and drilled, as shown in Fig. 4. The positions of the terminals and filament rheostat are indicated, but the diameters of the holes are not given, as these, of course, will vary according to the size of the actual terminals used and the diameter of the spindle of the rheostat.

The two valve-holders should be fitted in place as indicated, whilst the actual position of the holes for the screws securing the inter-valve transformers in place should be found by placing the transformers in position on the back of the panel and marking through the holes in the base of the transformer itself.

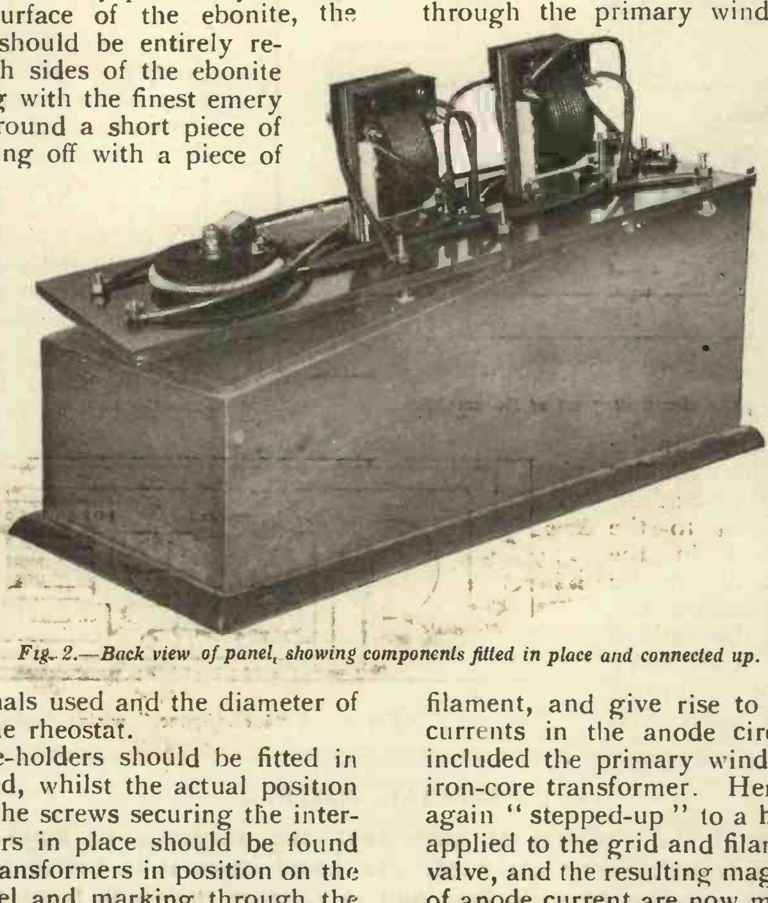


Fig. 2.—Back view of panel, showing components fitted in place and connected up.

As, no doubt, many readers will have had no experience in soldering, and therefore rather hesitate to take on a somewhat complicated looking wiring job necessitating soldering, the arrangement of the amplifier and the components used is such that soldering is entirely dispensed with. All connections are made by means of wires secured beneath nuts, and it is very important that the nuts in question should all be screwed up properly, as a bad connection at one of them may result in the production of very disturbing noises in the telephone receivers.

If more experienced readers prefer to solder the connections, so much the better.

Fig. 5 is a complete circuit diagram of the amplifier, the action of which is as follows:—The usual telephone terminals of the crystal or single-valve receiver are to be connected to the two input terminals of the amplifier, so that the pulses of current which previously operated the telephones are now made to flow through the primary winding of the first iron core transformer. These pulses of current through the primary winding produce currents in the secondary winding, but at higher potential, due to the "step-up" ratio between the transformer windings.

The ends of the secondary winding are connected to the grid and filament respectively of the first amplifying valve, so that the induced high potentials in the transformer secondary are applied to the grid and filament, and give rise to further magnified currents in the anode circuit, in which is included the primary winding of the second iron-core transformer. Here the currents are again "stepped-up" to a higher voltage and applied to the grid and filament of the second valve, and the resulting magnified alternations of anode current are now made to operate the telephone receivers.

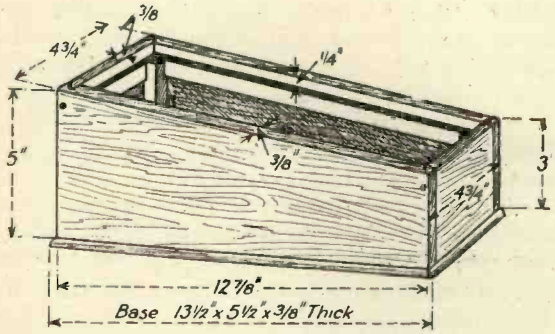


Fig. 3.—Details of the containing box.

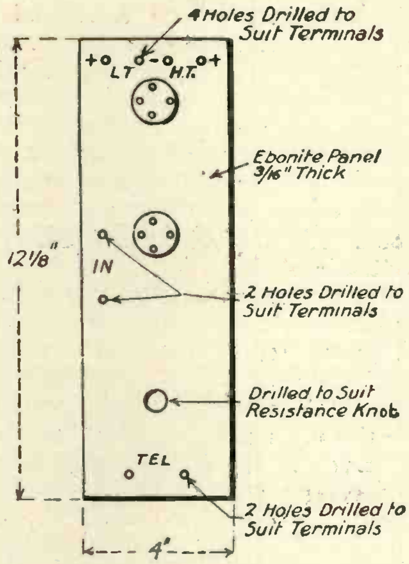


Fig. 4.—Drilling plan of the ebonite panel.

For the convenience of readers who are not accustomed to connecting up apparatus from the usual circuit diagram as given in Fig. 5, a complete "back-of-panel" wiring diagram is given in Fig. 6, and if this is carefully followed the possibility of any mistake is remote.

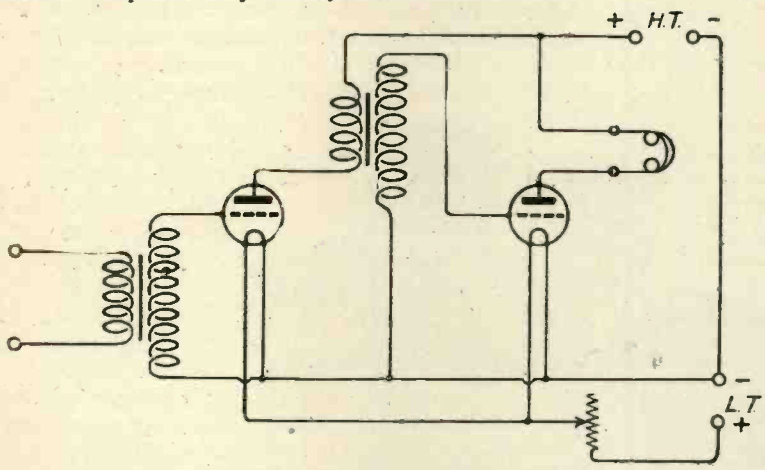


Fig. 5.—The circuit diagram of the amplifier.

The components used in the construction of the amplifier may be of any of the standard types. Those fitted to the amplifier illustrated in the photograph (Fig. 2) are by the well-known Peto-Scott Co. Occasionally with this type of amplifier there is a tendency for a low-frequency howl to be caused when the valve filaments are raised to full brilliancy. Sometimes the "howl" occurs only when one of the telephone terminals, either upon the amplifier or upon the telephone head-gear, is touched. In any case this undesirable defect can generally be prevented by the use of a well-insulated condenser of large capacity (say 0.3 to 0.5 μF) connected across the H.T. battery.

A telephone condenser may also be fitted if desired, the required capacity being 0.002 μF.

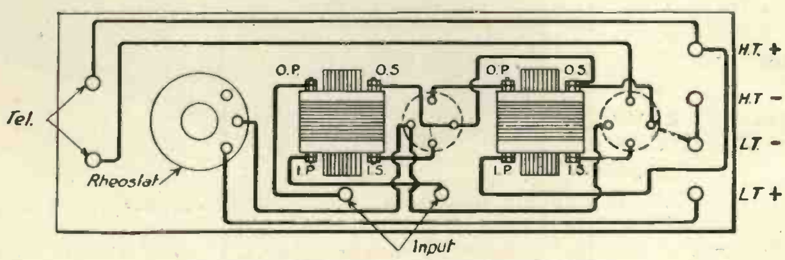


Fig. 6.—A "back-of-panel" wiring diagram.

SPECIAL NOTE.

The position of the rheostat is such that the tendency to howl is lessened when certain transformers are used. In some cases it is better to place the rheostat in the negative filament lead and to connect the leads from transformer secondaries to the negative of the accumulator.

THE B.B.C. AND THE P.M.G.

We have placed this space at the disposal of the British Broadcasting Company to air their views. We only think it fair that they also should have a hearing.

THE B.B.C. were surprised, when such delicate negotiations with the Post Office were proceeding, that public statements should have been made by the other party. By the time these words appear in print, developments will certainly have taken place, but, even so, the motives which prompted the company in their attitude should be of interest.

The initiative which led to the formation of the company came from the Post Office. No responsible people can regard the B.B.C. as a monopoly. The company was to be composed of *bonâ-fide* manufacturers, and in return for the large outlay of capital required, not only to form and operate the B.B.C. but in addition for launching out manufacture on a large scale, definite protection was promised for a limited period. The protection was simply that, in conjunction with the Broadcast Licence, only sets manufactured by members would be sold, and it must be noted particularly that this protection was necessary for another reason still, namely, that the Post Office insisted that the members should contribute, by way of tariff on sales, to the revenue of the company.

The company take the view that the threatened issue of 40,000 experimental licences would constitute a direct breach of faith repugnant to the whole spirit and intent of the signed agreement.

Broadcasting was made possible and popular by the enterprise of the B.B.C. members, and by the risk of their capital, and the opposition to its constitution now comes mainly from those who not only have nothing at stake, but who are prepared to a great extent, by the importation of foreign apparatus, to benefit at the cost of their British competitors.

Thousands of people are now in possession of home-made sets without licences, and others are waiting to construct. The Broadcasting Company indicated earlier that they were prepared to consider sympathetically a method which would cater for these people—and in this the Postmaster-General agrees—but, by the terms of their agreement, they are not bound to comply with the issue of a third licence. The stipulation which they had put forward, that components should be marked "B.B.C.," is strictly within their rights, and is simply to ensure that a certain part of that trade which should have been theirs under the agreement will still come to them under the new licence.

It must be remembered that every constructor's licence is a broadcast licence less, and a loss of promised revenue to the B.B.C. members. It is quite inaccurate that, as has been alleged, by the marking of components in this manner, the public will have to pay more for them. It is considered that if the Postmaster-General's proposals are carried out not only will reception become increasingly impracticable, due to interference, but also, by the importation of foreign apparatus, thousands of British men and women, to whom employment was given by this new industry, will become unemployed.

THE LICENCE DECISION

We are pleased to be the first wireless journal to publish the result of recent negotiations.

The P.M.G.'s Speech

SIR WILLIAM JOYNSON-HICKS, the Postmaster-General, announced in the House of Commons last Thursday, April 19th, that the question of the constructor's licence was being left over owing to his inability to come to terms with the B.B.C. who, although they have now agreed to the fee of 10s., state that they require all principal components to be marked with the stamp "B.B.C.," in other words, all manufacturers of components for sale to "constructors" would have to belong to the B.B.C.

The P.M.G. offered to insist on the apparatus being marked "British manufacture," but the B.B.C. would not agree to this. The net result is that negotiations virtually broke down and, pending the consideration of the whole matter by a Select Committee on which all parties will be represented, the P.M.G. is going to issue Experimental Licences liberally to all who, in his opinion, ought to get them.

In Parliament, the P.M.G. made the following remarks: "I am not sure that the House will consider that it is in accordance with public policy that we should collect what are, in fact, compulsory taxes for the purposes of giving half of them to the Broadcasting Company."

"I am not going to be a party to making any British manufacturer join any combine" (cheers). "I am not at all sure that the agreement made with the B.B.C. gives that company a licence monopoly, and that I cannot grant a licence to someone else."

The *Daily Express* reports that the P.M.G. stated to one of their representatives:

"In order to ascertain my position I felt it my duty to place the whole facts before the Law Officers of the Crown, and I have just received the opinions of the Attorney-General and the Solicitor-General. These are that I am not only entitled, but compelled by law to issue an experimenter's licence to those applicants in regard to whom I am honestly satisfied that they are genuine experimenters.

This being so, while it would be wrong to issue an experimenter's licence to the man who is obviously merely a broadcast listener-in, it would be equally wrong to decline to issue such licences *on a wholesale scale.*"

Our View

We hope to comment fully on the above in our next issue. Meanwhile, the position is alleviated, but we regret that the constructor's licence has not arrived. Nevertheless, it has got to come. The stupid rigmarole of the experimenter's licence—more a test of one's knowledge of the ropes than anything else—will not be tolerated by the new 200,000. But perhaps the P.M.G. is merely playing his trump card.

WORKSHOP PRACTICE

By C. W. OSBORN.

All who construct their own apparatus will appreciate these practical hints upon methods of working various kinds of materials.

THE following hints, the results of many years' experience in the use of small tools, are arranged to suit the needs of the amateur experimenter with a limited number of tools and a small equipment, but who is desirous of turning out work that is reliable and of good finish.

Tools

Amongst the tools absolutely necessary are a few files, rough and smooth cut in flat and half round, the size depending on the type of work that is to be done; in addition, a round and a square file, about 4in. long. A three-cornered file will also be found useful, and this should be of the same length. All flat files should have a safe edge, that is, one of the edges must be plain.

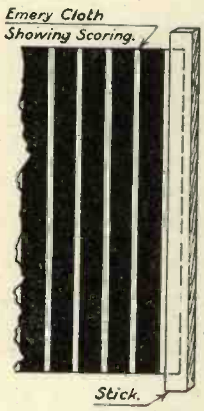


Fig. 1.—Showing emery stick.

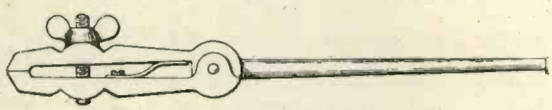


Fig. 2.—Pin vice.

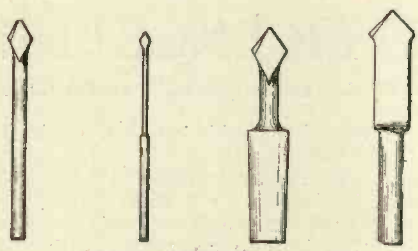


Fig. 3.—Small drills.


Fig. 4.—Drill stock.

Metal Working and Finishing

If it is desired to make a plate or strap in brass or aluminium, the work is first roughed out with a rough-cut file to the shape required, and all marks removed except those left by the file. If holes are to be drilled in the plate, this should now be done, after the exact position has been marked with a centre punch. Remove all burrs and countersink the holes if necessary. Make the plate smooth by using a smooth-cut file which will remove all marks left by the rough file. A medium cut emery cloth is now used, and all marks left by the smooth file are to be removed. After this, use a fine-cut emery cloth, followed by the finest emery cloth or paper. Each stage of the process should remove all marks left by the previous stage, and in this way only can a good surface be obtained. The edges should all be filed the *long* way with a smooth file, and, if required, they may be bevelled by removing the sharp corner. This should leave a good finish, but in some instances the following additional method may be employed. With an emery pencil make a series of spirally shaped marks all over the plate. All the marks should touch one another and may overlap a little. If care is taken the effect will be very good, quite a professional touch being given to the work. An emery pencil may be secured at a small-tool dealer's for a few pence, but if unprocurable use may be made of a piece of medium or rough emery cloth wrapped round and over the end of a blunt-pointed skewer. Emery cloth and paper and sand- or glass-paper used for the above processes should be placed on sticks, as it is impossible to keep any work flat using the hand or finger. These sticks are best made in the following manner: Take a piece of wood, say, a foot long by ¾in. by ¼in. The exact size is immaterial, but a bigger one is apt to be rather clumsy in use. Place a sheet of emery cloth (cutting-face downwards) on the bench and, putting the stick on this, parallel with the edge of the emery cloth, with none of the latter projecting, score along the cloth, using the edge of the stick as a guide. Turn up and score

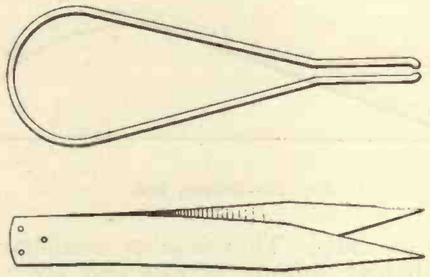


Fig. 5.—Tweezers.

again, folding the emery round the stick as the work proceeds, until the whole of the sheet is round the stick. If done properly this will leave an emery stick with square edges. Tie a piece of string round the middle, using a slip knot with a projecting end of about one inch. Any worn-out pieces may be torn off at the marks made by the scorer. The handiest tool to use as a scorer is the edge of a small screwdriver. Any number of these sticks may be made to suit requirements and they will be found very economical. Fig. 1 shows a stick unrolled. Round sticks may also be made, these not needing to be scored. Half-round ones will need to be scored at the two edges.

Lacquering

To prevent the metal tarnishing it should be lacquered or varnished. Lacquer and varnish are bad conductors, so none should be put on any connecting part. Every part of the article to be treated should be perfectly clean, and all grease and finger marks removed. Cold lacquer is the best for the amateur to use, and this may be put on with a camel-hair brush, applying a thin coat in the same direction as that taken by the file and emery sticks. Round surfaces should have the lacquer applied whilst the article is slowly rotated. A good appearance can be obtained by the use of clear copal varnish or shellac varnish, but in all cases the medium should only be applied as a thin coat, although sometimes more than one coat is necessary. Shellac varnish is easily made by dissolving shellac in methylated spirit, but it may be bought along with the two other preserving mediums at an oil and colour shop if it cannot be obtained at the usual wireless dealers.

Tips for Using Tools

When working in aluminium it will sometimes be found that the metal has a clogging effect on the file. Moistening the file will help to remove this difficulty.

A file that is used for brass should not be used to file steel. One that has served its first purpose for brass will be quite good enough when used on steel. *Vice versa,* it will never be of much use for brass, as the sharp new cutting edges of the file would be destroyed.

All files above four inches long should have handles; in fact, all files, except those with fine tapered points, are better to use if fitted with handles.

Drilling Metals and Ebonite

The most useful drilling tool for the average amateur experimenter is a hand drill with a gearing attachment, and a more or less complete set of drills. When using the smaller drills it will often be found an advantage to fix the drilling tool in the vice, leaving the wheels and chuck free, and taking off all undue weight from the drill itself. Should it be necessary to make any drills, this can be done as follows: Note should be made of the capacity of the chuck in the drilling tool, and steel wire or rod of a corresponding size used or filed down to fit.

BRITISH ASSOCIATION STANDARD THREAD.

No.	Diameter Millimetres.	Pitch Millimetres.
0	6·0	1·00
1	5·3	0·90
2	4·7	0·81
3	4·1	0·73
4	3·6	0·66
5	3·2	0·59
6	2·8	0·53
7	2·5	0·48
8	2·2	0·43

Fig. 6.—B.A. standard threads.

Most hand drills will take a rod $\frac{1}{8}$in. in diameter or smaller, and making a drill to fit is a simple matter. Take a piece of wire of the length required, but smaller in diameter than the size of the hole to be drilled, soften one end by holding it in a gas or spirit-lamp flame. Hammer this end to a shape resembling a long fan. See that this flattened end is central and file it smooth. Rub a piece of soap all over the drill, and, making it red hot, plunge it instantly into a jar of common oil. This should leave it dead hard and the action of the soap in removing the scale that would otherwise have formed on the metal, will leave it white, thus assisting in the next operation. Test with a file to see whether it is hardened properly. It will now be too brittle for use, so the drill must be tempered. Lay it on a brass plate, and holding both over a gas or spirit flame watch the drill change colour from the various shades of straw and red until it commences to turn blue. Then remove it and "quench" by plunging into cold water. This gives a suitable temper for drilling a hole in brass, and it remains only to sharpen the cutting edge upon a grindstone or oil-stone. A drill intended for drilling steel will require to be removed from the flame when a middle red colour is reached, but actually this depends on the hardness of the steel to be drilled.

Should the capacity of the chuck in the drilling tool be too large to grip the wire for a very small drill, thicker wire must be used. Fixing a length of this in a pin vice (Fig. 2) and rotating between the finger and thumb of the left hand on a support (consisting of a small block of hard wood with a groove in it, held in a vice), file until the required drill size is reached. Then finish the drill as before described. Should one be lucky enough to possess a good lathe, the drills may be turned so that no hammering is required, filing the end to shape being all that is necessary. This perhaps makes a better job, but the other methods described are very

Fig. 7.—Soldering iron.

satisfactory. Fig. 3 shows various shapes of useful drills.

How to Drill very Small Holes

Sometimes it is necessary to drill a very small hole and the above drilling tool is not suitable. In this case the best tool is a small one of a type used for many generations and still of great utility (Fig. 4), usually called a drill stock. The drill is fixed in it, and the pointed end rests in a small depression or hollow in the side of the jaw of the vice, the other end with the hole, collar and screw holding the drill which, of course, is held to the material to be drilled. It is revolved in the following manner, using a piece of cane or whalebone from 9in. to 18in. long. A safe rule to follow is, the smaller the drill the

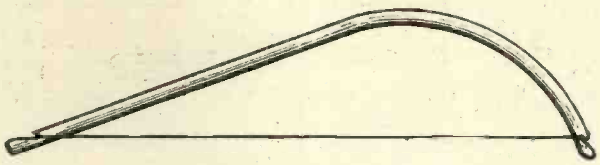


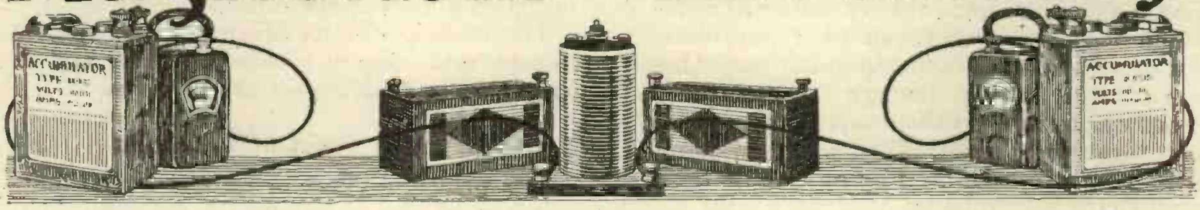
Fig. 8.—Drilling bow.

smaller the bow. This cane or whalebone is made slightly thinner at one end for about one-third of its length, and a notch is cut in each of the two ends. Between the notches is fixed a length of catgut or similar tough material (Fig. 8).

To operate, fix the catgut round the ferrule of the drill stock, and holding it in position against the jaw of the vice with the right hand, place the point of the drill in position on the material to be drilled, which is held in the other hand. Take the right hand from the drill stock, and taking hold of the bow near the bottom end, work it up and down, thus causing the drill to revolve. Care is needed to ensure the holes being drilled straight, but the necessary skill is soon acquired. Do not let the catgut get dry—oil it. String, cotton, or thread may be used in certain cases, according to the nature of the work, and these may be just wetted. Always oil the pointed end of the drill stock, otherwise it will soon get blunted. A drill used with a bow must be sharpened by bevelling on both sides, but where continuous motion one way only is applied, as in a hand-drilling tool, one side only of each face need be sharpened. The making of twist drills is beyond the scope of the amateur, although for a deep hole of small diameter a drill may be made from a flat piece of steel twisted whilst red hot and then straightened, hardened, tempered, and sharpened. Twist drills are the best type of drills for ebonite, as the clearance is good. When drilling a panel or slab rest it on a flat piece of hard wood, or the drill may break through, making a jagged hole. Oil is the best lubricant when drilling most metals, but for hard steel and glass use turpentine, and for ebonite, tallow.

(To be continued.)

Magnetism & Electricity



By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

Readers who are taking up wireless as a hobby, and have little or no electrical knowledge, will find a careful perusal of this special series of articles of great assistance.

PART III

(Continued from No. 2, page 84.)

Connecting Cells in Series

THE reader will have gathered from what has been said that the E.M.F. of a battery of cells made of certain materials depends upon those materials and cannot be otherwise regulated. For example, the E.M.F. of a cell made with zinc and carbon rods immersed in sal-ammoniac is about 1.5 volts: the E.M.F. of a cell consisting of zinc and copper rods immersed in sulphuric acid solution is about 1 volt, and so on.

How, then, are we to obtain higher voltages by means of batteries?

The answer is that we may obtain any required voltage from cells by connecting a sufficient number of them together "in series," that is to say, the positive terminal of the first to the negative terminal of the second, the positive terminal of the second to the negative terminal of the third, and so on. The connecting wire between adjacent cells should be of very low resistance, so that for practical purposes we can consider that the positive terminal of the first and the negative terminal of the second to be at the same potential, and so on. Suppose the E.M.F. of each cell is 1.5 volts, then the positive terminal of the second cell is 1.5 volts higher than the negative terminal: this latter, however, is the same as the positive terminal of the first cell, which is 1.5 volts higher than the negative terminal of the first cell. Thus the positive terminal of the second cell is 3 volts higher than the negative terminal of the first cell. Similarly, if we connect any number of cells in series, the E.M.F. of the battery is equal to the sum of the E.M.F.s of the individual cells (see Fig. 8).

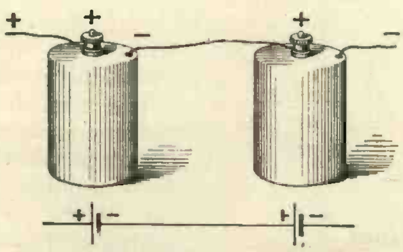


Fig. 8.—Pictorial representation (upper Fig.) and diagrammatic representation (lower Fig.) of two cells connected in series.

Effects of the Current

We have mentioned the volt, ohm and ampere as the unit of potential difference, resistance of a conductor, and current strength respectively, but we have not considered how any of these may be measured.

When a current flows in a wire it produces two principal effects: (1) it heats the wire; (2) it produces magnetic effects in the vicinity of the wire. Either of these effects may be made the basis of measurement of the strength of the current, but for general purposes the magnetic effect (or *electro-magnetic* effect, as it is called) is much more convenient, and is the one almost universally used. These two effects will be described presently, but we will not enter into any detailed account of the methods of measuring the volt, ohm or ampere, as that would be beyond the scope of these articles at the moment. It will suffice to say that there are a great variety of instruments available for the purpose of measuring these three quantities, but to give the reader some idea of their magnitudes in a general way we may mention that the E.M.F. of an ordinary cell used for ringing an electric bell is about 1.5 volts, that of a single accumulator is 2 volts, that of a battery used for wireless valves (3 accumulators in series) is generally 6 volts. The resistance of a mile of telegraph wire is about 10 ohms, the resistance of a telephone earpiece usually about 2,000 ohms, that of a metal filament lamp about 500 ohms. The current flowing through the filament of an ordinary wireless valve is about .75 ampere, that through a metal filament lamp about half an ampere, that used by an electric tramcar perhaps 100 amperes.

It should be mentioned here that certain substances which are commonly called "insulators" are in reality conductors whose resistance is so extremely high that their conducting power is for practical purposes negligible. Nevertheless, for special work we have sometimes to take account of their conductivity, and we speak of their resistance in "megohms," a megohm being one million

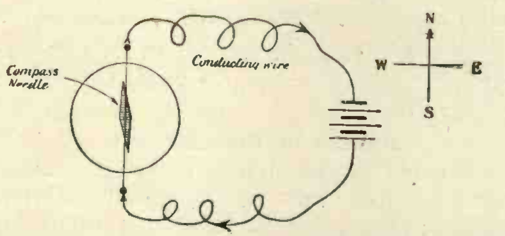


Fig. 9.—Plan showing how wire carrying current, held above compass needle, deflects North Pole to left when current is passing from South to North.

ohms. The thousandth part of an ampere is called a milliampere or a milliamp. (written m.a.). The current passing through the head telephones in a wireless receiving set is usually so small that we speak of it in milliamps.

Heating Effect of a Current

The heating of a wire when a current flows through it depends upon the resistance of the wire and the strength of the current; the greater either (or both) of these quantities, the greater the heating effect. Generally, when we use a conducting wire, we are anxious that it should not get hot, and so we choose a good conductor (low resistance) such as copper, and of such a thickness that it can easily carry the required current without heating up.

Sometimes, however, we actually wish to make use of this property for heating a wire, as in the filament of an electric lamp or wireless valve, or in the heating elements of an electric fire. For such purposes we choose a wire which is a poor conductor (high resistance), and so fine that when we force a certain convenient current through the wire it is raised to a high temperature.

The heating of a conductor by an electric current is a very valuable property, and is employed in a variety of useful ways.

Magnetic Effect of a Current

The principal effect of an electric current, however, is that it produces a magnetic field in the vicinity of any conductor through which it is flowing. This magnetic effect is exactly similar to that of an ordinary permanent magnet, such as a magnetised steel bar, but as it is due to the current and exists only whilst the current is flowing, it is more properly called "electro-magnetism." The discovery of electro-magnetism (by Faraday) was undoubtedly the most important discovery ever made in connection with elec-

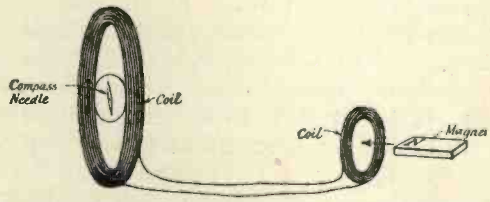


Fig. 10.—Compass needle placed at centre of coil, forming simple "galvanometer" or "ammeter." Inserting magnet in second coil causes momentary current in both coils and needle is deflected.

tricity, as upon it is based the whole of electrical engineering and allied sciences.

If a straight piece of wire through which a current is flowing is held above an ordinary compass needle the needle will be deflected, showing that there is a magnetic effect due to the wire. The effect increases with the strength of the current in the wire and vanishes if the current ceases. If we wind the wire into a coil, each convolution of the coil carries the same current and the magnetic effect is proportional to the number of turns in the coil. If the compass needle is placed at the centre of the coil it will act as a sensitive detector of current in the coil, and this is the principle of most measuring instruments for electrical work (see Fig. 10).

Just as the passing of a current through a coil makes that coil temporarily into a magnet, so the inserting of a permanent magnet into a coil creates a momentary current in that coil. This current is said to be "induced," and is called an "induced" current: the process of inducing the current is called "induction," and is the principle of the dynamo or electric generator.

The direction in which the current is flowing through a wire determines the direction of the magnetic force produced: reversing the direction of the current (by connecting the wire the other way round to a battery) reverses the direction of the magnetic force.

Meaning of Positive and Negative

The designation "positive" and "negative" for the poles of a battery, or any other source of electricity, is purely a matter of convention as to the "direction" of a current. There is really no more reason for calling the carbon element of a Leclanché battery the "positive" and the zinc element the "negative" than there is for calling the right hand "right" and the left hand "left." The two hands might just as well have been designated the opposite way round, but as long as we have an *understood agreement* as to which is which, the method is satisfactory enough.

A compass needle always sets with one end pointing towards what we call the "North Pole." If we hold above the needle, in a north and south direction, a straight piece of wire, the ends of which are connected to a battery, and the north-seeking pole of the compass needle is thereby deflected to the *left* (the observer facing north and looking down upon the needle), then we say that the current is flowing in the wire in the direction from south to north, and the terminal of the battery which is connected to the south end of the wire is called the positive terminal, the other being, of course, the negative terminal (Fig. 9).

It will be seen, therefore, that the positive and negative designation of the poles of a battery, and the direction of flow of a current from the positive terminal to the negative terminal, is just as arbitrary a convention as the designation of the north and south poles of the earth: when it was adopted it was not based in any way upon a knowledge of the nature of electricity.

As a matter of fact, as we shall see later on, of the two possible alternatives the *wrong* one (from the scientific point of view) was chosen. For we now know that an electric current in a wire consists of a stream of infinitesimal electric charges called "electrons," and these electric charges emerge from what is called the negative pole of a battery and are absorbed into the positive pole. In order to make our terms fit in, we are obliged to say that electrons are *negative* charges, so that a flow of electrons from negative to positive terminal is the same (theoretically) as a flow of positive electricity from positive to negative.

It is a pity this confusion of nomenclature has arisen. For the majority of purposes it does not matter in the least, but in wireless we require to understand the nature of an electric current in certain very special cases. The reader should bear in mind that the terms positive and negative simply belong to a well-understood convention, but that in reality an electric current is a stream of electrons from the negative terminal to the positive.

I have spent a little extra time on this question as it is often confusing to beginners, but I hope, as we go on, that the matter will present no further difficulty.

(*To be continued.*)

FORTHCOMING EVENTS.

April		
24th.	Tuesday. (till 28th).	South Shields and District Radio Club are holding their Wireless Exhibition in Congregational Hall, Ocean Road, South Shields.
25th.	Wednesday.	Radio Society of Great Britain: Lecture at 6 p.m. at Institution of Electrical Engineers by G. G. Blake, M.I.E.E., on "History of Radio Telegraphy."
25th.	Wednesday.	Wolverhampton and District Wireless Society, 26, King Street, Wolverhampton. Lecture on "Inter-valve Couplings" by Mr. W. Harvey-Marston.
26th.	Thursday.	Stoke-on-Trent Wireless and Experimental Society, Y.M.C.A., Marsh Street, Hanley. Mr. A. Whalley (Member) will lecture on "Faults."
26th.	Thursday.	Wireless and Experimental Association. Public demonstration at Central Hall, Peckham.
28th.	Saturday.	Luton Wireless Society, Hitchin Road Boys' School, Luton. 3rd Annual Exhibition.
May.		
3rd.	Thursday.	Dewsbury and District Wireless Society, South Street, Dewsbury. Discussion on "Difficulties."

A BEGINNER'S EXPERIMENTAL STATION

By G. H. RAMSDEN.

An article which will enable a beginner to make a cheap receiving set suitable for wavelengths between 300 and 10,000 metres.

THE writer built this single valve set soon after the Armistice. He was then an absolute beginner, and the set was intended to be experimental and to be built as cheaply as possible. In the following description no special sizes are given for screws and nuts, etc.

A diagram of connections is given in Fig. 1, the whole set being mounted on a baseboard.

The Baseboard

A piece of dry American white wood 20in. long by 16in. wide by ½in. thick. The lay-out of the apparatus is given in Fig. 1.

The Tuner

A range of from 300 metres to 10,000 metres is obtained with a series of six slab coils wound with No. 30 D.C.C. The number of turns for each coil is given below :—

No. I. 50 turns.
No. II. 75 „
No. III. 100 „
No. IV. 150 „
No. V. 225 „
No. VI. 325 „

These windings should be subject to experiment.

Construction of Coils

Cut out twelve discs of stiff cardboard, each 5in. in diameter, shellac well and then dry, or better still, bake in a warm oven. Two of these discs go to make each coil, and a centre piece of wood 1in. in diameter by ¼in. thick is necessary for each. The writer bought small wooden cart wheels from a local toy shop to serve this purpose. Each coil-former is then to be glued together, and, when dry, wound according to formula, the whole being immersed in melted paraffin wax to ensure rigidity and insulation. Care should be taken that each slab is wound in the same direction. Fairly long leads must be left in order to allow reaction adjustment, and on to the end of these small tags (Fig. 2A), made of thin sheet brass or tin, are to be soldered. The slot in the tags must be made big enough to slide under the aerial, earth, and reaction terminals, the aerial and earth leads being permanently secured by tags shaped as B, Fig. 2. This permits quick changes of coil. The A.T.I. is laid flat on the baseboard and the reaction coil slides over it.

The Aerial Tuning Condenser

From a piece of thin sheet zinc (say, 1-64in. thick) cut out two plates as shown in Fig. 2C.

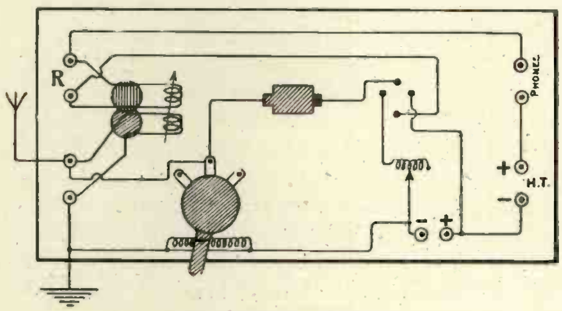


Fig. 1.—Lay-out of set.

One is fixed to the baseboard by means of screws through the flanges. The other is pivoted about ⅛in. above the first by a screw through the arm, which passes through a hole in it and through a washer placed below it. Tuning is carried out by moving the rotary plate over the fixed one, the latter being connected to the aerial end of the A.T.I.

Grid Condenser and Leak

From the remaining zinc cut two pieces as shown in Fig. 2D. These two plates are screwed down by the tags AA to the baseboard, but are separated by a piece of waxed paper.

The leak is formed by a pencil line on the board connecting the two plates. This line must be varied in width until the best results are obtained. Powdered lead should be rubbed on to both tags to ensure a good connection between condenser and leak.

The Valve Holder

Made out of valve legs costing 3d. each, mounted on a piece of ebonite 1½in. by 1¼in. by ¼in. thick and screwed on to the baseboard.

The Filament Resistance

A Kodak film spool is wound with insulated resistance wire, the ends of the winding being carefully fixed with sealing wax, and one of them led to two terminals. The spool is secured to the baseboard by hammering the metal flanges till they make a groove in the grain of the wood into which they are glued.

The amount of resistance in the filament circuit is adjusted by means of a brass arm (Fig. 2E), which is arranged to take in the whole coil, the arm itself being pivoted some distance away. The insulation is removed along the line described by the tip of the arm.

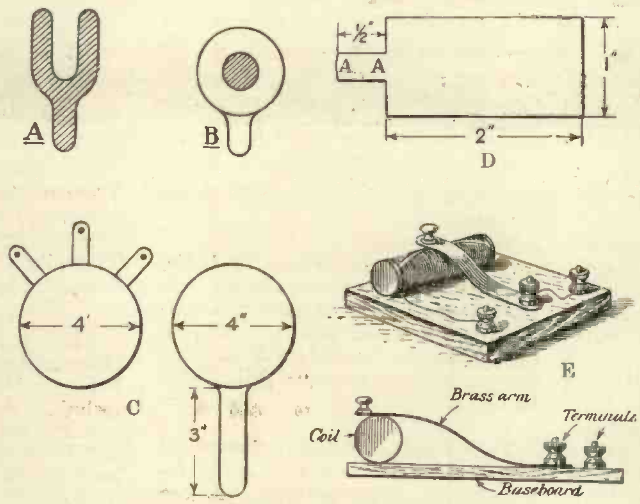


Fig. 2.—Illustrating the component parts of the set.

Without 'phones, batteries and valve, but including the aerial, the cost was about 15s. A fair price for the complete installation would be £4 at the most.

Operation and Results

When the operator wishes to receive C.W. the set must be oscillating, so the reaction coil must be slid over the A.T.I. until a loud click is heard in the telephones when the aerial terminal is touched. Then the condenser is adjusted till the desired signals are heard. If the valve refuses to oscillate, reverse the connections to the reaction coil or adjust the filament.

On this set all European stations, including MSK, IDO, EAB, and FF, come in well. Good telephony has been heard at 50 miles, and indifferent at over a hundred.

G. H. R.

Note.—It must be distinctly understood that a self-oscillating receiving set must not be used for the reception of broadcast transmissions in this country.—EDITOR.

THE REGULATIONS REGARDING AERIALS

FROM the number of letters received regarding the article entitled, "A Good Aerial," which appeared in our first issue, it is evident that the present day regulations are not properly understood. The original regulations were as follows:—

Height.—Not to exceed 100 feet.

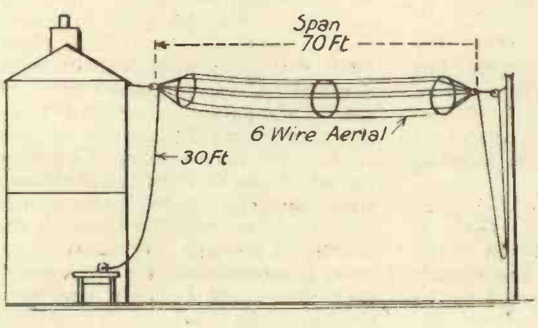
Length.—The total length of wire to be used must not exceed 100 feet if a single-wire aerial, or 140 feet if two or more wires are used.

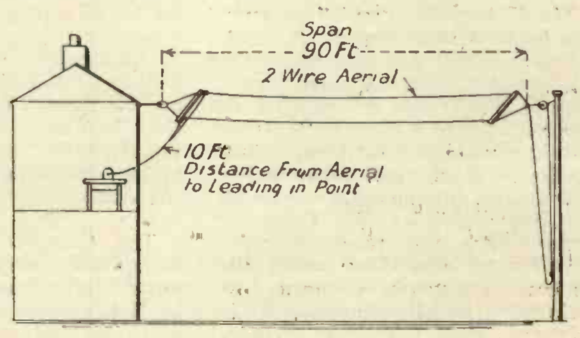
Some little time ago these conditions were amended o permit the use of an aerial the combined height and length of which does not exceed 100 feet *irrespective of the number of wires employed.* From enquiries made in the proper quarter, it was ascertained that by length is meant the horizontal or main aerial span, and by height, the vertical height above the leading-in point.

From this it will be seen that, if desired, a four- or six-wire aerial, 70 feet in length may be erected and the down-lead (also of four or six wires if preferred) be taken to a leading-in point 30 feet below.

On the other hand, should the lead-in be taken to an upper room and the "vertical height" accordingly be reduced, say to 10 feet, the horizontal span may now be made 90 feet in length.

The two methods just referred to are illustrated in the sketches herewith and, we trust, will make the matter perfectly clear.





News of the Week

THE Radio Corporation of America, which is either the first or second largest wireless company in the world, has made during the last year a net profit of about £600,000, most of which is allocated against reserves for taxes and patents, and the rest for miscellaneous expenses.

The amount of business done has been considerably greater than last year, and the Trans-oceanic Service shows an increase of 36 per cent., the marine traffic, however, only increasing 14 per cent. Important contracts have been entered into for the erection of several new stations in Europe and in South and Central America, and also in the Far East. No dividends are being paid on either the ordinary or preferred shares.

* * *

Two Bradford chars-à-bancs have been fitted with wireless receiving apparatus for the reception of Broadcasting. From what we gather, the aerials are not fixed on to the chars-à-bancs, but are erected in a field when a chars-à-banc makes a halt.

* * *

Considerable progress has been made in connection with the erection of the high-power station at Monte Grande, near Buenos Aires. The station will probably be ready for working in July, 1923. The cost of the station will be in the neighbourhood of £1,200,000.

* * *

The Federal Telegraph Company, which, as is well known, did very valuable work in exploiting the Poulsen Arc in the United States, entered in 1921 into a contract with the Republic of China for building certain wireless stations. The Radio Corporation of America has now entered into an agreement with the Federal Telegraph Company under which the two companies have formed a new one called the Federal Telegraph Company of Delaware, which company, it is proposed, shall take over concessions which the Republic of China has made to the Federal Telegraph Company.

* * *

According to the *Times of India*, it is proposed to form a radio club in Calcutta for the purpose of studying the science of wireless. Several big firms are interested in the development of wireless enthusiasm in India.

* * *

The *Stage*, which champions musical artists, is considerably interested in the question of the B.B.C. and the broadcasting of items from the theatre. This periodical states that "no industry in the world has ever been founded on so rotten a basis, and could not hope to succeed. If the theatrical industry does not now stand up for its rights, it will be in the position of the Press when all the big events of the day are broadcasted before they have had time to print and distribute the news." Dear, dear!

* * *

Cardiff listeners-in were disappointed at the refusal of the British National Opera Company to allow broadcasting during its visit to the Cardiff Empire. Major Corbett Smith, the Musical Director of 5WA, was one of the founders of the British National Opera Company, and was, incidentally, their official publicity agent. This made the situation quite intriguing. Major Corbett Smith believes that the opera would benefit greatly from the broadcasting of selections.

* * *

Manchester reports that the donkey radio barrel organ has arrived there. We understand that the Institute of Barrel Organ Grinders has passed a resolution to ban its members from steering the donkey.

* * *

The Glasgow station, 5SC, is being heard very clearly in many parts of the country. The signals in Nottingham are reported to be quite as loud as those from the Birmingham Broadcasting Station. The oscillating trouble seems to be rather severe in the Nottingham area. The local club meets every Thursday evening at Bennett's Garage, Shakespeare Street.

* * *

The engineer in charge of 5IT (Birmingham) is Mr. T. Amis, B.Sc. He recently gave a non-technical outline of the principles of wireless with particular reference to the Birmingham station. He is, incidentally, the "Fairy Dustman" to the kiddies.

* * *

Local clergymen are giving Sunday evening addresses at all the Broadcasting stations. The Rev. Alfred A. Lee, speaking recently from the Newcastle station, eloquently compared listening-in by wireless to intellectual listening. He said that if one really listened, as far as the world was concerned, one would hear three cries, the cry of Christendom for Unity, the cry of the nation for peace, and the cry of the world for the Gospel of Christ.

* * *

The Committee appointed by the theatrical managers, actors, and authors to consider the question of broadcasting from theatres, has, we understand, suggested that all connected with the theatre should refuse facilities for broadcasting.

* * *

We understand that the British Broadcasting Company have a clause in their lease of 2, Savoy Hill, Strand, W.C.2, which stipulates that no concert echoes must reach neighbouring inhabitants. A special sound-proof chamber is therefore being fitted. From this studio the Broadcasting Company intend in the near future to broadcast specially good programmes which will be radiated from all the provincial stations. It is not, however, contemplated, we understand, that there will be only one programme for all the stations.

Special items only will be broadcast from London, *via* the other stations.

* * *

A café at Clacton is fitted with wireless, and between 11.30 a.m. and 12.30 p.m. concerts are received. These, however, are largely interfered with by spark stations, and it is very questionable whether such demonstrations do any good.

* * *

The *Glasgow Herald* of April 9th contains the following:—"The writer may mention that, during the Easter holidays, he made trial of one of the new circuits introduced by the Editor of *Modern Wireless*—Mr. Scott-Taggart, to whom great credit is due for enterprising and useful departures from the beaten track. The circuit in question is applicable to a three-valve set with excellent results. The circuit works remarkably well with or without reactance. With reactance, the results with only two valves are, if anything, better than the writer had been obtaining previously with three, and while a little care is necessary in tuning and adjusting the filament lighting, the circuit presents no real difficulty of either construction or manipulation."

* * *

At a meeting of the Swansea Radio Society it was stated that one of the members had heard no less than five of the Broadcasting stations on a crystal receiving set. These stations were Glasgow, London, Manchester, Newcastle, and Cardiff. This, we believe, must be a record.

* * *

From all accounts, there is a trade slump as a result of the uncertainty which has existed over the licence question. There is no doubt that this will largely disappear in the very near future.

* * *

A new commercial service between Great Britain and the South American Republic of Colombia was inaugurated on the 12th April. The principal wireless station in Colombia is situated at Bogota, the capital.

Amongst the inaugural messages which were sent was one from the President of Colombia to the King, and others from the President to Senatore Marconi and Mr. Godfrey C. Isaacs, Chairman and Managing Director respectively of Marconi's Wireless Telegraph Company, Limited.

* * *

Captain P. P. Eckersley, who was in charge of the broadcasting from the Writtle station before it was closed down, is to give an entertainment weekly from 2LO, and a company of "Wireless Follies" is being formed.

* * *

The General Post Office has issued a warning to all possessing wireless sets to be on their guard against so-called "Inspectors." No one purporting to be an inspector should be allowed in the house unless he can produce adequate credentials of a documentary nature.

* * *

2LO beat the Press the other evening when they announced the defeat of the Government in the House of Commons twenty minutes after the sensational event had taken place.

* * *

Senatore Marconi's yacht, the "Elettra," has been stationed at Falmouth. This yacht formerly belonged to the Archduchess Maria Theresa, and was stationed at Falmouth naval base as an armed yacht during the war. It is fitted with a 3 kilowatt valve transmitter, in addition to the ordinary spark station.

We believe that there is only one Englishman among the crew and staff. According to the *Eastern Morning News and Mercury*, experiments are going to be carried out between the "Elettra" and Poldhu, which now no longer carries out the duties it once undertook.

* * *

Mr. H. P. Ford, who presided at a recent meeting of the Nottingham and District Radio Experimental Association, declared that the Society was the oldest in England. Any challenges?

* * *

Thirty British trawlers have been fitted by the Marconi Company with wireless transmitting and receiving apparatus.

Recently a fishing vessel made a £12,000 haul by being guided by a wireless message to a particularly suitable spot for fishing.

* * *

Prof. W. H. Eccles gave a demonstration at the Royal Institution on the evening of the 13th April on a novel method of transmission.

This method consists in obtaining different vowel sounds by combination of currents of different frequency.

By the use of such vowel sounds, Prof. Eccles thinks that the transmission of signals may be accelerated, and he states that the time taken is about half that required by Morse.

* * *

According to *The Times*, the demolition of the Eiffel Tower is being contemplated, and plans are already under consideration.

The famous Tower is represented as having lost its attractions for visitors, and as being no longer a necessity as a wireless station since the recently erected station at Sainte Assise, which is much more powerful, could easily deal with the wireless messages now despatched and received by FL.

General Ferrié, Inspector of the Military Telegraph Services, has stated that the wireless station of the Eiffel Tower serves so many scientific and military services that it cannot be dispensed with.

* * *

The interesting experiment carried out by 2LO in connection with Madame Lily Payling's singing at the Albert Hall on the 14th April was quite a success.

Madame Lily Payling sang her second song from 2LO, and this was received at the Albert Hall and made audible to the audience by means of a loud speaker.

The musical critic of the *Referee* stated afterwards that "the voice was thickened, its beauty and steadiness of tone were maintained, but the humanity of the tone seemed to be taken out of it. Subtleties of expression were conspicuous by their absence, and the personality of the singer, which was felt when she sang in the Hall, seemed to have vanished."

* * *

The Times music critic, commenting on the Madame Lily Payling demonstration, said: "The result was not very successful as the transmitter was too resonant, unduly magnifying the power of her voice, while the effect would have been better if the aria had been sung in the usual key instead of a minor third lower." We agree.

* * *

The Post Office has approached the Radio Society of Great Britain with the proposal that the experimental wavelength be raised to 720 metres.

* * *

Lord Desborough is shortly to speak from 2LO.

* * *

H.R.H. the Prince of Wales will broadcast a speech to the British Legion from 2LO on Whit-Sunday, May 20th, 1923.

This section will be enlarged to three pages next week.

A HANDY VARIABLE GRID LEAK

THE grid leak, whether fitted to the second of two valves coupled by the tuned-plate circuit, or to the rectifier, is a very important part of the wireless receiving set. In nine cases out of ten the leak with a value of two megohms, which has become almost a standard fitting, is mounted, and this will as a rule give quite respectable results. The experimenter, however, who is engaged in using different types of valves, and in trying to get the best out of them, will find it a distinct advantage to provide his set with some form of readily variable grid leak, such as that about to be described. The total cost of making it will be less than a couple of shillings, an outlay which is amply repaid by the time and trouble saved when experiments are in progress.

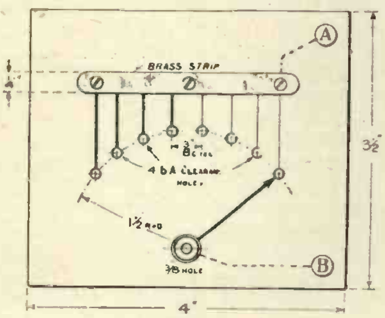


Fig. 1.

A piece of ¼-inch ebonite measuring 3½ inches by 4 is marked out and drilled as shown in the drawing. The central hole is for the spindle of a rotary switch arm, which can be bought complete with nut and bush for about 1s. from advertisers in this Journal. The circumferential holes, made with a 4B.A. clearing drill, are for studs of the ordinary type, from eight to a dozen of which may be fitted.

The highly polished surface of the ebonite is toned down by being rubbed with fine emery cloth, a little turpentine being used as a lubricant. Lines are now drawn with a B.B. pencil from the place where the brass strip will rest to each

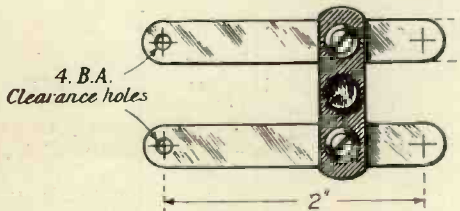


Fig. 2.

stud hole, care being taken to work the graphite well in at their ends so that contact may be as good as possible. Those on the right are made quite thin, those on the left about twice as broad. One thus obtains a great variety of resistances between the shortest thick line and the longest thin one.

So that the studs may make sound connection with the graphite, a flat washer is placed under the head of each, and it is drawn down as tightly as possible by means of its nut. For the same reason the brass strip is secured by means of three or more bolts, which enable it to be tightened down harder than would be the case if screws were employed.

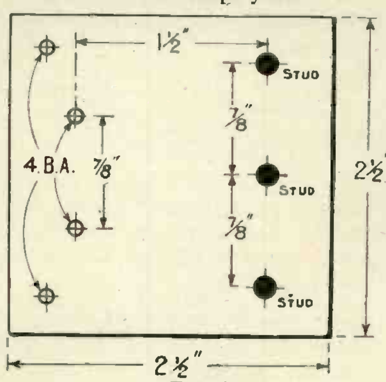


Fig. 4.

Two terminals A, B, are provided to take connecting leads (unless the variable leak is built into one of the panels of the set). The former is connected to the brass strip, the latter to the bush which forms a bearing for the spindle of the switch. When the leak is completed the pencil lines should be given a coat of shellac so that there may be no danger of their being rubbed off.

One feature of the variable grid leak is that it enables the proper value for any valve to be found very quickly. Once this has been ascertained a permanent leak for use with this particular valve can be made by mounting a pair of terminals on a small piece of ebonite and drawing a pencil line of the right length and thickness between them.

R. W. H.

AN EASILY MADE SERIES PARALLEL SWITCH

IT is a very great advantage to have on the wireless receiving set a switch which will enable the aerial tuning condenser to be thrown in a moment into either series or parallel with the inductance coil. Without such a switch one must make alterations in the wiring, always rather a fiddling business, in order to alter the position of the condenser: with it the desired change can be made by one small movement of a knob. For shortwave work the A.T.C. should always be in series with the inductance, otherwise the addition of capacity in parallel will have a certain damping effect. When we are dealing with very long waves it is an advantage to have the condenser in parallel, for to do so much increases the wavelength range of the particular coil that is in use.

Fig. 3 shows how the wiring of a series parallel switch is arranged. If the arms are placed as shown in the drawing on studs 1 and 2, the upper arm makes no contact with the coil. Impulses for the aerial pass through the condenser, then travel *via* the lower arm to the coil, after moving round which they reach the earth lead; the condenser

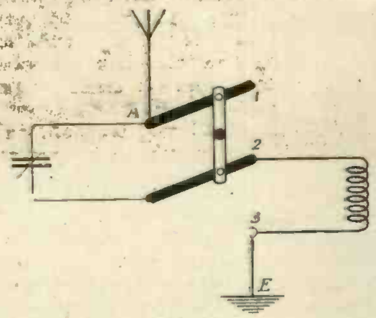


Fig. 3.

is thus in series. Place the arms on studs 2 and 3, and it is in parallel; impulses on reaching the point A have two paths open to them, they can reach earth either by way of the condenser or by travelling round the coil.

To make this switch is a very simple matter. The arms shown in Fig. 2 are cut with tin-shears from a piece of fairly stout sheet brass. The bridge is a piece of ⅛in. ebonite 1½in. in length. One hole is drilled in the middle of it to take the screw securing the knob; two others are for the 4B.A. round-headed screws which attach it to the arms. These are exactly 1in. apart, and they should be large enough to allow the screws to pass easily. Drill corresponding holes of tapping size in the brass arms and thread them with a 4B.A. tap. Take a ⅜in. screw, placing a flat washer on it, pass it through the ebonite, and drive it into the hole in the brass until the ebonite is securely held, but able to move without binding. File the end of the screw almost flush with the face of the brass, then burr its end with a few taps from a light hammer. When the second screw has been fixed in the same way the arms are ready except that they require 4B.A. clearance holes drilled as shown. The knob is made from a short length of ebonite rod. A piece of ebonite 2½in. square and ¼in. thick is now cut out and two 4B.A. clearance holes (A.A. Fig. 4) are drilled through it. These are to take a pair of terminals which will form the supports for the arms. Pass the terminals through and secure them with hexagon nuts. Now place the holes at the ends of the arms over their screwed rods as shown in Fig. 5. On each put a spring washer, a flat washer, and finally its milled nut.

It is best to find the positions of the holes for the two outer studs by trial. To do this stick a strip of stamp edging on to the ebonite: make a pencil dot on the centre line to show the position of the middle terminal, place one arm over this and mark the spot that is covered by the end of the other. The position of the third stud is found and marked in the same way. Apply the centre-punch to your pencil marks, drill 4B.A. clearance holes and remove the stamp edging. Ready-made studs can be bought very cheaply, but if they are not available 4B.A. cheese-head screws will do quite as well.

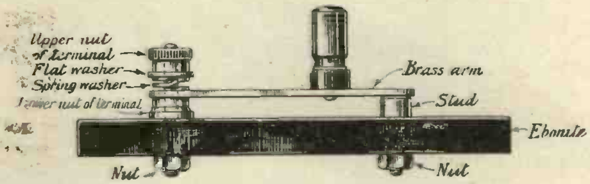


Fig. 5.

LOOKING AFTER ACCUMULATORS

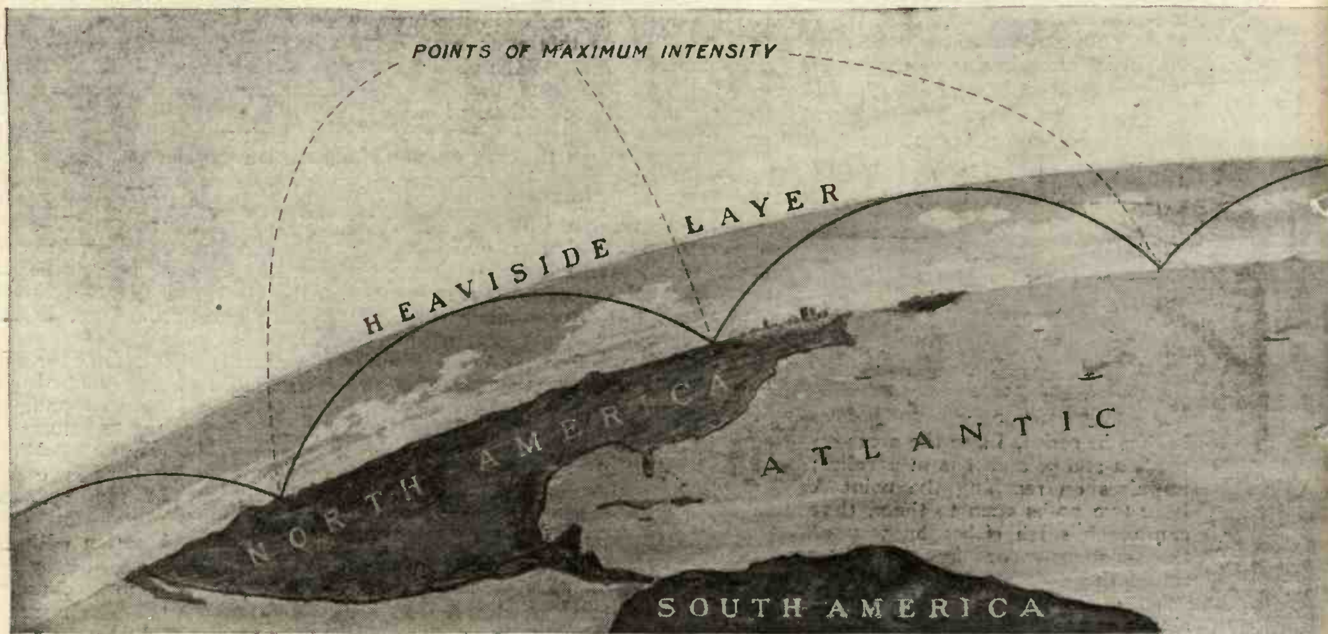
How many wireless enthusiasts give their accumulators the care that they need and deserve? We are all rather inclined to regard the L.T. battery simply as a store of energy for filament heating purposes, which can be drawn upon so long as it will enable the valves to work, and then requires no attention beyond being conveyed to the charging station for a refill. This is not quite fair to the accumulator, which is, after all, one of the most important parts of the receiving set. Accumulators that have been "made" by proper treatment in their early days will stand a certain amount of ill-usage, but during the first three months of their lives it is most important to give them every care.

The way in which an accumulator works is most interesting, and a proper understanding of it will help the wireless man to see that his L.T. battery is kept in good condition. The acid solution consists of vast quantities of molecules of sulphuric acid and water, each of which contains atoms of oxygen and hydrogen. During the charging process the solution is partly broken up. Hydrogen ions rush to the negative plates, where each is neutralised by taking one electron from the charging current. They then combine in pairs into hydrogen molecules. The negative plates become coated with a deposit of spongy lead, which gives them a grey colour. Oxygen negative ions make for the positive plates at whose surface a chemical change takes place. The gas atoms combine with those of lead, forming, as the stream continues, lead peroxide, which covers the surface of the plates with a chocolate coloured coating. When the accumulator is fully charged no free lead atoms remain for those of the gas to combine with; oxygen rises to the surface in the form of a stream of bubbles. The accumulator is then said to be "gassing."

It will thus be seen that the solution is robbed of pairs of hydrogen atoms and of single atoms of oxygen. Water molecules consist of two hydrogen atoms in combination with one of oxygen. Hence during charging the solution loses some of its original water, and the specific gravity becomes higher.

When the battery is brought into use in the wireless set the process described is reversed. Hydrogen rushes to the positive plates where, by combining with oxygen atoms, it breaks down the lead peroxide into lead monoxide and water. Peroxide of lead resists the action of sulphuric acid, but the monoxide speedily succumbs, being converted into lead sulphate and water. As discharging proceeds the plates lose their brown colour owing to the deposit of whitish lead sulphate which forms on them. At the negative plates lead sulphate is also formed, since oxygen ions combine with the lead to produce the easily attacked lead monoxide.

It will be seen that whilst discharge is taking place, the hydrogen and oxygen atoms taken from the solution during charging are given back again. They combine once more into water, and reduce the specific gravity of the solution. We can now see why it is that the hydrometer, which measures the specific gravity of the solution, provides such an excellent means of discovering the condition of the battery. It is in fact the only sure test. It is most important that the acid solution should be correctly mixed, and this is a point which must be watched, for many of those who run charging stations are very careless about it. The exact gravity generally varies with different brands of accumulators.



WAVE-REFLECTING "ROO

By E. HALL CHAPMAN

This interesting article by one of our Staff Editors will e

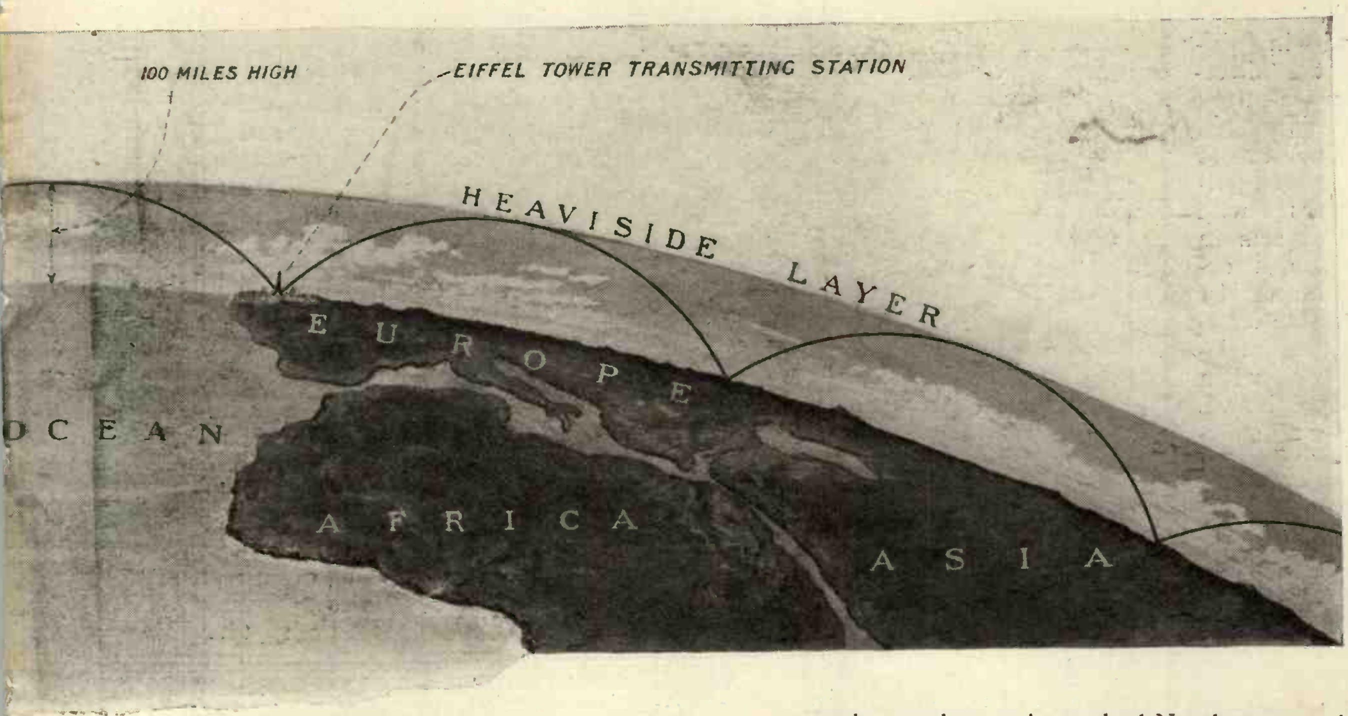
OUR knowledge of the way sound waves travel in the atmosphere may help towards an explanation of the many irregularities and occasional zones of silence observed in connection with the transmission of wireless signals.

We are all of us familiar with the simple analogy which can be drawn between the travel of sound waves and the travel of wireless waves. When, for example, the hour is struck on Big Ben, the 13½-ton bell in the Clock Tower at Westminster, sound waves travel in all directions and the resonant note is heard all over London. Big Ben, on such occasions, is a station broadcasting signals by means of sound waves and the human ear which picks up the sound is a receiving set for the sound waves transmitted by the famous bell.

Owing to the fact that sound waves are produced by *mechanical* means, such as those employed in the raucous and persistent alarm clock, it appears, at first sight, a little imprudent to pursue the familiar analogy with the *electrically produced* waves of a wireless transmitting station. Again, sound waves travel through the *air*, whereas wireless waves travel through the mysterious *ether*. There is also a tremendous difference in point of speed. Sound waves travel at a leisurely 750 miles per hour. Wireless waves move over 890,000 times as quickly. Some idea of the difference in these speeds can be obtained by comparing wireless waves with a sprinter doing the 100 yards in 10 seconds and sound waves with a snail taking three months to crawl the same distance.

Yet, in spite of these great differences, a careful study of the way sound waves behave when propagated through the atmosphere helps enormously in an attempt to visualise the travel of wireless waves.

Since the establishment of the broadcasting stations, wireless experimenters in many parts of the country have been puzzled by the curious inconsistencies in the strength of the telephony received from the several stations. As an example of this, three experimenters working with crystal sets on the Essex side of London a few weeks ago heard the Newcastle concert with great clearness. About the same time two other experimenters working with valve sets in the same district were surprised at the strength of the Newcastle telephony. Since the three experimenters possessing crystal sets have not yet succeeded in picking up the Birmingham or Manchester telephony, the question naturally arises as to why it



FS" IN THE ATMOSPHERE

, M.A., D.Sc., F.R.Met.Soc.

xplain many of the cases of long-distance reception freaks.

should be possible on certain occasions for experimenters in Essex to hear telephony from Newcastle, 270 miles away, better than telephony from Manchester, 190 miles away, or telephony from Birmingham, only 120 miles away.

In order to form some idea as to how questions such as these may eventually be answered, let us carry a step further the analogy between the travel of sound waves in the atmosphere and the travel of wireless waves through the ether.

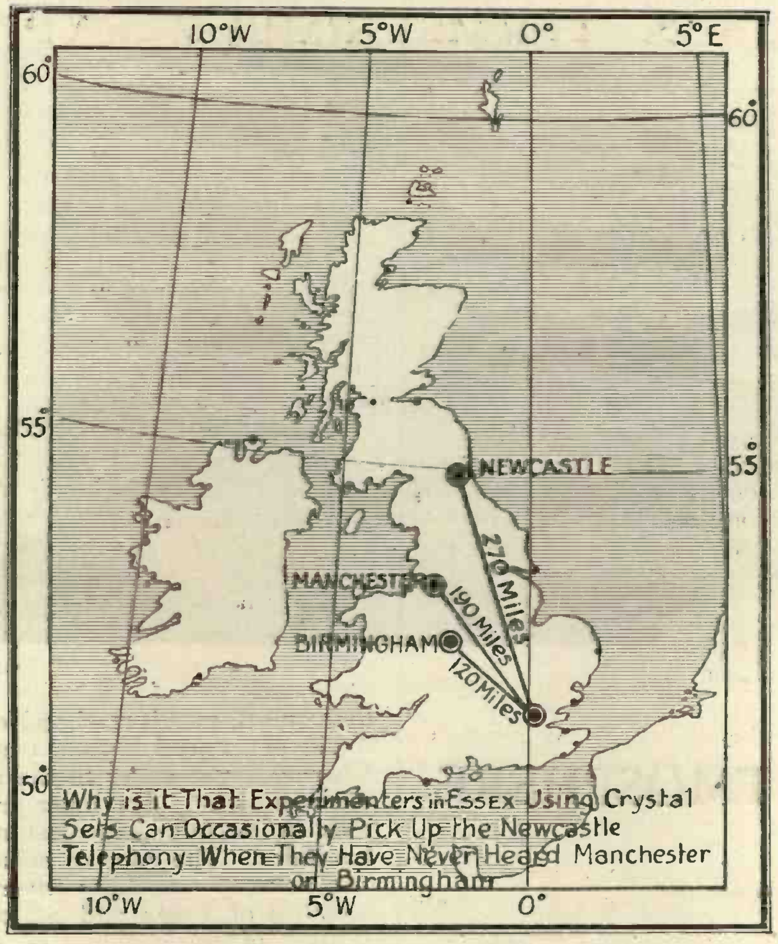
Within recent years one of the best examples of the curious way in which big sounds travel was provided by the Silvertown explosion of January 19th, 1917. Exhaustive enquiries made after the explosion revealed the most interesting fact that there were two distinct areas in which the sound of the explosion was heard, *and that these two areas were separated by a zone of silence forty miles wide*. The inner area of audibility embraced the whole of a circle of twenty miles radius centred at Charing Cross. To the south-east this area stretched as far as Canterbury and to the north-west it reached Northampton, but it did not extend beyond twenty miles from Charing Cross either to the north-east or to the south-west. The outer area of audibility took in Norfolk, Lincolnshire and Nottinghamshire. The zone of silence between the two areas of audibility covered most of the counties of Essex and Suffolk and a large portion of the counties of Cambridge and Huntingdon.

It has been suggested that this strange phenomenon of a zone of silence between two areas of audibility is due to varying wind currents in the atmosphere, but this explanation does not cover the many cases in which a zone of silence has been observed to leeward of the source of the sound. In fact, there is at present no very satisfactory explanation of these most interesting and strikingly curious zones of silence which are noticeable whenever big sounds are propagated through the atmosphere. Similar zones of silence no doubt exist for wireless waves, for it is no uncommon thing for a wireless receiving station to pick up signals from a particular transmitting station during the night-time but never from that same station during the daytime.

A very striking feature of the Silvertown explosion just referred to was that the intensity of the waves varied greatly in different directions. If we could explain *why* the intensity of the waves from the Silvertown explosion differed in different directions we might have discovered a clue as to why experimenters with crystal sets in Essex can occasionally hear the Newcastle telephony when they have never succeeded in picking up the Birmingham telephony which has to travel less than half the distance.

As far as sound waves are concerned, we may look upon the atmosphere above us as being, under certain circumstances, a huge echoing gallery. Any sound waves which travel upwards may be reflected back to earth, just as a beam of sunlight is reflected by a piece of broken mirror in the hand of a mischievous schoolboy. There are undoubtedly a number of reflecting "roofs" for both sound waves and wireless waves in the atmosphere above us. The problem of the reflection back to earth of such waves is, however, very complicated, since these reflecting "roofs" are not stationary. A strong wind may blow one of these sound reflecting "roofs" away. Sunlight may cause a wireless wave reflecting "roof" to be very patchy and perhaps full of great holes through which the waves may escape into space.

One great scientist has made the suggestion that with a wireless reflecting "roof" at a height of a hundred miles above us, wireless signals would be at a maximum strength at successive distances of 2,000 miles from the transmitting station. It is a most interesting fact to recall that about this height there is a surface of separation between the nitrogen of the lower atmosphere and the helium (not hydrogen) of the upper atmosphere. This interface may be a reflecting "roof" for wireless waves.



Why is it That Experimenters in Essex Using Crystal Sets Can Occasionally Pick Up the Newcastle Telephony When They Have Never Heard Manchester or Birmingham

TO CONTRIBUTORS

We are open to accept and pay for good illustrated constructional notes of about 250–300 words. Exclusive news items of special interest and high-class photographs are also welcomed.

WIRELESS TERMS SIMPLY EXPLAINED

Selected expressions used in general wireless practice will be explained in these columns from time to time.

Space Charge

IN the interior of a valve there is a certain distribution of potential between the electrodes—that is, between the anode and the filament. The conduction of electricity between these electrodes is effected by the flow of electrons or positive ions from one to the other, and it is the difference between the number of electrons and positive ions in a volume which we must take as unity, multiplied by the charge per ion, that is known as the "space charge." This is also referred to as the volume density of electrification, but it must not be confused with *space current,* which is simply the value of the flow of electrons between the electrodes of the valve.

Ionization

Any process which actually produces dislodged electrons is known as ionization. It will be appreciated that however this dislodgment comes about it involves overcoming such forces as may hold the electrons in the atoms from which they are to be ejected.

There are several means of ejecting the electrons, but two will be mentioned as being readily appreciated. The method of dislodgment which is most obvious to us all is that of *heating*: this forms the basis of the subject of thermionics. The second method is ejection by means of other electrons impinging on the object from which we wish to release electrons. This gives rise to the phenomenon of "secondary emission," which we will now explain. The blue glow sometimes seen in imperfectly exhausted or "soft" valves is an indication of ionization by collision of the electrons with molecules of residual gas.

Secondary Electrons

When electrons proceeding from the filament or cathode impinge upon the anode, they give rise to an emission of fresh electrons from this latter. These electrons, however, are at once returned to the plate because of the potential difference between them and the filament, but it is to be noted that secondary emission is not produced *unless* the velocity of the primary electrons (*i.e.*, those flowing from the filament to the anode) exceeds a certain value.

The impact voltage at which secondary electrons are emitted depends on the nature of the surface from which they are released; they also show a curious property, that as the speed of the primary electrons increases so the number of secondary electrons emitted *per impinging primary electron* increases. Indeed, if the impact voltage of the primary electrons can be raised to a sufficiently high value, our primary electron can expel as many as twenty secondary electrons.

Negative Resistance

The phenomenon of secondary electronic emission is directly connected with the property of negative resistance. If in a three-electrode valve the plate be kept at a fixed positive potential with respect to the filament, when no potential difference exists between the grid and the filament the current flowing in this latter circuit is very small. The reason for this is that almost all the electrons from the filament are drawn through the grid and over to the plate. If, however, we can give the grid an increasing *positive* potential (with respect to the filament), the grid current, as indicated by a milliammeter, will increase up to a certain point. If we still further increase the positive potential in the grid, we will, however, find a decrease of the grid-filament current, which will drop down to zero and then eventually flow in the reverse direction.

The explanation for this is that as the positive grid potential is increased, the electrons on striking the grid emit secondary electrons which are drawn to the plate or anode. When the velocity with which the electrons strike the grid increases beyond a certain value, the primary electrons, as already explained, can eject more than one secondary electron from the grid, and the current reverses. Thus the valve shows *negative resistance* properties.

In this connection it is of interest to note that if the grid potential is increased to such an extent that it becomes positive with respect to the anode, the secondary electrons are no longer drawn away to the plate, but are driven back again to the grid, so that the reverse current will decrease until it finally assumes the original direction.

A. L. M. D.

HIGH-SPEED TRANSMISSION AND RECEPTION

The new wireless installation on the liner "Majestic" which enables messages to be transmitted and received at a speed of 240 words per minute.

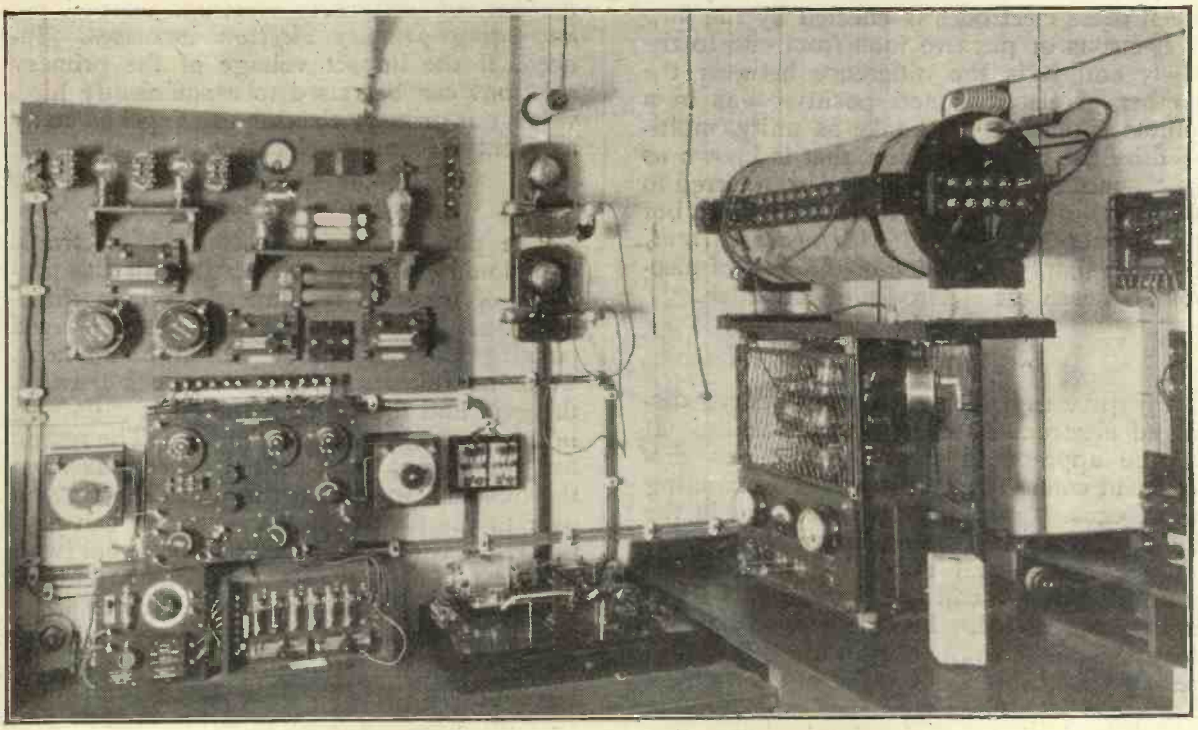


Fig. 1.—The complete installation in the wireless cabin.

THE giant White Star liner "Majestic" was the first ship to be fitted with high-speed automatic wireless apparatus. The automatic transmitter is a Wheatstone machine, and was fitted last November by the Marconi International Marine Communication Company, Ltd. The success attending its use has led to the installation of high-speed receiving gear in the form of an Undulator.

The introduction of high-speed transmission on board this liner was decided upon because of the large number of business and private messages which passengers using the "Majestic" desire to send when they are approaching the coast of America. The amount of traffic had grown so enormously that it was found impossible to cope with it adequately by ordinary hand speed working, and the "Majestic" now clears its Marconigrams to Chatham (Mass.) automatically. The maximum speed of this apparatus is 240 words per minute.

The fitting of high-speed receiving apparatus on board ship is a matter of much greater delicacy than the fitting of transmitting apparatus, as the movement of the ship is an important factor for consideration.

Experiments with the Undulator, however, have proved quite successful, and during the "Majestic's" first trip to New York with this apparatus on board messages were recorded at high speed over a distance of 700 miles.

The illustration on the opposite page (Fig. 1) shows on the table, from left to right :—

(1) The local oscillator, tuner and amplifier.

(2) High-speed automatic receiver.

(3) Continuous-wave valve transmitting panel.

Fig. 2 shows another part of the wireless cabin. The Gell perforator keyboard for the automatic high-speed wireless transmitter is shown in the centre, whilst just behind it, to the right, is situated the Marconi direction-finding apparatus, including a seven-valve amplifier. Note the special arrangement of the leading-in wires to the direction-finder.

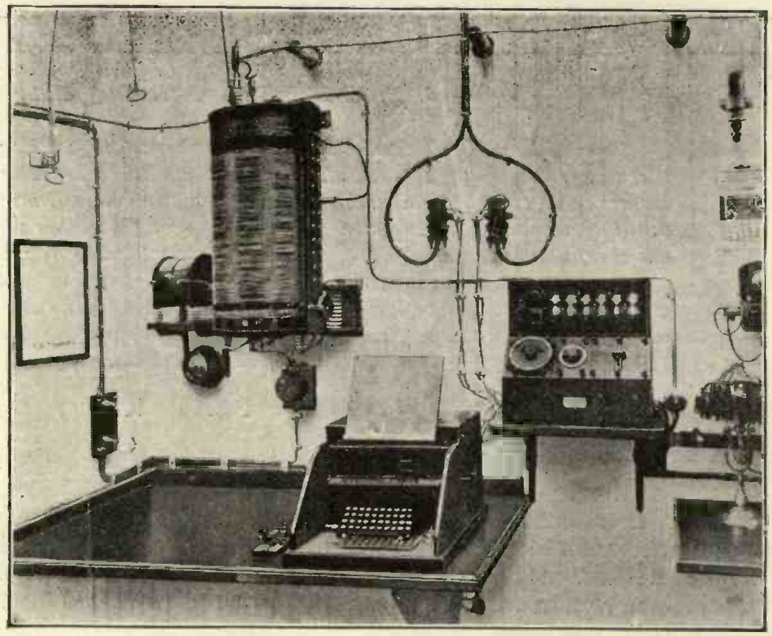


Fig. 2.—Another part of the cabin.

Our third illustration depicts the Wheatstone automatic transmitter, which operates from a perforated strip prepared by the Gell instrument shown in Fig. 2. The method adopted of mounting the automatic devices upon separate benches is necessary on account of the vibration which is caused during operation.

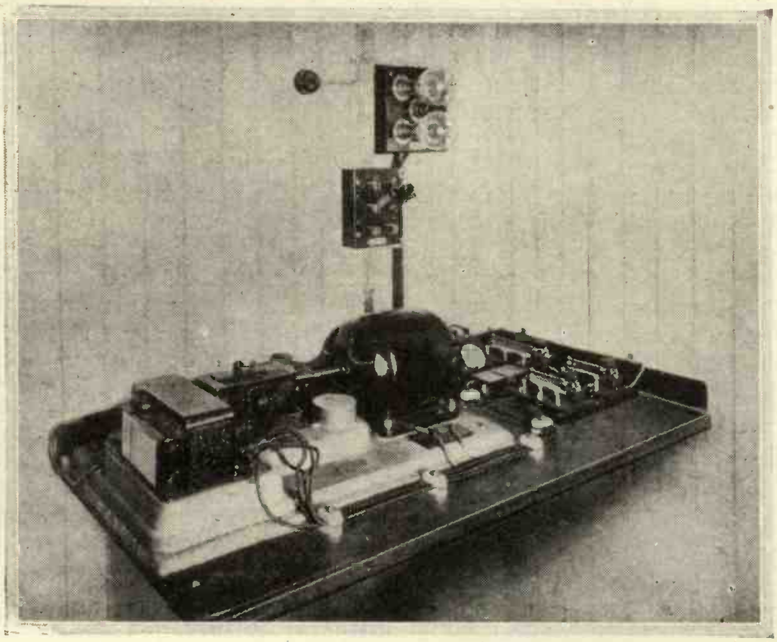


Fig. 3.—The Wheatstone high-speed automatic transmitter.

This high-speed transmitting and receiving installation has proved so successful that several other of the larger passenger ships will be fitted with similar apparatus in the near future. Considerable experimental work is necessary to obtain reliable and rapid working of the system, but now that experience has been gained with an actual practical installation, the system is being brought down to a reliable commercial proposition.

THE ELECTRICAL THEORY OF MATTER

By J. H. T. ROBERTS, D.Sc., Staff Editor (Physics).

Some of the most fundamental discoveries in physical science have been made during the past thirty years, largely by Sir J. J. Thomson and Sir E. Rutherford and co-workers at the Cavendish Laboratory, Cambridge, in their researches on the conduction of electricity through gases and the phenomena of radioactivity. The evolution of the wireless valve is directly bound up with this work, which will undoubtedly have further important bearings upon wireless in the future.

Dr. Roberts has been intimately associated with some of these problems at Cambridge and has collaborated with the eminent physicists mentioned above. In this series of articles he gives a simplified account of the very remarkable insight which science has gained of recent years into the nature of Matter and Electricity.

PART I

IT is common knowledge that matter consists of molecules, and that molecules are built up of atoms. Until recent years it was thought that the atom was the ultimate particle of matter, indivisible and immutable. The principal reason for this belief was that in chemical reactions between different elements, the minimum quantities of the elements engaging in the reaction always comprised a whole-number of atoms, no chemical reaction being observed in which a *fraction* of an atom took part.

In view of the information then available this belief was a very reasonable one and, in fact, the definition of the atom which obtains to-day is in close agreement with it so far as chemical reactions are concerned; the atom is still regarded as the smallest portion of matter which can take part in a chemical reaction.

Recent experiments, of a physical rather than a chemical nature, have shown, however, that the atom is neither indivisible nor immutable; it consists, in fact, of a miniature solar system,* in most cases of great complexity. Just as a solar system embraces a central sun with a number of planets circling round it under the influence of its attractive force and following appropriate orbits, so the atom consists of a central electrical nucleus with a number of isolated electrical charges circling round it in particular orbits.† The nucleus of the atom has a positive electrical charge, and the circling, or "planetary" charges are charges of negative electricity, the difference in sign of the charges of the planets and the nucleus accounting for the attractive force, according to the well-known elementary law.

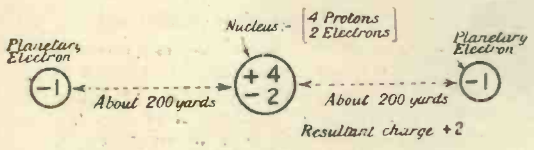


Fig. 1.—Representation of an atom of helium.

Protons and Electrons

The units of which the atom is built up are of two kinds only, namely, units‡ of positive electricity, called "protons," and units of negative electricity, called "electrons," the charge of a proton being equal in amount to that of an electron. The nucleus consists of a compact arrangement of protons and electrons, the protons, however, being in excess of the electrons—which accounts for the nucleus having a resultant positive charge. In the normal case, the number of planetary electrons is equal to the number of excess protons in the nucleus, so that the atom, as a whole, is electrically uncharged or neutral. For example, in the oxygen atom, the nucleus contains 16 protons and 8 electrons, and has, therefore, a resultant positive charge of 8 units; this is balanced by the 8 planetary electrons circling round the nucleus. The atom of hydrogen consists of a nucleus of one proton, with one planetary electron

* It should be stated that there are many theories of the constitution of the atom, designed to account for particular phenomena; the subject is of very recent growth and of almost infinite complexity, and it cannot be said that any theory has been universally accepted or has accounted for all the known properties of atoms. It is impossible in this short Article to enter into a consideration of alternative theories: a simple outline will therefore be given of the general trend of modern views of atomic structure. The Rutherford-Bohr theory is supported by an enormous amount of direct experimental evidence, and must be substantially correct.

† The orbits are not necessarily circular or stationary.

‡ The word "unit" here is used in the ultimate or natural sense, not in the sense of the conventional electrical units.

circling round it. The atom of helium has 4 protons and 2 electrons in the nucleus, balanced by 2 planetary electrons.

Size of the Atom

In order to form some mental picture of the atomic solar system, we may mention that the size of an electron is about 10^{-5} of that of

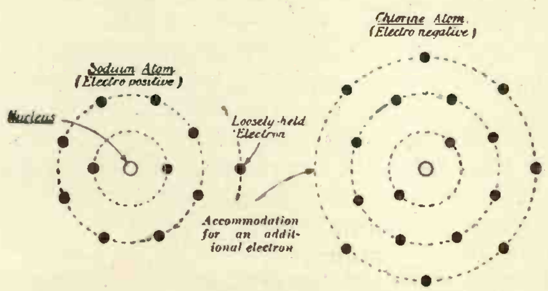


Fig. 2.—A sodium atom and a chlorine atom about to combine.

the atom and the proton is about 10^{-3} of that of the electron. By the "size" of the atom is meant the diameter of the space which it *occupies*, but it will be evident that it does not *fill* that space, any more than the planets fill the space around the sun which is enclosed by their orbits. A popular idea of the relative magnitudes has been given by saying that if the atom (that is, the space occupied by the atomic planetary system) were the size of the dome of St. Paul's, the electrons would be about the size of pinheads, and the protons would be the size of dust-particles. Or again, if the nucleus of the atom of helium be represented by a small marble, its two planetary electrons will be represented, on the same scale, as two smaller marbles revolving round it at a distance from it of about half a mile. These simple pictures may be useful in enabling us to form a conception of the relative magnitudes of the component parts of an atom, but they must not be taken too literally; the nucleus, for example, must not be supposed to resemble a sphere such as a marble.

Atomic Weight

The weight of the proton is about 2,000 times that of the electron, so that, for practical purposes, the weight of an atom is equal to the sum of the weights of its protons. Since the oxygen atom contains 16 protons and its atomic weight is taken as 16, it follows that the atomic weight of any other element (except hydrogen) is expressed by the number of protons contained in its atom—thus helium has 4 protons and its atomic weight is 4; sodium, atomic weight 23, has 23 protons, and so on.

The atomic system, containing about half* as many electrons as protons in the nucleus, with a balancing number of planetary electrons surrounding the nucleus, represents the normal, or uncharged, atom. An atomic system may be in any one of three different states, which we may call "satisfied," "unsatisfied" and "dissatisfied."

Stability

An atom may be "unsatisfied" because it has a deficiency or an excess of one or more external electrons, in which case it may be said to be *quantitatively* unsatisfied and is called an "ion"; or it may be "unsatisfied" because the number of its external electrons is such that the geometrical

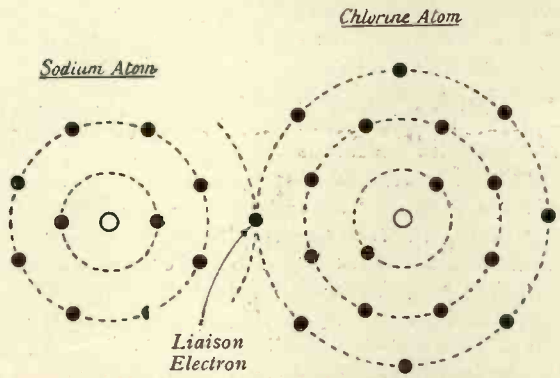


Fig. 3.—A salt molecule, the sodium and chlorine atoms sharing an electron between them.

arrangement would be more "comfortable" if one or more electrons could be borrowed

* An even number of electrons is not always equally divided between the nucleus and the external system (an odd number, of course, cannot be), and we now believe that this is connected with the existence of "isotopes," that is, elements with different atomic weights but the same chemical properties. For example, neon consists of a mixture of nine-tenths of an element of atomic weight 20 (20 protons and 10 electrons in the nucleus with 10 planetary electrons) and one-tenth of an element of atomic weight 22 (22 protons and 12 electrons in the nucleus, with 10 planetary electrons) giving an average atomic weight of 20.2. It is shown later in this article that the chemical properties of an atom depend upon the number of planetary electrons proper to the uncharged atom, so that the isotopes are indistinguishable by chemical means; they have, however, been identified by special physical experiments with the "mass spectrograph." There is strong reason for believing that the atomic weights of all the elements (except H) are expressible as whole-numbers (oxygen being taken as 16) and that where the atomic weight, determined chemically, includes fractions, the substance is a mixture of isotopes.

or loaned; it may then be said to be *qualitatively* unsatisfied, and, although it is not actually an ion, it is liable to become ionised by combination with another atom. "Unsatisfaction" in the above sense is concerned only with the external or planetary electrons and does not involve the nucleus.

The "dissatisfied" atomic system is that of a "radioactive" atom, where the disturbances produced are more deep-seated and affect the nucleus of the atom as well as the external electrons. For the time being, however, we will defer the consideration of a "dissatisfied" system and deal only with "satisfied" and "unsatisfied" systems, that is, with atoms which retain their nuclear construction, but which may have disturbances in their external electron system.

Chemical Properties of Elements

The chemical properties of an atom depend upon the net positive charge of the nucleus, that is, upon the number of external electrons proper to the atom in its uncharged or neutral condition. Provided the nucleus is not altered, therefore, disturbances may take place in the external electrons which influence the behaviour of the atom in certain respects without changing its chemical properties. An atom may, for example, lose one of its external electrons; it is then left with a resultant positive charge and is called a "positive ion": or it may gain a stray electron, when it is called a "negative ion." These states are temporary, and an ion will take the first opportunity of satisfying itself by losing or gaining an electron, as the case may require.

An atom which has a circle crowded by electrons may be qualitatively unsatisfied, even though it is quantitatively satisfied, and it may actually be in a condition favourable to losing electrons so as to satisfy itself qualitatively, even though it would, by the same act, render itself to some extent unsatisfied quantitatively. Similarly, an atom may be in a condition to increase its stability by the acquisition of another electron, even though such a condition would render it quantitatively unsatisfied. This tendency to lose or gain electrons is thought to be connected with the chemical combinations of atoms into molecules. An atom which has a tendency to acquire an electron into its external system is said to be electronegative, and an atom which has a tendency to lose an electron from its external system is called electropositive. A simple illustration of the application of this theory to chemical combination may be given by considering the molecule of common salt, which consists of the combination of the electropositive sodium atom (which can easily part with an electron) with the electronegative chlorine atom (which can easily accommodate an extra electron). Fig. 2 shows* the sodium atom containing an inner ring of 2 electrons, an outer ring of 8 electrons, and another electron which is loosely held and which, as it were, could to some extent be spared. Fig. 2 also illustrates the chlorine atom, containing an inner ring of 2 electrons, another ring of 8, and a further ring of 7 electrons; this atom could well accommodate an additional electron so as to make its outermost ring up to 8. If the sodium and chlorine atoms come into proximity, the loose electron of the former, without actually leaving its parent atom, may share itself between the two atoms, which are then held together by their mutual interest in the liaison electron (Fig. 3). Thus the sodium atom is not ionised, in the sense of having completely lost an electron, but may be said to be partially ionised whilst it remains in combination with the chlorine atom, and the same remarks apply to the latter. Under certain special circumstances, however, the chlorine atom may take complete possession of the borrowed electron, the sodium atom parting with it entirely; this is what happens when the salt molecule is dissolved in water, the effect being due to the motions and attractions of the surrounding water molecules. The sodium atom has now become a positive sodium ion, and the

(Continued on page 181.)

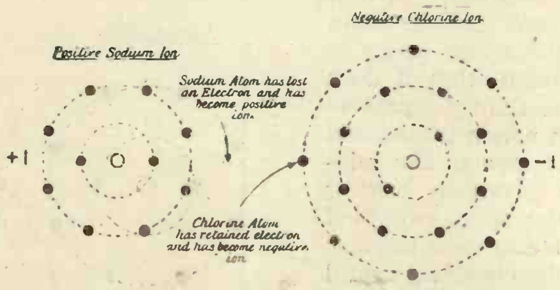


Fig. 4.—What happens when a salt molecule is dissolved in water.

* The electrons are here shown spaced upon rings in a plane, but it will be understood that three-dimensionally they will be situated (at any instant) upon a series of imaginary shells.

A PROGRESSIVE UNIT RECEIVING SYSTEM

This forms the third part of our special series of articles dealing with the construction of a complete unit receiving system. Every issue will contain complete instructions for making or using another component part, and the reader will have at his disposal the whole organisation of Radio Press to help him. These articles are written by the Editor himself, and the apparatus described has been designed and fully tested. By carefully following out the instructions given, it is impossible to obtain disappointing results. Every piece of apparatus will be subsequently used when more ambitious sets are described.

PART III

(Continued from No. 2, page 111.)

Receiver No. 1

IN the two preceding instalments we have dealt with a variable inductance consisting of 20 turns of insulated wire tapped at each turn, and also a variable inductance consisting of 100 turns of wire tapped at every 20 turns. A suitable crystal detector for use with these circuits has also been dealt with and we are now in a position to arrange the different components to receive signals.

Effect of Aerial Capacity

A common fault with many wireless receivers is that the aerial circuit is not properly tuned to the incoming wavelength. It should be possible on every receiver to obtain an adjustment which gives the loudest results; any variation of adjustment on either side should result in a decrease in signal strength.

If, for example, it were found that signals became stronger and stronger as the amount of inductance included in the aerial circuit was increased, but that even at the limit there was no falling off in signal strength, it would be a clear indication that quite likely the receiving apparatus was not properly tuned-in to the incoming signals, and that if a little more inductance were added perhaps better results would be obtained. Similarly, sometimes it is found that as the inductance is cut down, the signal strength increases, but at the lower limit strong signals are still obtained; this is a clear indication that there is too much inductance, and the fault is generally found on sets which do not provide for a sufficiently small amount of inductance to be obtained on the lowest adjustment.

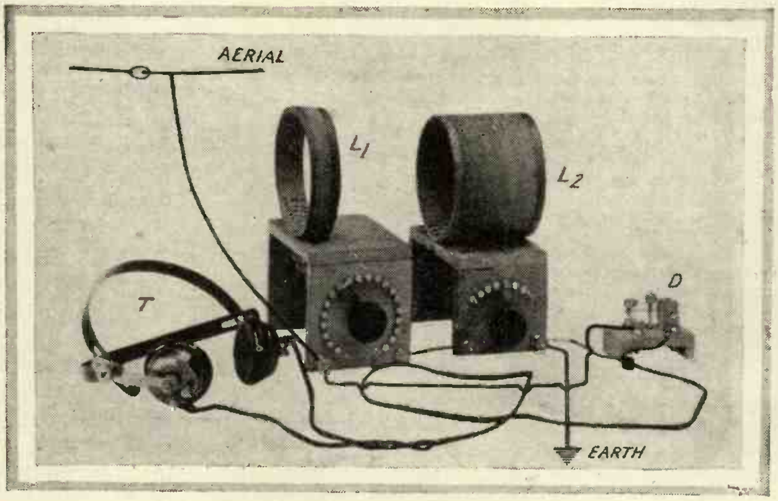


Fig. 1.—The complete receiver.

When apparatus of this kind is used, it will be found that different aerials give entirely different results. For example, a small aerial will require more inductance in the aerial circuit, whereas a large aerial, or one having a number of parallel wires, will require very much less inductance to tune to a given wavelength.

This is because the wavelength of the aerial circuit is governed by the value of the inductance and the capacity of the aerial. If a small aerial is used, the aerial capacity is small, and more inductance is required in the set to bring up the wavelength to correspond with the waves to be received. On the other hand, if a large aerial is employed, or one which consists of a number of parallel wires, or if a very long earth lead is used, then the set will require a smaller amount of inductance.

In order that there shall be no possibility of failure, we are going to use two variable inductances in series, one for the purpose of obtaining an inductance varying between 0 and 20 turns, and another inductance which will give us anything from 0 to 100 turns in sections of 20. By connecting these two inductances in series, both being in the aerial circuit, it will be possible to include in the aerial circuit any number of whole turns between 0 and 120. By this means we can guarantee that we will be able to tune in to

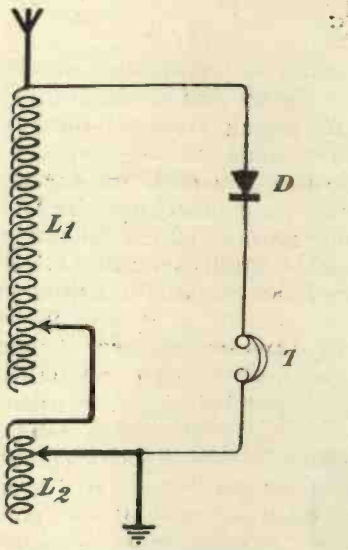


Fig. 2.—Circuit diagram.

any wavelength from about 150 metres to at least 800 metres.

Wiring Up the Set

Fig. 1 shows a photograph of the different component parts. The method of wiring up the different components is shown by means of ink lines drawn on the photograph.

It will be seen that the aerial lead-in is taken to one terminal of the unit inductance L_1. The other terminal is connected to the left terminal of the inductance L_2, which is the 100-turn inductance. The right terminal of this inductance is connected to the lead going to the earth, the earth preferably being a tin buried in the ground just outside the station.

One terminal of the detector D is connected to the left terminal of the inductance L_1. It is important to see that it is the crystal cup terminal which is connected to this terminal, which is also connected to the aerial. The other terminal of the detector D is connected to one lead of the telephone receivers T by means of a piece of insulated wire; the other telephone lead is connected to the right-hand terminal.

All the different connections may be made with the same wire used to wind the coils, namely, No. 26 double-cotton-covered copper wire. Bell wire or any other copper wire,

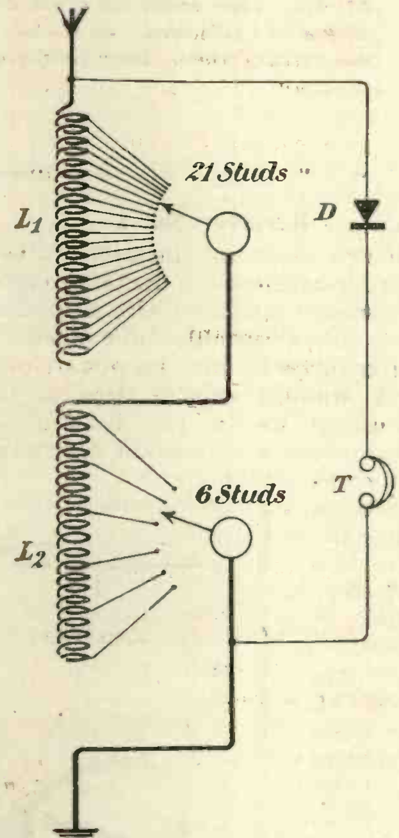


Fig. 3.—Practical circuit diagram.

however, may be used, but it should preferably be insulated.

The telephone T may either be of the single type, which type may be purchased for about 7s. 6d., or the double type, which are preferable. In any case, the resistance of the telephones should be at least 1,000 ohms, and it is cheaper in the long run to obtain the telephone receivers from a reliable firm. Several of the best makers of telephone receivers advertise in this journal.

It might be asked why it is important to connect the detector terminals in the way described. The reason why, if these connections were reversed, the design would not be so good, is because the terminal connected to the spring which touches the crystal is practically at the same potential as the earth. Touching the terminal head which adjusts the spring of the detector does not, therefore, in any way affect the signals heard, but, on the other hand, if the other terminal or the crystal cup is touched with the finger, there would be an immediate reduction in signal strength owing to the fact that the high-frequency current would leak away through the human body, which may be considered always as being at earth potential. If the leads to the detector were reversed, the adjusting knob would be directly connected to the aerial, and touching it would result in a loss of signal strength, which, however, would be restored when the hand left the detector. It would not, however, be possible to keep the hand on the terminal and adjust the sensitiveness of the crystal detector by noting the strength of the signals.

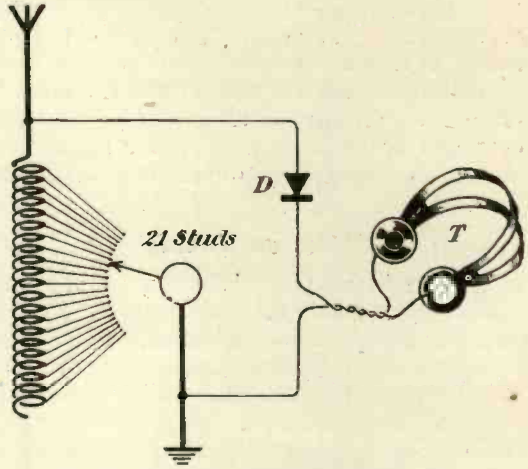


Fig. 5.—Circuital arrangement of Fig. 4.

Diagram of Circuit

Fig. 2 shows how the apparatus just described would be illustrated by a circuit diagram. It will be seen that the two inductances are shown as L_1 and L_2, while the detector and telephones are connected across the used portion of these coils.

Fig. 3 shows more exactly the circuit employed and the various tappings and studs are shown.

Method of Operating the Set

The set illustrated in Fig. 1 may be operated very readily.

The first thing to do is to adjust the crystal detector D so that the end of the spring rests lightly on the surface of the crystal. Having done this, the telephone receivers are placed on the head and the switch arm on the inductance L_2 is moved on the stud which cuts out the whole of the inductance L_2. We now really have in circuit only the inductance L_1 and, by adjusting the selector switch handle on this inductance, it is possible to obtain anything from 0 to 20 turns of inductance, and the switch arm should be moved from 0 to 21 studs to see whether any station is working.

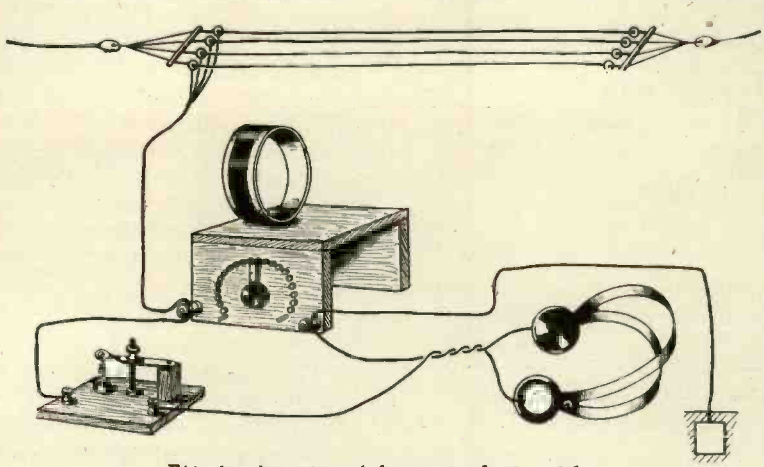


Fig. 4.—Arrangement for use on long aerials.

If a signal of any sort is heard, the detector D should be more carefully adjusted by trying different points on the crystal and also varying the pressure of the spring on the crystal. Having obtained as loud results as possible, the searching process should be continued. Having searched all over the studs on the inductance L_1, the next step to take is to move the selector switch arm on to the first active stud on the 100-turn inductance L_2. When on this first stud we have, permanently connected in the aerial, 20 turns of inductance and by searching again on the inductance L_1 by moving the selector switch backwards and forwards over the studs it is possible to obtain anything from 20 to 40 turns of inductance in the aerial circuit. If nothing is heard during this process, even after trying one or two adjustments of the detector, try the second active stud of the inductance L_2. Forty turns of inductance will now be permanently included in the aerial, and an adjustment of the selector switch on the adjustment L_1 will enable us to obtain any number of turns from 40 to 60. The same process is repeated, and when, say, a broadcasting station is heard, the two sets of switches should be carefully adjusted until the loudest results are obtained. Do not be satisfied unless you are able to weaken the signals by variation of inductance on either side of the value chosen.

A Note on Tuning

It will be found that signals are sometimes obtained either, say, on stud 3 on the inductance L_2 and the whole of the inductance L_1, or on stud 4 of L_2 and, say, only the first turn of the inductance L_1. It is a matter purely of trial, and the adjustment which gives the best result should be adhered to. Once signals have been heard, the crystal detector should be adjusted and should not be touched unless signals go off in strength.

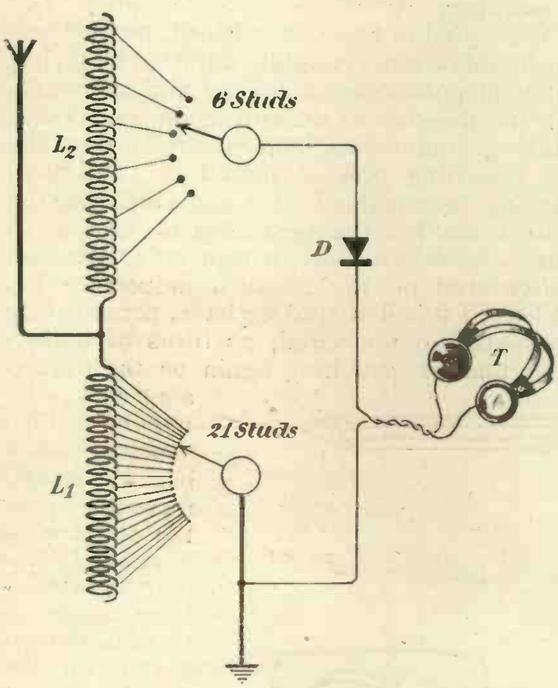


Fig. 6.—An experimental circuit.

Continuous scratching of the crystal in an endeavour to obtain louder results only impairs the sensitiveness of the delicate surface of the detector crystal.

Arrangement for Use on Long Aerials

When it is desired to receive very short wavelengths or signals on the broadcast wave band when an aerial having several wires is employed, it may be found possible to dispense with the 100-turn inductance and simply to work on the 20-turn coil.

The apparatus is now arranged as shown in Fig. 4. It will be seen that the inductance is shunted by the crystal detector and telephones T and that no additional inductance is needed. A four-wire aerial is shown in use, but, of course, it is entirely a matter of trial as to whether a single inductance is to be employed. In any case, it must not be imagined that because broadcasting may be received on the 20-turn inductance that the other inductance will not be needed, because both inductances will be found suitable when longer wavelength ranges are desired. On the apparatus described in this issue it should be possible to receive very many spark stations, such as ship and coast stations working in the Morse code. These stations work on 600 metres mostly, and will be found if an adjustment of inductance just above the broadcast wavelength is made.

Fig. 5 shows the circuital arrangement of Fig. 4.

Use of Telephone Condenser

In all these circuits no mention is made of a telephone condenser as we do not really at this stage need to employ one. A telephone condenser in many cases results in no improvement in signal strength, but later we propose to describe how to make such a condenser very simply.

Another Arrangement to Try

Fig. 6 shows an experimental circuit which the reader may care to try out, as it sometimes will give rather better results than the more straightforward circuit of Fig. 3. We now include the inductance L_1 tapped at every turn directly in the aerial circuit, while the other inductance L_2 having 100 turns is connected in the detector circuit, but is outside the aerial circuit, which simply includes the aerial, the used portion of L_1 and the earth. Both inductances are carefully adjusted until the loudest results are obtained in the telephones. Experiments may be tried by placing the two coils L_1 and L_2 close together.

This class of circuit sometimes gives better results when a long aerial, or one containing a number of wires, is employed. For general use we would advise the arrangement of Fig. 3 which is shown pictorially arranged in Fig. 1.

Special Note

Since writing the first two instalments of this unit system, the author has found it desirable to wax the two inductance coils so that there is no fear of the turns slipping off.

Apparatus we have tested

Conducted by A. D. COWPER, B.Sc. (London), M.Sc.

A Two-unit Four-valve Broadcast Receiver

MESSRS. Leslie McMichael, Ltd., have submitted for test two units, a two-valve H.F. Amplifier-detector, and a two-valve L.F. Amplifying unit.

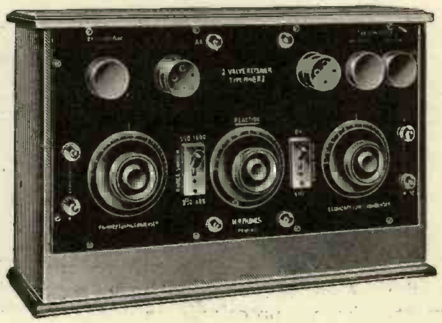
The first, the M.H.B.R.2, is a very highly finished and handsome "B.B.C." receiver, with the one H.F. amplifying valve followed by and coupled with the detector valve through a very efficient type of intervalve coupling with adjustable reaction (allowed here by the P.M.G.) on this coupling. The enclosed tuning device is controlled by two two-way switches and covers the range of 350-1,000 metres on a P.M.G. aerial; provision is made for plug-in coils of usual type to cover any higher wavelength, in a very neat manner.

The reaction allows of "search" with the second (detector) valve oscillating quite quietly—no interference can possibly be caused through oscillations getting back to the aerial—over the whole range. With critical reaction, the tuning is quite sharp, and pretty selective considering the relative simplicity of control: only three adjustments being required—primary, secondary, and reactance. For simplicity, no filament resistances are used, simply a switch with a four-volt battery.

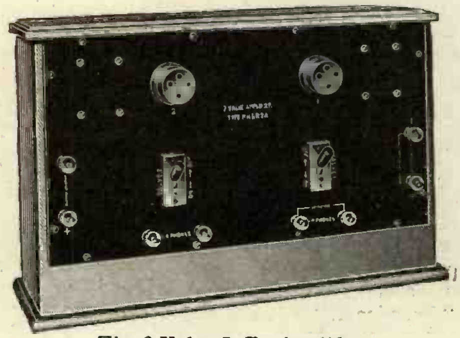
With a good twin 40-foot P.M.G. aerial in the outer suburbs, 2LO gave a reasonable measure of loud-speaking; was loud on a low single 30-foot aerial and audible without any aerial at all—a sufficient testimony to the efficiency of the adjustable reaction fitted. Cardiff, Newcastle, and Glasgow were tuned in successively without any difficulty in the intervals of 2LO.

The workmanship both exterior and interior is of a very high order; the business-like design and arrangement of the interior fittings show the results of experience. Controls worked smoothly; there were signs of careful inspection and effective testing of each instrument before issue.

A minor criticism might be offered as to the exposed position of the valves, and the experimenter would no doubt, if the set had been designed for him, have preferred a filament rheostat. A thoroughly sound piece of work.



The Amplifier-Detector.



The 2-Valve L.F. Amplifier.

L.F. Amplifying Unit, M.H.B.R. 2A.

This is a two-valve amplifier uniform with M.H.B.R.2, and arranged to link up with the former.

The finish and general appearance and interior workmanship are of the same high order. The switch gear is particularly convenient: the two first valves alone, with one note-magnifier, or all four valves can be used at will, by snapping either of two switches, which simultaneously turn on and off the valve filaments. As in the former instrument, no filament resistances are used. Provision is made for both high-resistance 'phones and loud-speaker.

In conjunction with M.H.B.R.2, a magnificent volume of sound was obtained from 2LO, using an R4 valve as power-amplifier in the last stage: too loud for a small room, and readily audible and measurable 100 yards away from the house, with loud-speaker inside and facing the open door. The dance-music came through loud enough for an open-air dance on the lawn; the late transmission relayed from Glasgow *via* 2LO was similarly audible all over the house. The other broadcasting stations (including Glasgow) and 10-watt amateurs came in on the loud-speaker, and were readily tuned in without head-'phones.

There was complete absence of parasitic noises—the transformers had been placed with evident care—and remarkably little distortion unless reaction was pushed too far.

The two instruments make a very fine set indeed for the reception of broadcasting.

Broadcasting News

BY OUR SPECIAL CORRESPONDENT.

By the time these notes appear we hope that the vexed problem of the third licence will be solved for a considerable time. The question of copyright should also be disposed of soon, and finality reached with regard to the broadcasting of plays. After which it is to be hoped that the B.B.C. will be able to get on with its job of providing first-class programmes.

* * *

One extraordinary feature of the protracted proceedings with the P.M.G. was the unprecedented way in which he seemed ready to give interviews to all and sundry who should ask him. It has hitherto not been the custom for Cabinet Ministers to discuss uncompleted negotiations with the Press. But it is undoubtedly the case that the P.M.G. was greatly impressed by the public interest in the matter, and it is all to the good that he has dispensed with red tape.

* * *

Great things are promised whenever 2LO is transferred to the new studio at 2, Savoy Hill. The Grenadier Guards Band will probably lead off, and a strong effort will be made to induce Lord Birkenhead and other eminent people to "broadcast."

* * *

The Women's Half Hour promises to be a great success. There will be talks by Lady Duff Gordon on fashion, Gossip by Ariel, cookery recipes, talks on babies, household problems, shopping novelties, etc. Although this paper appeals primarily to the masculine mind, the wise man will be grateful for the tip and have his set judiciously out of order while these shopping novelties are on. Some of the items will be given from every station. Lady Gordon's talks will be repeated from each station by various ladies.

* * *

A special quarter of an hour for men is to be introduced into all the programmes, with useful homely hints on "How to catch a tiger," and things of that sort. There are to be talks on sport—(but no tips will be given)—dress, golf, and hobbies. The things that are supposed to interest men will all be authoritatively and interestingly treated.

* * *

One of the most interesting incidents of the recent conference between the B.B.C. and representatives of the Press was the duel between a journalist and Mr. Godfrey Isaacs. The man of the ready pen took it upon himself to give Mr. Isaacs a lesson on finance. The smile on the face of the latter was a thing for chuckling over for many a day to come.

* * *

Captain P. P. Eckersley, the humourist-in-chief to the British Broadcasting Company (incidently he is also the company's engineer) is reviving the "Wireless Follies" which were so popular a feature of the Writtle Entertainments. He proposes to give a talk to boys "on choosing a career."

* * *

It may be recalled that Mr. F. Lloyd, of Sheffield, enlivened the somewhat prosaic statutory meeting of the B.B.C. by saying that reception in Sheffield was "like an insurrection in Hell." Captain Eckersley has been making experiments in Sheffield, and a sub-transmitting station will probably be built at the University. It will be of about 100 watts power. The London programme will be received in the ordinary way, and then amplified at the sub-station for the benefit of the Sheffield listener-in. If the experiment is successful the sub-station may be introduced into other parts of the country not properly served at present.

* * *

It has been stated "authentically" in the press lately, that (1) Bournemouth shall be the centre of the new South of England Broadcasting station. (2) Plymouth has been definitely promised the new station. (3) That Southampton will probably be the venue. The fact is that no promise has been made to any locality. It may ultimately be that the new station will be on an island. The difficulty is to reduce shielding to a minimum.

* * *

Relaying experiments are still being carried on. The other evening a Glasgow concert was radiated from 2LO, and very good results were obtained.

* * *

It is rather surprising that although most broadcasting stations receive an enormous number of letters of appreciation, the Glasgow station gets very few letters of any kind. The B.B.C. should not be downhearted, however. The fact that the Scots are not complaining is the highest praise of the quality of the programmes.

* * *

It is a curious fact that the Glasgow Station has been well heard in Stockholm, Madrid, Torquay, and Cornwall, but it is being heard very badly in Aberdeen. The Aberdeen people have practically been promised a broadcasting station of their own, and they are not so stupid as to convey the impression that they can hear Glasgow quite well and that it would serve their purpose all right. Sensible folk—the Aberdonians!

* * *

The Cardiff Sunday programmes are attracting great attention. The broadcasting of *Parsifal* was one of the biggest successes since the Covent Garden operas.

* * *

It is hoped that during the summer the performances of the Grenadier Guards Band will be broadcast not only from London, but from every other station of the B.B.C. near which the band happens to be playing.

A provincial ex-Mayor has been very much annoyed because the B.B.C. wished to see his manuscript before broadcasting it. He refused to submit to such an indignity. The precaution, however, is necessary. One bland reverend gentleman was advertised to speak on "The Love of God." He had no manuscript. He kept on his topic for two minutes, and then launched out into a diatribe against those who held different political opinions from himself. The poor announcer was in desperation, but he could do nothing. Since that nerve-trying episode the B.B.C. has exercised its right to know exactly what is to be broadcast.

* * *

The site of the new Manchester Broadcasting Station will probably be in the vicinity of Deansgate.

* * *

There seems to be an erroneous impression that the British National Opera Company has refused to allow its performances to be broadcast because owing to other circumstances there were no transmissions of the operas at Cardiff. When the B.N.O.C. open at Covent Garden, it is hoped that opera will be transmitted once more. The relations with the B.B.C. are most cordial.

* * *

Tests have been carried out by 2LO radiating concerts to America. The results are not yet to hand.

* * *

At the date of going to press the all-important question of the constructor's licence has not been decided. No doubt, however, by the time that this appears the Postmaster-General will have made some decision in the matter. Wireless prophets, however, have been so often in the wrong that he is a brave man who ventures to say that anything is likely to happen before a given date.

* * *

The Press has certainly become very active in dealing with the licence question. The *Daily Express*, particularly, became excited, but like many other papers which have attempted to discuss technical problems, failed to realise the impression they would make on those of their readers who knew the whole situation. In wireless, particularly, it has become necessary for specialists to deal with specialist problems.

Mr. Stanton Jeffries, Musical Director of 2LO.

At the same time, any publicity which brings to light manifest injustices is all to the good. If the grumble is overdone and the wrong people blamed, the situation is rendered more complex, but at the same time public attention is drawn to the matter, and when this happens those in authority tend to act more expeditiously

* * *

The Postmaster-General favours a constructor's licence costing 10s., and is against the marking of component parts with the B.B.C. stamp. This is excellent news for the beginner, but whether the British Broadcasting Company can really carry on an efficient service with 5s. from each licence is somewhat doubtful. None of us would like to see the company go into liquidation.

* * *

Mr. Reith has stated that the studio of 2LO is to be removed from Marconi House to the offices of the company at 2, Savoy Hill on May 1st. The first programme will be particularly good and should not be missed.

* * *

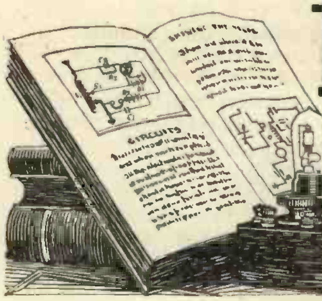
The British Broadcasting Company were proposing to broadcast the Duke of York's wedding, but although the Duke gave his consent (the Duke himself is a wireless enthusiast), the Dean and Chapter of Westminster Abbey declined to agree to it.

This seems to us rather a narrow-minded attitude to take up. After all, the Bishop of London has spoken by wireless, and many other eminent clergymen have used the medium of the ether to reach the ears of a great audience. Why, then, should certain dignitaries object to the broadcasting of such a happy event as the Duke of York's wedding?

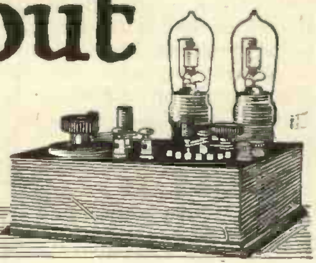
REGULAR BROADCASTING

London	2LO	369 metres.	Newcastle	5NO	400 metres.
Birmingham	5IT	420 ,,	Cardiff	5WA	353 ,,
Manchester	2ZY	385 ,,	Glasgow	5SC	415 ,,

All work between 11.30 a.m.—12.30 p.m., and 5.30 p.m.—about 10.30 p.m.



Mainly about Valves



A causerie relating to the use of valves. This feature will appear every week and will be conducted by the Editor.

Distortion Effects in Valve Receivers

IT is surprising the number of valve receivers in which avoidable distortion occurs. One of the main troubles is that distortion occurs at the rectifying stage. It is important to see that the detector valve is carrying out its functions properly and that the grid condenser and gridleak have suitable values. A variable gridleak often assists matters, but, on the other hand, most of the types met with are very much worse than a reliable fixed gridleak, as the contact with the high resistance is often very faulty and the set may, in many cases, be working without a gridleak path at all, in which case distortion is very likely to occur. The far end of the gridleak may be connected either to the negative or positive terminal of the filament accumulator, and it is a question of trial in each case to see which gives the best results.

A crystal detector will often be found to give purer speech than a detector valve, but this need not be so if the detector valve is operating properly. It is important to see that the high tension voltage on a detector valve is at a suitable value, and many experimenters have a separate tapping from the high tension battery for the anode of the detector valve.

Distortion effects often occur in the low-frequency amplifier part of the apparatus, and here the trouble is due in many cases to faulty design of the intervalve transformer.

If intervalve transformers are purchased, it is worth while paying a little more to get a really sound article. One of the causes of distortion is that the low-frequency amplifier part of the apparatus tends to oscillate and a reaction effect is obtained which unquestionably strengthens certain notes more than others. Low-frequency circuits rarely receive the same attention as the high-frequency circuits, although almost equally important.

More than two stages of low-frequency amplification are not advisable owing to the tendency of the amplifier to oscillate. Speech may sometimes be made more mellow by connecting anode resistances having a value of about 100,000 ohms across the primary and secondary of each intervalve iron-core transformer. Condensers in these positions also somewhat improve the tone, but each type of intervalve transformer has to be treated on its own merits.

The common fault is to expect loud signals when only a small value of H.T. is used. The valves only have a certain output, and this is determined by the length of the characteristic curve of the valve. By increasing the filament temperature and by increasing the high tension voltage the curve may be made considerably longer, and provided the operating point lies somewhere along the steep, straight portion of the characteristic curve, distortion, due to the representative point travelling round one or other of the bends of the characteristic curve, may be avoided.

The question of operating the valve so as to avoid distortion effects is very often the same as the question of operating loud speakers effectively.

Operating Loud Speakers

There are very few who seem to be able to get really good results out of a loud speaker. One hears different comments about the different commercial types. In many cases those who are most emphatic in their opinions regarding loud speakers fail to get the best results through lack of knowledge of some of the essential precautions which have to be taken when working these instruments.

The most important cause of disappointment is the supply of distorted current to the loud speaker itself. Many blame the loud speaker for not reproducing good speech when the real trouble is that the distortion takes place in the receiver itself and not in the loud speaker.

The last valve of the receiver is probably the cause of most of the distortion experienced when using a loud speaker. Assuming that there is no distortion in the detector valve, and that the intervalve transformers are of a reliable make, the trouble is usually that the last valve is not operating at a suitable point on its grid voltage anode current curve.

Fig. 1 shows a typical characteristic curve of a valve operating as an amplifier, the loud speaker being included in the anode circuit.

It is always unwise to allow the grid potential of an amplifying valve to become too positive or, in fact, positive at all, as the establishment of a grid current introduces damping which, in turn, results in distortion and loss of signal strength.

If the alternating potential variations applied to the grid of the last valve have a value of 10 volts, it is important to see that the negative potential on the grid of the last valve is at least −10 volts. If this negative potential were applied in the case of a valve working with an anode voltage of about 50 volts, the representative point would be near the lower bend and very considerable distortion and loss of signal strength would be experienced.

When using the valve as an amplifier the operating point should lie about half-way along the steep straight portion of the characteristic curve, and when a fairly high negative potential is applied to the grid of a valve it is necessary to increase the anode potential in order to keep the operating point at the required position on the characteristic curve.

Fig. 1 shows a characteristic curve of a power amplifier. It will be seen that the straight portion BD of the characteristic curve lies to the left of the vertical ordinate OX through zero grid potential. In the case of an ordinary amplifying valve, this line would pass through about the middle point on the characteristic curve.

In order that we may operate at the point C, half-way between B and D, it will be seen that a negative potential of several volts is necessary on the grid.

In order to arrange the characteristic curve A B C D so that it comes to the left of the vertical ordinate OX, it will be necessary to use a higher anode voltage, and the effect of increasing the anode voltage is to shift the characteristic curve to the left. An additional advantage of a higher anode voltage is that, when combined with an increase in the filament current, the characteristic curve between B and D is longer, and therefore, if the alternating potentials applied to the grid of the last valve are large, the representative point on the characteristic curve will not travel round the bends B and D, as they would do if the characteristic curve were short, due to too low an anode voltage and too small a filament current.

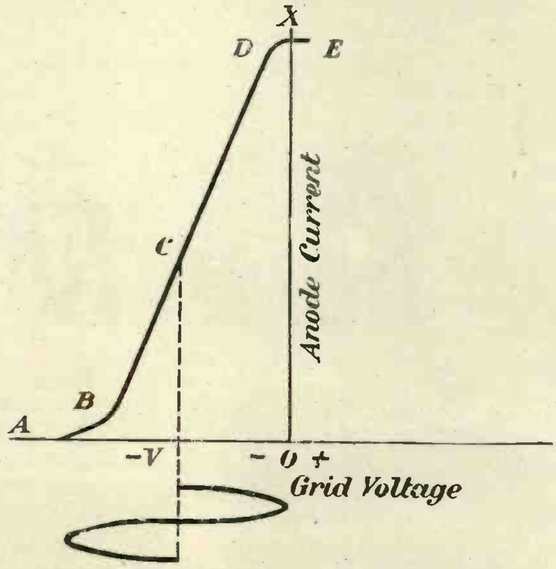


Fig. 1.—Characteristic curve of a power amplifier.

ELECTRICAL THEORY OF MATTER. *(Continued from page* 172.)

chlorine atom has become a negative chlorine ion (Fig. 4). The presence of these ions in the liquid accounts for its electrical conductivity, substances which, on solution, yield electrically conducting liquids being well known by the name of "electrolytes." If electrodes are immersed in the liquid and an electric field established, the negative ions will drift towards the positive electrode and the positive ions towards the negative electrode. The separation of the parts of a molecule into ions when in solution is called "electrolytic dissociation."

It should be mentioned that some atoms are very well "satisfied" both quantitatively and qualitatively; their rings of electrons are very stable, so that there is no tendency for them to borrow or loan electrons. They will, therefore, have no occasion for "satisfying" themselves by combination into molecules, and we find that elements whose atoms are of this character are chemically "inert" substances such as helium, argon, neon, and krypton.

(To be continued.)

A THREE OR FOUR-VALVE RECEIVER USING VARIOMETERS

Last week we described the use of variometers for aerial tuning and intervalve coupling. This week we are describing the development of the two-valve circuit so as to form a three or four-valve receiver.

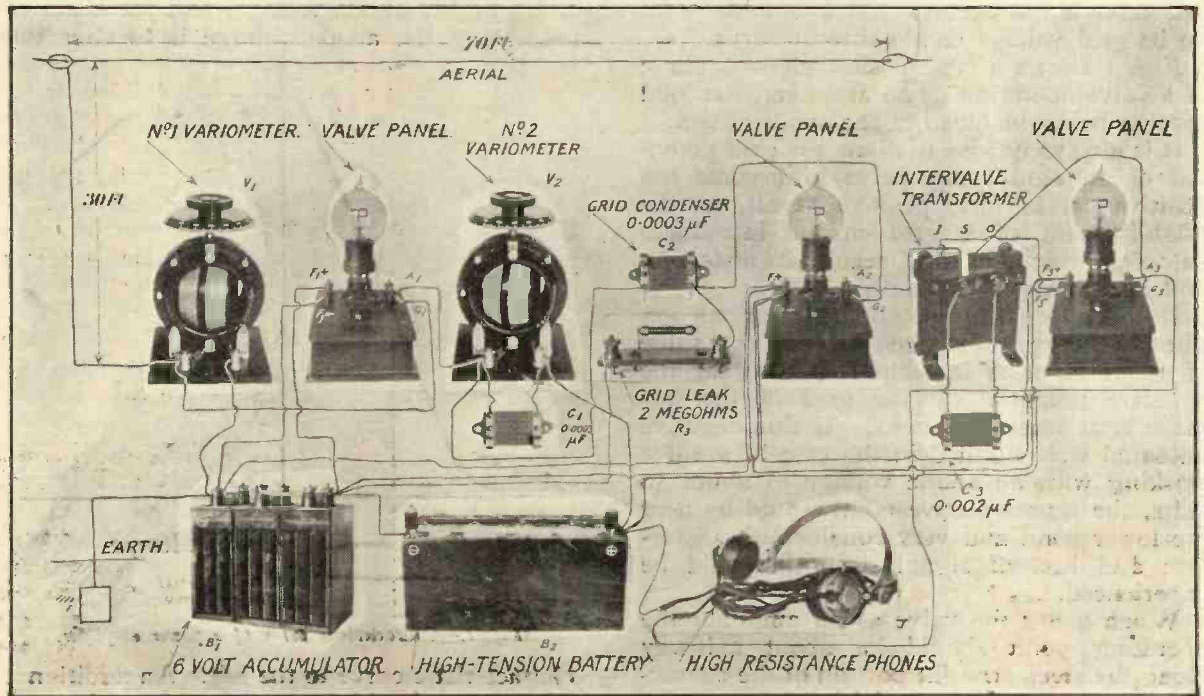


Fig. 4.—The complete 3-valve circuit.

THE arrangement described last week will give considerably stronger signals by the addition of a low-frequency amplifying valve. The additional requirements are a valve panel and an iron-core step-up intervalve transformer. Both of these should preferably be purchased, particularly the intervalve transformer.

Fig. 4 shows the complete circuit. It will be seen that the aerial circuit is tuned by the variometer V_1, the anode circuit of the first valve consisting of the variometer V_2, which is exactly similar to V_1, shunted by a fixed condenser C_1 having a capacity of 0.0003 μF. This fixed condenser is, in fact, a grid condenser, and the actual one employed in these tests was of the Dubilier type. A grid condenser C_2 has a capacity of about 0.0003 μF, while the grid leak is either variable or has a value in the neighbourhood of 2 megohms. This leak R_3 is connected directly between the grid and the positive terminal of the filament accumulator B_1, which should preferably be a 6-volt accumulator. The anode circuit of the second valve contains the primary T_1 of a step-up transformer T_2. The secondary T_2 is connected between the grid of the third valve and the negative terminal of the filament accumulator. The anode circuit of the third valve contains the telephones T.

This circuit ought to work a loud speaker comfortably when at a distance of 20 miles from a broadcasting station. The actual tests carried out at 10 miles gave very good results on a loud speaker.

Fig. 5 is a wiring diagram of the complete arrangement of apparatus. It will be seen that purchased valve panels are used, although, of course, it would be possible to make these in accordance with the instructions given, for example, in *Modern Wireless*, Vol. I., No. 3, page 217.

The Four-Valve Set

Fig. 6 shows the four-valve set which requires an additional valve panel and low frequency intervalve transformer. It will be seen that the circuit is the same as Fig. 4, the only difference being that an additional transformer T_3, T_4 is connected, so that the primary winding T_3 is in the anode circuit of the third valve, and the secondary winding T_4 in the grid circuit of the fourth valve. In the anode circuit of this latter valve we have either the telephone receivers (which should be of high resistance, of course, whenever included directly in the anode circuit of the valve), or a loud speaker. This apparatus, like the others, only requires

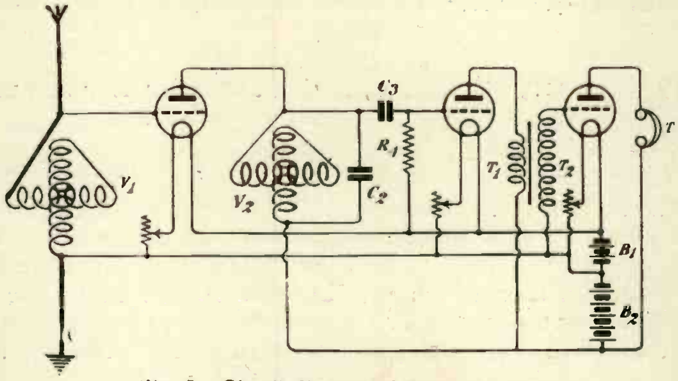


Fig. 5.—Circuit diagram of three-valve receiver.

apparatus, and it will be seen that a very sensitive receiver may be built out of the various component parts at a very economical price.

The four-valve set will be found to work excellently over distances of 50 miles. When close to a broadcasting station the last valve should preferably be of the special power type for use with loud speakers, and an additional 30 or 40 volts may be given to the anode. This may be done by simply adding a battery of 30 or 40 volts in series with the anode of the last valve. It might, for example, be connected between the bottom terminal of the telephones and the positive terminal of the high tension battery

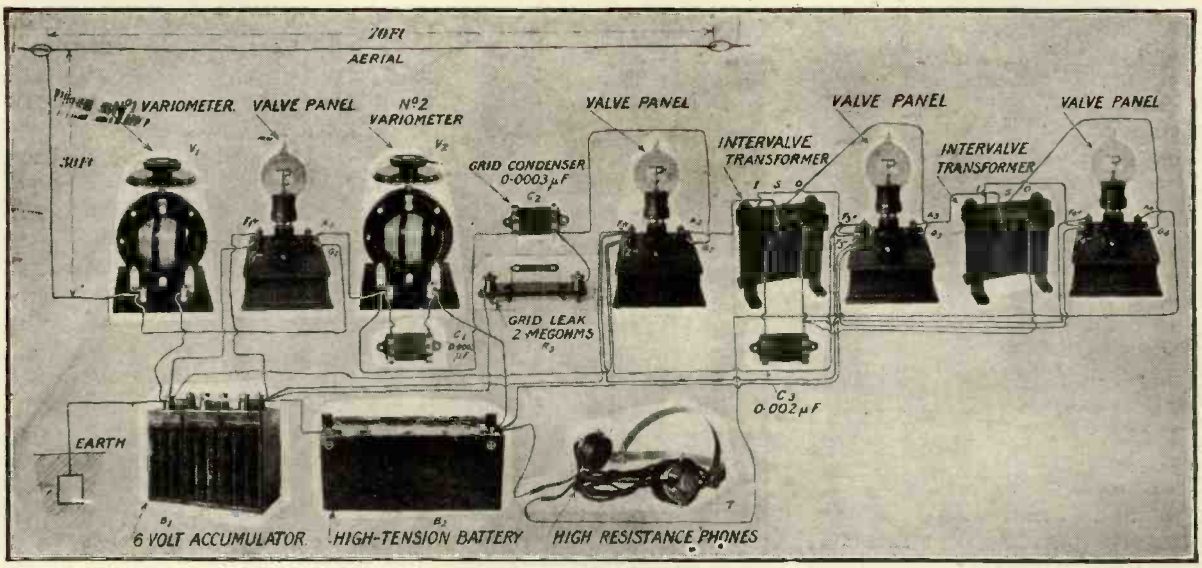


Fig. 6.—The four-valve receiver.

two adjustments, provided the filaments are illuminated to the correct degree. These two adjustments are those of the two variometers V_1 and V_2.

Fig. 6 shows the general layout of the

B_2, which may have a value of about 70 volts.

(N.B.—The variometers used were supplied by McLelland and Co.)

A NEW MAGNETIC WIRELESS RECORDING DEVICE

The following account is based upon a Lecture delivered before the Institution of Electrical Engineers on April 11th by N. W. McLachlan, D.Sc., one of the experts to the Marconi Company. It apparently represents an important advance in the automatic recording of both line- and wireless-telegraphy.

Introductory Summary

THE essential principle involved in this instrument is the increased sliding friction between an iron drum and a small iron shoe riding upon the surface of the drum when a magnetic force is set up between the two. The instrument consists essentially of an iron drum, as shown in Fig. 1, in which a suitable slot is arranged for housing one or more coils of wire, the ends of the coils being connected to slip-rings for the purpose of completing the circuit whilst the drum is in rotation. The shoe is machined so as to fit the surface of the drum very accurately, and is held in position by means of two opposed springs. If a signal-current passes through the coils the shoe sticks to the drum, and a considerable tangential force is necessary to cause the shoe to slide on the surface of the drum. The magnitude of the expected tangential pull has been calculated on the usual formula for the magnetic attraction and with ordinary assumptions as to coefficient of friction, but experiments have shown that the pull obtained is in some cases 50 times as great as the expected pull, so that a considerable magnification or amplification is obtained. The action of the device appears to depend upon some form of cohesive effect produced by the close contact under the magnetic force. It will be obvious that the action may be utilised in constructing a recorder or relay.

Dr. N. W. McLachlan with his apparatus.

General Description

A reference to Fig. 1 will show the general features of the device. A is the iron drum mounted upon the spindle in ball bearings, B_1, B_2, B_3 and B_4 are the slip-rings with contact brushes. It will be noticed that two cast-iron rings are fitted on to the Swedish iron drum, and it is upon these rings that the shoe actually rides; the reason for this is to facilitate replacement of the rings after wear. The drum is driven at a slow speed by means of a 15/1 worm-reducing gear, the worm being driven by a variable speed electric motor of about $\frac{1}{10}$ h.p. running at a maximum speed of 3,000 r.p.m. The shoe is cut from a ring of Swedish iron, and side play is prevented by a projection which fits into the annular slot in the drum between the cast-iron rings. The coils are arranged co-axially with the drum, and are seen in Fig. 2, which represents the plan of this part of the instrument. Fig. 3 shows a plan of the shoe and the springs. X_2 is a weak spring and serves, as seen in Fig. 4, to keep the shoe in contact with the drum. X_1 is a stronger spring, and it is against the force of this spring that the tangential pull of the shoe operates when a current is passing in the coils. It will be seen from Fig. 3 that when the shoe is given an impulse in the direction of the arrow, the system of levers will be rotated about the point P and the arm L will move transversely. In the complete instrument, the end of this arm L operates a siphon-recorder, and the markings are recorded upon a paper tape in the usual way. Owing to the large force and the relatively small inertia of the moving parts, the appearance of the tape, especially at speeds above 100 w.p.m., is claimed to be very much superior to that obtained with the usual pattern of siphon-recorder.

The description of the instrument is briefly this: A slowly-rotating iron drum is fitted with coils and has an iron shoe riding on its surface. When the signal current passes

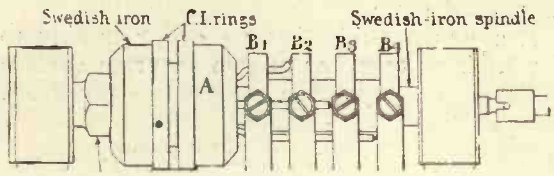


Fig. 1.

through the coils, the drum becomes magnetised and the shoe sticks to it, and is, therefore, tangentially pulled, and so operates the siphon-recorder levers. When the signal-current ceases, the shoe is released and slides easily over the surface, and the recording levers are restored by springs to their zero position.

Constructional Details

Great importance is laid upon the accurate machining of the contact surfaces of the drum and the shoe. These are machined, in the first place, to 0.0001 inch, and are subsequently ground in together by means of car-

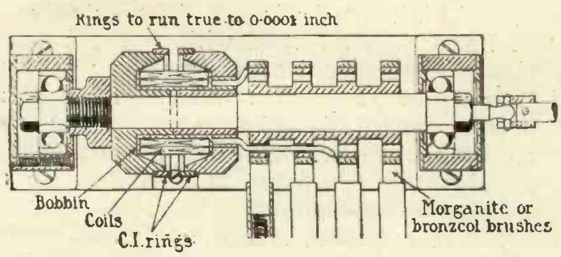


Fig. 2.

borundum paste. The life of a shoe varies from 3,000 to 5,000 hours, according to its initial thickness: a number of spare shoes are provided with each instrument. The wear on the cast-iron rings is inappreciable compared with that on the shoe. Under favourable conditions, both rings and shoe

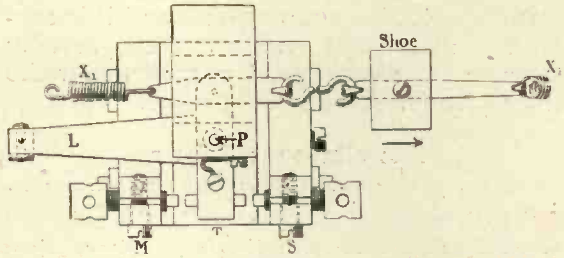


Fig. 3.

become highly polished, but should a very strong marking signal be continued for some time, a brown deposit appears; this seems to occur chiefly when the surface is getting warm.

The inductance of the drum measured at a frequency of 100 ~ is given in the following table:—

Inductance of Recorder Coils at F = 100 ~ and R.M.S. Ampere-turns = 40.

Lowmoor Iron Shoe 3/32in. thick.

No. of Turns on Coil.	Resistance (48 s.s.c.).	Inductance.	
		Shoe on.	Shoe off.
	Ohms.	Henrys.	Henrys.
500	—	0·16	0·125
1,000	—	0·65	0·5
2,000	1,900 (outer coil)	2·6	2·0
4,000	—	10·4	8·0
8,000	—	41·6	32·8

The recorder may be used in single-current or double-current line working, and circuit diagrams for this purpose are given.

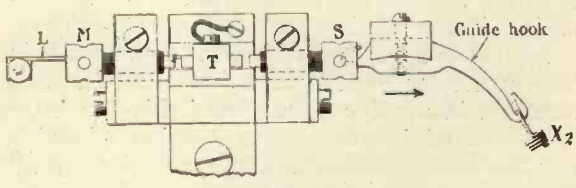


Fig. 4.

There is considerable latitude in the matter of the current through the coils of the drum. The pull on the lever increases with the current, but there is no point in increasing the current beyond an adequate working value. The controlling value is the ampere-turns: 25 ampere-turns is found to be adequate for any speed up to 250 w.p.m. in single-current working, and smaller values can be used for lower speeds.

The highest speed yet attained with this instrument is about 320 w.p.m., and it is considered that these figures are probably adequate for all practical purposes in radio telegraphy for some time to come.

Miscellaneous Effects

Since the pull on the shoe is independent of the direction of the current in the coil, the instrument may be supplied with alternating current, and the alternations appear above the datum line. This effect is, therefore, a form of *electro-mechanical rectification*. The action is enhanced by using a small polarising current in one of the coils of the drum.

If the recorder and the drum coils are connected together after the manner of an electric bell and battery current is supplied, the recorder is set into rapid *oscillation*, which is maintained so long as the battery current continues. The frequency of the note emitted under these circumstances may be varied from about 200 to 500 per second.

It has already been shown that the instrument *amplifies*, and the two foregoing paragraphs show that it also *rectifies* and *oscillates*. It therefore does *electro-mechanically* what a triode valve does *electrically*.

Since the operating current is so small, it is reasonable to expect that the recorder will function in a valve circuit, and this has been corroborated in practice, a number of valve circuits being given which have been found successful.

Tape Records

In Fig. 5 a number of specimens of the records obtained on the paper tape are given, together with the speed of working and the current in the coils of the drum.

Discussion of the Phenomenon

No satisfactory explanation has yet been found for the great discrepancy between the calculated and observed values of the sliding friction between the shoe and the drum. If B assumed uniform, and A is the total contact area, the simple formula $f=B^2A/8\pi$ should give the radial force between the shoe and the drum, and if μ is the coefficient of friction, the tangential force should be μF. It is hardly feasible that the coefficient of friction, in the accepted sense of the term, could be of the order of 30 and upwards. A considerable amount of experimental work has been done to determine the radial force upon the shoe, and although the experiments are difficult to perform, the result obtained does not by any means account for the very large value of the tangential force.

It seems possible that the action is akin to the sticking together of two accurate surface plates. Perhaps the magnetic attraction serves to bring the surfaces of the drum and shoe sufficiently near to one another to exclude air, a condition which is difficult to obtain between two curved surfaces by mechanical pressure. Lack of space, however, prevents us here from entering into a full discussion of this very interesting effect.

Dr. McLachlan demonstrated the use of this instrument at the conclusion of his lecture, and high-speed wireless signals received from Paris were recorded without the use of a relay. The instrument will pick up wireless signals without any of the mechanical relays at present employed, and may be used also to re-transmit them automatically to a land telegraph line. A message from Glace Bay, Nova Scotia, approximately 3,000 miles from the coast of England, has been received at an English coast station, automatically re-transmitted to the Post Office telegraph line, and received simultaneously in London at Marconi House.

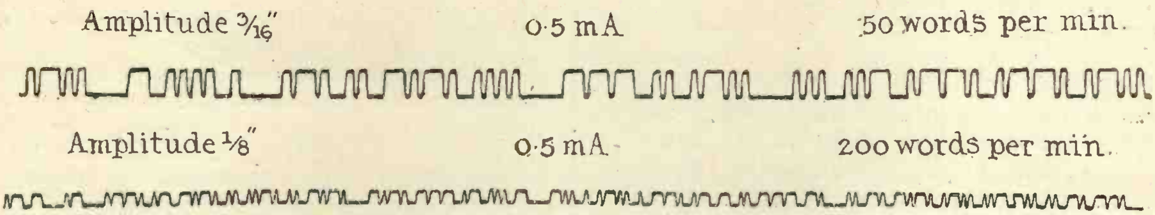
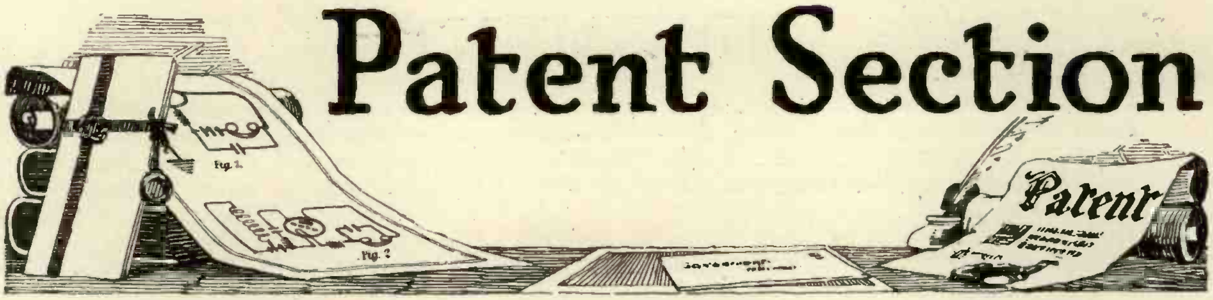


Fig. 5.

Patent Section



The following list has been specially compiled for "Wireless Weekly" by Mr. H. T. P. GEE, Patent Agent, Staple House, 51 and 52, Chancery Lane, W.C.2, and at 70, George Street, Croydon, from whom copies of the full specifications published may be obtained post free on paymeut of the official price of 1s. each. We have arranged for Mr. Gee to deal with questions relating to Patents, Designs and Trade Marks. Letters should be sent to him direct at the above address.

APPLICATIONS FOR PATENTS

8468. ASTON, C. D.—Contact means for potentiometers, etc. March 26th.
8468. GLEDALL, E. D.—Contact means for potentiometers, etc. March 26th.
8985. AVERY, A. H., AND KENT, LTD., G.—Rheostats. March 29th.
8825. BASTOW, F.—Crystal detector. March 28th.
9035. BENNETT, C. G., AND L. W.—Electric switches. March 29th.
9031. BRITISH THOMSON-HOUSTON CO., LTD.—Electron discharge apparatus. March 29th.
8828. BROWN, W. J., AND BURCH, C. R.—Wireless telegraphy, etc. March 28th.
8747. BURLI, A.—Terminal blocks for electric conductors. March 27th.
8593. BURNDEPT, LTD., AND PHILLIPS, C. F.—Wireless apparatus. March 26th.
8781. CATFORD, E. O.—Means for operating automatic electric signals. March 28th.
8866. COWPER, A. D.—Signalling receiving systems. March 28th.
8868. COWPER, A. D.—Wireless receiving-apparatus. March 28th.
8512. COX, C.—Crystal detectors. March 26th.
8680. EWART, L. A. C.—Insulator for wireless lead-in. March 27th.
8755. FITZJOHN, H. B., AND HINE, J. J.—Wireless Aerial. March 28th.
8741. GRAHAM, E. A.—Sound directing or amplifying horns, etc. March 27th.
8762. HARRISON, C., HARRISON, N. C., AND HARRISON, R. C.—Wireless receiving sets. March 28th.
8688. HUSS, S. A.—Inductance coil for wireless telegraphy, etc. March 27th.
8798. JACOBS, C. E.—Wireless headphone supports. March 28th.
8954. KNOWLES, J. R.—Recording and reproducing sound. March 29th.
8782. KYNASTON, J.—Radio receiving-apparatus. March 28th.
8898. LONG, S. H.—Thermionic valve circuits. March 29th.
8899. LONG, S. H.—Receiving continuous wave wireless signals. March 29th.
8535. LYNES, B. J.—Electromechanical sound-transmitting and reproducing devices. March 26th.
8996. MCPHERSON, W. I.—Transformers for wireless receiving-sets. March 29th.
8975. MASCHINENFABRIK OERLIKON.—Device for operation of a circuit-breaker. March 29th. (Switzerland, April 4th, 1922.)
8778. MEARS, T. de Q.—Aerials for wireless telegraphy, etc. March 28th.
8828. METROPOLITAN-VICKERS ELECTRICAL CO., LTD.—Wireless telegraphy, etc. March 28th.
8644. MITCHELL, F. B.—Reproducers for gramophones, etc. March 27th.
8762. NORRIS, G.—Wireless receiving sets. March 28th.
8696. PERNOT, F. E.—Means for receiving alternating-current signals. March 27th.
8593. PHILLIPS, C. F.—Wireless apparatus. March 26th.
8985. PISTOR, D. R. A.—Rheostats. March 29th.
8866. RADIO PRESS, LTD.—Signalling receiving systems. March 28th.
8914. RAWNSLEY, R. V.—Operating variable condensers, etc., for wireless telegraphy. March 29th.
8829. ROBINSON, J. N.—Cut-out insulators for electric circuits. March 28th. (New Zealand, May 26th, 1922.)
8702. SCOTT, W. H.—Device for opening and closing electric circuits or contacts. March 27th.
8758. SHANNON, D. S. B.—Wireless receiving-apparatus. March 28th.
8880. SILUMINITE INSULATOR CO., LTD.—Manufacture of electric insulators. March 28th.
8996. SMITH, C. P.—Transformers for wireless receiving sets. March 29th.
8866. TAGGART, J. SCOTT.—Signalling receiving systems. March 28th.
8825. THORNE, A. E.—Crystal detector. March 28th.
8820. VINCENT, A. W.—Basket aerial for wireless reception. March 28th.
8996. WESTERN ELECTRIC CO., LTD.—Transformers for wireless receiving sets. March 26th.
8997. WESTERN ELECTRIC CO., INC.—Signalling systems. March 29th.

ABSTRACTS FROM FULL PATENT SPECIFICATIONS RECENTLY PUBLISHED

192,697. WESTERN ELECTRIC CO., LTD.—In high-frequency signalling systems, particularly for use on long lines with highly-selective tuned circuits, distortion of the received signals is reduced by working the receiving-device beyond its saturation point. (January 30th, 1923.) (Convention date, February 4th, 1922.)

192,744. KEMP, G. S.—A condenser is built up of a number of metal plates with a distance piece of rubber secured to each plate. The distance pieces may comprise rings, tubes, or pads of a rectangular section. Each plate may be provided with a pair of apertured lugs at opposite ends of a diameter, by means of which the plates may be threaded alternately on two pairs of stems or rods. The plates may be made of aluminium, zinc, tin, or other metal, and may have wires soldered to them for connection as desired. (October 13th, 1921.)

192,785. PRESTON, L. G., AND SHEARGING, G.—In valve transmitting-sets wherein the valves are arranged in series or in parallel groups, with each group comprising two valves in series, signalling is effected by varying the inductance-capacity value of an intermediate circuit, coupled to the grid circuits of the series-connected valves. The normal inductance-capacity product of the intermediate circuit is identical with that of the aerial circuit. (November 9th, 1921.)

192,936. BARBER, W. E., AND WARNER, H. J.—Coils for wireless apparatus and other purposes, principally intended for use as frame aerials, are wound on metal frameworks forming part of the coil circuit. (February 25th, 1922.)

JUDGMENT

The following is the second section of the Judgment of the Court of Appeal in the action of the Marconi Company against the Mullard Radio Valve Company, Limited. It will be remembered that the Marconi Company sued the Mullard Radio Valve Company, Limited, for alleged infringement of their two Patents 28,413/13 and 126,658. Mr. Justice Lawrence held that neither of the Patents was infringed by the Defendants, and Plaintiffs appealed against this decision.

The appeal was dismissed by the Court of Appeal with costs, and the reasons for the decision are given below.

Mr. J. Hunter Gray, K.C., Mr. James Whitehead, K.C., and Mr. W. Trevor Watson (instructed by Messrs. Coward & Hawksley, Sons and Chance) appeared for the Appellants.

Sir Duncan M. Kerly, K.C., Mr. R. Moritz and Mr. Courtney Terrell (instructed by the Treasury Solicitor, Law Courts Branch) appeared for the Respondents.

(Continued from No. 2, page 105.)

I THINK no other construction is consistent with the plain language of the document or with the surrounding circumstances to which I have referred. The words "completely surround" seem to me to point in the same direction.

I think I ought to deal with two arguments of the learned Counsel for the Plaintiffs. They are, that the grid cannot be closed in the ordinary sense because, first, it is made of netting which has interstices, and, secondly, it cannot be closed because the leading-in wires have to pass through one if not both ends. I think neither of these arguments is well founded, and I think they both ignore the fact that the words are "In the form of" and "formed as closed cylinders." Of course, a cylinder formed of a wire netting, however small the mesh, cannot be entirely impervious, and the grid would not fulfil its function if it were; but there is no difficulty in rolling such a netting into the form of a cylinder and closing it in the ordinary sense, *i.e.*, at both ends. Again, I can see no reason for saying that a grid is not formed as a closed cylinder because certain leading-in wires are brought through the closed ends. The question remains: On this construction, has there been an infringement? I think not. There is no closed cylindrical grid, in the sense in which I interpret the words, in the Defendants' valve. I am inclined to doubt whether there is any grid at all; there is a loosely coiled wire, and I doubt very much whether it can be called a grid formed as a cylinder at all. At any rate, it is not formed as a closed cylinder for it has no closed ends. I am not sure that, looking at the dimensions of the straight filament used as compared with those of the coiled wire, that it is even electrically closed, or that for use in a hard valve it is necessary that it should be, but it is not necessary to decide that point; it certainly is not closed in the only proper sense in which I think the word should be used. No doubt Round's patent was a very useful invention, and if the use of soft valves had continued would very likely have held the field, but the introduction of hard valves has made it possible to produce the same result without employing the apparatus which I think was the subject of the patent. This view of the case makes it unnecessary for me to consider the question of the validity of Round's patent.

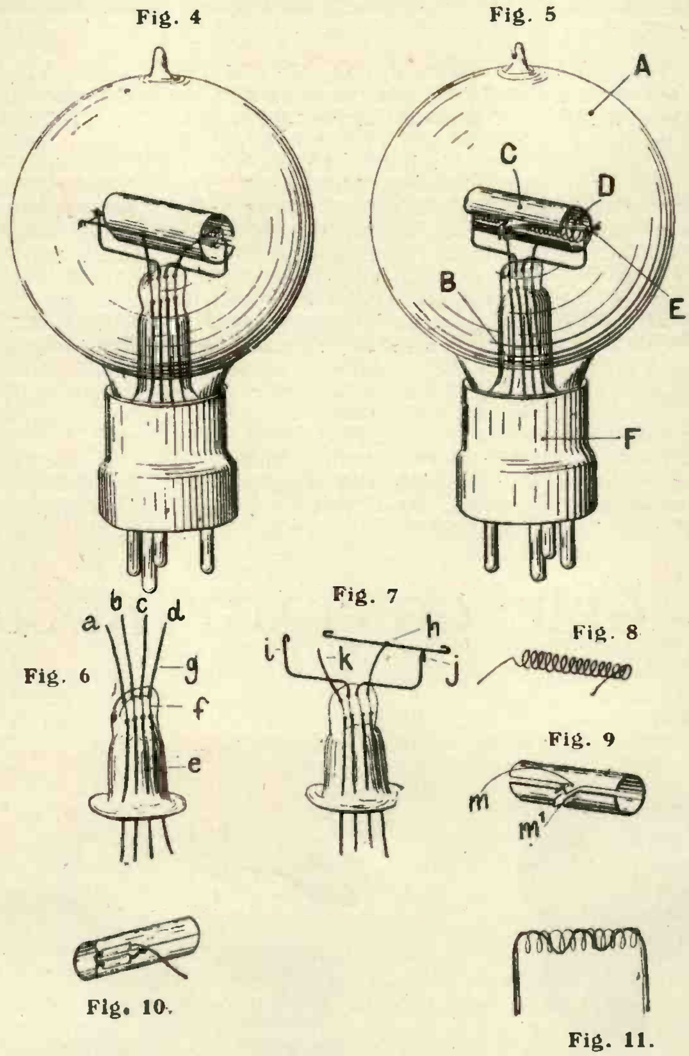
The other patent, Péri's patent, is of much less importance and I do not intend to discuss it at any length. I think Mr. Justice Lawrence has correctly construed the specification in these words: "In my opinion, therefore, his patent does not cover any forms or shapes other than those particularly described, although such other forms or shapes might operate to bring about the same results or function in the same manner. The only claim which Péri makes is to a particular method of shaping, arranging and fixing the various well-known parts of a valve of this type, so as to obtain a cheap and convenient method of manufacture whilst at the same time enabling the valve, when assembled, to perform its usual and well-known functions. As a matter of construction, the ambit of the claiming clauses in Péri's patent is, in my opinion, confirmed to a combination of the following five elements. Firstly, the filament, grid and plate must be arranged concentrically; secondly, each leading-in wire must come through the same glass foot and must form the support for its particular electrode; thirdly, the filament must consist of a straight wire stretched between the two branches of its conductor, which branches must be elastic so as to allow for the expansion and contraction of the filament; fourthly, the grid must consist of a spirally-rolled wire supported at its two ends, or in case of extra length by another spirally-rolled thicker wire with an elongated thread directed in the opposite direction to the spiral of the grid; and, fifthly, the cylindrical plate which surrounds the filament and the grid must be attached to its conductor by one or two hooks."

I entirely agree with what he has said as to the nature of the patent and the fact that there has been no infringement and the reason he has given for those conclusions, and I see no reason in repeating them. Here again there is no necessity to consider validity.

The appeal must be dismissed with costs.

LORD JUSTICE WARRINGTON: The action in which this appeal arises is an action for the alleged infringement of two patents, the property of the Plaintiffs. Mr. Justice P. O. Lawrence, before whom the action was tried, has found that, on what he holds to be in the case of each patent the true construction of the specification, neither of the patents has been infringed and the action therefore failed and was dismissed; but the learned Judge at the same time held that on the construction he adopted both patents were valid, and that the defences of want of novelty and subject-matter failed. This last decision made it necessary to deal specially with the costs, but did not otherwise affect the result of the action.

The Plaintiffs appeal against the dismissal of the action and the Defendants have given a cross notice disputing the learned Judge's finding on the issue of validity, and asking that this decision be reversed and the patents declared invalid. The first of these two patents, No. 28,143 of 1913, which I will refer to as Round's patent, is for "Improvements in receivers for use in wireless telegraphy," and relates in particular to the construction of the "valve" which forms part of the receiving apparatus. The second of the two patents, No. 126,658 of 1916, which I will refer to as Péri's patent, is for improvements of vacuum tubes of the Audion type and relates to the mode of construction of such tubes. Such tubes, though they may be used for other purposes, are most commonly used as valves. The object and effect of the valve in wireless telegraphy is to convert the high frequency alternating electric current generated in the aerial of the receiving station into a continuous current capable of conveying the signals to the receiving instrument. This conversion is generally referred to by the term "rectification." Professor Fleming discovered that if two conductors are enclosed in a vessel in which a good vacuum is made, one being heated to a high temperature, the space between the hot and cold conductors possesses an unilateral electric conductivity and negative electricity can pass from the hot conductor to the cold conductor, but not in the inverse direction.



Figs. 4 to 11.—Illustrations taken from Patent 126,658 (Péri-Biguet).

(*To be continued.*)

A Dictionary of Applied Physics. In Five Vols. Edited by Sir R. Glazebrook. (Macmillan. Price £3 3s. per Vol.) Vol. II. Electricity. (1,100 pp.)

The Dictionary of Physics meets a long-felt want, not only amongst physicists, but amongst engineers and chemists and those engaged in many other branches of science. The developments of recent years have been so rapid and so various that it is almost impossible for any individual to keep in touch with the original sources of information, and these volumes aim to present the most up-to-date collection of experimental results and prevailing theories. The work is under the able editorship of Sir Richard Glazebrook, and the various articles are contributed by well-known and acknowledged experts in their various subjects. It is obviously impossible to give here any detailed list of the contents of these 1,100 pages, but amongst representative articles may be mentioned those on photo-electricity, positive rays, electron theory and spectrum analysis, inductance and capacity measurements, dynamo-electric machinery, thermionic valves, incandescent lamps, thermionics, static transformers, and hot-wire microphones, In the list of distinguished contributors one notices the names of Sir W. H. Bragg, Prof. Allmand, Dr. Crowther, Dr. Eccles, Prof. O. W. Richardson, Prof. Fortescue, Dr. F. E. Smith, F.R.S., and the Staff of the General Electric Co.

Each article is furnished with a comprehensive and very valuable bibliography, and an elaborate system of cross-references enables the reader to obtain in a short time an amount of information which would take days of searching amongst original records. It is to be regretted that there is not, however, any simple subject index provided; this would have added greatly to the reader's convenience when wishing to make reference only to a minor point. Altogether this fine work represents a most valuable contribution to scientific literature. J. H. T. R.

THE GRIP CONTACT HOLDER

THIS invention (Patent applied for) is for use in Crystal Detectors to prevent the difficulty of accidental displacement of the "Cat-Whisker" so frequent in certain types of detectors through vibration and various other causes.

Fig. 1.—The ebonite cap fitted with copper gauze.

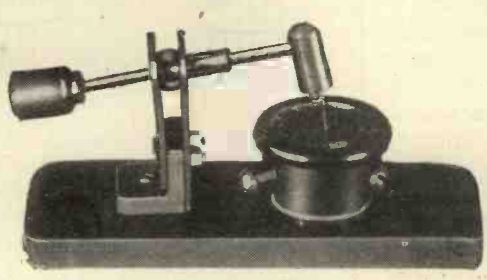


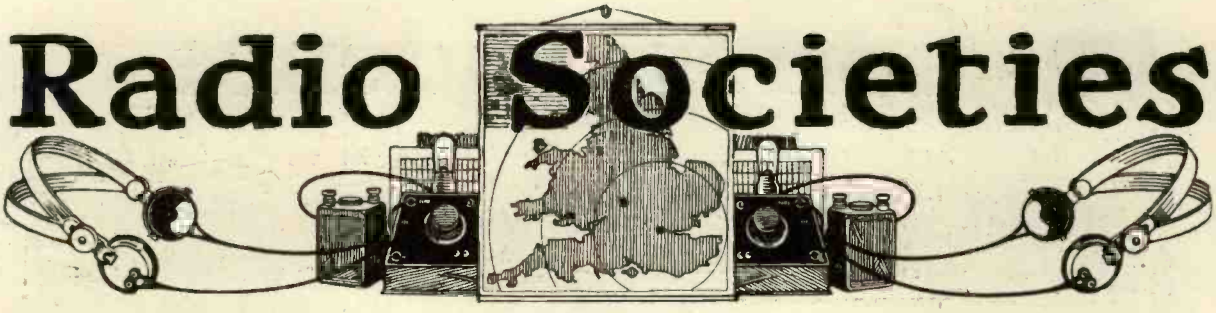
Fig. 2.—The device in use.

As can be seen by the photograph, the "Cat-Whisker" or wire can be easily passed through any part of the gauze in order to find a sensitive point of contact with the crystal.

The "Cat-Whisker" or wire in passing through the gauzes pushes the strands aside so that the natural tendency of the strands to resume their original position exerts a spring grip or hold on the "Cat-Whisker." The Grip Contact Holder is of very simple construction, having no screws or special apparatus for fixing it, can therefore be fitted in one second to any existing crystal cup, and with ordinary care will last a life-time. A good contact point once found, there is no further need to displace same, so that in not having to readjust the "Cat-Whisker" the life of the crystal is greatly extended.

It can be obtained from any supplier of wireless parts.

Radio Societies



CAMBERWELL WIRELESS & EXPERIMENTAL ASSOCIATION (H.Q., Camberwell Central Library).

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

This Snciety is giving a public demonstration at Headquarters tomorrow evening, Thursday, April 26th, and all members are at present devoting their energies to ensuring its success. Items recently under discussion included variometers, Reinartz tuners, and the advantages of electro-static over electro-magnetic reaction.

We understand that one of the members gave several lucid reasons for his preference of the former method, but, unfortunately, details are not available up to the time of going to press.

CAMBRIDGE & DISTRICT RADIO SOCIETY (H.Q., Liberal Club, Downing Street, Cambridge).

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

On Monday, the 9th of April, Mr. Diver lectured on "The Simple Crystal Set." He illustrated his remarks by blue-print diagrams of single-slide tuning circuits, advancing to double-slide inductances and then variometers and condensers. Apparatus was shown, including his own home-made gear, and an ingenious item was a condenser made from a shaving stick tin and a mica-covered tube of cardboard. The majority of the members use valve sets, owing to the distance from the nearest broadcasting station, but the lecture was keenly followed and many questions asked. Interest was shown in arrangements to reduce atmospherics. The membership of this club is now over 70.

THE RADIO SOCIETY OF HIGHGATE (H.Q., Highgate 1919 Club, South Grove, Highgate, N.6).

Hon. Sec., Mr. J. F. Stanley, B.Sc., A.C.G.I.,
49, Cholmeley Park,
Highgate, N.6.

On the 13th of April Mr. H. Andrews, B.Sc., gave the fourth lecture on the elementary theory of the valve. A brief account of the theory of the constitution of matter was given, and the subject of the development of the valve and the work of Edison, Fleming, and De Forest followed. The characteristic curves of a 3-electrode valve and the methods of obtaining them were explained, and various other matters of interest gone into. We anticipate much useful work being put in this season.

THE NORTH ESSEX WIRELESS SOCIETY (H.Q., Mechanics Institute, Braintree, Essex).

Hon. Sec., Mr. F. T. Smith,
Felsted, Essex.

This Society commenced its new year on the 4th of April, a broadcast receiving set being installed for general use in the evenings. One evening a week is devoted to technical subjects, and it is hoped to arrange for visits by very capable lecturers to assist in this direction.

HACKNEY & DISTRICT RADIO SOCIETY (H.Q., Y.M.C.A., Mare Street, Hackney, E.8).

Hon. Sec., Mr. C. C. Phillips,
247, Evering Road,
E.5.

On Thursday, April 12th, the chairman, Mr. H. A. Epton, F.B.E.A., lectured on the construction of his home-made 4-valve set. His first 2-valve set was built from a Mark III. tuner, and after gaining some useful knowledge from this he constructed a 2-valve low-frequency panel, using Radio Instrument transformers and parts from Fullerphone field telephone sets.

The detector panel was built on a Fullerphone case, and it was subsequently decided to use one high-frequency stage with switches to the high-frequency and detector valves, so that a crystal might be used. The tuner was of the three-coil type, and the potentiometer was made from a lead-pencil. An "Amplion" loud speaker was used on this receiver and gave excellent results, a fixed condenser of 0.004 μF across its terminals softening the tone considerably.

At the close of this lecture an interesting demonstration was given showing how high-frequency amplification produced much clearer signals than low-frequency, but, of course, not so loud. At the same time the superiority of the tuned anode coupling over the high-frequency transformer was clearly demonstrated.

A Dutch valve was found to work better as a detector than a French "R" valve, but was useless as an amplifier. Loud signals were subsequently received on a frame aerial.

THE HORNSEY & DISTRICT WIRELESS SOCIETY (H.Q., Queen's Hotel, Broadway, Crouch End).

Hon. Sec., Mr. H. H. Hyams,
188, Nelson Road,
Hornsey, N.8.

At a recent meeting home-made apparatus was exhibited by members, each being allotted 10 minutes to explain the method of construction employed. The evening was subsequently devoted to questions, the chairman, Mr. Carter, dealing with the subject of oscillatory currents; Mr. Manser explained, with diagrams, the rejector circuit and how to exclude broadcast concerts; whilst Mr. Doyle gave his experience of a 3 a.m. reception of American telephony.

HUDDERSFIELD WIRELESS SOCIETY (H.Q., 14, John William Street, Huddersfield).

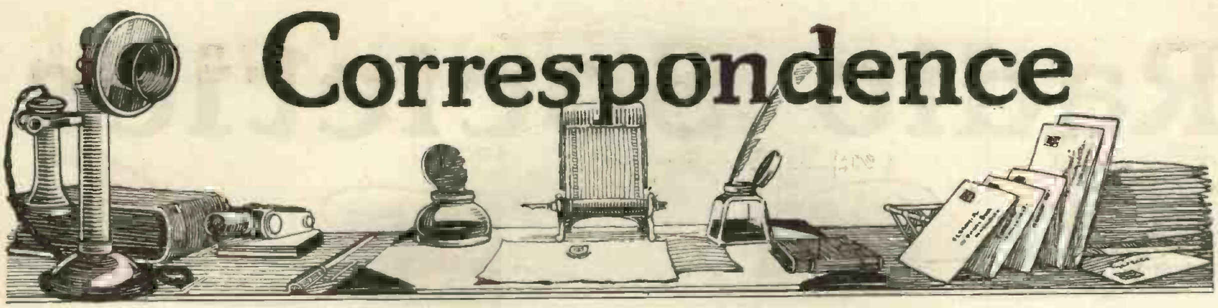
Hon. Sec., Mr. C. Dyson,
Darbey Fields, Leymoor, Golcar,
Huddersfield.

Many successful demonstrations have recently been held by this Club, and at one, telephony transmitted by two local amateurs was made audible by means of the Society's receiver, which is a 2-valve set.

An ex-army C.W. receiver has recently been converted into a telephony transmitter by the Technical Committee, 200-volt A.C. mains being used for the power supply. Interesting lectures have lately been given by Mr. S. Dyson, dealing with a 7-valve receiver and other subjects of equal interest. Considerable interest has been aroused by one member who has a frame aerial in his car, and has located some oscillating offenders in this district.

In spite of bad interference from A.C. power stations, etc., several experimenters here have recently received American broadcasting.

Correspondence



NEIGHBOURING AERIALS

To the EDITOR, *Wireless Weekly*.

SIR, — I read with interest "Snooks'" letter *re* "Effects of Neighbouring Aerials" in No. 1 of *Wireless Weekly*, as I have experienced the same trouble myself.

In my case the two aerials are end-on, there being a distance of only 5ft. between them as a common support is unfortunately used. We have found that the aerial further from the transmitter is screened by the other if it is also tuned to the same wavelength, but no screening effect can be observed if we are working on different wavelengths.

When two valve sets, both using reaction, are used a very considerable falling off of signal strength is experienced with the further set, and a perceptible decrease with the other.

Another interesting phenomenon has also been observed. When one is a simple crystal set and the other a valve employing reaction, when tuned to the same wavelength a considerable *increase* of volume is experienced with the crystal set, but no perceptible difference of signal strength occurs with the valve set.

As only preliminary tests have been carried out, a very concise report is not as yet forthcoming, but I hope at a later date to be able to supply further details.

I am, etc.,

Bedford. L. B. COOK.

To the EDITOR, *Wireless Weekly*.

SIR,—I have had an experience similar to "Snooks," Basingstoke. By experimenting I have found it best to see that the earth is not a common one, namely, a water tap. This may partly help matters. Then, if possible, draw the aerial out of parallel to the one next door. I did this by getting permission of my neighbour, who had not got an aerial, to put a pole in his tree with a rope through the top. Then I let down my aerial and joined the rope to it, not forgetting insulators. Two helpers held the ropes at the other ends, and adjustment was made quite easily. This was successful in solving the problem.

I can get 2LO on a crystal set at 20 miles quite well, with three valves in use on my next door neighbour's set.

It might interest you to know that a piece of carborundum out of a pre-war detector gave good results despite atmospherics last night; the "whisker" being a fine copper wire. I am, etc.,

Chertsey, Surrey. PARALLEL.

CARBORUNDUM

To the EDITOR, *Wireless Weekly*.

SIR,—With reference to the letter from your correspondent, C. Mulch, regarding the use of carborundum crystals without a potentiometer, I may say that I also have confounded the experts who say that it cannot be done. Although I understood that a potentiometer was necessary when using carborundum, I purchased one or two samples of this crystal and tried it on an ordinary crystal set fitted with a single slider.

The results exceeded my most sanguine expectations, for 2LO came through almost as well as with my original crystal, Hertzite. The voice of the announcer was, if anything, even clearer than before. I reside nearly 14 miles from 2LO, so that, judging from the results obtained, there is every reason to suppose that carborundum is quite an efficient detector when used without a potentiometer.

I am obtaining excellent results from my set, and four pairs of head-phones can be used without any appreciable decrease in the volume of the speech or music received. The only fly in the ointment is that a budding engineer two doors away has fitted up a lathe which he drives off a motor cycle engine. It is very disconcerting to have a noise like a machine gun suddenly butting in on the strains of 2LO. I am afraid, however, that I have no redress and shall simply have to put up with it, unless, of course, I can convert him to wireless.

In conclusion, may I congratulate you on the excellence of No. 1.

I am, etc.,

Bickley, Kent. PICKWICK.

ENTHUSIASM

To the EDITOR, *Wireless Weekly*.

SIR,—I am a busy man, but I feel that I must write to congratulate you on the great success of *Wireless Weekly*. I am not a novice at the game of wireless (I made my first set about 20 years ago), but when I bought No. 1 of *Wireless Weekly* to read in the train yesterday, I felt mighty glad that the train was a slow one and the journey long, after I had perused a few pages. It is the only periodical that I have read completely through (including adverts.) from front to back for several years.

I am giving a series of lectures on wireless and will certainly recommend my pupils to become regular subscribers. I am a great admirer of your books and *Modern Wireless*, but *Wireless Weekly* is the best, and meets a great want in a most praiseworthy manner.

I have much pleasure in wishing *Wireless Weekly*, its staff, including yourself, long life and prosperity. I am, etc.,

T. S. BAIRD,
F.C.O., F.R.M.S., F.N.A.O.
Edinburgh.

APPRECIATION

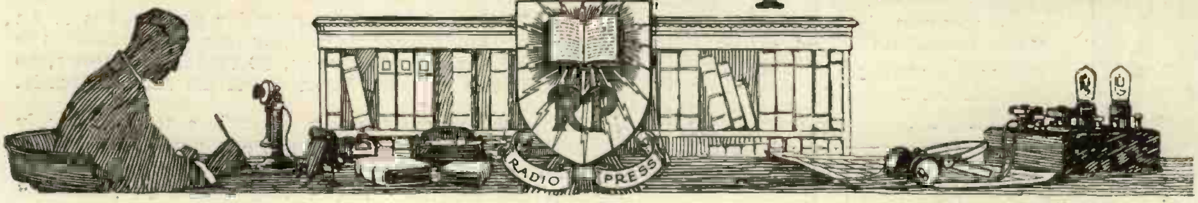
To the EDITOR, *Wireless Weekly*.

SIR,—As a reader of your excellent monthly, *Modern Wireless*, allow me to congratulate you on your latest publication, *Wireless Weekly*, which is just the paper I have been looking for.

I am, etc.,

ALEX CECIL DIXON.
Leeds. A.Inst.R.E.

Information Department



Conducted by J. H. T. ROBERTS, D.Sc., assisted by A. L. M. DOUGLAS.

In this section we will deal with all queries regarding anything which appears in "Wireless Weekly," "Modern Wireless," or Radio Press Books. Not more than three questions will be answered at once. Queries, accompanied by the Coupon from the current issue, must be enclosed in an envelope marked "Query," and addressed to the Editor. Replies will be sent by post if stamped addressed envelope is enclosed.

F. A. F. (DALMELLINGTON) is constructing the inductively coupled crystal receiver described in the April issue of "MODERN WIRELESS." He is situated about 35 miles from 5SC and wishes to know whether he will hear this station with the receiver as it stands, or if not, what amplification is necessary for satisfactory reception?

Thirty-five miles is a little beyond the capabilities of this receiver. One stage of high-frequency amplification should be used to ensure satisfactory strength of reception at this distance. Two high-frequency stages will probably be necessary to obtain Paris telephony.

K. W. (BEARSDEN) asks for a good book describing the different components of a valve receiver with working explanations of each part.

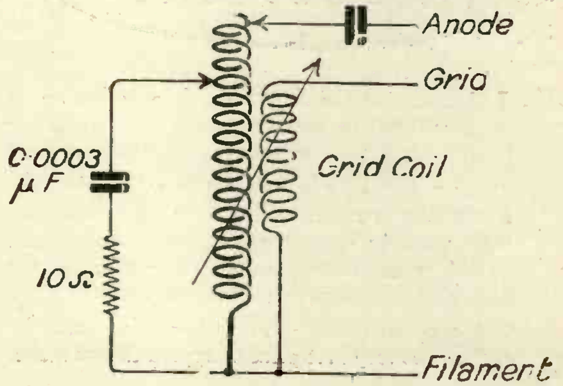
"The Construction of Wireless Receiving Apparatus," Radio Press, Limited, by Paul D. Tyers, will fill your requirements.

J. V. S. (MANOR PARK) has recently purchased an ex-Government two-valve receiving set (C.W. Mark III). He wishes to have an idea of the range of the instrument, having obtained exceedingly satisfactory reception from 2LO, and what alterations or additions would be necessary to enable him to receive from other broadcasting stations.

The receiver you mention is an exceedingly good instrument and probably the best of its class. It comprises a detector valve and one low-frequency valve, and it provides complete tuning over a range of from about 300 to 1,300 metres, with reaction. This must not, of course, be used when receiving British broadcasting. We think that situated as you are, you should be able to hear Cardiff and possibly Birmingham or Newcastle with this instrument, although it is not very selective and you may find difficulty in tuning out 2LO. A high-frequency stage could easily be added to this receiver, and any of the arrangements for this purpose sold on the "unit" system would prove suitable.

H. P. (STOCKTON-ON-TEES) has constructed a two-valve note magnifier described in No. 2 of "MODERN WIRELESS," and finds that when receiving music and speech it makes a grating noise. He asks for possible explanations of this fault.

If you are sure that your valve, high-tension battery and low-tension battery are in order, the grating noise is probably due to a loose contact in your set. The connections to filament resistances, etc., should be carefully examined and if your terminal points are not soldered this should be done. The primary of the low-frequency transformer should be shunted by a fixed condenser having a value of about 0.002 μF, and the telephone terminals should be shunted by a similar condenser. The high-tension battery may be bridged with a condenser of from .5 to 2 μF. We anticipate that grating sounds will cease altogether if these instructions are followed out.



Artificial aerial

EBONITE (CARMARTHENSHIRE) wishes to know how to make an artificial aerial for testing purposes.

We presume you mean for transmission testing purposes. In this case such an aerial consists of a condenser, resistance and the ordinary tuning inductance. No other inductance is required. The resistance might be 10 ohms, which is a fair estimate of the average resistance of an amateur transmitting aerial, and could consist of 10 yards of No. 22 gauge Eureka wire. The capacity should be about 0.0003 μF, and the condenser which constitutes it must be capable of withstanding large potential differences. It should be able to carry, perhaps, 1 ampere without excessive heating at 2,000 volts. This artificial system, consisting of the resistance and condenser in series, should be connected between where the earth lead would normally be on your circuit and a certain point on the inductance, which may be adjustable and determined by experiment. Transmissions effected on this type of aerial would not be heard any further than a few hundred yards.

J. E. B. (GLASGOW) asks for particulars of an alternating current transformer to reduce the lighting main at 100 volts, 50 cycles to 6 volts, so that he can light the filaments of his valves from it.

The detailed construction of such a transformer is rather outside the scope of these columns, but a practical working description of a vibratory rectifier incorporating such a transformer will be appearing in the course of the next week or two in this journal. We may say that we do not recommend you to use 50-cycle A.C. for lighting filaments of receiving valves without taking special precautions. The only result you will probably get will be a loud and continuous hum which will completely spoil any telephony reception.

R. E. D. (SOUTHPORT) is constructing a small telephony transmitter and wishes to know how many turns of wire to wind on an iron core to give about 1 henry inductance value as a speech choke.

The core should be ¾in. in diameter by 4½in. long, and may consist of soft iron wire. The windings should be 3,000 turns of No. 38 d.s.c. copper wire. A much better winding for a speech choke if your anode potential is sufficiently high is 20,000 turns of No. 40 s.s.c. copper wire on an iron core ¾in. in diameter and 5in. long. This gives excellent control, but gets slightly warm during working, which does not, however, have any material effect.

W. T. (SCARBOROUGH) wishes to know how many foils, what thickness of mica and what size of sheets he should use to make fixed condensers of capacities 0.01 μF and 0.001 μF.

If the thickness of the mica is 0.005 centimetres (22 mils.), the condenser of 0.01 μF will have 15 foils with an overlap of 4 by 2 centimetres, and the 0.001 μF condenser will have 7 foils with an overlap of 2 by 1 centimetres. Condensers can be more accurately calculated when their dimensions are taken in centimetres and millimetres than in inches.

C. C. V. H. (NORTHALLERTON) wishes to make a basket tuning coil for use on a 100 foot aerial to tune to 2,600 metres, when shunted by a variable condenser of 0.001 μF.

If the internal diameter of the coil (that is, of the former on which it is wound) is 2in., 250 turns of No. 28 gauge double cotton covered wire will give a reasonable overlap on this wavelength. The outside diameter of this coil will be about 4in., so it will not be too bulky for your receiver.

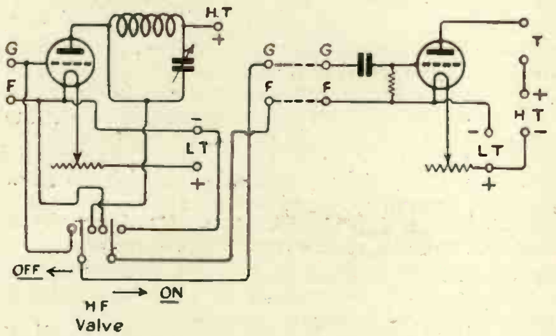
R. T. V. (PUTNEY) wishes to know (1) What amount of No. 24 gauge enamelled wire will be required to wind a tube of 4 inches by 11 inches to receive the Paris time signals. (2) If two leads can be taken in from the one aerial so that one or the other may be used at will. (3) Whether the length of the lead-in is a vital point.

(1) Just under ½ lb. of No. 24 gauge enamelled wire will be required. (2) Two leads may be taken in as indicated, and may, of course, be used alternately

when desired. (3) The length of lead-in, if it is not beyond a certain figure, is not very important. It should, of course, be kept as short as reasonably possible.

F. G. (EDGWARE ROAD, N.W.8.) wishes for a simple diagram of how to add a high-frequency amplifier to his detector panel. He proposes to use a plug-in high-frequency transformer.

We give herewith a suitable circuit diagram of the necessary arrangements.



Showing the addition of a H.F. valve to the detector panel.

A. M. (CAMPBELTOWN) asks the following questions: (1) What is the best arrangement for the lead-in from a standard single wire aerial. (2) Can a variometer be used to adjust the wave-length of a 180 to 200 metre transmitter. (3) A question regarding certain transformers described in the March issue of "MODERN WIRELESS." (4) Whether we can recommend any book giving data for the construction of transmitting apparatus.

(1) The lead-in should be taken from the end of the aerial pointing towards the transmitting station. (2) A variometer is a very suitable method of adjusting the wavelength of a short wave transmitter, as it enables the radiation factor to be constant. (3) The transformers you refer to may be any of the standard types of intervalve L.F. transformers now on the market. (4) There is no book at present published giving data for the construction of experimental transmittnig apparatus. We are always pleased to advise experimenters on this subject through these columns, and a page shortly appearing in *Modern Wireless* will be devoted exclusively to this feature in every issue.

F. J. C. (BRIDGWATER) asks the following questions: (1) Is it necessary to get a Post Office licence before erecting a wireless set. (2) What is the cost of a licence and is it an annual fee. (3) Will the crystal receiver described on page 48 of No. 1 of "WIRELESS WEEKLY" receive broad-casting from the Cardiff station, which is about 20 miles away.

(1) It is necessary to be in possession of a Post Office receiving licence before wireless apparatus can be actually put into operation. This does not prevent the experimenter from building or constructing his own apparatus, provided it is not used. (2) The licence question is at the moment in rather an un-settled state and you would do well to wait a week or two until the situation straightens itself out. (3) The crystal receiver you describe might give results

from Cardiff if very carefully adjusted and if your aerial is good. We understand reception in some districts surrounding Cardiff is rendered rather difficult, as there appear to be a good number of "blind" spots in this district. We would suggest adding one high-frequency valve to this receiver to obtain satisfactory signal strength.

C. H. D. (DARTFORD) wishes to know the number of turns required for honeycomb coils to tune with an 0.001 μF condenser from 1,000 to 30,000 metres.

At least eight coils should be used for this purpose. We suggest if you use your condenser in parallel all the time, winding the first coil with 100 turns, the second with 200, the third with 300, the fourth with 500, the fifth with 700, the sixth with 900, the seventh with 1,200, and the eighth with 1,500 turns of No. 26 s.w.g. d.c.c. wire. The number of turns on the last coil appears large, but it is essential to cover the wavelength range you specify.

A. F. (HONG KONG) proposes to build a low-frequency amplifier employing choke coils for intervalve coupling. He wishes to know how to construct suitable choke coils for this purpose.

Useful coils for this purpose can be made from an old low-frequency transformer by using the primary and secondary in series. If you wish to build one, the following particulars will prove of use: Core iron wire ½in. in diameter, 3in. long. Winding, 2 oz. of No. 40 s.s.c. copper wire.

W. F. T. (NOTTINGHAM) wishes to know whether he is allowed to use a greater length of wire for a frame aerial than he is for an outdoor aerial.

There is no restriction on the amount of wire that may be used on a frame aerial. For short wavelengths the 100 ft. allowed for an outside aerial is quite sufficient for a frame, but for long waves a greater length of wire should be used.

BEGINNER (HARROW) wishes to know the dimensions of an anode coil to cover a wavelength of from 300 to 1,500 metres, and for a suitable reaction coil to use in conjunction with this.

The anode coil may consist of a winding of No. 30 d.c.c. on a tube 2½in. in diameter and 5in. long. Ten tappings should be taken from this at half-inch intervals. A suitable reaction coil for this might consist of 100 turns of No. 38 d.s.c. wire on a former 3in. in diameter. This would mean that it would slide outside the anode coil.

A. G. (ROMFORD) asks if the capacity of a Dewar switch will seriously effect results if used for switching of high frequency circuits.

No serious losses will occur if the component parts of the switch are well spaced apart. Dewar switches, however, of a suitable pattern are rather expensive, and the ex-Government type is not generally useful. Small double-pole throwover switches should be used, as these are not only satisfactory but relatively quite cheap. Connections are also much more easily effected.

R. A. G. (DUBLIN) has some 36-gauge German silver wire and wishes to make a potentiometer suitable for valve work using this wire.

Assuming the potentiometer to have a resistance of 250 ohms, and that the 36-gauge German silver wire is used, the actual winding length should be 6in. and the former ½in. in diameter. This refers to circular rod. Ebonite will be suitable for this purpose.

B. B. H. (CAPETOWN) has some tellurium in his possession and wishes to know whether it is a good crystal to use as a rectifier, and if so, how to use it.

Tellurium is a very good rectifier. It should be used in conjunction with zincite in a crystal detector of the type employing two cups, so that one of the crystals may press upon the other. No local battery or potentiometer is required for this crystal, which has the advantage of being very stable, and at the same time lasting for long periods, though not necessarily without adjustment.

D. D. (EPSOM) asks whether he may increase the capacity of an air dielectric condenser for transmission purposes by immersing it in oil, and what sort of oil should be used. He also wishes to know whether placing coils near this condenser will effect the capacity of the condenser.

If transformer oil be used to immerse the condenser in, the specific inductive capacity of this is about 2.2. Care should be taken that no moisture is present in the oil. No harmful effects will result from the placing of the coil and condenser near each other, and no interaction will take place.

H. P. (CORNWALL) asks if when using a grid condenser the oscillations actually pass through the dielectric of the condenser so as to effect the potential of the grid.

The instantaneous accumulation of a charge on one side of the plate induces an opposite charge on the other side, and thus affects the potential of the grid. There is no actual passage of current, as it were, through the condenser.

G. R. (DUNDEE) asks for a practical test to determine whether the set is oscillating.

A practical test of oscillation is to touch the grid condenser of the first valve while listening with the receivers on. If the circuit is oscillating, a loud "pop" will be heard in the receivers when the connection is touched, and when the finger is removed. To stop the oscillations, the filament circuit and H.T. potential should be adjusted, and if the circuit persistently oscillates the reaction coil should be reversed. It will also sometimes improve matters to connect one end of the grid leak to the positive leg of the low-tension battery.

S. W. (WALTHAMSTOW) wishes to construct a crystal receiving set, capable of tuning between 300 and 3000 metres, and at same time of a simple nature.

The simple crystal receiver described on page 24. Vol. I., No. I., of this journal will fill your requirements; if carefully handled the range of this receiver is very good.

A. J. (BIRMINGHAM) wishes to know the different values of condensers in microfarads and inductances in microhenries to tune to 1,000 metres.

The aerial condenser should have a maximum value of .001 μF and be in series with the A.T.I. The closed circuit condenser should have a maximum value of ·0005 μF. The aerial coil might possess an inductance of 450 microhenries and the closed circuit 220 microhenries. Under these circumstances the wavelength range would be from 600 to 2,000 metres, using an ordinary P.M.G. aerial, and will thus overlap considerably the wavelength which you desire to tune to.

No. 3 of a famous series!

How to make your own Broadcast Receiver 1/6

By John Scott-Taggart, F.Inst.P.

Contents

Why not build a simple Crystal Set ?

—you will find it handy for emergency use.

WHEN your accumulator or your H.T. Battery runs down in the middle of an enjoyable Concert, and you have no spare—then you will find a simple Crystal Set very handy. In this new Book by John Scott-Taggart, F.Inst.P., Editor of "Modern Wireless," you will find instructions for making, at very little cost, no less than three different types of Crystal Sets All can be made at home from inexpensive material, and all will work efficiently with a minimum of adjustments.

If you are contemplating making a Receiving Set for the first time, you cannot do better than start with one of the simple Sets. You are certain to gain valuable experience which will stand you in good stead later on.

From all Booksellers and Newsagents, or 1/7½ post free direct.

Radio Press, Ltd
PUBLISHERS OF AUTHORITATIVE WIRELESS LITERATURE
DEVEREUX COURT. STRAND. W.C.2.

Look for this sign on all good Wireless Books

 (continued from page vi) *quality of a periodical must fall off. If "Wireless Weekly" does not become the premier weekly*