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NOISY LOUD-SPEAKERS A CRIMINAL OFFENCE?

IN these days of flat life and crowded habitations, complaints are often received from those who suffer from the over-exertions of the man who owns a five-valve set and a mammoth loud-speaker. Some of these individuals, whose idea of music tends to quantity rather than quality, seem to try to force as much volume from their apparatus as the merry-go-round man gets from his mechanical organ—and often with approximately the same result. The unfortunate neighbours, we are told, try vainly to listen-in on their two valves and "Tinie" loud-speaker, and the children are kept awake till midnight by the distorted roar which was once the dance music from the Savoy Orpheans or Selma Four.

Pleadings appear to be mere waste of oratory, and empty threats do nothing but increase the annoyance. Perhaps the law can help us in our efforts to avoid a breach of the peace or the contemplated suicide. There has been a case in the Law Courts where a musician insisted on displaying his talent to the neighbourhood, much to its annoyance and vexation, and the occupier of the house next door successfully brought an action for nuisance against this over-ardent player.

If one piano, when played to vex and annoy a neighbour, can be a legal nuisance, why not the distorted sounds of a whole orchestra when emitted from an over-worked loud-speaker? Perhaps some courageous sufferer will be bold enough to put it to the test in the Law Courts; but there are two important points on the law of nuisance which he must bear in mind if he is going to win the day. First, it was not the actual playing and practising of the musician which constituted the legal nuisance, but the making of the noise so as to "vex and annoy" his neighbour. We hope our intending litigant will not bring an action against a kindly neighbour who is using his instrument of torture for the benefit of the man next door and with no other idea than that of friendship.

The second point to remember is that when an action of nuisance is based on mere discomfort or inconvenience—as ours is—the discomfort or inconvenience must be substantial; it must not be merely trifling or imaginative, or such as the "average man" is content to submit to. The law pays no regard to trifles.

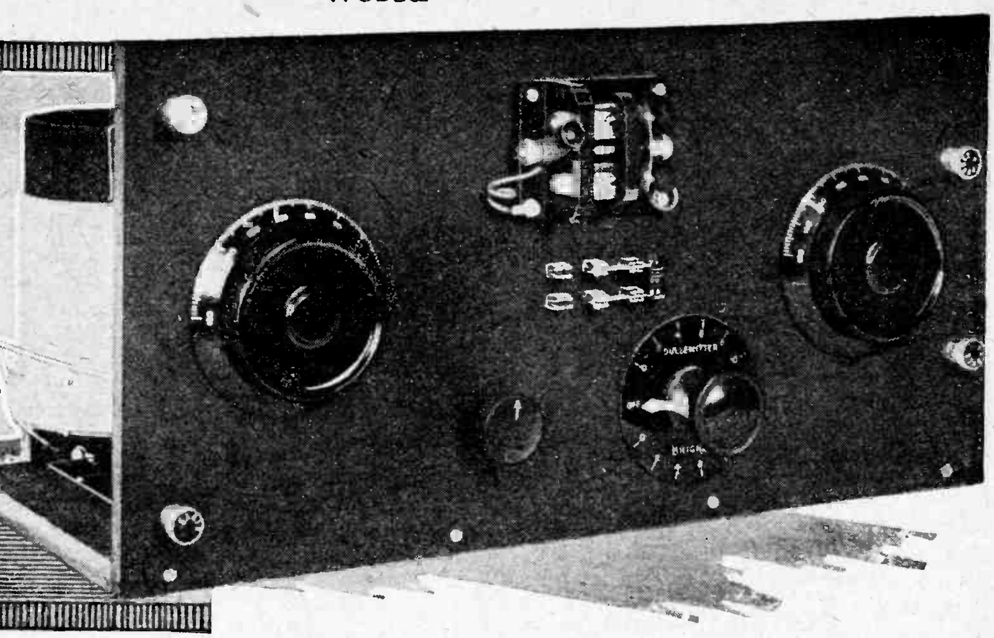
When you have once got your man, not only can you proceed against him in a Civil Court, but it is also a criminal offence to commit a nuisance, and if you can persuade the learned judge that the loud-speaker was as annoying to the neighbourhood as a merry-go-round—since proprietors of merry-go-rounds have been successfully proceeded against in the criminal courts—you can hope for a conviction. The loud-speaker might even be put in as evidence and a private performance given to the Court.

One word of warning to intending litigants; don't start legal proceedings until you are sure you have got a good case; you must remember that besides an action for nuisance, there is also one for "malicious prosecution."

CONTENTS.

SINGLE VALVE LOUD SPEAKER SET

by H. F. SMITH.



A Neutralised Reflex Receiver.

OUR ideas as to the number of valves necessary for the operation of a loud-speaker have lately undergone a radical change. A year or two ago a detector and two note-magnifying valves were considered to be the minimum even for local work. Nowadays, due to the use of increased power at the transmitting stations, better valves, and principally to the fact that low-frequency transformer design has made such great advances, we are able to omit one L.F. stage and still obtain good reproduction up to quite considerable distances without having to make excessive use of reaction. Even a good crystal receiver, with an efficient L.F. stage, will give respectable results from a near-by station.

In designing an economical receiver, one is naturally inclined towards the reflex or dual system, by which one valve is made to perform the double function of both high- and low-frequency amplifier, a crystal generally being used as the rectifier. A single valve operating in this manner might, at first sight, seem to be equal to a standard 1-v-1 receiver using three valves. In practice, unfortunately, this is not quite the case, partly because the valve detector generally supplies a certain amount of regeneration, either intentional or incidental. However, the writer would submit that a carefully designed single-valve reflex set, such as that to be described, is, from practically every point of view, slightly more effective than a "straight" arrangement of two valves. It must be admitted that it is only a very little cheaper to construct, as many of the components incidental to a set with a larger number of valves are needed. There will, however, be a considerable reduction in maintenance cost.

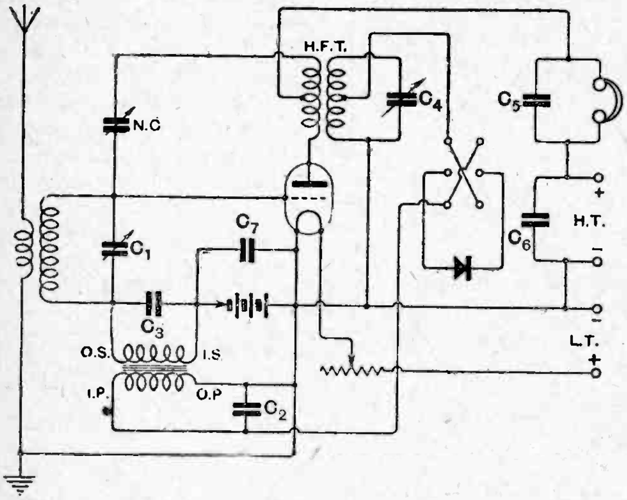


Fig. 1.—The theoretical circuit diagram. C_1, C_2, C_4=0·0005 mfd., C_3 = 0·0003 mfd., C_5 = ·001 mfd., C_6, C_7 = 1 mfd. N.C. = neutralising condenser.

The Circuit.

Referring to Fig. 1, it will be seen that the circuit adopted is standard, as far as essentials are concerned. The aerial circuit is rather loosely coupled to the grid coil, and is not separately tuned. The crystal is coupled to the anode circuit through a high-frequency transformer. Unless artificial damping is introduced, the valve will oscillate when its grid and plate circuits are brought approximately into tune. Positive grid damping by the use of a potentiometer or other device is most distinctly out of place where the valve is acting as a combined high- and low-frequency amplifier. In this particular case, as every precaution must be taken to avoid any waste of energy, the circuit is stabilised by the well-known and effective balancing or neutralising method. The crystal is connected across only a part of the secondary coil, with the result that it exerts only a small damping effect on the anode circuit. The tuning of this circuit will, therefore, be sharp, and for reasons which have already been explained in this journal a higher overall efficiency will

Single Valve Loud Speaker Set—
result, provided that the tapping point is made at the correct position. That given below in the instructions for winding the transformer will be about right for the average artificial or treated galena crystal which it is intended should be used in the detector.

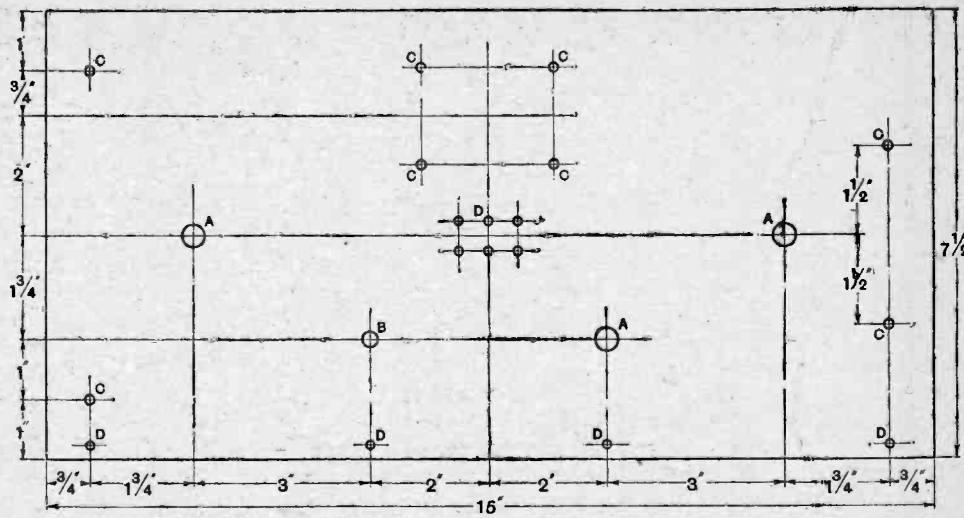


Fig. 2.—Drilling details of the panel. Sizes of holes are as follow:—A, 3/8in. dia.; B, 1/4in. dia.; C, 5/32in. dia.; D, 1/8in dia.

L.F. Transformer Ratio.

As crystals of this type have quite a low resistance, the primary of the low-frequency transformer may have a correspondingly low impedance, and it is therefore possible, from practical considerations, to use an instrument having a high step-up ratio and giving a high degree of magnification. If real loud-speaker volume is to be obtained from a single valve, particular attention must be paid to this point; the amateur cannot expect to get the best results unless he uses a good transformer of suitable ratio (8 : 1 or possibly 6 : 1).

It is almost essential for several reasons that the valve should have a low impedance, and the H.F. transformer is designed on the assumption that a power valve will be used.

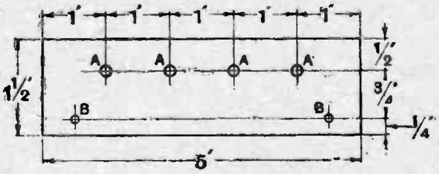


Fig. 3.—The terminal panel. A, 5/32in. dia.; B, 1/8in. dia.

A reversing switch is fitted for the crystal, as its use will be found beneficial under certain conditions. It is not, however, absolutely necessary, and may be omitted if desired.

The set as described will cover a wavelength range of from about 200 to well over 500 metres. The design would need to be radically altered for long waves.

Constructional Details.

The method of winding the aerial coupling and high-frequency transformers is shown in Fig. 6. The secondary of the former consists of 70 turns of No. 20 D.C.C. wire closely wound, and commencing ⅜in. from the bottom of the ebonite tube. Over the lower end is wound the aerial coil, or primary, consisting of 12 turns of the same wire, spaced from the secondary by 13 wooden matchsticks in the manner already described in this journal. The beginning and end of the secondary and the beginning of the primary are passed through holes in the tube and soldered to tags secured by a No. 6 B.A. screw and nut. The end of the primary winding is held down by two or three turns of stout thread, and is then bent over to connect with another soldering tag. Two small brass angle brackets, bolted to the tube, are used to secure the coil to the baseboard. The connections of the four ends of the windings are clearly shown.

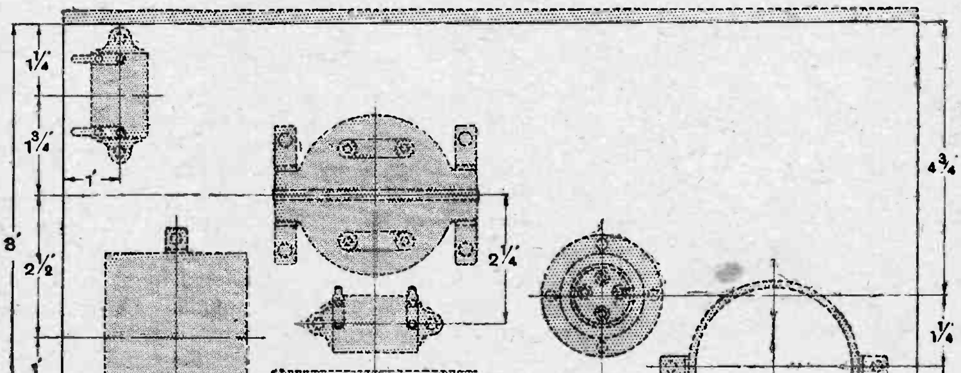


Fig. 4.—Layout of the baseboard. Note that the H.F. transformer is secured by a single brass bracket.

The high-frequency transformer is of similar construction, but of smaller size, and is wound on an ebonite tube of dimensions as shown. The secondary has 65 turns of No. 24 D.S.C. wire tapped at the 20th turn from the start for connection to the crystal. This tapping is made by slightly raising the wire with the blade of a knife, placing underneath it a small piece of empire cloth, and scraping away the silk insulation for soldering. The neutralising winding has 20 turns of No. 36

Single Valve Loud Speaker Set.—

D.S.C. wire, and wound continuously with it another 20 turns for the primary proper. There are thus 40 turns, tapped at the centre, making a total of six connecting points in all on the transformer, all of which are brought out to soldering tags bolted to the tube. The combined neutralising and primary winding commences $\frac{3}{16}$in. below the secondary; the tapping point should come immediately over the beginning of this latter winding. A single turn of string, having approximately the same diameter as that of the 24 gauge wire, is passed round the tube as shown, in order that the 12 spacing strips may lie flat. These wooden strips should be laid on one at a time as the first turn is wound. After three or four turns have been completed the strips may be straightened out and equally spaced.

Assembly and Wiring.

In the diagram illustrating the construction of both transformers, the lettering indicates the ultimate connections of the various ends and tapping points of the windings. Corresponding lettering appears on the practical wiring plan.

The drilling of the panel and terminal panel and the mounting of the components on both panel and baseboard are clearly shown in the accompanying diagrams and photographs, and little comment is necessary. It should be noted that the 6-volt grid bias battery is secured by two clips of springy brass in order that it may be easily changed when necessary. The battery is bridged by a large condenser in order to bye-pass both H.F. and L.F. currents when its resistance increases with age. Two of the screws securing the crystal detector to the panel serve also as the electrical connections, which are completed by short lengths of rubbered flex attached to its terminals. The condenser C_2 rests on the top of the L.F. transformer, and is soldered direct to tags screwed under the terminal heads.

The practical wiring diagram is given in Fig. 5. No. 16 or No. 18 bare tinned copper wire is used throughout, and the usual precautions are taken to keep grid and plate leads clear of each other.

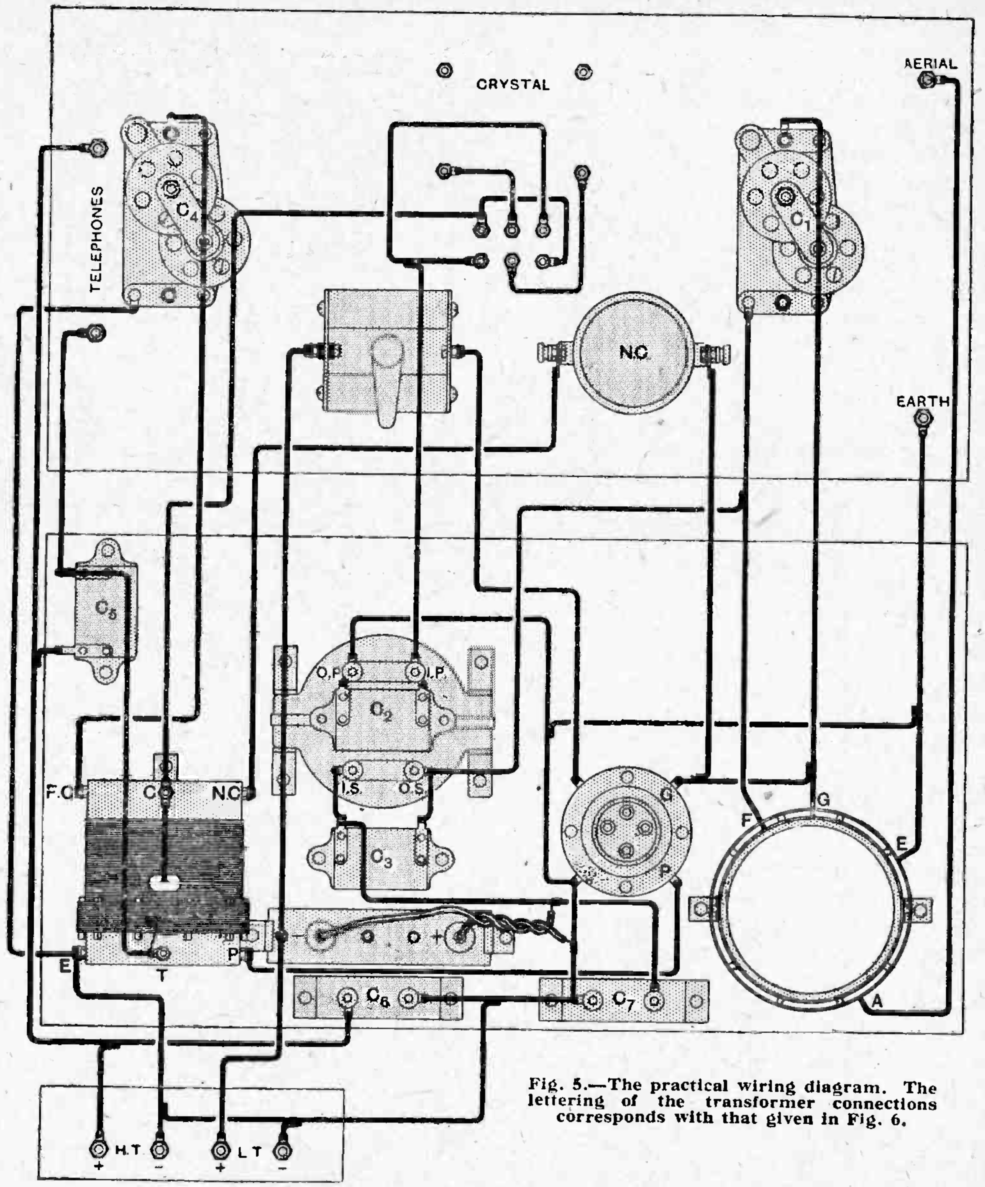


Fig. 5.—The practical wiring diagram. The lettering of the transformer connections corresponds with that given in Fig. 6.

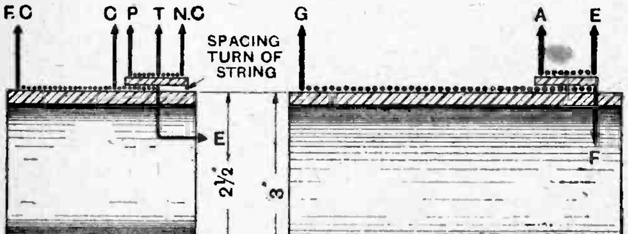
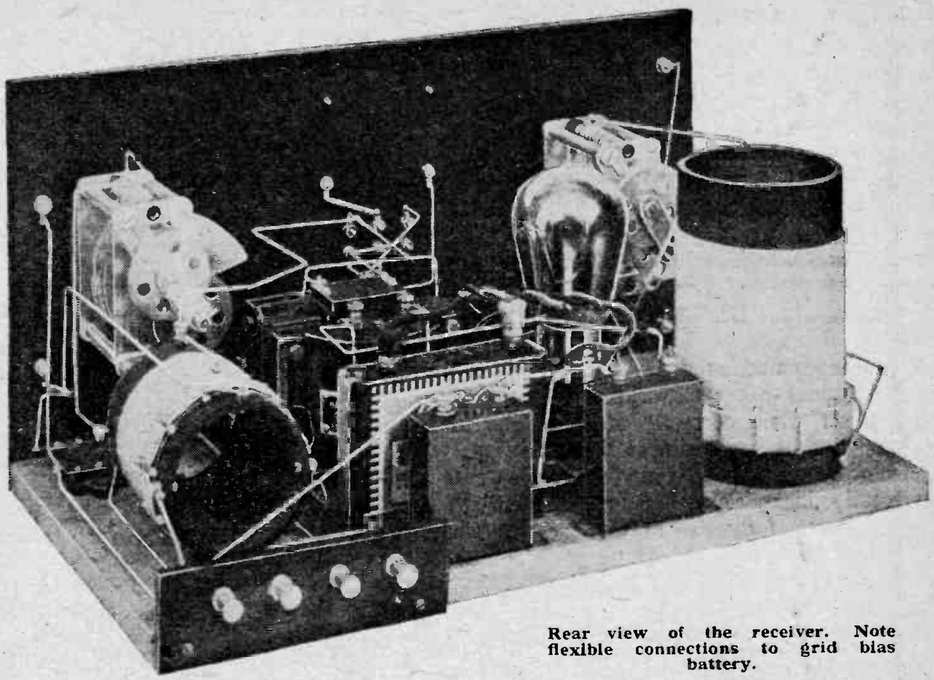


Fig. 6.—Constructional details of H.F. and aerial tuning transformers. F.C. indicates connection to fixed plates of condenser C_4.

Operation.

As already stated, a low-impedance valve is used, and at least 100 volts high tension should be applied, with a

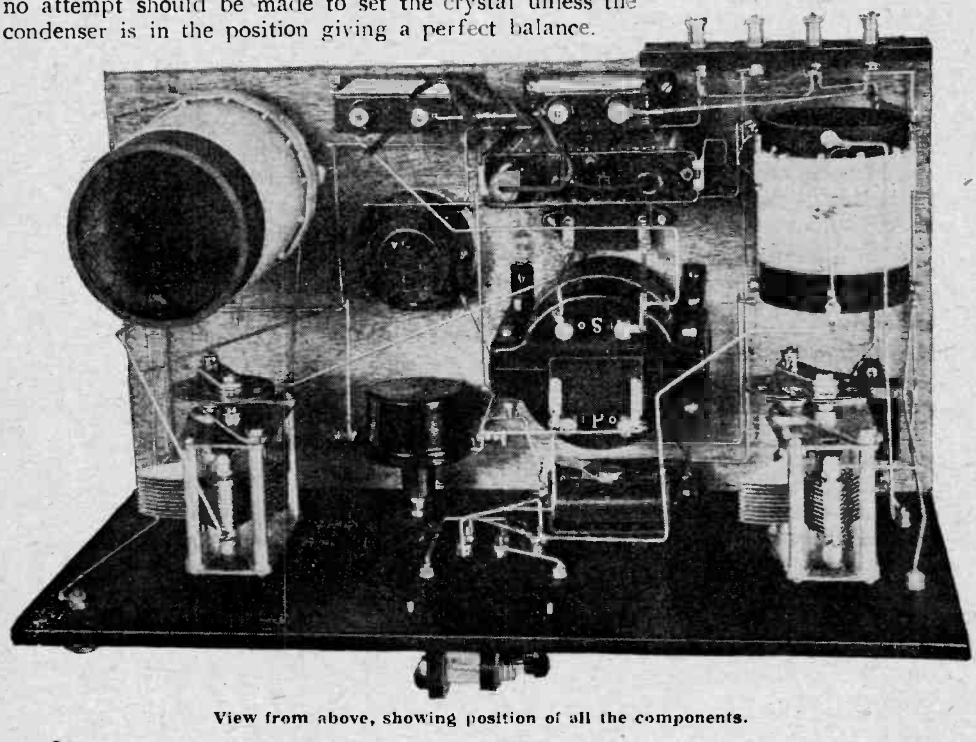
Single Valve Loud Speaker Set—
grid bias of about $4\frac{1}{2}$ volts. It will be easiest to make the preliminary neutralising adjustment if the valve is used as a simple detector, working on the bottom bend of its characteristic curve. To do this, reduce H.T. to about 50 volts, and cut out the crystal by opening the switch or taking off the catwhisker contact. Set the balancing condenser at zero, and rotate the tuning dials until the local station is heard. The valve will oscillate freely as the circuits come approximately into tune. The neutralising condenser knob should now be turned until oscillation ceases. Re-tune, and, if necessary, make further balancing adjustments until a state of perfect stability is reached. The set will oscillate at low- as well as at high-frequency; this former condition is denoted by the production of a loud and comparatively low-pitched note in the telephones.



Rear view of the receiver. Note flexible connections to grid bias battery.

Final Adjustments.

Having completed the balancing, the high-tension voltage should be increased to a normal value. The crystal is now adjusted, and the effect of reversing its connection should be noted. Increased sensitivity may be obtained by introducing reaction by partially de-neutralising, but no attempt should be made to set the crystal unless the condenser is in the position giving a perfect balance.



View from above, showing position of all the components.

It will be found convenient if both tuning condensers read approximately the same for a given station. If the transformers are wound exactly as described, it will probably be found that the reading of the left-hand condenser C_1 is slightly lower than that of the other. This is intentional, as the grid end of the aerial-secondary coil is readily accessible, and turns may easily be removed (one at a time) till both dials show the same reading, when the receiver is accurately tuned.

The number of turns specified for the primary winding is approximately correct for the average aerial, but the constructor will find that an increase of selectivity (with, unfortunately, a reduction of strength) will result if only some six or eight turns are used. On a very short aerial a considerably greater number of primary turns should be used. There is some scope here for experimental work, and the amateur may, if he so desires, adjust this winding to suit his actual working conditions for maximum results. The specification given will, however, be sufficiently correct in the great majority of cases. The tapping point on the secondary winding of the H.F. transformer may be experimentally varied to get maximum efficiency from the actual crystal used; but here

LIST OF COMPONENTS.

1 Ebonite panel, 15in. × 7½in. × ¼in.
1 Ebonite terminal strip, 5in. × 1½in. × ¼in.
1 Baseboard, 15in. × 8in. × ⅜in.
1 Ebonite tube, 3in. diameter, 5in. long.
1 Ebonite tube, 4in. diameter, 3in. long.
2 Variable condensers, 0·0005 (G.E.C.).
1 Micro condenser (Igranic).
2 Fixed condensers, 1 mfd. (T.C.C.).
1 Fixed condenser, 0·0005 mfd. (Dubilier).
1 Fixed condenser, 0·001 mfd. (Dubilier).
1 Fixed condenser, 0·0003 mfd. (Dubilier).
1 Filament rheostat (R.I.).
1 Valve socket (Sterling).
1 Grid battery, 6 volts, tapped (G.E.C.).
1 Crystal detector, double type, with centre rod (Edison Bell).
1 L.F. transformer, 8 : 1 ratio (Marconiphone).
1 D.P.D.T. panel mounting switch (Radio Components, Ltd.).
Small quantity No. 20 D.C.C., No. 24 D.S.C. and No. 36 D.S.C. wires.
Screws, terminals, connecting wire, etc.

again the connection given may be relied upon as being correct under average working conditions.

The set when correctly adjusted should be perfectly stable, and is very simple in operation. The double detector fitted will be found convenient, as anyone who is totally inexperienced may easily switch over to the other crystal if the one in use loses its sensitiveness.

Results.

It is impossible to make very definite claims as to the range of any receiver without fully knowing the conditions under which it will be used. The writer considers that the set as described should be capable of operating a loud-speaker at sufficient volume up to distances of at least twenty miles from a main broadcasting station under favourable conditions.

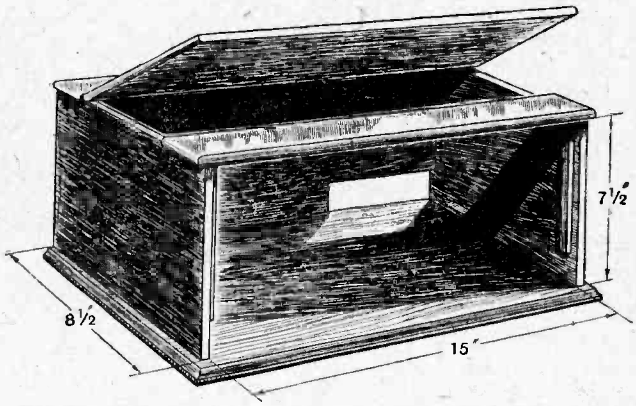


Fig. 7.—Cabinet for the receiver, constructed of wood 3/8 in. thick.

If the receiver is to be operated on a very short indoor aerial, this latter should be generally connected direct to the grid of the valve instead of to the primary winding. In cases where it is desired to use a perikon or similar crystal combination of higher resistance than the galena specified, the L.F. transformer should have a step-up ratio of not more than 6 : 1, and the crystal tapping on the secondary of the H.F. transformer may be taken from about the centre point of the winding.

WHAT IS BEING SAID.

THE MOON AND THE BAROMETER.

"It would appear that (1) a waning moon is helpful to good DX reception; that (2) depressions of the barometer are bad; that (3) a steady rise after a fall is good.

"Who will come to the rescue and tell us for certain what are the ideal atmospheric conditions for best work?"

—W. J. Turberville-Crewe, in *Experimental Wireless.*

TUNING IN AMERICA.

"It is just as well to make sure before beginning a vigil that conditions are favourable. My own plan, which seems to work very well, is to employ a 'standard station' for testing purposes. The one that I use is Aberdeen, whose transmissions are seldom very strong in the locality in which I live. If I propose to sit up for America I try for Aberdeen just before that station closes down for the night. Should I be able to tune it in at good strength and without atmospheric interference, then the omens are propitious; if, however, 2BD is difficult to find, if signal strength is poor, or if atmospherics are present to an appreciable extent, I go to bed, and defer the attempt until another night."

—A Correspondent in *The Times.*

ONE WAY OF PUTTING IT.

"From all indications a noisy group of long distance cranks who yap over their records like silly school kids, want all of the broadcasting stations in Chicago to close shop one night in each week while they paw over the ethereal wares of the country.

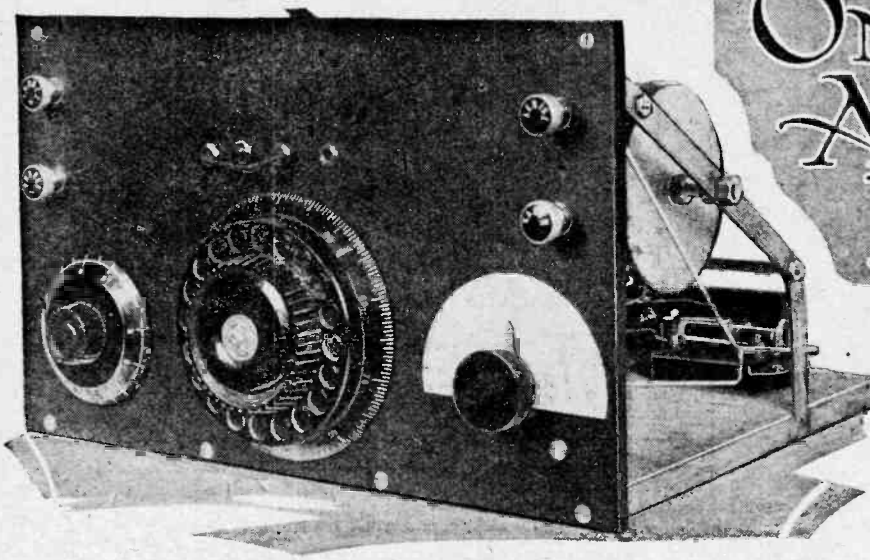
"Things are coming to a pretty pass when a bunch of idiots set out to prevent the sensible people in Chicago from listening to their local stations. Yet, aided by the newspapers, they seem to be making out quite a case for themselves and we should not be a bit surprised to find them in the end victorious. After all it is the squawker who wins his point in the long run."

—*Popular Radio*, New York.

FACING THE MICROPHONE.

"I've peeped at one (a microphone) in its lair. At first sight it looks something like a shell with its fuse off. But as you look closer, you discover that it is a kind of octopus waiting to spring from its blanket (assuming that octopi do spring from their blankets) and annihilate you. I'd rather face a covey of haberdashers."

—"Gadfly," in *The Daily Herald.*



ONE VALVE ALL WAVE RECEIVER

Tuning Range 300-30,000 Metres

By F. L. DEVEREUX, B.Sc.

RECEPTION on long wavelengths offers many attractions both to the broadcast listener, who previously may have heard nothing but wireless telephony, and to the experienced amateur who may want to trace the fundamental wavelengths of long-wave C.W. stations that are interfering with reception on short wavelengths.

This receiver was designed with the object of providing in compact form an inexpensive instrument capable of covering the whole wavelength range between 300 and 30,000 metres.

The A.T.I. consists of eight sections connected in series, tappings being taken from the junction between each section to the contacts of a distributing switch. The switch is designed to short circuit the sections not in use, thus overcoming absorption and "dead-end" effects. When sections are short-circuited in this way, however, it will be found that the short-circuited turns have the effect of reducing the inductance of the section of the A.T.I. remaining in the aerial circuit. In order to reduce this effect as far as possible, the individual sections of the A.T.I. have been enclosed between pairs of discs, and have been spaced apart by means of smaller discs so that the distance between the sections is nowhere less than ½in.

The reaction coil has been built on the same principle, two sections being employed, spaced approximately 1⅛in. apart. The smaller section next to the A.T.I. is used for wavelengths up to 2,500 metres, and when this section is in use the remainder of the reaction coil is short circuited by means of a wander plug and socket on the front of the panel just above the tuning condenser. The short-wave sections of the A.T.I. are nearest to the reaction coil in order to reduce, as far as possible, losses in the remaining short-circuited turns.

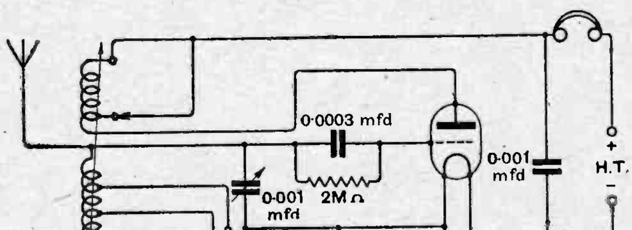


Fig. 1.—Circuit diagram showing in schematic form the arrangement of the wavelength range switch.

Construction.

The first stage in constructing the instrument is to cut to size the front panel and baseboard. Drilling details for the front panel are given in Fig. 2.

It will be observed that the holes for securing the Silvertown switch are set at an angle of 45 degrees; this was done with the object of facilitating the wiring.

The positions occupied by components on the baseboard are shown in Fig. 5. It will be observed that the soldering tags on the 0.001 mfd. condenser have been turned in opposite directions in order to shorten wiring.

At a distance of 2¼in. from the back edge of the baseboard slots ⅜in. wide and $\frac{1}{16}$in. deep are cut for the brass brackets supporting the tuning coils and the front panel.

The material used for the brackets is extruded brass strip ⅜in. wide, the total length required for each bracket being approximately 8⅞in. At a distance of ½in. from one end a right-angle twist is made, and the strip is bent at an angle of 60° at a point 2⅜in. from the other end. In order to make the latter bend it is necessary to hold the edges of the strip in the vice with the flat surface upwards, and to hammer the strip round by easy stages, frequently removing it from the vice in order to hammer out any kinks which may tend to fall on the inside of the bend. Provided that extruded Delta metal strip is used no difficulty will be found in making this bend. Holes

One Valve All Wave Receiver.—

are drilled at each end for securing to the panel and baseboard respectively; the remaining three holes are for supporting the A.T.I. and the guides for the reaction coil. The spacing of these holes is given in Fig. 3, which also shows details of the method of mounting the reaction coil.

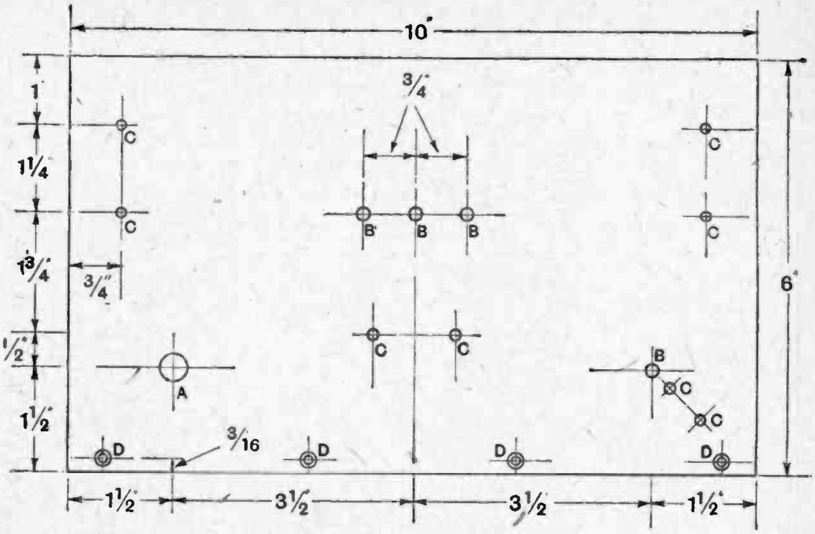


Fig. 2.—Drilling details of the front panel. A, 3/8in dia.; B, 3/16in. dia.; C, 5/32in. dia.; D, 1/8in. dia., countersunk for No. 4 wood screws.

Constructing the Tuning Coils.

The wooden discs supporting the windings of the A.T.I. are cut from plain hard wood $\frac{5}{32}$in. in thickness. At first sight it would appear to be preferable to use 3-ply wood, but it was found that the 3-ply wood showed a tendency to split at the edges which caused subsequent difficulty when winding the coils. Four of the sections have slots $\frac{5}{32}$in. wide formed by washers $\frac{3}{4}$in. in diameter cut from the same material; the remaining four sections nearest to the reaction coil have slots approximately $\frac{1}{16}$in. wide, formed by cardboard spacing washers $\frac{3}{4}$in. in diameter. The sections of the coil consisting of the large discs $2\frac{1}{2}$in. in diameter and the $\frac{3}{4}$in. spacing washers, are in turn spaced apart by means of spacing washers $1\frac{1}{4}$in. in diameter and $\frac{5}{32}$in. in thickness in order to reduce the effect of the short-circuited turns on the inductance of those remaining in circuit. The number of turns and the gauge of wire required for each section are given in the table.

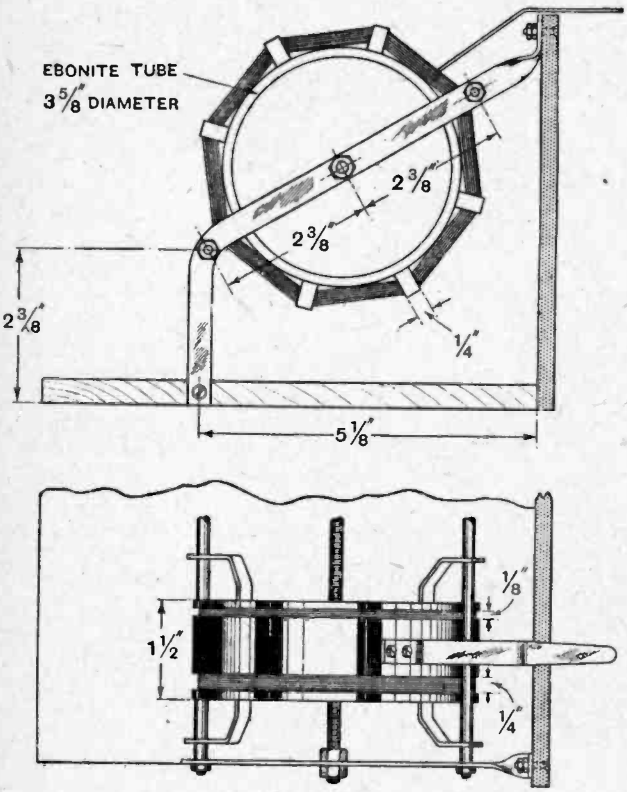


Fig. 3.—Details of the reaction coil former and method of mounting.

Small holes are drilled at the bottom of the slots to lead out the inside ends of the coils. In the case of the narrow slots it may be necessary to pass a short length of wire through from the outside and to solder this to the end of the supply reel of wire in order that it may be pulled through from the inside. When the windings have been completed the end of the first winding is connected to the beginning of the second, and a lead from the junction between the two windings is connected to the appropriate contact of the distributing switch. The remainder of the sections is treated in the same way, and if desired, a strip of insulating tape may be used to cover the edge of each winding and to hold in position the leads to the switch.

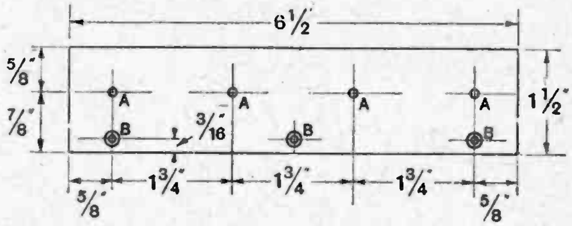


Fig. 4.—The terminal strip. A, 5/32in. dia.; B, 1/8in. dia., countersunk.

The former for the reaction coil consists of a section of ebonite tube $3\frac{5}{8}$in. in diameter and $1\frac{1}{2}$in. wide. Eight ebonite spacing blocks are fixed at regular intervals to the

Section.	Turns.	Wire.	Wavelengths. Metres.
1	40	No. 26 D.C.C.	300— 500
2	30	No. 26 D.C.C.	400— 800
3	50	No. 26 D.C.C.	650— 1,200
4	100	No. 28 D.S.C.	900— 2,000
5	200	No. 28 D.S.C.	1,600— 4,000
6	500	No. 30 D.S.C.	3,500— 8,500
7	1,000	No. 34 D.S.C.	8,000—17,500
8	1,000	No. 34 D.S.C.	16,000—30,000

One Valve All Wave Receiver.—
outside of the tube by means of "Seccotine." The dimensions of the spacing blocks are $1\frac{1}{2}$in. by $\frac{5}{8}$in. by $\frac{1}{4}$in., and slots are cut in each of the spacing strips for the two sections of the reaction coil, the smaller section being wound in slots $\frac{1}{8}$in. wide and $\frac{1}{4}$in. deep. The slots for the larger section of the coil have the same depth and are $\frac{1}{4}$in. wide.

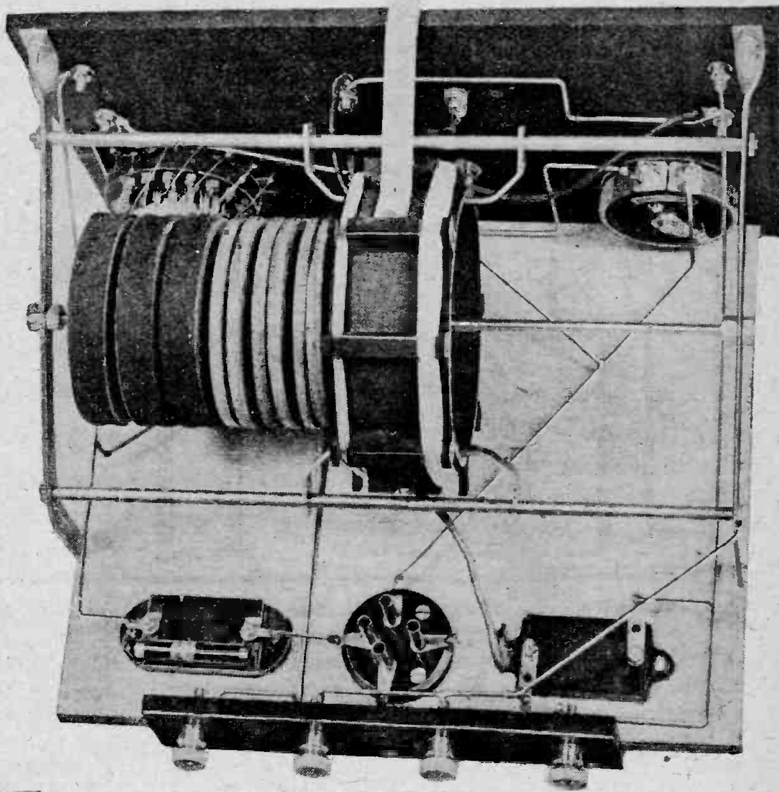
The reaction coil is wound with No. 30 S.W.G. D.S.C. wire, 45 turns being used for the first section and 200 for the second. The sections are connected in series and flexible leads are taken from the beginning and end of the reaction coil as a whole to P and R_2 respectively in Fig. 5, and also from the junction between the two sections to R_1. The reaction coil slides on parallel brass rods $\frac{3}{16}$in. in diameter, supported by the brass brackets at each side of the baseboard, the shape of the brass stirrups supporting the coil being shown in Fig. 3. The same diagram shows the brass lever passing over the top edge of the cabinet which is used as a handle when adjusting the reaction coupling.

Wiring and Testing.

The wiring is carried out in accordance with the diagram in Fig. 5, and is quite straighforward. The connections to the A.T.I. switch should cause little difficulty if the A.T.I. unit is temporarily moved to one side on the screwed rod during the soldering operation.

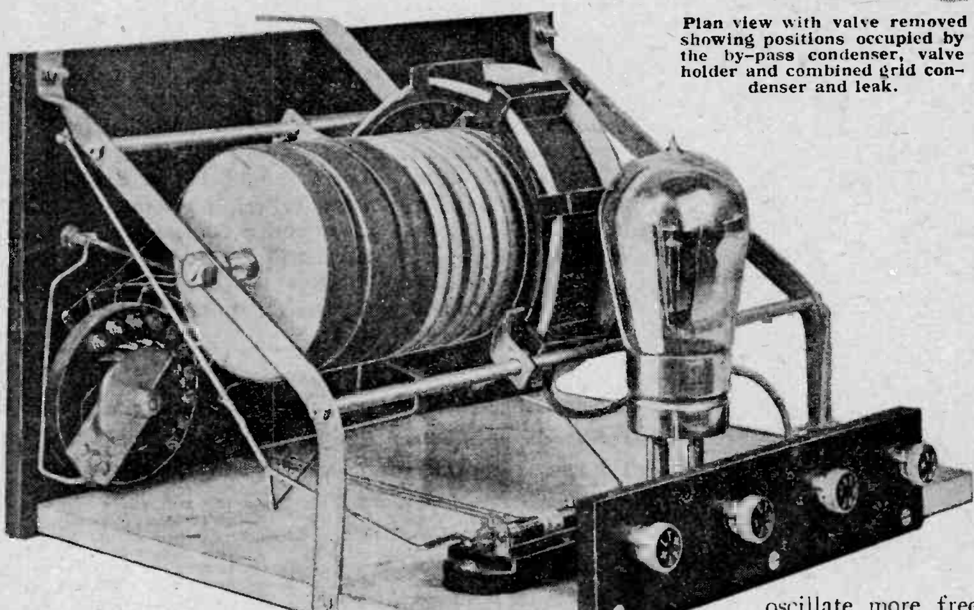
In testing the receiver it is advisable to commence with the lower wavelengths where the transmissions from near-by broadcasting stations can be easily recognised.

If the reaction coil is connected correctly the set should oscillate with the wander plug in R_1 on all sections of the coil up to No. 5. Oscillations may be set up on certain wavelength bands even when the reaction coil is reversed so that the foregoing short-wave test should be carried out to make quite sure that the coil is connected correctly. If the connections are incorrect, it will be necessary to change over the flexible leads joined to the plate socket P of the valve holder and to R_2.



Plan view with valve removed showing positions occupied by the by-pass condenser, valve holder and combined grid condenser and leak.

The approximate wavelengths obtainable with each section of the aerial tuning coil are given in the fourth column of the table, and should serve as a guide in identifying the stations received at each position of the switch. The values given for the turns both in the A.T.I. and reaction coil were adjusted for use with a 100ft. aerial having a capacity of approximately 0.0003 mfd. If a smaller aerial is used the set will oscillate more freely, and it will be necessary to reduce the number of turns to less than 45 on the first section of the reaction coil. Should



Another view showing more clearly the method of mounting the tuning and reaction coils.

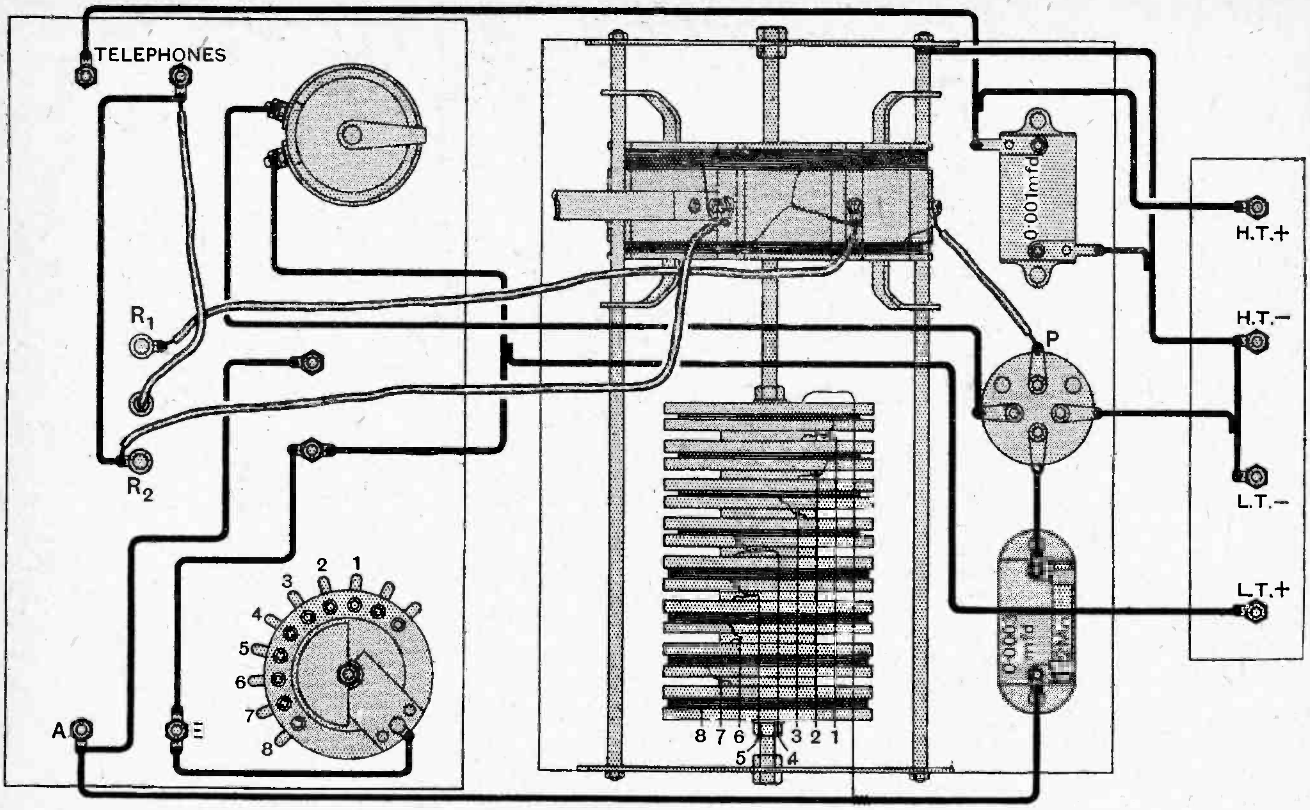
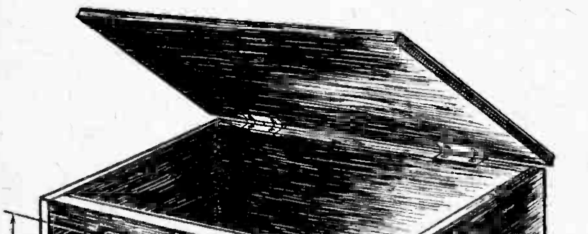


Fig. 5.—Wiring diagram. The numbered leads from the junctions between the sections of the A.T.I are soldered to the corresponding contacts on the distributing switch.

the effective resistance of the aerial system be so high as to prevent oscillation on the lower wavelengths, it may be advisable to connect a fixed capacity of 0.0005 mfd. between the aerial terminal and the aerial lead-in. Alternatively the number of turns on the first section of the reaction coil may be increased.

The results obtained were in every way satisfactory.



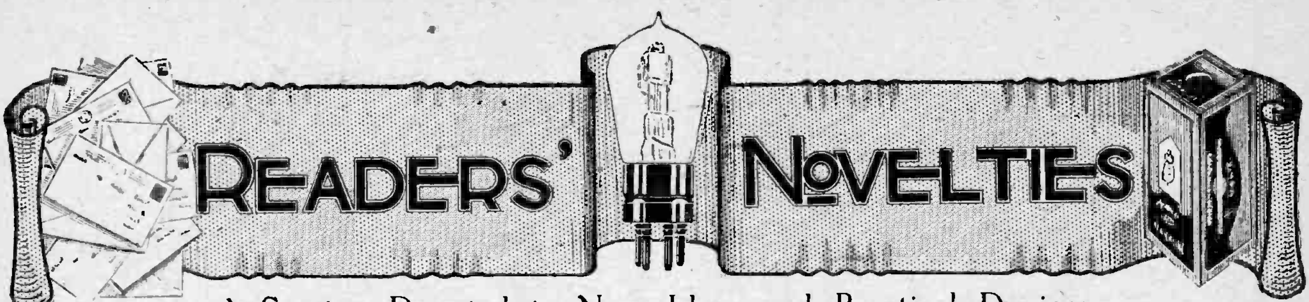
Leading dimensions of the cabinet. The recess cut in the under side of the bar supporting the sides is to allow free movement of the reaction coil lever

On the first section three of the B.B.C. stations were received without allowing the set to oscillate. The second section brings in the broadcasting stations at the upper limit of the 300-500 metre wave band and also ship and coast stations working on 600 metres. The Civil Aviation transmissions fall in the third section and at the beginning of the fourth, which also brings in Daventry. The fifth section also includes Daventry and receives the Radio-Paris and Eiffel Tower broadcasting stations. The remaining sections are occupied by high-power c.w. stations, which may be identified by means of their call signs. There should be no difficulty in recognising the Air Ministry (GFA), 4,100 metres; Eiffel Tower (FL), 4,700, 5,000, and 7,000 metres; Leafield (GBL), 8,750 metres; Lyons (YN), 10,000 and 15,000 metres; Rome (ICO), 10,850 metres; Nauen (POZ), 18,075 metres; and Bordeaux (LY), 18,940 metres.

LIST OF COMPONENTS.

- 1 Ebonite panel, 10in. × 6in. × 1/4in.
- 1 Ebonite panel, 6½in. × 1½in. × 1/4in.
- 1 Baseboard, 9½in. × 7½in. × 3/8in.
- 1 Variable condenser, 0·001 mfd. (G.R.C. Type 63).
- 1 Fixed condenser, 0·001 mfd. (Edison Bell).
- 1 Combined grid condenser and leak (Edison Bell).
- 1 Filament resistance (Macitone).
- 1 Valve holder (Burwood).
- 1 Ten-way switch (Silvertown).
- 8 Terminals (Belling-Lee).
- 3 Clix sockets and plug.
- 1 Ebonite tube, 3 5/8in. dia., 1½in. long.
- Wood for coil discs, 5/32in. thick (3/16in., planed).
- Brass Strip, 3/8in. wide, 3/16in. brass rod, No. 2 B.A. screwed rod.
- Small quantity No. 26 D.C.C., No. 28 D.S.C., No. 30 D.S.C., No. 34 D.S.C., and No. 16 tinned copper.

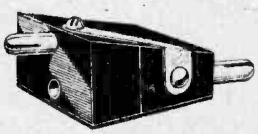
Approximate cost of set excluding valves, batteries, etc., £2 0s. 0d.



A Section Devoted to New Ideas and Practical Devices.

COIL MOUNTING PLUG.

In sensitive circuits which include H.F. amplifying valves it is often difficult to reduce the reaction coupling sufficiently to stop oscillation when the tuning coils are mounted in a three-coil holder. Most three-coil holders provide a 90° movement for the reaction coil when



Right-angle coil plug.

theoretically the coupling should be zero; but in practice it is found that a slight positive coupling still remains, and that oscillation in the receiver still continues. When this condition exists, the coupling may be still further reduced by turning the plane of the reaction coil at right angles to that of the A.T.I. or secondary coil. This may be conveniently accomplished by constructing a special coil plug of the type illustrated in the diagram. Two ordinary coil plugs should be obtained, and, after being cut down to the required length, screwed together with the centre lines of the pins and sockets at right angles. Thin copper strip connectors joining the adjacent pins and sockets together complete the unit, which can be used equally well for providing a weaker coupling between the A.T.I. and the secondary tuning coil.—A. R.

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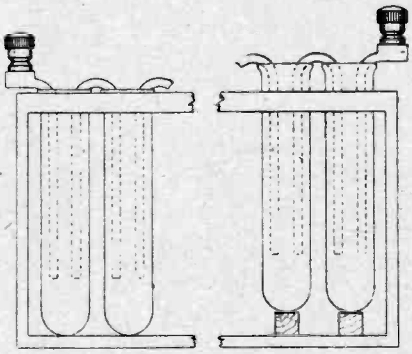
INSULATION OF H.T. ACCUMULATORS.

One of the principal troubles experienced with banks of small accumulator cells is due to leakage, which rapidly discharges the cells during the periods when they are standing idle. In the type of battery in which chemical test tubes are used to contain the acid the leakage takes place across the top of the rack supporting the tubes through the film of acid deposited by spray during charging. It will be found that this leakage will be considerably reduced by raising the cells from the base of the container by small wooden blocks as indicated at the right-hand side of the sketch. It will be seen that the leakage path is thereby increased, as leakage can only take place after passing down the walls of the test



Reducing leakage in H.T. accumulators.

tubes. The leakage path is equal to twice the height of the edges of the tubes above the top of the supporting rack.—W. A.

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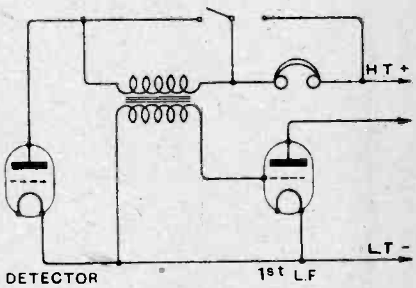
SWITCHING TELEPHONES.

It is frequently desired to insert a pair of telephones after the detector valve in a receiver incorporating transformer-coupled L.F. amplifiers.

Many amateurs connect the telephones either in series or in parallel with the primary winding of the first intervalve transformer. Neither of these systems of connection, however, is to be recommended, as, in the first case, the telephones do not receive the maximum current available from the detector, and, in the second case, the volume obtainable from the loud-speaker will be considerably reduced if it should happen that both the telephones and the loud-speaker are in use at the same time. A far better arrangement is that indicated



Connecting telephones in series with a transformer primary winding

in the diagram; the telephones are connected permanently in series with the primary winding of the intervalve transformer, and a single-pole double-throw switch is connected, so that in one position the primary winding of the transformer is short-circuited, and in the other the telephones. Thus, when it is desired to receive with telephones, the primary winding will be short-circuited, and the telephones will be the only impedance connected in the anode circuit of the detector valve.

When the amplifier is in use, on the other hand, the telephones will be short-circuited and will not draw energy which would otherwise be prevented from passing through the amplifier to the loud-speaker.—T. A. L.

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AERIAL TUNING.

The diagram in Fig. 1 shows a system of connections for the aerial circuit of a receiver which provides at least ten different arrangements of the pairs of coils and condensers involved. No switches are employed, and the connections are changed by means of connecting links between seven terminals A to G. In some cases the connecting links are inadequate, and it becomes necessary

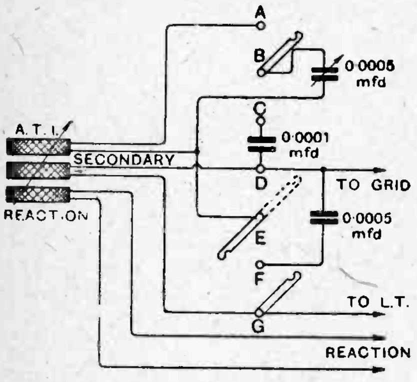

Fig. 1.—Aerial circuit connections giving the circuits shown in Fig. 2

to use short lengths of flex provided at each end with spade terminals.

The circuits given in Fig. 2 are as follow :

(*a*) Aperiodic aerial, tuned secondary with common earth.

(*b*) Aperiodic coupling with isolated aerial system.

(*c*) Tuned A.T.I. with fixed series condenser.

(*d*) Tuned A.T.I., condenser in parallel.

(*e*) Tuned A.T.I., condenser in series.

(*f*) Tuned A.T.I., condensers in series and parallel.

(*g*) Coupled circuit with tuned aerial, common earth connection.

(*h*) Coupled circuit with tuned aerial, isolated aerial system.

(*i*) Tuned A.T.I. with series wave trap.

(*j*) Tuned A.T.I. with parallel wave trap.—H. W. W.

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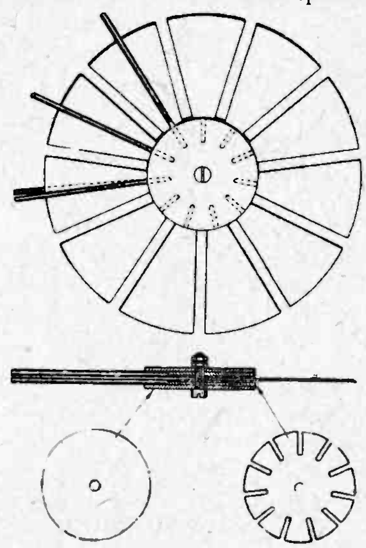
BASKET COIL FORMER.

The self-capacity of fixed coils wound on thin fibre or ebonite formers may be considerably reduced by means of the method indicated in the diagram.

Four brass discs, approximately 1½in. in diameter, are first obtained, and two of these are slotted to correspond with the slots in the disc former. The remaining two are left plain. Holes are provided in the centre of each disc for the purpose of assembling the former, which is shown in section in the centre of the diagram. The plain discs are assembled at the outside, and the slotted discs take up positions next to the thin sheet former. The slots of these discs are placed midway between the slots in the former, and brass rods of suitable diameter are inserted on each side. When the coil is wound these rods will space the



Improved basket coil former.

wire away from the segments of the former, thus reducing both the self-capacity and the dielectric losses in the finished coil. The spacing rods are withdrawn from the coil after releasing the securing bolt passing through the centre of the former.—E. W. W.

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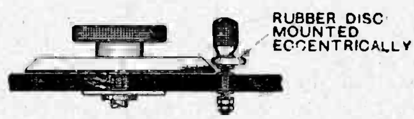
VERNIER ADJUSTMENT.

A well-known method of providing a vernier adjustment for variable condensers consists in mounting a small rubber wheel in contact with the bevelled edge of the condenser dial. The range of adjustment for



Improved condenser vernier.

which this attachment is required is generally not more than one or two degrees, but the rubber wheel is always in contact with the dial, and considerably retards the movement of the condenser when searching with the main dial.

By mounting the rubber wheel eccentrically, it is possible to turn it out of action when fine adjustments are not required, and this modification does not in any way affect the vernier movement for the one or two degrees for which it is required.—F. C. S.

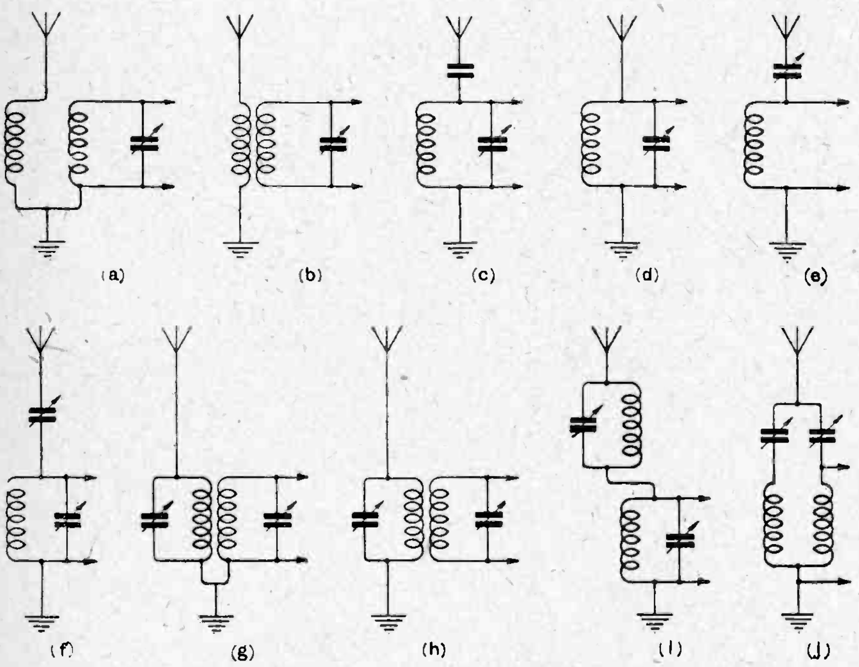


Fig. 2.—Circuits obtainable with the system of connections shown in Fig. 1.

Circuit :	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Aerial :	A	A	C	D	F	B	A	A	A	F
Earth :	G	E	G	G	G	G	G	E	G	G
Join :	E-F-G	F-G	F-G	F-G	—	D-E, F-G	A-B, E-F-G	A-B, F-G	A-B, D-E, F-G	E-G, B-F

FOUR-ELECTRODE RECEIVING VALVES.

Function of the Inner Grid in Reducing the H.T. Voltage.

By A. C. BARTLETT.

VALVES having two grids have been available for some time. The usual and probably the most satisfactory method of using such a valve is to connect the inner grid direct to the positive terminal of the H.T. supply, while the outer grid and anode are used in exactly the same way as the grid and anode of the ordinary valve.

The chief advantage is that a much smaller high tension voltage can be used. In fact quite good results can be obtained using only 6 volts or even less, which can be obtained from the filament accumulator by using the positive terminal of the accumulator as H.T.

This fact of course explains the statements that have

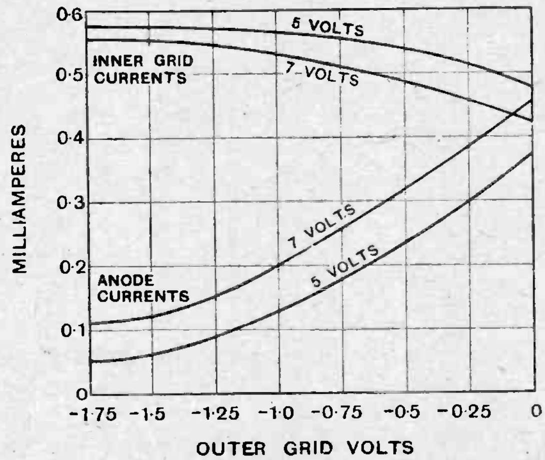


Fig. 1.—Grid and anode current characteristics of the D.E.7 four-electrode valve for anode voltages of 5 and 7 respectively; inner grid potential in each case, 6 volts.

been made, that the valves can operate without H.T. Though it has been stated that except for the connection of the inner grid to the positive H.T., the valve can be used in the same way as the ordinary three-electrode valve, one important practical point arises: with the small H.T. voltages used only correspondingly small D.C. voltage drops can be allowed in the anode circuit.

Low Resistance Phones Necessary.

Thus the valve cannot be used for resistance amplification, or at least if this method is used the advantage of the low anode volts is lost, due to the large increase required in the H.T. battery to overcome the D.C. drop in the anode resistance or transformer.

Further, the telephones or loud-speakers of high resistance should not be connected direct in the anode circuit.

Either they should be of low resistance, or if of high resistance should be shunted by a choke coil of large inductance, but low D.C. resistance.

Characteristic curves can be taken in a large number of ways, but when the valves are to be operated with constant volts on the inner grid the following procedure should be followed.

Suppose the valve is to be operated with 6 volts H.T. Then set the inner grid volts at 6 and the anode volts at 7, and take a curve of anode current with the outer grid volts from about -2 to 0 by steps of either $\frac{1}{2}$ or $\frac{1}{4}$ volt.

Since the valves are to be used as amplifiers or detectors there is no point in taking observations with the control grid positive.

Impedance and Amplification Factor.

Take a similar curve with the inner grid at 6 volts, the anode at 5 volts, varying the outer grid from -2 to 0 volts. From these two curves the "m" valve and impedance can be obtained in the usual way. Of course the inner grid current should be taken at the same time, but its value does not enter in the "m" factor or impedance determination.

Similarly for operating at 15 volts the curves should be taken with 17 and 13 volts on the anode and 15 on the inner grid.

Such curves for a D.E.7 valve are shown in Figs. 1 and 2.

Consider the curves of Fig. 1; at grid volts -0.75 a change of anode volts of $7-5=2$ gives a change in plate current of 0.08 mA $=0.00008$ amp., and therefore the impedance of the valve is $\frac{2}{0.00008}=25{,}000$ ohms. An anode current of 0.23 mA is obtained at 5 anode volts and -0.5 grid volt, while if the anode volts is increased to 7 the grid volts have to be reduced to -0.85

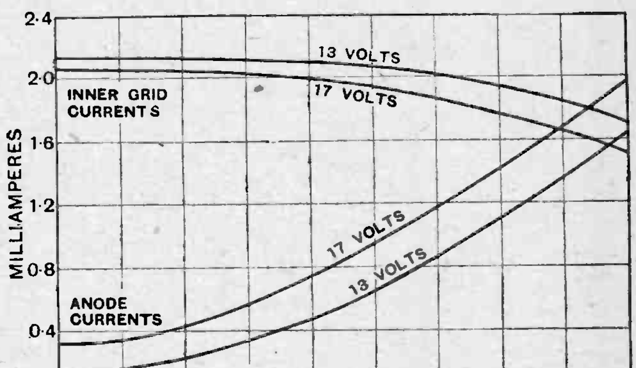


Fig. 2.—Characteristics of the D.E.7 valve for anode voltages of 13 and 17; inner grid potential, 15 volts.

Four-Electrode Receiving Valves.—

volt to give the same anode current as before, so that the "m" or amplification factor of the valve is $\frac{7-5}{0.85-0.5}=\frac{2}{0.35}=5.7$. These figures show that with 6 volts H.T. the valve compares quite well with an ordinary general purpose valve though its amplification factor is rather low, while with 15 volts its characteristics are good.

The design of such valves is complicated by the difficulty of calculating the ratio of inner grid current to anode current. In valves such as the D.E.7, the inner grid current is kept reasonably small by placing the grids very close together, winding them of the same pitch with turns opposite, and at the same time aiming at a low "m" value.

The Trend of Design.

The ideal aimed at is a construction such as that shown in Fig. 3, where the distances between corresponding grid wires is very small compared with other dimensions.

This construction points to a simple physical aspect of the action of the four-electrode valve.

Suppose, for example, a voltage of +30 is applied to anode and inner grid and of −2 to the outer grid, then positive equipotential surfaces of (say) +20 volts can be drawn surrounding the two grid wires somewhat as shown in Fig. 3. The field at the surface of the filament will be the same if the 20 volt equipotential surface were a solid wire at a potential of +20 volts.

Thus we may regard the four-electrode valve of this type as a modified three-electrode valve, the dividing of the grid into two parts being a device that enables the valve to be used with a high positive grid potential, but ensures that the energy absorbed by the grid currents is supplied by the anode battery and not by the grid circuit as would be the case in an ordinary three-electrode valve with its grid at a high positive potential.

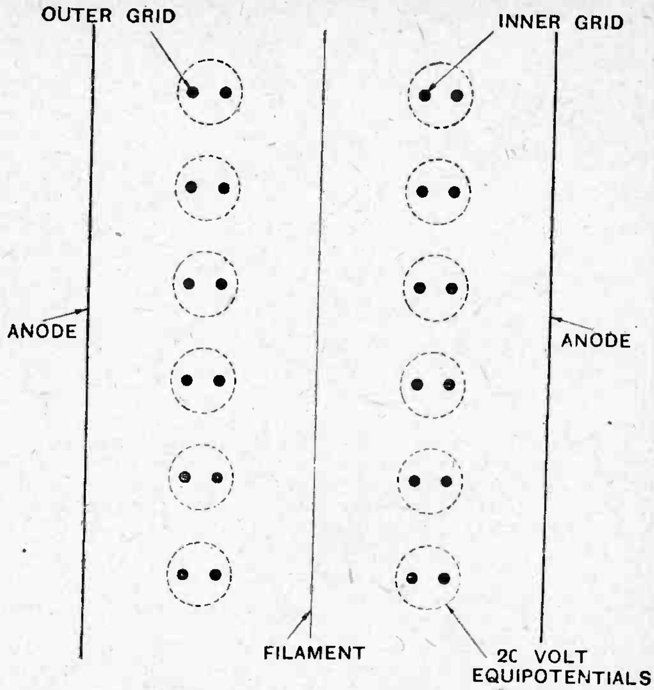


Fig. 3.—Ideal arrangement of the electrodes in a four-electrode valve, the distance between the inner and outer grids being small compared with other dimensions.

SOME RECENT CONSTRUCTIONAL ARTICLES.

Frequent requests are received from readers for articles which have appeared in back numbers of "The Wireless World." Below we publish a brief list of some recent constructional articles which, we think, will be a useful reference guide, especially to the new reader.

Push-pull Receiver Amplifier.
How to obtain loud-speaker volume and quality with general purpose valves. Published September 23rd, 1925.

Two-valve Neutrodyne Unit.
Non-oscillating selective H.F. amplifier for 220-520 metres. Published October 21st, 1925.

Valve-crystal Neutrodyne Receiver.
A stable and selective combination of H.F. and L.F. amplification with crystal detector. Published November 11th, 1925.

Four-valve Quality Receiver.
The design and operation of a broadcast receiver for loud-speaker work. Published September 16th, 1925.

Five-valve Neutrodyne Receiver.
An easily constructed long-range broadcast set for loud-speaker reception. Published October 28th, 1925.

Broadcast Wavemeter.
Published July 22nd, 1925.

"Fixed Tuning."
Three-valve set for local and 5XX programmes without controls. Published October 7th, 1925.

Single-control Two-valve Receiver. (Frame Aerial.)
With special provision for maintenance of valves and batteries. Published October 14th, 1925.

Three-valve Receiver Operating from the Electric Mains.
A convenient method of obtaining H.T. and L.T. supply. Published October 28th, 1925.

Two-station Receiver.
Working design for a novel broadcast receiver. Published November 4th, 1925.

40 Metres and Below.
How to build an ultra short-wave receiver. Published July 15th, 1925.

Four-valve Safety Receiver.
Long-range loud-speaker reception without reaction. Published August 19th, 1925.

Events of the Week in Brief Review.

UNAUTHORISED TRANSMITTERS IN SWITZERLAND.

According to a *Times* correspondent, ten unauthorised amateur transmitting stations in Switzerland have been seized by the Geneva police.

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NORDDEICH MASTS COLLAPSE.

During the storm which raged over Germany on the night of Wednesday last, the three 500ft. masts of the new wireless station at Norddeich were blown down. Fortunately no lives were lost.

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THE FAIR ANNOUNCER.

Radio Toulouse has set an example by being the first French broadcasting station to have a female announcer. The lady is Mlle. Maddy Bertel, who occupies the post of "speaker en second."

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THE BROADCASTING COMMITTEE.

Meetings of the Committee, appointed by the Postmaster General under the chairmanship of Lord Crawford to advise as to the future policy in regard to broadcasting service, will be held on the 3rd and 4th of December in Committee Room No. 4 of the House of Lords at 4 p.m., to hear evidence to be tendered by the British Broadcasting Company, Ltd., and the Wireless League respectively. The public will be admitted.

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MR. FORD'S WIRELESS PROSECUTION.

Mr. Robert Moffat Ford, whose summons at the instance of the Postmaster-General on the charges of installing and working a wireless apparatus without the necessary licence, has occupied public attention for several weeks, again appeared at the Marlborough Street Police Court on Thursday last.

Having pleaded "Not guilty" at the last hearing, Mr. Ford continued his defence by questioning the meaning of the word "message" as defined by the Wireless Telegraphy Act.

The Magistrate (Mr. Mead) fined the defendant £10 and ordered him to pay £10 costs, with the alternative of 11 days' imprisonment in the second division.

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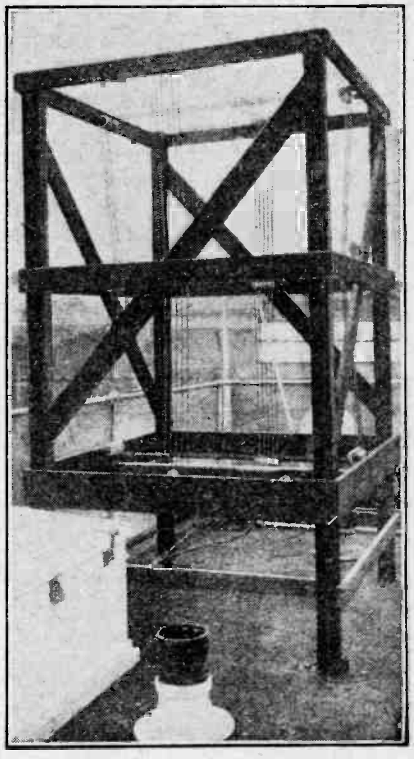
IRISH PORTS AND WIRELESS.

The recent rescue of the steamer "Pencisely" in Dublin Bay through the agency of a wireless amateur has raised the question of whether adequate wireless facilities are available in the neighbourhood of Irish ports. Should a ship get into difficulties a few miles out of Dublin the nearest land wireless station to which she may appeal for help is Liverpool.

R.S.G.B. DEBATE.

Several hundred members of the Radio Society of Great Britain, after the debate at Selfridge's on Thursday night, decided by a large majority "that the present system of broadcasting, as represented by a single monopoly, is the best for this country."

Those who supported the motion contended that the B.B.C. was not a monopoly so much as a centralised control, and that a number of smaller organisations engaged in broadcasting would be unable to pay the fees necessary to secure the best performers.



WIRELESS AT THE SHIPPING EXHIBITION. The new Marconi D.F. aerial, now on view at Olympia. Economy of cost and space are both achieved with the new arrangement without sacrificing the accuracy obtainable with a large and unwieldy loop.

RADIO TOULOUSE HEARD OFF CEYLON.

A gratifying report has been received by the directors of *Radio Toulouse* to the effect that the station's programmes were picked up regularly by the crew of the French mail ship "Commandant Mages" when the vessel was lying off Ceylon, a distance of nearly 5,000 miles.

BROADCASTING IN CEYLON.

A proposal is under consideration to instal a broadcasting station at Colombo, to operate on a wavelength of 800 metres.

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ITALIAN AMATEUR TRANSMITTING CONTEST.

The co-operation of all amateurs is requested in connection with the Radio Transmitting Contest which has been organised by *Il Radiogiornale*, the official organ of the Radio Club of Italy. Great help will be rendered to the participators if amateurs in all parts of the world, and especially in America, Australia, Africa, and Asia, will kindly forward reports promptly to Italian transmitters whom they hear.

Fuller particulars of the contest appear in this issue under "Transmitters' Notes and Queries."

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STRIKE OF WIRELESS OPERATORS.

More than 5,000 marine wireless operators were involved in a strike which was called on Thursday last by the Association of Wireless and Cable Telegraphists.

The strike is understood to be against a proposal by the employers for a wage reduction of 22s. 6d. a month. Other points on which the Association "awaits settlement" relate to foreign service allowances, annual leave, and stability of employment.

The employers' organisations interested are: The Engineering and Allied Employers' London and District Association, the Shipping Federation, the Marconi International Marine Communication Company, the Radio Communication Company, and Messrs. Siemens Brothers.

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THE WIRELESS INSTITUTE.

In view of the decision to proceed with the registration of the Wireless Institute, the following officers and members of the Council have been elected:—

Chairman:—Mr. Nelson.

Vice-chairman:—Mr. E. H. Turle.

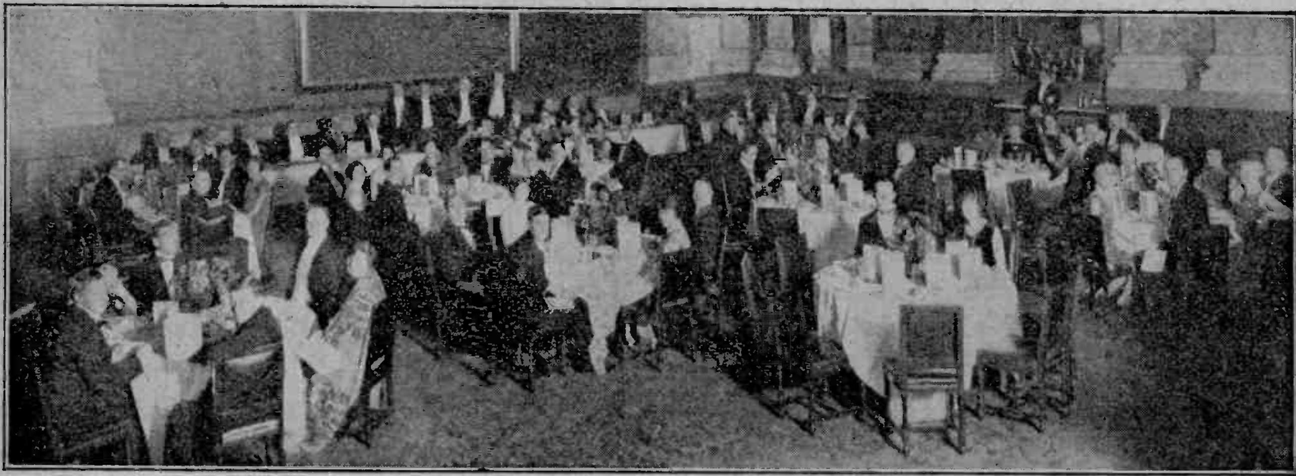
Hon. Sec. and Treasurer:—Mr. Y. W. P. Evans.

Assist. Hon. Sec.:—Mr. H. King.

Council:—Mr. A. F. H. Baldry, Mr. H. W. Gambrell, Mr. C. E. Baldwin, Mr. J. H. Tanton, Mr. W. E. Cooper, and Mr. A. Woodmansey.

The following have been appointed district representatives:—Mr. J. H. Tanton, London Area; Mr. C. E. Baldwin, S.E. Counties; Mr. Lowe, S.W. Counties; Mr. Gambrell, Midlands; Mr. Woodmansey, N.E. Counties; Mr. Bradshaw and Mr. Simpson, N.W. Counties.

The headquarters of the Institute will be situated in London.



RADIO ASSOCIATION ANNUAL DINNER. A photograph taken at the Hotel Cecil on November 19th, showing the guests assembled at the Radio Association's Dinner. The chair was occupied by the Duke of Sutherland.

OPENING OF THE NEW OXFORD STUDIO.

By A SPECIAL CORRESPONDENT.

THE opening of the new Oxford Studio marks a new and in many ways an interesting departure in the B.B.C. activities. I had the opportunity, at the formal opening ceremony on Monday, November 23rd, of learning something of what may be expected in the near future from this "permanent point for outside broadcasts," as the B.B.C. engineers are disposed to describe it officially.

One might at first be tempted to think that Oxford means nothing more than the "dry as bones" talk, purely academical and beyond the range of any but serious students. Any such thoughts were at once dispelled by the simple yet earnest opening words of the Master of Balliol. "Though lectures are good for us, the give and take of argument is more valuable. It is not the set speech, which can be more thoroughly appreciated from the printed word, but the live discussion, that is important." The words are those of Dr. Lindsay.

No Local Transmitter.

Perhaps we shall look to Oxford for more "after dinner philosophy," but the drama and music will, I am assured, find a place in the Oxford programmes of the future.

OPENING OF THE OXFORD STUDIO. Dr. A. D. Lindsay, Master of Balliol College, who delivered the inaugural speech on November 23rd.

The new studio has no call sign, for there is no local transmitter, the microphone being linked direct to the S.B. board at London headquarters. The station is staffed from London, and there is no resident engineer.

The studio is smaller than usual and is draped in the University colours. Speech and music are amplified for tone and quality through a five-stage resistance capacity coupled amplifier of the usual shrouded pattern before being put over the land line to London.

Besides the Master of Balliol, who performed the opening ceremony, there were many distinguished men, representing all phases of the University's life, present at the opening ceremony. Admiral Carpendale, controller of the B.B.C., and Mr. Nicolls, of the Headquarters Programme Department, were also present, and the technical arrangements were in the hands of Mr. R. H. Wood.

HINTS and TIPS for NEW READERS

A Section Devoted to the Practical Assistance of the Beginner.

THE CHOICE OF A RECEIVER.

The amateur who is thinking of undertaking the construction of a valve receiver for the first time is apt to be bewildered by the multiplicity of circuit arrangements which are open to him. Experience shows that the great majority of our readers have very little difficulty in assembling and wiring-up even the more elaborate sets of which detailed descriptions are given in *The Wireless World*, but our correspondence seems to show that a certain number of the totally inexperienced fail to obtain quite the results which are to be expected, due rather to difficulties encountered in making preliminary adjustments than in actual construction.

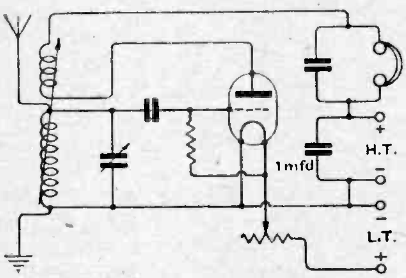


Fig. 1.—A simple single valve receiver with reaction.

It is suggested that the beginner would be well advised at the outset to assemble a simple set, and by actual practice to acquire that elusive something which may best be described as the "feel" of a receiver. If at the same time he learns something of the theory of what actually happens when the various adjustments are made, he will soon be in a position to undertake with confidence the construction of a more ambitious instrument, and will probably save himself much vexation and possibly considerable expense. If wisely chosen, the majority of the components used will serve again in the new set.

A type of receiver which may be recommended in this connection is the classical single valve detector with reaction, which is shown diagrammatically in Fig. 1. Although such a set is hardly suitable for long-distance reception unless reaction coupling is tightened excessively, with the consequent risk of causing interference by radiation, much may be learnt from it. The valve detector, of course, forms the nucleus of the majority of multi-valve receivers, and high- and low-frequency amplifying units may be added to the set as it stands.

Another type of receiver suitable for the beginner is shown in Fig. 2. This is a crystal set followed by two stages of low-frequency amplification, and has the advantage that a loud-speaker may be operated from it up to distances of about 20 miles. The construction is perfectly plain and straightforward, and, again, additions may readily be made to it, or the component parts may be made use of in the construction of a larger set.

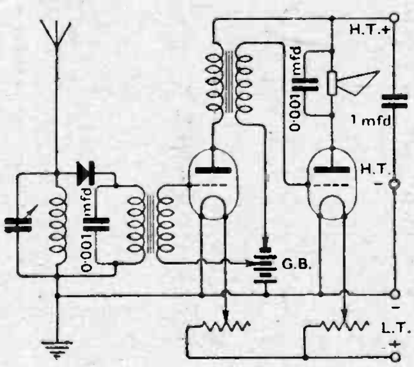


Fig. 2.—Crystal set with two L.F. amplifying valves.

In spite of the fact that constructors of multi-valve receivers such as those described in detail in the pages of this journal may, and often, indeed, do, obtain good results at the outset without having had any previous experience of such work, it is felt that success will be more certain if the plan recommended is adopted. Also, very valuable and interesting experience will have been gained. When operating a simple set it is comparatively easy to assign a reason for any particular effect which may be observed; this is not the case when dealing with a more complex instrument.

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SELECTING VALVES.

It may be said, broadly speaking, that there are four classes of valves available to the amateur: those operating from either two-, four-, or six-volt accumulators, and those with filaments which may be heated by a dry battery. Each class has its advantages and disadvantages, and final decision as to which should be adopted is governed by such consideration as facilities for accumulator charging, maximum loud-speaker volume required, and, to a certain extent, on the type of circuit to be used. The question of initial and upkeep cost is also to be considered.

The two-volt valves are increasing in popularity, and deservedly so. Although the current taken is not particularly low, the *power* consumption is extremely moderate. Considered in terms of valve burning hours per pound weight of accumulator, they show up well in comparison with most other valves. A fair range of types are available, and for every purpose except the handling of abnormally large output power this class may be recommended. As far as is known, tubular low-capacity valves with 2-volt filaments are not yet obtainable. One disadvantage is that not more than about four or five of such valves can be used in parallel with a single cell battery, as the small voltage margin available is not sufficient to compensate for the inevitable drop in voltage in the leads and internal resistance of the cell.

A fairly large range of four-volt valves are on the market, but many require more power for heating than do those of the class mentioned above. Again, there is no large power valve, but this will only be a drawback in a few isolated cases, the average user being well catered for.

Where expense and accumulator-charging difficulties are not a serious consideration it would seem advisable to use a six-volt battery, as designers have produced valves for almost every conceivable purpose with filaments working on this voltage. Of course, valves with a lower rating may be used in conjunction with them if a suitable value of resistance is inserted in series with the filament lead. Strictly speaking, it is incorrect practice to waste power by using it to heat a resistance, but this will generally be preferred to the use of two batteries.

Dry battery valves of the 0.06 ampere class are almost a necessity for those who have difficulty in arranging for accumulator charging. They have the disadvantage that the filaments are rather fragile, and there is an unfortunate tendency to overrun them. The selection of types on the market, as far as impedance values are concerned, is rather limited.

The bright emitter may safely be said to be obsolescent, and offers no advantage (other than that of low initial cost), except, perhaps, to those who are able to charge their batteries with a minimum of trouble and expense.

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SHORT WAVE RECEPTION.

The "extra-short" wavelength band, below, say, 150 metres, offers an interesting field for experimenting, but unfortunately there are, at the present, not many telephony transmissions available. Whether or no this will remain so is doubtful, but in any case the Westinghouse station at Pittsburgh, on 64 metres, can generally be counted on to provide signals quite early in the evening—a distinct advantage, as the stations on the 300-500-metre waveband seldom come in well until the early hours of the morning. The greatest interest, however, is provided by the short wave transmissions in Morse, but, unfortunately, many amateurs find the difficulty of mastering the code is an insuperable one.

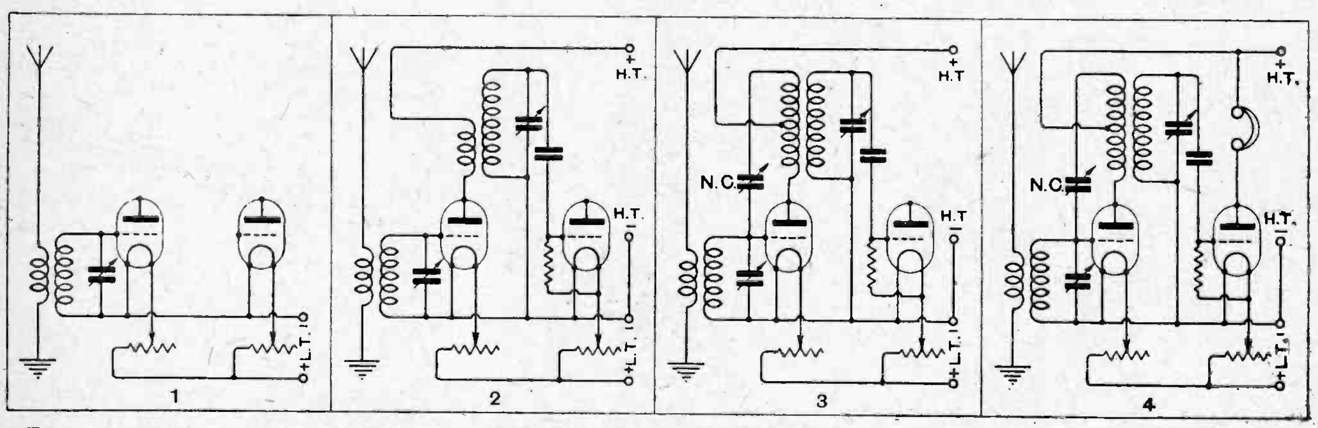
The art of reading Morse at speeds of twenty words a minute or more is only attained after considerable practice, but, luckily, many transmissions are at a speed of some twelve words a minute, which should not be beyond the capabilities of anyone willing to devote a little time to practice.

Suitable receivers for these short wavelengths have been described in this journal on several occasions. High-frequency amplification would seem, at our present state of knowledge, to be definitely ruled out, and it may safely be said that 95 per cent. of the long-distance reception reported in our "Calls Heard" section is carried out with a valve detector and one stage of L.F. amplification. At the present time, a set covering the wavelengths between about 40-70 metres is likely to be the most useful, as these are being extensively used by amateurs.

DISSECTED DIAGRAMS.

No. 8.—A "Neutralised" H.F. Amplifier-Detector.

For the benefit of those who have not yet acquired the simple art of reading circuit diagrams we are giving weekly a series of sketches showing how the complete circuits of typical wireless receivers are built up step by step.



Two valves, with filaments connected in parallel across an L.T. battery, and rheostats inserted in the positive leads. Voltage variations induced from the comparatively loosely coupled aerial circuit into the tuned secondary circuit are applied between grid and filament of the first valve.

The anode circuit of this valve is completed through the primary winding of an H.F. transformer and H.T. battery. The tuned secondary is connected between grid and filament of the detector valve, through a grid condenser in conjunction with a grid leak. The set will normally oscillate when—

—the circuits are brought into tune. A neutralising winding is added to the primary, and is connected to grid through a small condenser, N.C., in such a manner as to neutralise when properly adjusted the high-frequency currents fed back through the internal capacity of the valve.

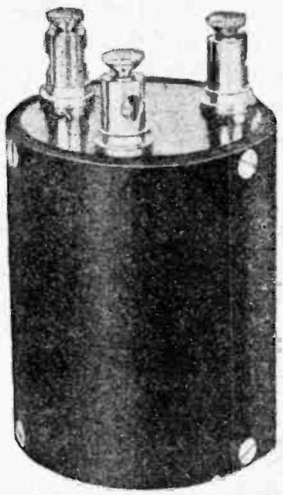
The plate circuit of the detector valve is completed through the telephones and H.T. battery. If the transformer windings are correctly designed and the capacity of the condenser N.C. is suitable, the receiver will not oscillate over the whole of the tuning range provided by the variable tuning condensers.

NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

THE ATLAS APERIODIC COUPLER.

A useful device for improving selectivity without making structural alterations to the receiving set is manufactured by H. Clarke and Co. (Manchester), Ltd.,



Atlas aperiodic coupler for improving selectivity without making structural alterations to the receiving set.

Atlas Works, Old Trafford, Manchester, and is sold under the name of the Atlas Aperiodic Coupler. It consists of a totally enclosed winding of suitable dimensions for inserting inside the plug-in coil used for aerial tuning. As the aerial connections are transferred from the aerial and earth terminals of the set to the terminals of the coupler, thus removing the parallel capacity of the aerial itself, it becomes necessary to substitute a slightly larger tuning coil. The receiver must, of course, be wired with the tuning inductance and condenser in parallel, an arrangement which is now generally adopted.

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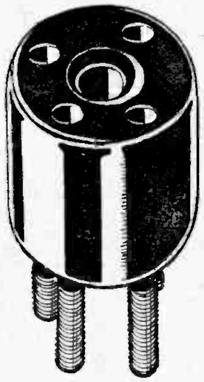
A NEW VALVE HOLDER.

A useful type of valve holder is manufactured by A. H. Clarkson, Ltd., 119, Fleet Street, London, E.C.4. It is well finished in polished ebonite and the ends of the sockets are recessed below the top to prevent accidental contact between the filament pins of the valve and the high



Ebonite valve holder by A. H. Clarkson, Ltd., type V.136.

tension connected socket of the holder. Grid-plate capacity is reduced by providing a $\frac{5}{16}$in. hole right through the centre of the holder between the pins.

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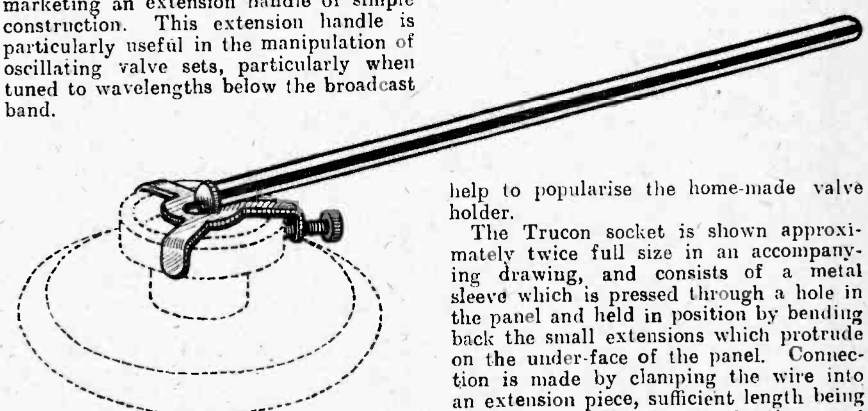
BURWOOD ANTI-CAPACITY HANDLE.

Hand capacity effects can be largely eliminated and critical tuning obtained by the use of insulating extension handles attached to the tuning dials.

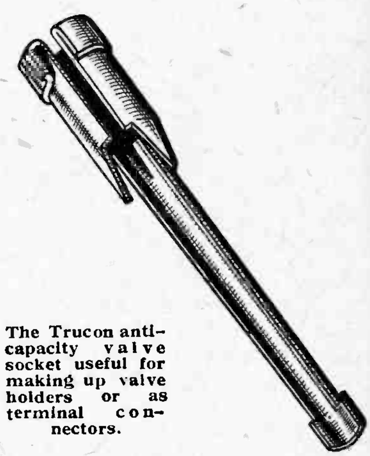
The Burwood Electrical Supplies Co. (1924), 41, Great Queen Street, Kingsway, London, W.C.2, have for some while been marketing an extension handle of simple construction. This extension handle is particularly useful in the manipulation of oscillating valve sets, particularly when tuned to wavelengths below the broadcast band.



Burwood extension handle for eliminating hand capacity effects and providing critical control.

THE TRUCON VALVE SOCKET.

At one time the amateur constructor made his valve holders by inserting sockets through holes in the ebonite instrument panel, and there was much



The Trucon anti-capacity valve socket useful for making up valve holders or as terminal connectors.

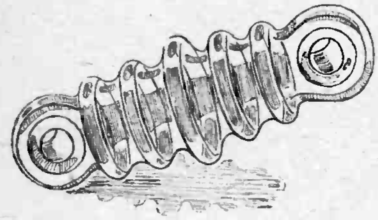
to be said for this simple form of valve holder.

The introduction of a valve socket by Wates Bros., Ltd., 12-14, Great Queen Street, Kingsway, London, W.C.2, which does not make use of back nuts and which can easily be mounted in the instrument panel will perhaps once more help to popularise the home-made valve holder.

The Trucon socket is shown approximately twice full size in an accompanying drawing, and consists of a metal sleeve which is pressed through a hole in the panel and held in position by bending back the small extensions which protrude on the under-face of the panel. Connection is made by clamping the wire into an extension piece, sufficient length being allowed to prevent overheating and loosening of the socket in the panel when soldering.

PYREX AERIAL INSULATORS.

The general adoption of Pyrex glass as an insulator in apparatus operating at radio frequencies has led to the introduction of an aerial insulator moulded in this material by James A. Jobling and Co., Ltd., Wear Flint Glass Works,



The new Pyrex glass aerial insulator.

Sunderland. It measures a little more than 3in. overall, and is stated by the manufacturers to withstand a strain up to 450 lb., a pull far in excess of that likely to occur with any of the usual types of single- or two-wire receiving aerials.

Pyrex is an ideal material for the construction of aerial insulators and other parts of radio equipment where permanent high insulating values are desired. It is homogeneous and of a continuous uniform structure, and so does not depend for its insulating properties on a surface glaze. Moreover it does not absorb water or attract moisture, and its smooth permanent surface prevents the collection of dust. It is mechanically strong and is light in weight, thus enabling even high-power transmitting insulators to be made with reasonable dimensions.

The use of Pyrex glass as an insulator for radio work will probably be extended, and may in the near future largely supersede other insulating materials at present in use for a variety of purposes.

C.A.V. LOUD-SPEAKER.

The high reputation which C.A.V. loud-speakers enjoy is the outcome of sound design and good workmanship, coupled with many minor constructional features.

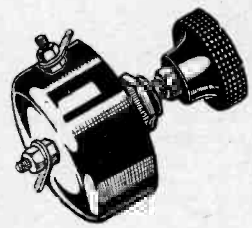
The standard model here illustrated is capable of producing sufficient volume to make it suitable for use in large halls and general use out of doors where considerable volume is required. An interesting feature in design is the manner in which adjustment of the distance between diaphragm and the pole pieces is obtained. The diaphragm is attached to the cap of the base, which, when rotated, gives a fine adjustment by operating in a fine thread.

Other models include the "Junior" and "Tom Tit."

Standard model C.A.V. loud-speaker.

NEW TYPE VARIABLE GRID LEAK.

Many are the endeavours that have been made to design a variable high-resistance suitable for use as a variable leak in conjunction with a condenser used in the leaky condenser method of



The Success variable grid leak.

rectification. The difficulty of making such a component has only been partly solved when semi-fluids are used to form the high-resistance material, for they can rarely be relied upon to remain constant in value.

The New Success variable gridleak introduced by Beard and Fitch, Ltd., 34, Aylesbury Street, London, E.C.1, makes use of a strip of flexible resistance material winding on a brass centre and pulling against a tension spring.

Being a product of a firm of engineers who specialise in gear-cutting, the mechanical design and workmanship are up to a high standard. A clean outside moulding measuring a little more than ½in. in diameter carries a centre brass piece which is rotated by the knob on which a strip of cloth-like material is wound, pulling against a coiled spring held in position in a circular recess. This component takes up very little space on the panel, to which it is attached by a one-hole fixing.

TRADE NOTES.

Aston and Mander Cabinets.

In describing the construction of the Five-Valve Neutrodyne Receiver in our issue of October 28th, it should have been stated that the cabinet used was constructed by Messrs. Aston and Mander (1917), Ltd., for whom the sole distributing agents are Messrs. The Compton Electrical and Radio Trades Supplies, 63, Old Compton Street, London, W.1.

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An International Catalogue.

A copy of the 68-page illustrated catalogue of British and American wireless apparatus, issued by Messrs. Will Day, Ltd., 18 and 19, Lisle Street, Leicester Square, London, W.C.2, will be forwarded by the Company to any reader on receipt of 6d. to cover postage. The catalogue is free to callers. A review of this interesting publication appeared in *The Wireless World* of November 18th.

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"N. & K." Headphones.

It is interesting to note that Messrs. Neufeldt and Kuhnke, of Kiel, whose diving apparatus has been employed in the search for the ill-fated submarine M1, are the manufacturers of the well-known "N. & K." headphones and loud-speakers.

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A Burndept Film.

Leading cinemas throughout the country are now showing, or will shortly show, the new Burndept cartoon film, which depicts the career of "The King of Hearts." His entertaining adventures in association with Burndept valves will interest all wireless enthusiasts.

BOOKS RECEIVED.

"Wireless Telegraphy": James Bowman Lindsay and other pioneers of invention, by A. H. Millar, LL.D., with a foreword by Senator Marconi. 96 pp. with 8 illustrations, published by Malcolm C. MacLeod, Glasgow, Price 3s. net.

"Variations of Apparent Bearings of Radio Transmitting Stations." Part II.—Observations on Fixed Stations, March, 1922—April, 1924. By R. L. Smith-Rose, Ph.D., M.Sc. (Radio Research Board Special Report No. 3.) Published by H.M. Stationery Office. pp. 107, with 32 diagrams. Price 4s. 6d. net.

CATALOGUES RECEIVED.

"Marconiphone Company, Ltd." (Marconi House, Strand, W.C.2). Publication No. 425, describing the "Ideal" range of transformers.

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"British Thomson-Houston Co., Ltd." (Coventry). Pamphlet dealing with B.T.H. low-frequency transformers.

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"Attaix, Ltd." (36, Bernard Street, Southampton). Price list of "Attaix" components and accessories, and of the "Adaptolite" four-valve set.

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"Service Radio Co., Ltd." (67, Church Street, Stoke Newington, N.16). Description and price list of "Service" accessories.

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"H. Clarke and Co. (Mchr.), Ltd." ("Atlas" Works, Old Trafford, Manchester). Illustrated catalogue of "Atlas" radio components.

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"Hart Collins, Ltd." (38a, Bessborough Street, London, S.W.1). Brochure relating to the Hart Collins range of wireless receivers.

INTRODUCTION TO WIRELESS THEORY

Inductance in Alternating Current Circuits.

By N. V. KIPPING and A. D. BLUMLEIN.

ONE, as a rule, hears A.C. voltages spoken of as so many volts, and A.C. currents as so many amperes. This, at first, sounds absurd, because one may justifiably argue that the current is constantly changing. At some instants there is no current at all, at other instants there may be quite a large current in one direction, and a fraction of a second later it may flow in the other direction. This is perfectly true, but the frequency of alternating currents is such that we are seldom interested in their instantaneous values, but only in an average value, which represents the effects it produces. This average value has, therefore, been chosen so that 1 ampere A.C. requires the expenditure of as much power as 1 ampere D.C. to drive it through a given resistance. A.C. amperes and A.C. volts, therefore, satisfy Ohm's law. Thus an A.C. voltage of 6 volts will drive an alternating current of 3 amperes through a resistance of 2 ohms. The power expended will be 18 watts. We therefore see that where a circuit contains only resistance, A.C. is in every way equivalent to D.C. It is, in fact, quite commonly used for lighting systems; electric lamps of 100 volts rating are, then, suitable for either 100 volts D.C. or 100 volts A.C., this latter voltage being the average value that we have described. For the wave-shape shown in Fig. 1 (this is called a sine-wave), the average value of current used for measuring purposes is about two-thirds of the maximum or peak value.

The object of this series of articles is to present to the reader in simple form the elementary laws of electricity and magnetism, in order that he may be in a position to read and understand the more specialised articles appearing in this journal from time to time.
The present section deals with the effect of inductance on alternating currents and concludes with notes on the principle of the transformer.

Now, as we have already seen, inductance in an electric circuit opposes any rapid change of the current flowing. If the current is D.C., the only effect of inductance on the circuit takes place when the current is switched on or off or is changed, but if the current is A.C. and is therefore constantly changing, the inductance has considerable effect, and, the more rapid the changes—i.e., the higher the frequency of the A.C.—the greater is the effect of the inductance.

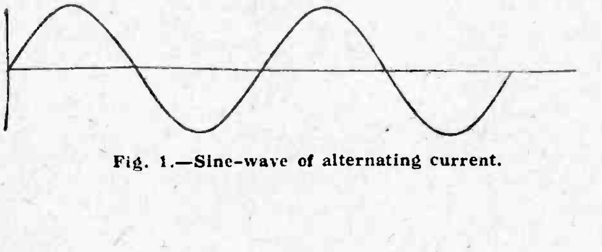


Fig. 1.—Sine-wave of alternating current.

Inductance, however, does not only have this retarding effect on alternating currents, but also has a definite reducing effect. In Fig. 2 is drawn a picture of an A.C. voltage wave of 20 volts from an alternator which we shall suppose to be connected to an inductance, with a resistance in series of one-tenth, or 0.1, of an ohm. We know that if this voltage were D.C., the current forced through the resistance and inductance would be $\frac{20}{0.1} =$ 200 amperes, though if the inductance were very large it might take several seconds to reach this value. But, as the voltage is alternating, we can see at once that the instantaneous value of current will never have time to rise to its maximum, as, long before it has reached that point, the direction of the voltage will have reversed and will be pushing the current in the other direction.

In Fig. 2, then, the dotted line represents the alternating current produced in the inductance, supposing that the switch chances to be closed at the moment when

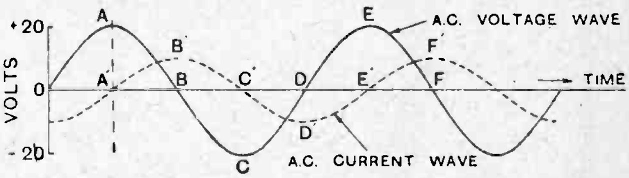


Fig. 2.—Curves showing the effect of an inductance on the current in an A.C. circuit.

the voltage is at its maximum value in one direction (A in the figure).

Let us follow in detail how the current shown by the dotted line is produced. At the point A, when the switch is closed, no current is flowing. During the first quarter cycle, from A to B, the voltage from the alternator is in a positive direction, and the current in the inductance builds in a positive direction, as shown by the curve A′B′. But by the time it reaches B′ the voltage has dropped to nothing, so that the current ceases to build up. At this point the voltage reverses and becomes negative, and tends to make the current build up in a negative direction correspondingly. It must first stop the

Introduction to Wireless Theory.—

current which is already flowing, and in the figure we see that this has happened when the voltage is at C. It may be noticed, though, that for a quarter of a cycle the A.C. voltage has been undoing the work it did in the first quarter cycle in building up the current wave. After this the whole process repeats itself, only in the reverse direction, as the point C corresponds to the point A, except that it is negative. This process, in turn, repeats itself, and the same kind of thing can easily be traced out as far as we like to go. It is not essential to turn on the switch when the A.C. voltage is at its maximum positive value, as at the point A. This was only done for the sake of easy demonstration.

To summarise, the introduction of inductance into an A.C. circuit not only causes a lagging behind of the current wave, but also causes a definite reduction of its value. Resistance in an A.C. circuit causes the reduction in value of the current without causing it to lag behind the voltage, and acts just the same as it will in a D.C. circuit.

Even if the inductance has no appreciable resistance through being a coil of heavy wire, it yet has the reducing effect on the A.C. wave. We already recognise the lagging effect as being characteristic of inductance, and the reducing effect as being characteristic of resistance. This leads us to the conclusion that, although an inductance may have practically no resistance in a D.C. circuit, yet it may have the effect of a resistance (as well as of an inductance) in an A.C. circuit. Like any other resistance effect, this may be measured in ohms, but, to distinguish this A.C. inductance resistance from D.C. resistance, it is talked of in "reactive ohms" or as so many ohms *reactance*. The word "reactance" is used because the effect of the inductance is not so much a pure hindering effect on the current (as with a resistance) as a reaction to the tendency of the current to alter.

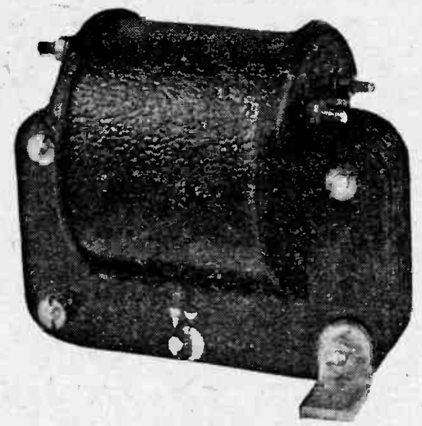


Fig. 3.—Typical intervalve transformer for stepping up the voltage between L.F. amplifying valves.

Calculation of Reactance.

Reactive ohms follow Ohm's law. For instance, an A.C. voltage of 2 volts will push an A.C. current of ½ ampere through a reactance (i.e., inductance) of 4 ohms. It must, however, be remembered that reactive ohms and D.C. resistance ohms cannot be added directly for the purpose of calculation, but in most circuits, especially in wireless, one is generally so much greater than the other that the smaller can be neglected for calculation purposes.

We have spoken of inductance both in henries and in reactive ohms. It will be clear that the hindering effect of inductance gets greater as the frequency of the A.C. voltage gets greater, and consequently the inductance will have a different reactance at different frequencies. The measure "henries" does not take account of frequency, but merely measures the potentialities of inductance when put in an A.C. circuit. For those who are mathematically minded, we append a simple formula for calculating the reactance which an inductance will produce at any frequency, assuming its resistance to be negligible.

$$X = 2\pi f L,$$

where X = reactive ohms,
L = inductance in henries,
f = frequency in cycles per second,
$\pi = 3.14$, etc.

The Alternating Current Transformer.

When talking of inductance and mutual inductance in a D.C. circuit, it was explained that, by suitable mutual inductance, a high voltage could be induced in a circuit. By using A.C. in the first circuit, thus replacing a mere interruption of D.C. by a continually varying current, the induced voltage in the second circuit will be an A.C. voltage, and not just a momentary effect. The value of the voltage depends on the value of the inducing current and on the arrangement of the turns of the coils. If the second circuit has a large number of turns, the induced voltage in the second circuit will be greater than the inducing voltage in the first circuit, provided the resistance is not too great.

This device for producing a change in A.C. voltage is called a transformer. A transformer can be designed to alter an inducing voltage to any other voltage needed within very wide limits, whether higher or lower. Roughly, it is true to say that if the second circuit, or secondary, has five times the number of turns of wire in the first circuit, or primary, then the step up of voltage due to the transformer will be five times, and so on for any other ratio. Of course, no gain in *power* is obtained with the use of a transformer, as, although the voltage in the secondary is higher than that in the primary, the current is correspondingly lower. In the case we gave, the current obtainable in the secondary is one-fifth that in the primary.

Transformers will not operate in D.C. circuits, as steady currents produce no inducing effects in the secondary, and D.C. voltages cannot be stepped up or down without expensive machinery. The possibility of transformation of voltages constitutes one of the great advantages in favour of the use of alternating currents.

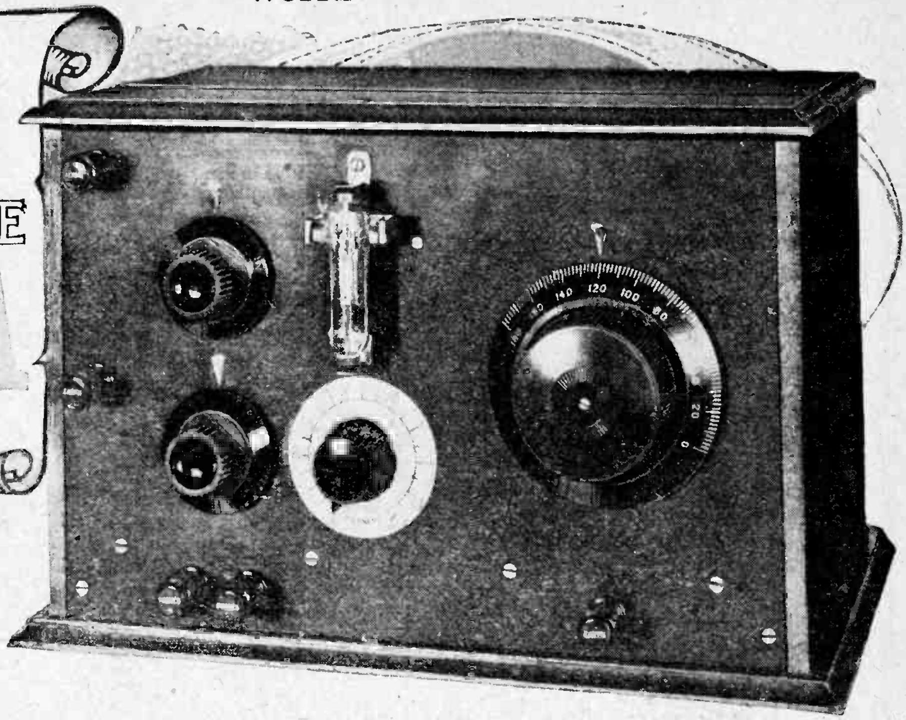
To give an example, to transmit a large quantity of power, it is more economical to use a large voltage and small current, than a small voltage and large current, because the size of conductor necessary in the latter case would be greater. Power is therefore transmitted at a high voltage and stepped down by a transformer to a voltage safe for domestic use.

Fig. 3 shows a photo of a typical wireless transformer. The coil windings are linked through an iron core, so that an easy path is provided for the lines of force, and a large number of linkages may be produced.

(*To be continued.*)

KDKA SHORTWAVE RECEIVER

USA



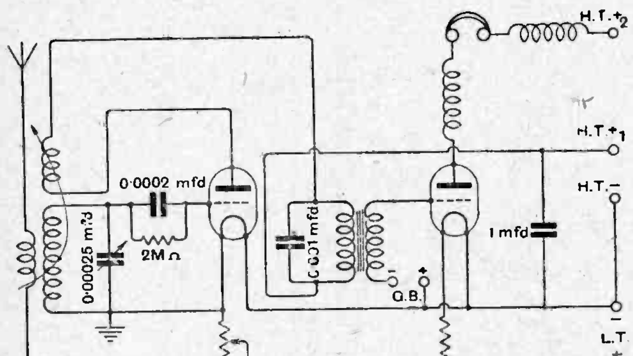
An Easily Constructed Set Tuning from 50 to 100 Metres.

By F. H. HAYNES.

PROBABLY more interest attaches to the reception of American broadcast than to most foreign transmissions owing to the enormous distance covered, and more especially by reason of the fact that the programmes are delivered in the English language. During last winter the more skilled amateurs made a practice of listening to the Westinghouse Station at Pittsburg, KDKA, for it was found that with any well designed short wave set, the transmission then sent out on 68 metres with an aerial energy of 1.5 kW. could be easily tuned in.

Considerations in Design.

The set to be described was designed essentially for the reception of long-range short wave telephony and for the interception of amateur transmissions on the short wave band 50 to 100 metres. Although the design adopted is a very simple one and the most elementary circuit principle employed, it is the outcome of a good deal of listening-in with short wave receivers developed especially for use in conjunction with a transmitting set.



Typical short wave receiving circuit suitable for tuning over a limited wavelength range.

The writer has described from time to time a number of short wave sets making use of special methods to provide smooth reaction adjustment and with circuit arrangements based upon the well-known Reinartz and Weageant principles in which an additional series variable condenser is connected in the detector valve plate circuit to give better facility for controlling regeneration.

It must not be overlooked that the ratio of capacity to inductance in the tuned circuit and the harmonic relationship between the natural wavelength of the aerial used and the wavelength to which the closed circuit is tuned governs the reception from particular distant localities.

When making up a short wave set three essentials present themselves. Firstly, the apparatus employed in the tuned circuit in which losses increase proportionally with the oscillation frequency must be carefully selected. The tuning coils must be of good design and possess low self-capacity with a minimum of solid dielectric material in proximity with the turns, while moving and fixed plates of the tuning condenser must likewise be supported in a manner to minimise losses. The second consideration is the adoption of a layout of the components so that hand capacity effects will not be produced in the process of tuning, while the wiring up of the apparatus in the oscillatory circuits can be carried out with short and direct leads.

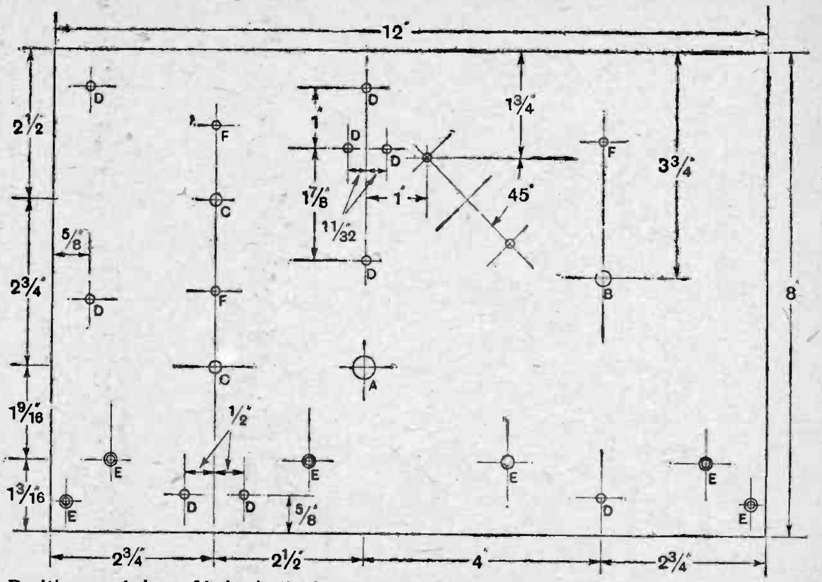
Obtaining Reaction.

The other point of importance is the method by which self-oscillation is set up and critically controlled. It is often pointed out that by feeding the plate current of the valve through a choke coil and connecting a variable condenser in series with the reaction inductance a smoother control of reaction is obtained. Whether or not this is the case depends entirely on the capacity and inductance values of the reaction circuit, and given a reaction coil carefully adjusted in size the simple oscillating circuit shown in the accompanying diagram will

KDKA Short Wave Receiver.—

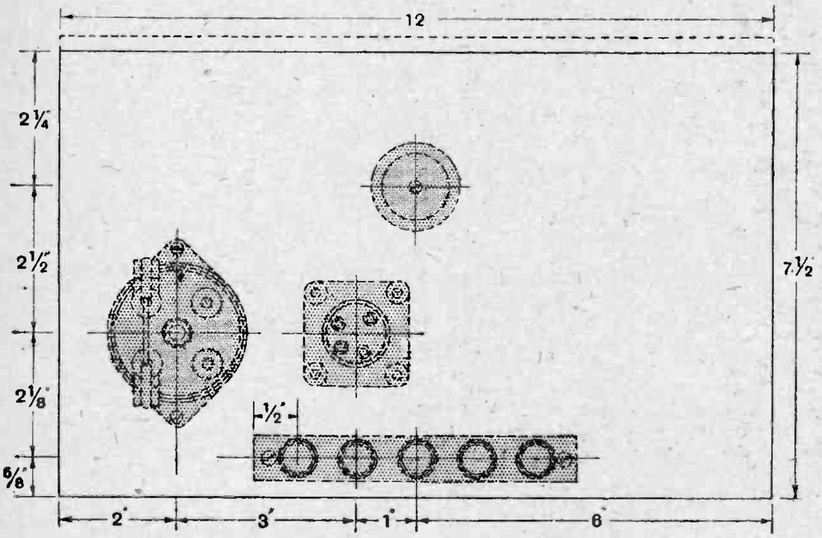
be found easy to operate and will produce signal strength at least equal to the choke feed circuit. This latter arrangement should be employed in receiving sets which are tunable over a wide range, and in which it becomes necessary to alter the constants of the reaction circuit. Thus, in an "ultra" short wave receiver operating, say, from 15 to 50 metres where the wavelength at maximum is 3½ times that at minimum the choke feed with series reaction condenser is recommended; and similarly, in the case of a set designed to efficiently tune from 50 to 200 metres where the frequency change is still considerable.

The wavelength range in this instance is about 50 to 100 metres, and a fixed value reaction coil provides the necessary reaction control, though it is necessary to operate both the reaction coupling adjustment and the tuning condenser simultaneously. The two adjustments moving together systematically are, however, easily manipulated. It becomes imperative, of course, to experimentally determine upon the best size for the reaction coil. This will depend upon the size of the aerial and its tightness of coupling with the closed circuit, the properties of the valve employed, the extent of damping set up by the grid condenser and leak rectification and the normal working H.T. potential. Using a V.24 type valve, a plate potential of 45 volts, with a 6-volt filament battery and with filament rheostat and grid condenser and leak connected up as shown, it was found that best reaction control was obtained with four turns removed from the reaction winding with which the tuner is fitted. If a QX valve is substituted, the plate potential should be about 60 volts. Inter-electrode capacity in the valve tends to make the circuit oscillate, and thus better control is obtained by using the low-capacity tubular types.



Positions and sizes of holes in the front panel. A, 3/8in.; B, drill according to condenser template; C, 5/16in.; D, 3/16in.; E, 1/8in. and countersunk; F, 1/8in.

It will be seen that the tuning coils are constructed so that when assembled the windings are at a sufficient distance behind the panel to prevent changes of tuning by hand capacity. The tuner is placed on the left-hand side of the panel so that it can be operated without the hand approaching too close to the grid and plate connections of the valve and other apparatus. The aerial and earth terminals, which are on the left of the panel, will be found to be almost unaffected by stray capacity. On the right of the panel is the tuning condenser, conveniently situated so that it can be critically operated with the wrist resting upon the table. The clips of the V.24 valve are attached to the centre of the panel with the grid clip on the right-hand side to simplify wiring up. The filament rheostat is immediately beneath it, and one fitted with a vernier adjustment will be found exceedingly useful, as it will provide an additional reaction control by giving a very critical regulation of filament brightness. The note-magnifying valve is not fitted with a variable rheostat, and a suitable value of filament current is obtained by means of a spiral of resistance wire permanently connected in the wiring. The general arrangement consists of attaching the tuning and detector valve apparatus to the ebonite front panel so that it can be wired up with short and rigid leads, whilst the note-magnifying apparatus and battery terminals are carried on the baseboard and joined together with indiarubber covered No. 22 wire passing beneath the baseboard so as to be remote from the H.F. apparatus.



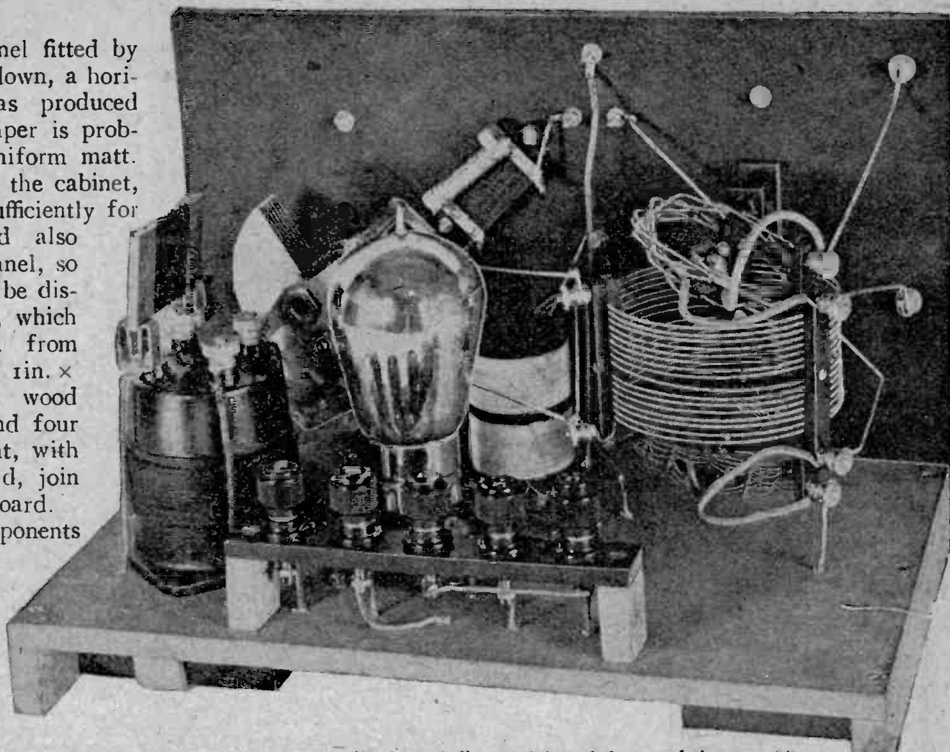
The layout of the components on the baseboard. Ample room is allowed for the substitution of other types of components, though apparatus should not be brought too close to the coils.

Constructional Details.

The cabinet is a standard one, and the beginner without workshop facilities would

KDKA Short Wave Receiver.—
do well to have the ¼in. panel fitted by his local dealer. In rubbing down, a horizontal straight line finish as produced with medium carborundum paper is probably to be preferred to a uniform matt. A baseboard is supplied with the cabinet, and two 1in. strips raise it sufficiently for the underneath wiring, and also strengthen the fixing to the panel, so that metal angle brackets can be dispensed with. These runners, which also prevent the baseboard from warping, are attached with 1in. × No. 4 countersunk brass wood screws, three at each end, and four similar screws along the front, with an additional one at each end, join together the panel and baseboard.

The positions for the components on both the panel and baseboard are shown in the drawings on the previous page and the constructor is not required to build any components other than the choke coil, which consists either of a cardboard or ebonite tube 1½in. in diameter plugged at one end and wound with two sections of No. 36 D.S.C. wire, both windings being in the same direction and each spool consisting of forty turns. No tapped holes are required, and construction is further simplified by substituting the usual flush-fitting back terminal strip with a row of baseboard terminals carried on two wooden blocks, the connecting leads to the batteries passing through holes in the back of the cabinet.



The parts are arranged to give simple and direct wiring of the tuned circuit. The terminal strip supported on two pieces of wood and connected up through holes in the back of the cabinet is easier to construct than the vertical terminal strip with flush fitting.

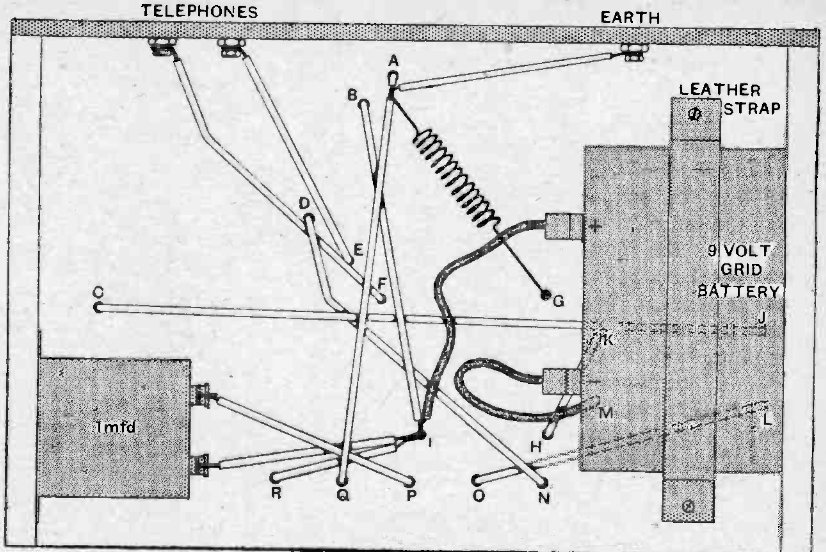
Unless the special type of terminal shown in the illustration is employed, tags should be inserted under all nuts. Connecting tags are required also, under the back nuts used for securing the V.24 valve clips. The tuner is easily attached in position with the aerial coil uppermost, and it will be found that the screw of the lower dial indicator passes right through the ebonite mounting piece attached to the coil. The particular type of condenser used is fitted with a centre nut for securing it to ⅛in. panel, and must, therefore, be attached by means of the three screws supplied with it, making use of the paper template. Instructions are given with the reduction gear dial showing the method of attachment. The components on the baseboard are held down with black round-headed screws. The clips which give

This view shows the baseboard layout.

KDKA Short Wave Receiver.—

support to the condenser bridging the primary of the transformer may need a little adjustment to obtain a good grip.

No. 16 tinned copper wire is run by the shortest path to wire up the front panel, while most of the battery connections are made beneath the baseboard as shown in the practical wiring diagram.



The leads on the underside of the baseboard. Reference letters show the continuation of leads in the diagram on the next page.

Aerial and Counterpoise.

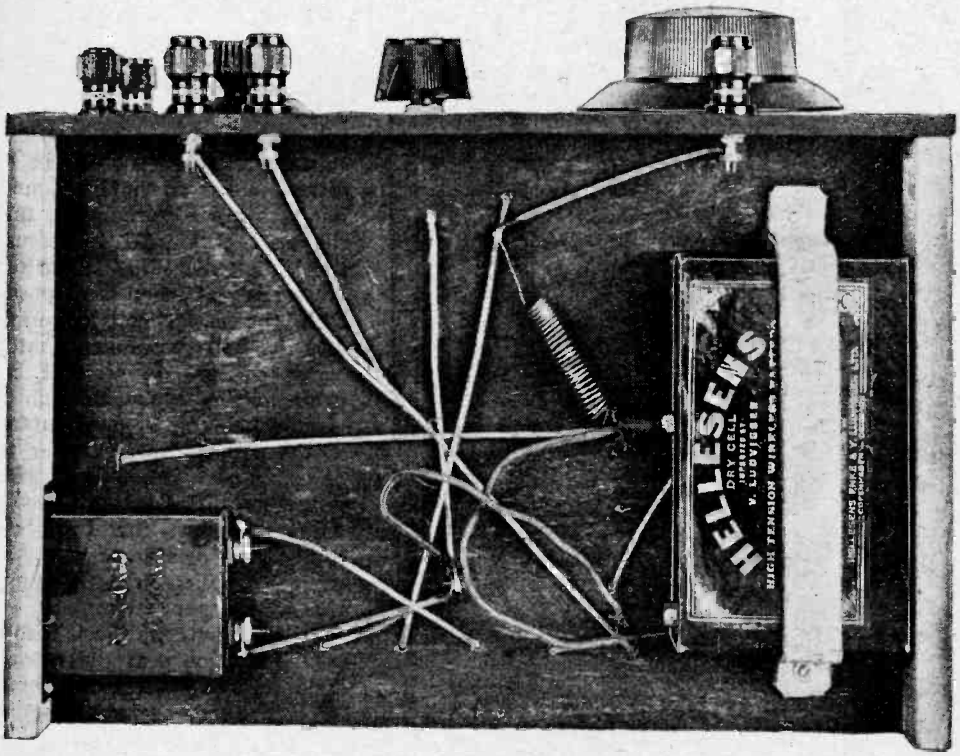
For the best results the aerial should not exceed 60ft. in length, and the far end should be as high as possible. A well-insulated counterpoise falling away to the far end to a height of, perhaps, 10ft. above the ground has been found to produce the best results for short wave reception. A short-earth-connected wire may be connected to the earth terminal beneath the condenser dial to further stabilise the working of the set, though, if it is found to impair reception, should be abandoned, and it then becomes important to insulate the H.T. and L.T. batteries from earth and to connect them up with short leads.

The construction of the particular instrument shown was completed on November 14th and brought into operation late that night. KDKA was received at good strength on two pairs of telephones in the early morning of Sunday, the 15th, though the atmospheric conditions were, perhaps, not too favourable. The signal strength was constant, and the speeches which were being relayed easily understood, which is a more severe test than the reception of musical items.

Method of Tuning.

The tuning process consists of adjusting the reaction coil to a position of minimum coupling, yet keeping the circuit so that it is definitely oscillating, as is discerned by the picking up of carrier waves on many settings of the tuning condenser. With one hand on the reaction coupling control, and the other operating the condenser knob, the two dials can be rotated with a little practice, so that self-oscillation is just maintained. The need for a reduction gear for operating the condenser will be at once appreciated, and one is reminded that the same effect cannot be obtained with a vernier plate condenser, as signals will be missed when using the coarse movement. When the required carrier wave has been tuned to, the reaction coupling is further loosened, following with the condenser to the silent point.

KDKA transmits on the wavelength of 64 metres and usually at the following times: 11.15 p.m., 1.10 a.m., 2 a.m., closing down at about 3 a.m. G.M.T.



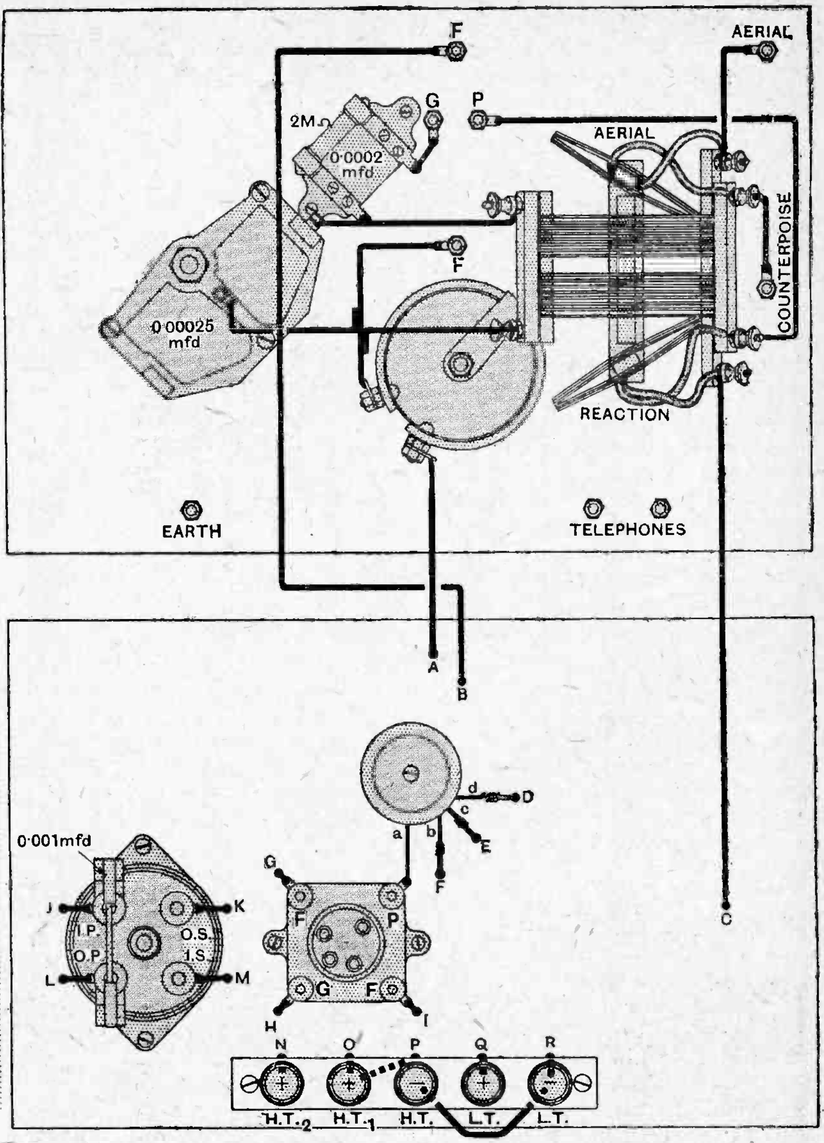
The grid battery is held in position with a thin piece of leather strap. A spiral of resistance wire (No. 28 "Eureka") is connected in the filament circuit of the L.F. valve and should be adjusted on test.

KDKA Short Wave Receiver.—

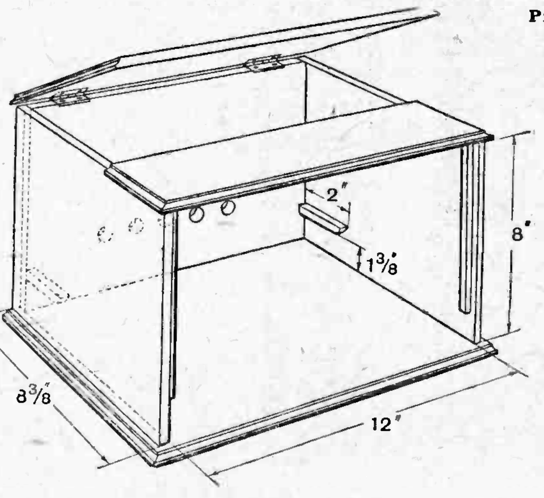
COMPONENTS REQUIRED.

Pranco short wave tuner, 50/200 metres. (Peranne and Co., Ltd., Diamond Works, Regent's Park Road, Church End, Finchley. N.3.)
Bremer Tully variable condenser, 0·00025 mfd.
Set of clips for V.24 valve. (Marconiphone Co., Ltd.)
Benjamin valve holder.
Pelican geared dial,
Cabinet for panel, 12in. × 8in. (Compton Electrical and Radio Trades Supplies, 63, Old Compton Street, W.2.)
Ebonite panel, 12in. × 8in. × ¼in.
10 terminals. (Belling & Lee).
M-L intervalve transformer.
Burndept filament rheostat, 7 ohms.
T.C.C. condenser, 1 mfd.
Condenser 0·00025 (Dubilier type 600, with clips for leak.)
Condenser, 0·001 mfd. with clips (McMichael).
Grid battery (Hellesen).
2 Wander plugs for grid battery.
3 Dial indicators (Decko).
Grid leak, 2 megohms (Dubilier).
3in. ebonite tube, 1½in. diameter.
Ebonite for terminal strip.
Small quantity of No. 36 D.S.C.
3 yds. No 22 indiarubber covered wire (Ripaults).
Small quantity of No. 16 tinned copper wire for wiring up.
Length of resistance wire, No. 28 Eureka

The total cost of all the components mentioned above is less than £6, and a considerable saving can be effected if desired by substituting less expensive but reliable components and dispensing with the polished mahogany cabinet. The cost can then be brought down to a little over £2.



Practical wiring of the front panel and baseboard connections.



Details of the cabinet. The holes and fitting of the guide pieces are the only changes necessary.

Another American telephony transmission is made by the high-powered experimental station of the General Electric Co., Ltd., of America.

The station 2XAF does not operate regularly, but periodically relays the programmes of WGY on a wavelength of 41.88 metres, with an input power up to 50kW. This transmission was heard between 11 p.m. and 1 a.m. on November 23rd, 24th, and 25th. The wavelength is below the minimum tuning range of the set here described, which is intended to embrace the amateur wavelength of 90 metres. By the removal of three of the turns, however, from the centre of the secondary coil, the tuning range may be brought down to 40 to 85 metres.

* * *

A further design for a short wave set with a tuning range of 30 to 65 metres and suitable for use on the now much used amateur transmitting wave band of 45 to 50 metres will be described in an early issue.

NEWS FROM THE CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Kensington Radio Society.

At the Society's November meeting Mr. Maurice Child gave his very popular lecture on "High Frequency." Numerous scientific experiments, all of which proved successful, greatly added to the interest of the lecturer's remarks. On December 3rd a representative of Messrs. S. G. Brown, Ltd., will lecture on "Modern Headphones and Loud-speakers."

Hon. Secretary: Mr. Herbert Johnson, 81, Cromwell Road, Wimbledon, S.W.19.

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Barnsley and District Wireless Association.

A feature of the Society's Second Annual Dinner at the Arcadian Restaurant on October 20th was the highly appetising menu. Included in the items were High-tension Chicken (10,000 volts on the plate), Valve Resistance Creams (particularly smooth in action), and Loud-speaker Cheese (non-resonating). A very successful evening was spent, an excellent musical programme being contributed by a number of the members.

An attractive syllabus of fixtures has been prepared for the winter months. Prospective members should communicate with the Hon. Secretary, Mr. W. Peacock, 28, Park Grove, Barnsley.

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Ilford and District Radio Society.

By kind permission of the B.B.C. two parties of members were enabled to visit the studio and control room at 2LO, and also the transmitting station in Oxford Street, the first party on November 11th and the second on November 16th. The parties were very courteously conducted round the station by a member of the B.B.C. staff, who carefully explained the apparatus and its operation. Of particular interest to the transmitting members was the very systematic manner in which broadcasting is carried out.

With the permission of the B.B.C. the Society is arranging in conjunction with the whole Essex Group to organise a large party to visit Daventry (5XX) in the near future.

Hon. Secretary: Mr. David S. Richards, "Swinford," 50, Empress Avenue, Ilford.

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Muswell Hill and District Radio Society.

An extremely practical lecture and demonstration was recently given before the Society by Mr. R. G. W. Garvey, A.M.I.M.E., assisted by his sons. The subject of the lecture was "Construction." Every phase in the building of a receiver was dealt with thoroughly, from the marking of the ebonite to the completion of the wiring; finally, an excellent demonstration was provided with a three-valve receiver.

An excellent programme has been prepared for the winter session, and a warm invitation is extended to new members. Particulars of membership are obtainable from the Hon. Secretary: Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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North Middlesex Wireless Club.

Every experimenter reaches a stage, sooner or later, where quantitative work becomes a necessity. Valuable assistance in this direction was given to experimenters in a lecture delivered at the Club's last meeting by Mr. E. Laister, who took as his subject: "Simple High Frequency Measurements."

Increased interest was given to the lecture by the practical demonstrations given with an oscillating valve circuit, which could be brought into resonance with the circuit to be tested.

A variable condenser was first calibrated with a fixed condenser of a known capacity. Then, using a chart prepared for the calibrated condenser, capacity and inductance measurements were easily made, employing the ordinary formula of wavelength, inductance and capacity.

Other demonstrations given by Mr. Laister were the measurement of aerial-earth capacity, and the self capacity and inductance of coils.

Hon. Secretary: Mr. H. A. Green, 100, Pellatt Grove, Wood Green N.22.

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FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 2nd.

Institution of Electrical Engineers. Wireless Section.—At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "The Performance of Amplifiers," by Mr. H. A. Thomas, M.Sc.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Lecture: "Sound and Wireless," by Mr. D. W. Milner, B.Sc.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Lecture: "Fundamental Principles of Radio Reception," by Mr. Maurice Child.

THURSDAY, DECEMBER 3rd.

Kensington Radio Society.—Lecture: "Modern Headphones and Loud Speakers," by a representative of Messrs. S. G. Brown, Ltd.

Walthamstow Amateur Radio Society.—Lecture: "Short Waves," by Mr. G. A. V. Sowter, B.Sc.

MONDAY, DECEMBER 7th.

Swansea Radio Society.—Lecture: "Valve and Crystal Circuits," by Sir A. Whitten Brown, K.B.E., M.Inst.M.E.

Hackney and District Radio Society.—At 8 p.m. At Holy Trinity Institute, Mayfield Road, Dalston Junction. Demonstration of unique two-valve receiver, by Mr. F. H. Spiller.

TUESDAY, DECEMBER 8th.

Bolton and District Radio Society.—Demonstration by Radio Communication Co., Ltd. (Provisional.)

Lewisham and Bellingham Radio Society. "More Experiments."

Sheffield and District Wireless Society.

"Wireless in Relation to Music" was the title of an interesting lecture delivered by the Hon. Secretary, Mr. T. A. Blower, on November 6th.

Comparing sound and electro-magnetic waves, the lecturer showed illustrations of wave formations as produced by various musical instruments and their super-imposition on the transmitted radio carrier wave. The effect of overtones or harmonics on the quality of the resultant sound was also pointed out, and was the subject of a number of fascinating experiments.

The lecture was followed by a healthy discussion on the faithful reproduction of musical sounds by amplifiers and loud-speakers.

On November 13th the second of a series of elementary lectures was given by Mr. F. Lloyd, M.Eng., on "Ether Waves—Continuous, Damped and Modulated." These lectures are proving of great assistance to old and new members and, as in past sessions, are well attended.

Hon. Secretary: Mr. T. A. W. Blower, Dept. of Applied Science, St. George's Square, Sheffield.

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Radio Society of Norway.

All the Norwegian radio clubs are now grouped under the Norsk Radio Forbund (Radio Society of Norway), of which the President, Mr. C. Bödtker, is a member of the board of the Oslo Broadcasting Company.

The Hon. Secretary is Mr. Harald Thaulow, Jernbanetoriet 4, Oslo.

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Lewisham and Bellingham Radio Society

Some fascinating experiments were carried out on November 17th, when a number of Continental broadcasting stations were tuned in with a single-valve reaction set, using valves of different makes. Many of the valves employed showed unsuspected qualities.

Hon. Secretary: Mr. C. E. Tynan, 62, Ringstead Road, Catford, S.E.6.

Announcing the New—

Rotax High Tension Battery.

ROTAX

Rotax High Tension Battery.

Super Capacity DRY BATTERIES

High and Low Tension

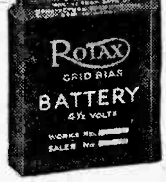
Rotax Low Tension Battery.

FOR a considerable period we have carried out extensive research and experiment to produce a Dry battery with greater capacity than hitherto made. We have now much pleasure in announcing that we have produced a high grade battery, capable of withstanding really heavy continuous discharge and giving 3 to 4 times the life of the usual type now being sold.

They are made with special large capacity cells, the construction of which is based on secret formulæ, while minute care has been taken to ensure perfect insulation—a very important feature.

Supplies are actually available—and the prices are exceedingly reasonable. The following extract is from our List which will be sent on application

Type	Voltage	No. of Cells	PRICE Without Tappings	PRICE With Tappings
H.G. 2	30	20	9/9	10/-
H.G. 3	45	30	14/6	15/-
H.G. 4	60	40	19/-	19/6
H.G. 5	90	60	28/6	29/6
H.G. 6	105	70	33/6	34/6
G.B. 3	4½	GRID BIAS 3	PRICE—1/6 EACH.	



Rotax Grid Bias Battery.

ROTAX BROADCAST RECEIVING EQUIPMENT

OUR Special Wireless Broadcast Receiving Equipment Catalogue, describing our latest 2 and 3 Valve Receivers, will be published at an early date.

May we send you a copy when ready?

ROTAX HIGH GRADE LOW TENSION ACCUMULATORS

PERFECT radio reception is more dependent upon the efficient performance of the low tension Accumulator than is fully realised. This is the outstanding feature of Rotax Accumulators While our high reputation as battery makers is your guarantee, in itself, for dependability, it is in actual use that their sterling qualities are fully appreciated.

A wide range of sizes and capacities is available. They are constructed in best quality ebonite cases, and marketed at reasonable prices. The sizes opposite are extracted from our list, which will be sent to you on application.

Cat. No.	Volts	Capacity Ignition Amp.Hrs.	Capacity Actual Amp.Hrs.	PRICE Un-chgd.	PRICE OF CRATE.
E.W.140	6	60	30	36/-	6/6
E.W.143	2	80	40	15/3	5/9
E.W.146	4	80	40	30/-	6/6
E.W.149	6	80	40	43/9	7/-

Emphasis is placed on the importance of Ebonite construction, as it eliminates the FIRE risk associated with celluloid.

Rotax Low Tension **Ebonite** *Accumulator.*

Eliminates the fire risk.

THE ROTAX HIGH TENSION ACCUMULATORS in glass cases are offered for users of large sets to whom initial cost is not a material consideration. Prices and particulars on application.

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BIRMINGHAM: Landor St. *Telephone:* East 410. *Telegrams:* Rotaxmo, Birmingham. TAUNTON: Newton's Works. *Telephone:* Taunton 9. *Telegrams:* Arc, Taunton
GLASGOW: 19/21, Oswald St. *Telephone:* Central 379. *'Grams:* Rotaxmo, Glasgow. MANCHESTER: 291/3, Deansgate. *'Phone:* Central 7415. *'Grams:* Rostarlite, Manchester
BRISTOL: 7, Temple Street. *Telephone:* Bristol 5756. *Telegrams:* Rotax, Bristol. LEEDS: 117, Park Lane. *Telephone:* 26788. *Telegrams:* Rotax, Leeds

£10 Weekly in Cash Prizes

A New and Simple Competition for all Readers of "The Wireless World"

To be continued weekly until further notice.

HIDDEN ADVERTISEMENTS

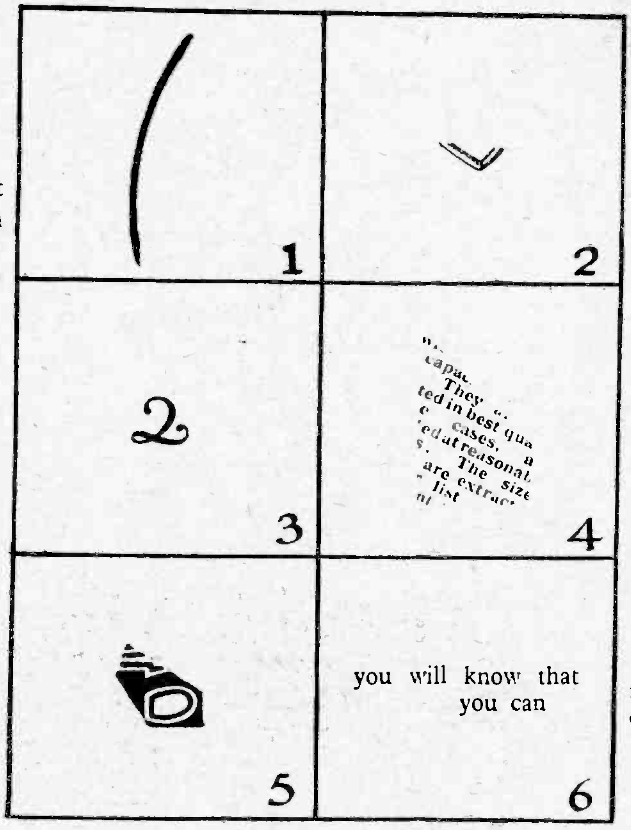
Below will be found six reproductions of fragments cut from the Advertisement pages of this issue of "The Wireless World." Each fragment is a clue. Can you from these clues identify the Advertisements? Seven cash prizes will be awarded to the first seven readers who send us correct solutions. No technical skill is required, merely observation. There are no restrictions or entry fees and the conditions are simple.

£5

for the first correct solution opened.

£2

for the second correct solution opened.



£1

for the third correct solution opened.

and

4

consolation prizes of

10/-

Each

for the next four correct solutions opened.

CONDITIONS

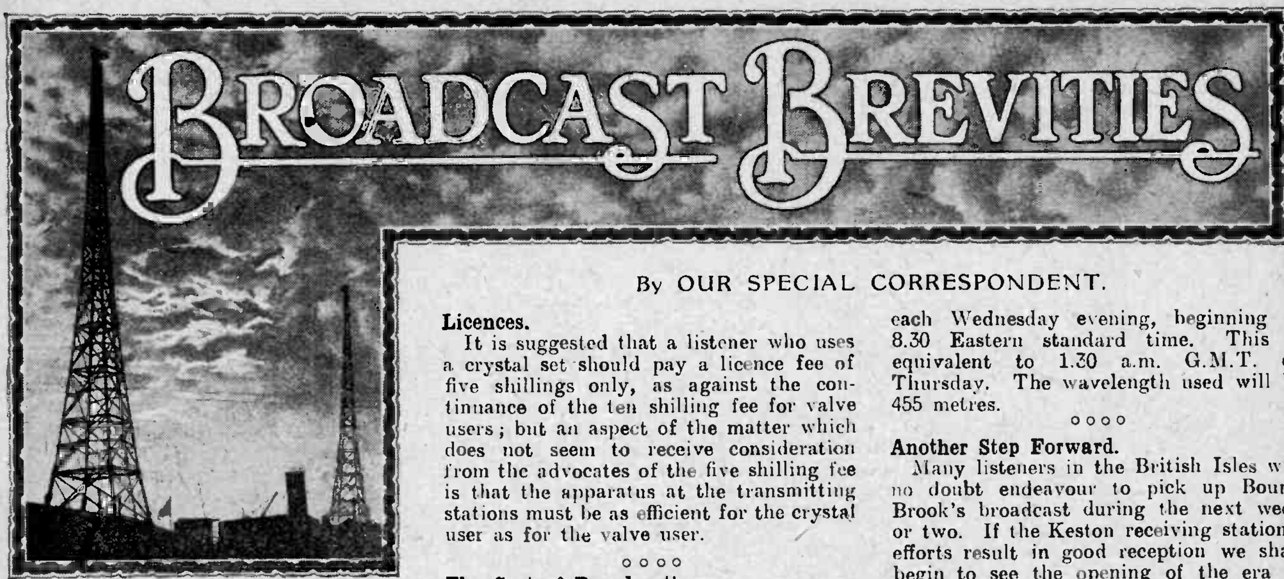
1. All solutions must be written on the special coupon appearing on an advertisement page in this issue and addressed to *The Wireless World*, Dorset House, Tudor Street, London, E.C.4, and marked "Hidden Adverts." in bottom left corner. Provided no other message is enclosed, coupons may be sent in an unsealed envelope with halfpenny stamp affixed.

2. Clues will not, of necessity, appear in the same way as in the advertisement page, but may be inverted or placed in some other position.

3. In order that town and country readers may compete on equal terms, solutions will not be dealt with until 10 a.m. on Monday next. All solutions received before that date will be retained until Monday morning. Competitors may submit any number of entries. Erasures or alterations on a coupon will disqualify the entry.

4. The first prize of £5 will be awarded for the first correct solution opened; the second prize of £2 to the next correct solution; the third prize of £1 to the third, and four consolation prizes of 10/- each for the next four correct answers. In the event of no readers sending correct solutions the prizes will be awarded to the competitors whose solutions are most nearly correct.

5. The decision of the Advertisement Manager of *The Wireless World* is final, and no correspondence can be entered into. Competitors enter on this distinct understanding. No member of the staff of the paper is permitted to compete.



By OUR SPECIAL CORRESPONDENT.

The Thousandth Programme.

Glasgow station's broadcast of its thousandth programme, on November 30th, is a reminder of the small percentage of breakdowns that the various stations experience in the course of their work.

○○○○

Less than Two Minutes' Break.

Glasgow listeners, for example, have been without service for only .03 of an hour during broadcasting hours since January 1st last; and the enforced silence on that one occasion, when the station was automatically closed down, was not due to any engineering fault, but owing to the pedestal on which the microphone rested shedding one of its legs as the announcer was about to move the apparatus to another part of the studio.

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Two Hundred Engineers.

The aim is to secure a clean bill of engineering health at all the stations, and the staff has consequently grown beyond all expectations. Two years ago the B.B.C. had about twenty engineers. When the broadcasting scheme was originally planned it was proposed to run a main station with two engineers, but it has been found in practice that six or more are required for each station. The total engineering staff is now two hundred, and there are possibilities that it will grow still further.

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Daventry Engineers.

Daventry, even at the present stage, when there is not the great pressure that will be felt when the interchange of programmes with the United States of America is in full swing, requires eight engineers working about seventy hours a week. With a station of the power of 5XX, eight hours extra are occupied weekly in starting up. The station must be run for more than half an hour in the morning with the power half on and gradually increased; for it would be fatal to the water-cooled valves to put on full power immediately.

Licences.

It is suggested that a listener who uses a crystal set should pay a licence fee of five shillings only, as against the continuance of the ten shilling fee for valve users; but an aspect of the matter which does not seem to receive consideration from the advocates of the five shilling fee is that the apparatus at the transmitting stations must be as efficient for the crystal user as for the valve user.

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The Cost of Broadcasting.

The expense of broadcasting, in other words, is not lessened because there are more users of cheap receiving apparatus. Take the valve bill alone: Transmitting valves work out at an average cost of £20 apiece; they last about 1,000 hours, and there are eight per station. Thus it costs £160 per 1,000 hours per station to keep the valves going, working out at a little over three shillings per hour. It takes quite a number of seven-and-sixpences a year to pay for seven hours' broadcasting (one guinea in valves alone per day).

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New Jersey Calling.

The Bound Brook, New Jersey, station, which is shortly expected to be operating on 50 kilowatts, and will thus be many times more powerful than New York's largest station, has cabled to the B.B.C. to the effect that it proposes to carry out experiments on part power of 35 kilowatts each Wednesday evening, beginning at 8.30 Eastern standard time. This is equivalent to 1.30 a.m. G.M.T. on Thursday. The wavelength used will be 455 metres.

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Another Step Forward.

Many listeners in the British Isles will no doubt endeavour to pick up Bound Brook's broadcast during the next week or two. If the Keston receiving station's efforts result in good reception we shall begin to see the opening of the era of British-American interchange of programmes.

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New S.B. Board.

The new S.B. board at Savoy Hill is an ingenious advance on the old method of arranging for the simultaneous transmission of 2LO programmes.

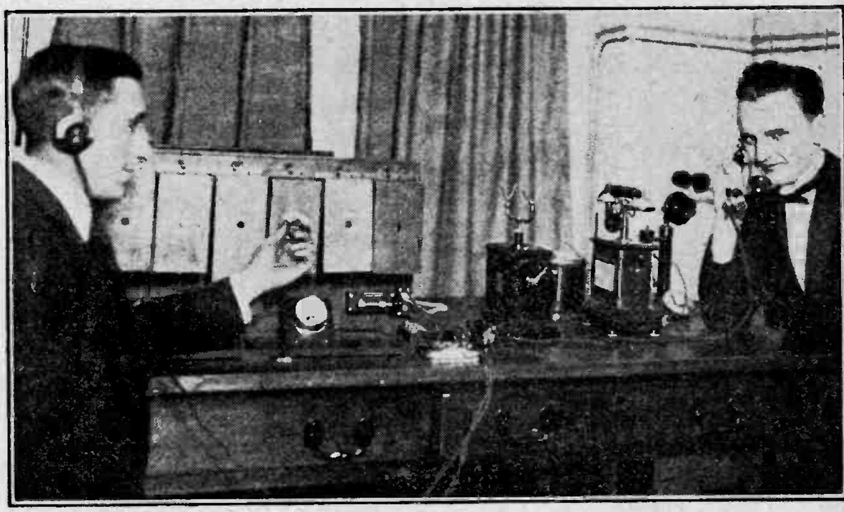
○○○○

The Old Method.

Under the old system, when a concert was passed through the Control Room at least five separate operations were necessary in various parts of the room and required to be done by hand. These were as follow: —

- Out-puts connected;
- In-puts connected;
- Two amplifiers switched on;
- Telephone warning given to distant station.

Now all these things are done automatically.



OXFORD CALLING. A view in the control room of the new Oxford studio, which was opened by Dr. A. D. Lindsay, Master of Baliol, on Monday, November 23rd. Mr. R. H. Wood, engineer-in-charge, is seen on the right.

The New System.

Let us take Birmingham as an example. Suppose Newcastle is taking Birmingham's programme at, say, 10.30 p.m. The above arrangements are now cut out, and, instead, the engineer at 2LO inserts a plug at 10.20 into the jack on which Birmingham's line terminates. Newcastle may not be ready and may possibly not come in until 10.32 p.m., but when that station is ready the Newcastle engineer inserts a plug in his board, automatically lighting two amplifiers and simultaneously notifying the 2LO engineer that Birmingham is "live." If by chance Birmingham should come in before London is ready, an "engaged" signal is received at Birmingham. Simultaneously, a lamp lights on the London board and a buzzer warning given that Birmingham is waiting. When London is ready the insertion of a plug at the 2LO board lights the necessary amplifiers.

oooo

Rough Sea to Order.

The 2LO engineer can handle ten programmes at one and the same time. If Nottingham were broadcasting a Bournemouth programme which included sea effects, and the sea was not sufficiently rough at Bournemouth, 2LO could requisition the sea from Plymouth and put it through to Nottingham on a separate line.

oooo

2LO Studios.

The glorious uncertainties of wireless have been brought home to me in connection with a reference to the new 2LO studios which I made here a short while ago. One of these studios, I wrote, was larger than anything else of the kind in the British Isles, and perhaps throughout Europe. The inference drawn was that this record was not likely to be challenged in the near future.

oooo

Birmingham's New Station.

I now learn, however, that the new premises of the Birmingham station will be ready early next year, and that the studio will be even larger than the London studio. Birmingham's studio is to be 50ft. × 45ft. The larger of the old 2LO studios is 45ft. × 27ft., and the larger of the new studios is 48ft. × 23ft.

oooo

Meeting of Station Directors.

The station directors from all over the country assembled last week at Savoy Hill for a conference on broadcasting administration, and an important move was made in setting up a scheme of close co-operation as regards the programmes.

oooo

Closer Touch with Headquarters.

It has been felt for some time that a system of liaison was essential to the maintenance of a high standard of broadcast programme; but unfortunately the station directors are busy men who can seldom be spared from their posts. Arrangements have now, however, been made to enable them to attend conferences at headquarters at regular intervals, when ideas will be compared and the work of the various stations consolidated. Listeners will reap considerable benefit from these meetings, as many new programme schemes will be launched as the result of the joint deliberations of the station directors.

FUTURE FEATURES.

Sunday, December 6th.

BOURNEMOUTH.—9.15 p.m., Dvorak.

CARDIFF.—9.15 p.m., "The Golden Key."

MANCHESTER.—3.30 p.m., Mozart's Last Masterpiece—Musico Drama in 3 episodes.

Monday, December 7th.

LONDON.—8 p.m., Chamber Music.

BIRMINGHAM.—6 p.m., Children's Choir of Sir Josiah Mason's Orphanage.

BELFAST.—9.15 p.m., Recital of Ulster Ballads.

Tuesday, December 8th.

LONDON.—8 p.m., Musical Comedy Past and Present.

Wednesday, December 9th.

LONDON.—8 p.m., Jewish Programme.

ABERDEEN.—8 p.m., Scottish Community Singing Concert.

GLASGOW.—8 p.m., Opera and Ballet.

Thursday, December 10th.

BIRMINGHAM.—8.30 p.m., Special Dance Programme.

BOURNEMOUTH.—8 p.m., Pictures and Humour.

CARDIFF.—8 p.m., "The Spirit of Adventure—IV. In West Wales."

MANCHESTER.—7.30 p.m., The Hallé Orchestra, conducted by Sir Hamilton Harty, relayed from the Free Trade Hall.

GLASGOW.—8.30 p.m., Scottish Regiment Series.

Friday, December 11th.

LONDON.—9 p.m., (probably) "Lionel and Clarissa" relayed from Lyric Theatre, Hammersmith.

CARDIFF.—7.55 p.m., Violin Recital by Victor Olof. 8.15 p.m., Conviviality in Song.

MANCHESTER.—8 p.m., "The Golden Legend," Cantata by Sir Arthur Sullivan.

NEWCASTLE.—9 p.m., In Spain.

BELFAST.—8 p.m., British Composers.

Saturday, December 12th.

LONDON.—8 p.m., A Gather Round.

NEWCASTLE.—8 p.m., Songs—Humour—Orchestra.

Taking the Village to Town.

The village concert to which referenc[e] has already been made in these column[s] is to take place to-morrow evening (Thurs[-] day, December 3rd), with Vivian Foster the "Vicar of Mirth," as Master o[f] Ceremonies. Numerous concerts fro[m] town and city have been taken on th[e] ether to isolated villages; but the typica[l] village concert still awaits interpretatio[n] for the benefit of town and city listeners. The B.B.C. are, therefore, going to repair the omission by broadcasting works by Eric Fogg, and Dale Smith (baritone) will be assisted by the Virtuoso Quartet and Sidonie Goossens (harp).

oooo

Weather Interference.

Peculiarities attendant upon reception in various parts of the country during south-westerly gales recently prompted an enquiry as to the conditions elsewhere in the same circumstances. A listener in Hunstanton, Norfolk, in a letter on broadcasting and weather generally, throws an interesting sidelight on this question. He says that a 50 per cent. improvement in signals takes place during sea mist, his district being one that is notorious among seamen for fog, owing to the out-flow from the Wash and the presence of the Silver Deep.

oooo

Any Old Time Won't Do.

A lady who is travelling in the Ardennes writes to tell me that she has visited recently a remote farming village which bears the stamp of age on its cottages, and as she waited for déjeuner on the balcony of the solitary inn, the brooding silence was suddenly broken by the unmistakable voice of Big Ben booming its chimes and clanging out mid-day. It came from a loud-speaker in a corner of the balcony turned towards the *Place.* "Yes," said Madame la Patronne, when my correspondent remarked on the familiar sound, "Like that, everyone in the village has the precise hour. It is good." "But is it the right time for you here?" asked my correspondent. "Why not?" was the answer, "It is very good time, *en effet* all that there is of the best time. *Ca vient de Greenveetch, n'est ce pas?*" And, *en effet,* why not?

oooo

Nothing New Under the Sun.

The 2LO programme on Tuesday next (December 8th) will consist of "strange resemblances." The most casual listener to modern music must sometimes be struck by the distinct resemblance between olden tunes and certain themes or figurations employed in recent work. This plagiarism is frequently intended; for instance, in the dance music played by symphonic syncopated orchestras. A number of cases will be illustrated in this programme, and will afford no little amusement. The good old tune, "Yip-i-addy-i-ay," to take one case, seems to remind us of one of the Beethoven Scherzi, and still stronger remembrances will be quoted.

DICTIONARY OF TECHNICAL TERMS

Definitions of Terms and Expressions commonly used in Wireless Telegraphy and Telephony.

This section is being continued week by week and will form an authoritative work of reference.

Inductance. The property of a circuit in virtue of which a current flowing through it causes a magnetic field to be set up linked with that circuit, and possibly also with one or more neighbouring circuits. The case where the flux produced is linked with the circuit carrying the current represents *self-inductance*, and where a magnetic flux produced by a current in one circuit is linked with a second circuit *mutual inductance* is said to exist between the two circuits. The two cases are dealt with separately under SELF-INDUCTANCE and MUTUAL INDUCTANCE respectively. For units see COEFFICIENT OF SELF-INDUCTION and COEFFICIENT OF MUTUAL-INDUCTION.

Inductance Coil. See TUNING INDUCTANCE.

Induction. (a) See ELECTROMAGNETIC INDUCTION. (b) The density of electrostatic or magnetic *lines of force* in a given medium, *i.e.*, the number of lines per square centimetre. Often called "Induction density," or "Flux density."

Inductive Capacity. The degree to which a *dielectric* permits electrostatic *lines of force* to pass through it. See SPECIFIC INDUCTIVE CAPACITY.

Inductive Coupling. The arrangement of two circuits so that an alternating current in one of them will induce an alternating E.M.F. in the other by means of *electromagnetic induction*, *e.g.*, the primary and secondary windings of a *transformer*. See REACTION and Cf. ELECTROSTATIC COUPLING. See also COEFFICIENT OF COUPLING.

Inductive Reactance. That part of the *reactance* of a circuit due to the inductance, being equal to $2\pi fL$, where f is the frequency of the current and L the inductance of the circuit. See ALTERNATING CURRENT CIRCUITS, and Cf. CONDENSIVE REACTANCE.

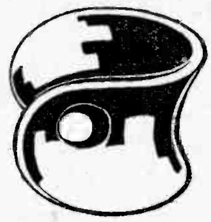
Inductive Resistance. A *resistance* which possesses *inductance* to an extent which is not negligible with respect to the resistance.

Instantaneous Power. See POWER IN A.C. CIRCUITS.

Insulation. (a) The electrical isolation of a conductor or circuit from other conductors, circuits, or the earth by interposition of a non-conducting material or *insulator*. (b) The material employed for effecting the above. (c) Abbreviation for *insulation resistance*.

Insulation Resistance. The actual resistance in ohms, or millions of ohms (megohms) measured between two circuits or between a circuit and earth, where the *insulation* is not perfect, thus allowing a minute current to leak from one circuit to the other when a potential difference exists between them.

Insulator. (a) A material of almost negligible *conductivity* and suitable for purposes of *insulation*. (b) A piece of insulating material moulded or shaped to a convenient form for supporting mechanically, and at the same time insulating any given conducting system from earth, etc., *e.g.*, aerial insulator.



"Shell" aerial insulator.

Inter-electrode Capacity. The electrostatic *capacity* between the electrodes of a thermionic valve, e.g., the capacity between the *grid* and the *plate*, between the grid and the filament, etc. The effects of these capacities are negligible at low frequencies or at long wavelengths, but the effects are quite considerable at short wavelengths, for instance where both the grid circuit and the plate are tuned the interelectrode capacity assists in the setting up of *self-oscillation*. See NEUTRODYNE RECEIVER.

Interference. The interruption, either intermittent or continuous, of the reception of wireless signals caused by extraneous electrical disturbances or by undesired signals at or near the same wavelength of the one being received. See HETERODYNE INTERFERENCE.

Intermediate Circuit. Refers to an extra tuned *oscillatory circuit* placed between the *aerial circuit* and the *detector circuit* of a wireless receiver for the purpose of increasing the *selectivity* and reducing *interference*.

Intermittent Current. A unidirectional current which is interrupted at regular time intervals.

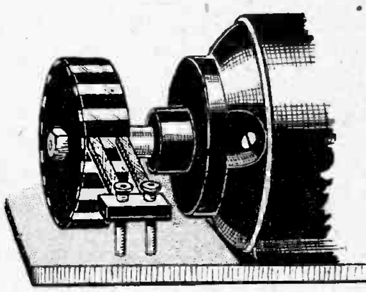
Internal Impedance (of thermionic valve). Refers to the *impedance* of the circuit between the *plate* and *filament* inside the valve. The value of this impedance is more or less constant at all frequencies, and is therefore rather in the nature of a pure resistance, and may be defined as the ratio of a given increase of *plate potential* to the resulting increase of *plate current*, taken over a small range on the straight portion of the plate-potential plate-current *characteristic*, the grid voltage and filament current being kept constant at normal values.

International Ampere. For definition see CURRENT.

International Ohm. For definition see RESISTANCE.

International Volt. That electrical pressure which is necessary to drive a current of one *International Ampere* through a resistance of one *International Ohm*. Equal to 1.00043 true volt.

Interrupted C.W. A system of transmission of Morse signals by the employment of undamped waves or *continuous waves* which are interrupted at an audible frequency so that they can be received without the use of a *heterodyne*. The interruption is usually effected by means of a rotary interrupter called a *tone wheel*. Cf. TONIC TRAIN and see TONE WHEEL.



Commutator interrupter.

Interrupter. A device for interrupting or chopping up a current into unidirectional pulsations, *i.e.*, for producing an intermittent current, *e.g.*, the trembler of a buzzer, or a *tone wheel*.

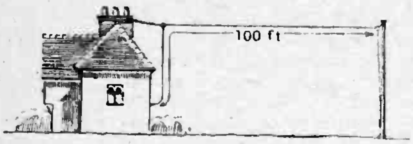
Intervalve Coupling. That part of a *valve circuit* which connects two *thermionic valves* in cascade in a valve amplifier, and by means of which energy is transferred from the plate circuit of one valve to the grid circuit of the

Dictionary of Technical Terms.—

next valve. See INTERVALVE TRANSFORMER, TUNED ANODE, RESISTANCE-CAPACITY COUPLING.

Intervalve Transformer. A *transformer* by means of which the output from the plate circuit of a *three-electrode valve* is transferred to the grid of the next valve in a cascade amplifier. For a *high-frequency amplifier* the transformer usually consists of two windings wound on a non-magnetic, non-conducting former, and is said to be "air-cored." For *low-frequency amplification* the two windings are wound on an iron core consisting of *laminations* of soft iron wires. The *primary* is connected between the positive terminal of the H.T. battery and the *plate* of the first valve, and the *secondary* between the grid and the negative end of the filament of the second valve.

Inverted "L" Aerial. An aerial consisting of one or more horizontal wires, the *down lead* being taken from one end of the horizontal portion. Such an



Inverted "L" aerial.

aerial has semi-directional properties, signals being received best from stations situated in the same vertical plane as the horizontal wires, *i.e.*, from the direction in which the aerial points.

Ionisation. The converting of a gas into a conducting state by splitting it up into *ions*. This can be effected in different ways, chief among them being the application of a potential difference. A gas is very easily ionised when in a rarefied condition. The conduction of a current through a gas in this manner is often characterised by a luminous glow. See IONS.

Ions. Minute particles dissociated from the mass of a substance and carrying positive or negative charges of electricity, such a state occurring during electrolysis of a liquid or during a glow discharge through a gas. When a glow discharge takes place through a gas the gas is split up into two sets of dissociated corpuscles or ions, and is said to be "ionised." The positive ions are those which carry a deficiency of negative electricity or *electrons*, and the negative ions carry an excess of electrons. The current through the gas is made up of streams of these ions flowing in opposite directions.

I^2R Loss. The power in watts lost as heat in a conductor of resistance R ohms carrying a current I amperes. Sometimes referred to as the "copper losses."

Iron Loss. The energy lost in the iron cores of transformers, etc., due to *eddy currents* and *hysteresis*, these losses only taking place, of course, when the magnetic flux is an alternating or varying one.

J.

Jack. An arrangement used on control panels, etc., for connecting and disconnecting easily and quickly a flexible cord such as a telephone lead, to the circuits behind the panel. The jack consists of a number of contact springs mounted relatively to a metallic bush in such a manner that when the plug at the end of the flexible lead is inserted through the bush contact is made between the various parts of the plug and the spring contacts, at the same time opening or closing any other spring contacts which may be provided, the latter not being directly connected to the flexible cord, but to other parts of the circuit.

Jamming. Interference in the reception of wireless signals caused by loud signals from other stations on or near the wave-length as that of the desired signal.

Jar. A unit of *capacity* at one time used extensively in wireless. It is equal to 1,000 centimetres or 1-900th of a *microfarad*.

Jigger. An *oscillation transformer* used for transferring the high-frequency oscillations in a transmitter from the source to the aerial.

Johnsen-Rahbek Effect. See ELECTROSTATIC ADHESION.

Joule. Practical unit of electrical energy being the amount of energy represented by a current of one *ampere* flowing for one second under a pressure of one *volt*, *i.e.*, the energy of one watt-second. 1 joule is equivalent to 10^7 ergs of work and to 0.239 calories of heat.

Joule's Law. "The heat liberated in a circuit is proportional to the square of the current, to the resistance, and to the time for which the current flows." If a current I flows for t seconds through a circuit of R ohms, the heat liberated is equal to 0.239 I^2Rt calories. See JOULE.

Junction, Thermo-electric. See THERMO-COUPLE.

K.

Kathode. See CATHODE.

Keeper. A piece of soft iron used for completing the magnetic circuit of a horseshoe type permanent magnet when the latter is not in use. This is to protect the magnet against the demagnetising effect of its own poles and so to preserve its strength.

Kenotron. A kind of two-electrode *thermionic valve* exhausted to a high degree of vacuum and used as a *rectifier*. The current is almost entirely in the form of an *electron* stream between the plate and filament, the vacuum being too high to allow any *ionisation* current to flow. The velocity of the electrons is not sufficiently high to produce any *secondary emission* from the plate. Cf. DYNATRON.

Key. A type of spring switch which always remains open unless depressed by the finger. Sometimes called a "tapping key."

Kilocycle. One thousand *cycles*. For convenience *radio frequencies* are sometimes measured in thousands of cycl or kilocycles, thus entailing the use smaller numbers. For instance, a wav length of 600 metres, representing frequency of 500,000 cycles per secon is equivalent to 500 kilocycles.

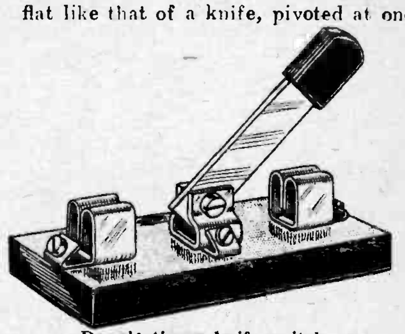
Kilowatt. The electrical power repr sented by 1,000 watts.

Kilowatt Hour. Unit of electrical energ used for commercial purposes, being th amount of energy represented by power of one kilowatt developed for on hour, or the equivalent. Also calle the Board of Trade Unit. Cf. JOULE.

Kinetic Energy. The mechanical energy possessed by a body in virtue of its motion. If a body of mass M is moving with a velocity of V the kinetic energy is given by $\frac{1}{2}MV^2$.

Kirchoff's Laws. (1) The algebraic sum of all currents meeting at a point or junction where a number of wires meet is equal to zero. (2) The algebraic sum of all the E.M.F.s in a circuit is equal to the sum of the resistances of the various parts multiplied by the current.

Knife Switch. A switch whose blade is flat like that of a knife, pivoted at one



Double-throw knife switch.

end, and wedges in between the two spring clips when closed.

kW. The usual abbreviation for *kilowatts*.

L.

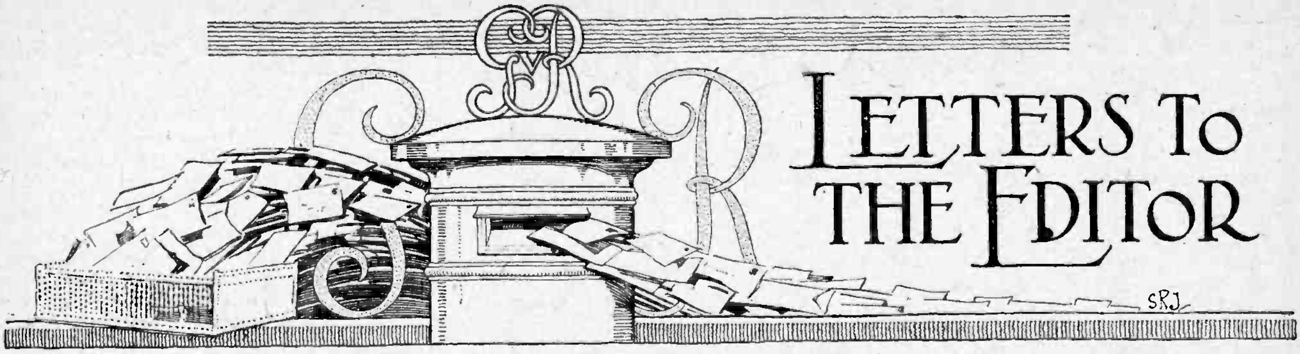
"L." The usual symbol for *self-inductance*.

Lag. See PHASE DIFFERENCE.

Lagging Current. An *alternating current* which is *out of phase* with the voltage producing it in such a manner that the current reaches its maximum positive value at some fraction of a half-cycle after the voltage passes through its maximum positive value. See PHASE DIFFERENCE.

Laminated Core. For *alternating* magnetic fields the iron part of the magnetic circuit is usually built up of "laminations" or thin sheets of iron or steel, the sheets being *insulated* from each other and laid in such a direction as to be parallel to the direction of the magnetic lines of force. An iron core is laminated in this way in order to limit the flow of *eddy currents* in the core and so to reduce eddy current losses.

Laminations. Sheet iron or steel stampings for building up the cores of transformers, etc. See LAMINATED CORE.



LETTERS TO THE EDITOR

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

THE POST OFFICE AND INTERFERENCE.

Sir,—I see that in *The Wireless World* you have devoted a good deal of attention to Northolt interference with broadcast reception.

I hold no brief for the Post Office, but it seems to me that the traffic undertaken by the Post Office stations must always be given preference over broadcasting. Broadcasting is, after all, merely a toy for the purpose of entertainment or, at the best, education, and any suggestion that serious wireless communication should give way to broadcasting requirements can surely not be regarded as important. S. R. COLLINS.

N.W. London,
November 14th, 1925.

THE REINARTZ CIRCUIT.

Sir,—Is it humanly possible to improve on a well-made Reinartz set? I append a list of the properties of my 3-valve Reinartz :—

(1) Loud-speaker range of 60-70 miles from main station, but often (in case of foreign stations) up to 800 miles. Rome, Madrid, Toulouse and several German stations can often be heard quite loud in the loud-speaker. (2) Perfect control of reaction and absolutely simple to tune. (3) Distortion practically *nil.* (4) As cheap or cheaper than most sets. A low-loss basket coil can be made for about 9d. (5) Exceedingly selective. (6) Can be adapted for Daventry. A 2-valve Reinartz will give strong loud-speaker results at over 100 miles. (7) Will bring in a station every few degrees of the condenser. (8) Can be easily made to work on quite short waves.

I fail to see the advantage of making other circuits, unless for experiment. For a fairly cheap, easily constructed and thoroughly efficient set for the home, is there anything to beat "John Reinartz"? LEONARD G. HULLS.

Chidham, Hants.

NORWEGIAN LOW-POWER TRANSMISSION.

Sir,—It may interest readers to know that on November 6th, between 18.00 and 19.00 G.M.T., I carried out tests with English G6DO (Mr. Dorte, Lynwood, Weybridge, Surrey) on inputs down to 0.24 watts. G6DO reported the strengths as R6 for inputs of 8.64 and 4.68 watts, R3-R4 for an input of 1.68 watts, and, finally, R2-R3 for an input of 0.24 watts. G6DO was using a two-valve receiver.

Moen i Maalselv, J. DIESEN (LA1A).
Norway.

SOURCES OF RARE METALS.

Sir,—As we know you get enquiries from time to time from your readers who wish to purchase special materials for wireless work that are difficult to obtain, we should like to mention that if any of your readers desire to obtain supplies of tantalum metal in sheet form (which is being much experimented with for rectifiers), and any other special metals, such as tungsten, molybdenum, and rare metals generally, we can supply these specialities. A. W. BLACKWELL.

(Geo. G. Blackwell, Sons and Co., Ltd.)

The Albany, Liverpool.

CURRENT FROM LIGHTING MAINS.

Sir,—One notices from time to time various articles describing how current can be obtained from the lighting mains to supply wireless sets.

A perusal of some of these articles indicates that the authors are not familiar with the regulations governing electricity supply.

I notice in one paper a paragraph which reads as follows :—

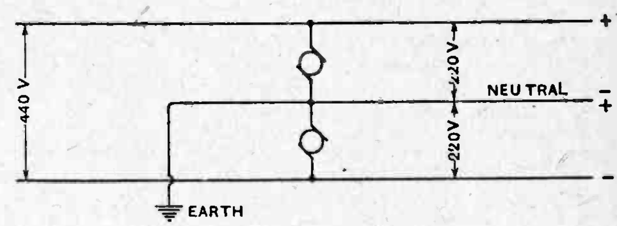
> "Incidentally, the potential of the 'earth' side of the switch to earth *can* be used as an absolutely gratis source of current, but it is subject to remarkable fluctuations which make it unreliable for charging accumulators."

The text matter preceding it does somewhat modify it, but I can imagine a schoolboy getting hold of this particular paragraph and causing the supply authorities a good deal of trouble trying to trace earths.

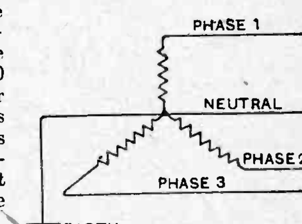
I think it would be of general benefit if you would point out that the Electricity Regulations specifically lay down that the neutral of a distribution system must only be earthed at one point. This point is usually at the generating station, or, in the case of an isolated network, at the sub-station.

This does not prevent a wireless set being earthed by the means of condensers, but it does prohibit *any other kind of earth*, such as one side of the high-tension supply.

The two diagrams may make the method of supply clear to amateurs.



DIRECT CURRENT 3 WIRE



ALTERNATING CURRENT 3-PHASE 4 WIRE

In the first case we have a very common form of distribution, mainly three-wire direct current with, say, 220 volts between each conductor and the neutral, and 440 volts across the neutral. In this case the lighting load is connected to the main so that half would be on the positive side and half on the negative. This is a point which should be remembered when using the main for high-tension supply, as it will be obvious from the diagram that approximately 50 per cent. of the houses will be connected in such a manner that the positive is earthed.

Large motors are usually connected across the outers, *i.e.*, across the 440 volts, so that neither pole will be earthed. This form of distribution is being largely superseded by three-phase alternating current. The distribution connection for this system is also as shown in the sketch, the neutral being earthed at the transformer. JAMES NELSON.

THE B.B.C's BIRTHDAY.

Sir,—In your issue of November 11th is a Dubilier advertisement congratulating the B.B.C. on their fourth birthday. No doubt many of your readers will have noticed the mistake, for the B.B.C. are only three years old.

We trust that the B.B.C. will forgive us for having inadvertently described them as a year older than they are: the truth is that the B.B.C. seems to have been with us for years, and it requires a considerable effort of the imagination to recall the blank nights when there was no broadcasting.

R. WATKINS-PITCHFORD,
pp. Engineering Publicity Service, Ltd.

CARILLON CONCERTS BROADCAST.

Sir,—My attention has been called to a paragraph in your issue of November 18th in which it is stated, referring to the broadcasting of the carillon of 53 bells at Park Avenue Baptist Church, New York, by WGY, that these bells were cast in Belgium.

I beg, therefore, to inform you that the bells for this carillo were cast in Croydon, and it may perhaps be of interest to yo to know that when they were completed in our works last Ma a series of demonstrations was given on it for two weeks by number of Belgian, Dutch, and English carillonneurs, and it wa finally broadcast by the B.B.C. from all stations with grea success.

During the fortnight in question Their Majesties the King an Queen visited our foundry and heard a recital on the carillon.

We are at present in course of constructing a carillon of th same size and weight (48 tons, bass bell $9\frac{1}{4}$ tons) for the new Houses of Parliament at Ottawa, which is to form a memoria to the men of Canada who fell in the war.

Croydon. CYRIL F. JOHNSTON
(Gillett and Johnston).

B.B.C. AND ADVERTISING.

Sir,—I quite agree with your remarks in the November 11th issue of *The Wireless World*, and think that a stop should be put to the advertising of the *Radio Times* by the B.B.C., and especially other forms of advertising.

We do not want advertisements sandwiched in between the items broadcast. ARTHUR F. HARDY.

Bishop's Waltham,
Hants.

TRANSMITTERS' NOTES AND QUERIES.

General Notes.

Mr. J. C. Lisk, the Ohio news manager of the A.R.R.L., is operating the amateur station U8EQ at 902, S. Elizabeth, Lima, Ohio, on 40 and 80 metres, and will be pleased to hear from anyone picking up his signals.

Senor Carlos Braggio (CB8), Belgrano 120, Bermal, Buenos Aires, will be transmitting telephony on 35 metres on Sunday mornings during December (about 0400 to 0700 GMT), and will welcome reports.

Mr. Charles Whiteley (U2AGT), 115, Wadsworth Avenue, New York, is also transmitting on about 40 metres, and will be glad to hear from any British amateur who has heard his signals.

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Italian Amateurs.

The following Italian amateurs have entered for the Radio Transmitting Contest organised by "Il Radiogiornale," the official organ of the Radio Club of Italy:—

1NO, F. Marietti, Turin; 1AS, P. Silvio, Novara; 1JR, J. N. Ottone, Turin; 1LP, L. Ponzio, Turin; 1AP, G. Sella, Turin; 1AU, F. Strada, Turin; 1FD, F. Deregibus, Turin; 1CO, G. L. Colonnetti, Turin; 1AY, G. Fontana, Piacenza; 1GW, B. Brunacci, Rome; 1GS, G. Serra, Turin; 1RM, Associazione Radio Montatori, Rome; 1BS, L. Fausto, Piacenza.

The competition includes greatest distance, largest number of two-way communications, and best general report on short-wave transmissions.

The National Radio Club of Italy, Viale Miano 9, Milan, will welcome reports from amateurs all over the world.

During October the following short-wave transmitters were in touch with New Zealand:—1RM, 1AS, 1AU, 1BS, 1CO. 1AS was also in communication with Australia 3BQ (Box Hill, Victoria). and 1GW with Argentine AA8 (Federal Capital). 1AU has communicated with Australia 2YH (Mosman, N.S.W.), and 1RG ("Radiogiornale," Milan), has been in telephonic communication with many European amateurs.

oooo

Addresses of Stations Wanted.

We shall be glad if any of our readers can give us the QRA's of the following stations. (In some cases it is inadvisable to publish the names and addresses, but any replies indicating that publication should be witheld will be communicated, in confidence, to the enquirers):—G2APU, G2BMA, G2CL, G2FU, G2HAG, G2RK, G2ZA, G5CO, G5PM, G5QL, G5SO, G5SR, G6JH, G6TMG, G6UJ, GC2BE, HBK (India), KK3, NPC3, P8RB, G5IU, G5IV, G5ZB, G6MA, G6NB, GB2, GHG, GHSI, ANF, CKSD, I1BD, NOF3, NOPX, PCLL.

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Station Identified.

NSTB is the low-power experimental station of the Dutch Military Aerodrome at Soesterberg, Holland, transmitting on 23 to 46 metres. It is understood that this station has established communication with Algeria, America, Porto Rico, Cuba, and New Zealand.

oooo

New Call Signs Allotted.

6VZ. A. E. Stephens, West View, Chewton Road, Keynsham, Bristol.

5WP. W. E. Russell, 5, Walton Road, Woking (in place of 2AZA), transmits on 150 metres C.W. and telephony, and wishes to get into touch with other amateurs for tests on this wavelength.

Calls Heard.
Extracts from Readers' Logs.

Reading.

November 8th to 21st.

Great Britain: 'Phone—2KF, 2KT, 2LZ, 2NM, 2SZ, 6KT, 6PT; Morse—2BZ, 2DX, 2EC, 2FO, 2MX, 2VS, 5DH, 5EC, 5IV, 5PM, 5YM, 5SK, 5WQ, 6KK, 6NF, 6QB, 6VP, 6YU.

U.S.A.: 1BS, 1RD, 1SI, 1UW, 1ACI, 1BYR, 2CV, 2RR, 2AHM, 2XAF ('phone), 3JO, 5OK, 8ALY, 8BYN, WIZ, WQO, KDKA ('phone), NKF. France: 8BE, 8CO, 8JB, 8AIX, 8PKX, 8RBP, 8RGK, OCTU. Holland: OAW, OF3, OPL, OKW, OWC, PCLL. Italy: 1AS, 1BD, 1GW. Sweden: SMZS, SMZZ. Belgium: H6, Y2. Yugo-Slavia: Y7XX. Porto Rico: 4UR. Miscellaneous: ANF, CKSD, GB2, GHA, NTT.

(0-v-1 Reinartz, on Indoor Ae. and Cpse.) Mostly 30-50 metres.

R. C. Bradley.

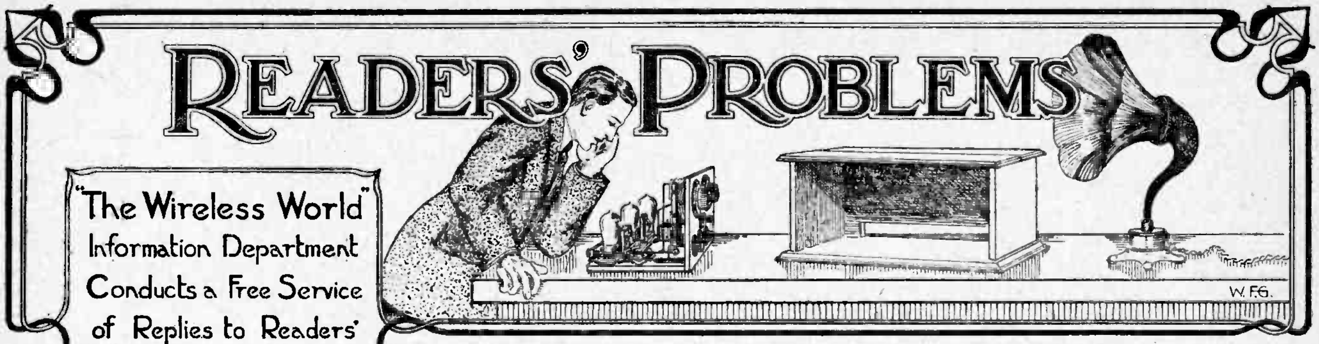
Ilford.

October 16th to 19th.

Great Britain: 6IZ, 6DA, 2OD, 6PT, 2NM, 2DX, 5PM, 6TM, 5NN, 5RS, 5YZ, 2SL. France: 8RAT, 8TIS, 8GRA, 8LX. Holland: 0AX, 0PX, 0RO. Italy: 1KY, 1AY. Africa: MAROC. Canada: 1AR. U.S.A.: 1CKP, 1CAW, 1BXG, 1TSB, 1SI, 1AC, 2AGQ, 2AHM, 2SI, 2BUY, 2CBO, 2APV, 2WK, 2BBX, 2AHK, 2CXL, 2BCK, 3XO, 3JW, 4TV, 4JE, 4KT, 8DP, 8JQ, 8ES, 8ALY, 8ZG, 9BCN. Spain: EAR 20, EAR 21. Yugo Slavia: 7XX. Finland: 2CO.

On 20-90 metres.

C. E. Largen.



"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Using a Reflex Receiver as a Simple Crystal Set.

Having acquired possession of a single-valve reflex receiver of the conventional type, using plug-in coils, I am desirous of being able to make use of the instrument as a plain crystal receiver at such times as my accumulator is away at the charging station. I have carefully searched through back numbers of several wireless journals, but have failed to find the necessary circuit, and therefore wish to take advantage of your information service department for guidance in the matter of the correct circuit to adopt. S.G.C.

It is certainly, as you suggest, a very great advantage to be partially independent of the L.T. battery in such a case as you mention. Fortunately a suitable circuit presents no great difficulties, and we indicate one in Fig. 1

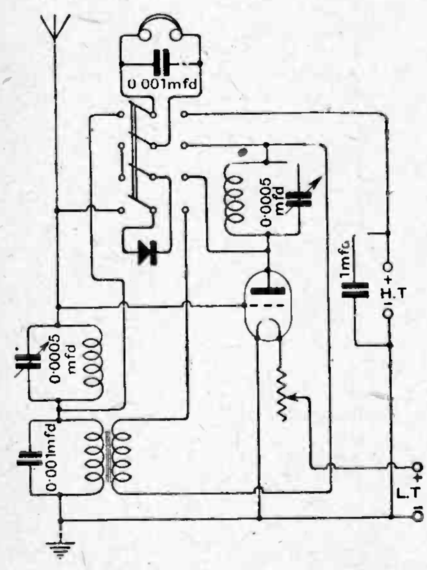


Fig. 1.—Single-valve reflex receiver with switching to convert to a simple crystal circuit.

which will meet your needs. The wiring of the switch points should be carefully spaced in order to reduce any possible losses which might be introduced by this switching arrangement.

Connecting Accumulators in Parallel.

A discussion recently arose amongst some members of our local radio society concerning the difference in efficiency, if any, of employing a 2-volt 90-amp.-hour accumulator, or three 2-volt 30-amp.-hour accumulators in parallel for operating a receiver using 2-volt valves throughout. I should be glad if you would offer an opinion in this matter. R.A.B.

The number of "burning hours" obtainable from each arrangement is, of course, exactly similar, and at first sight it would seem that the advantage, if any, would be with the arrangement of parallel accumulators, since they could be used as a 4- or 6-volt accumulator when desired. In connecting a number of accumulators in parallel, however, it must be borne in mind that although the normal voltage of each cell is 2 volts, there are, in the cases of even different specimens of accumulators of the same type, slight differences in voltage, and when connected in parallel they are liable by discharging one into the other to set up chemical reactions, which is at least not to their advantage.

o o o o

Using the Telephone Lines for an Aerial.

Recently perusing a foreign journal, I read that it was possible to make use of the telephone lines as an aerial, but I understand that tampering with the telephone is contrary to the regulations of the Postmaster-General. Is there no way in which I can experiment in this manner without infringing these regulations? F.B.T.

It is possible to use the telephone wires as an aerial without in any way infringing the Post Office regulations by interfering with the wiring, in the case of the desk type telephone. Obtain a small metal tray and attach to it a wire from the aerial terminal of the receiver, either by soldering or by piercing the tray and affixing a terminal. Place the tray on the table and place the telephone on the tray. The telephone wires will then act as an aerial, owing to the capacity existing between the tray and the wiring inside the telephone, the base of the instrument forming the dielectric. In this manner it is sometimes possible to obtain very surprising results. It is also a usual expedient to employ this method in conjunction with a normal aerial as a rough counterpoise in place of an earth connection in those cases where it is desired to get rid of interference from nearby tramway systems or other electrical machinery.

o o o o

An Easily Adjusted Two-range Crystal Receiver.

Being desirous of building a simple crystal receiver in which I desire, by means of a simple switching arrangement, to change over from "aperiodic" aerial coupling on the normal B.B.C. wavelengths to direct aerial coupling on the longer wavelengths, I should be greatly obliged if you could suggest a suitable circuit. J.T.D.

The circuit which we illustrate in Fig. 2 should be quite suitable for your purpose. The switching arrangements have been reduced to the utmost simplicity possible. The coil for the normal

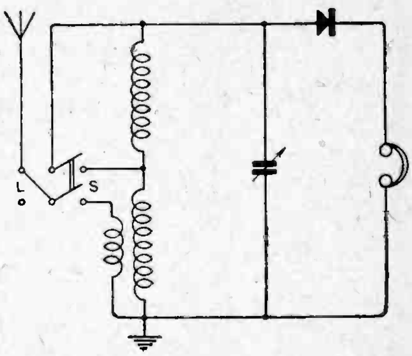


Fig. 2.—Crystal circuit with "aperiodic" coupling for short wavelengths and direct coupling on long wavelengths

broadcasting band of wavelengths may either consist of one of the many "aperiodic" aerial coils at present upon the market, or can be constructed by winding 60 turns of No. 20 D.C.C. on a cylindrical former 3 inches in diameter by 4 inches in length to form the secondary winding, a separate primary of 15 to 20 turns being wound over this. The loading coil may consist of almost any type of plug-in coil, a No. 100 being of sufficient size, since it must be remembered it will be in series with the sixty-turn coil already in the circuit.

Overrunning a Bright Emitter.

Is it possible for a bright emitter valve to be overrun by use of excessive H.T. and L.T. without actually burning it out, as in the case of a dull emitter? I ask this because I have a very long-lived bright emitter in my possession which still functions, but very inefficiently compared to its original performance. T.P.C.

By overrunning a bright emitter valve for a prolonged period in the manner suggested it is certainly possible greatly to impair its efficiency, as you suppose. In the case of a bright emitter, however, it is usually possible momentarily to overrun the filament without appreciable harm, whereas such a course in the case of most dull emitters would be impossible.

oooo

Alternative Grid or Anode Rectification.

I am contemplating the building of a three-valve receiver (1-v-1), *and wish to so arrange matters that the detector valve will give me either anode or cumulative grid rectification; the idea being to use the former method to give the greatest possible purity of reproduction on the local station, the latter method being brought into use to increase sensitivity when searching for distant stations.* S.W.B.

It is possible to arrange for the above in quite a simple manner. The circuit is given in Fig. 3, and it will at once be seen that only a single-pole switch is needed to change over from one to the other of the two methods of rectification possible. Thus no detrimental complications are introduced to the wiring. The reason for using two fixed condensers in conjunction with the switching arrangement shown is in order that the tuned grid circuit may be retained in use irrespective of whatever form of rectification is used, thus considerably assisting selectivity.

The H.F. choke may either consist of an efficient type of plug-in coil of suitable value (a No. 250 is suitable for broadcasting wavelengths), or can consist of a special H.F. choke sold by advertisers in this journal, thus enabling all wavelengths up to about 4,000 metres to be covered without interchanging coils. The tuning of a receiver of this type will be no more difficult than the tuning of the conventional tuned anode circuit, the grid coil of the detector valve having the same value as the tuned anode coil in the more conventional circuit. It is unfortunate that many people desirous of combining maximum quality from the local station with maximum sensitivity on more distant stations do not make more use of some such circuit as this rather than attempt to arrange switching to substitute a crystal for the valve rectifier, since with this latter a four-pole switch is called for instead of a single-pole switch. The crystal is less stable than the anode rectifier, is productive of flatter tuning, and it is doubtful whether under normal circumstances it has the slightest advantage over the anode rectifier from the point of view of purity of reproduction.

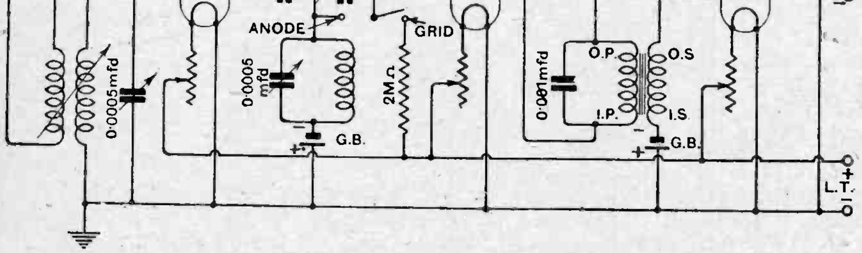


Fig. 3.—Three-valve receiver with alternative grid and anode rectification.

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Increasing the Life of a Valve.

A friend has informed me that I should fit a filament-reversing switch to each of my valves, since he asserts that when a valve burns out it is always the negative side of the filament which gives out, usually long before the positive side shows any appreciable signs of wear. Is this correct? B.E.S.

Whilst, of course, it is true that slightly more electronic emission occurs from the negative side of the filament than from the positive side, and therefore one would expect the negative side of the filament to become attenuated long before the positive side, the difference is in practice very slight, and in our opinion valve filaments fracture as often on the positive side as they do on the negative side. In the case of a new valve it is unlikely that all portions of the filament are of equal robustness, and an aged valve usually succumbs at its weakest point, which may be anywhere along the filament. Of course, if a weak spot were present on the negative side of the filament, undoubtedly the phenomenon to which you refer would hasten the end. In our opinion the provision of the switches you contemplate would on balance be a distinct disadvantage and detrimental to efficiency.

oooo

Preventing Evaporation in Electrolytic Rectifiers.

I am greatly troubled by creeping and evaporation of the solution in the electrolytic rectifier which I use for the purpose of charging my H.T. accumulators from my A.C. mains. Can you tell me how to prevent this? D.A.O.

An excellent preventive is to cover the top of the electrolyte with a layer of oil, medicinal paraffin being especially suited to this purpose and of the correct viscosity. Keep the rectifier on an even keel and do not attempt to tilt it sideways, otherwise the oil is apt to run down into the electrolyte.

oooo

Noden Valves.

Can you inform me why a Noden valve is called such, when, in fact, it is not a valve at all, but merely a chemical rectifier? H.A.H.

In the first place we would inform you that this chemical rectifier is indeed a valve, as are all other forms of rectifier, be they thermionic valves, chemical valves, or mineral valves. Your confusion arises owing to the narrow construction which the average wireless enthusiast places upon the term "valve." The particular form of valve we are discussing was named after its discoverer, a chemist who bore the family cognomen of Noden.

The Wireless World

AND RADIO REVIEW
(13th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

A WIRELESS CHRISTMAS.

AT this season the call of the fireside is more pronounced than at any other time of the year, and with it is coupled thoughts of Christmas and goodfellowship. Wireless has taken its place in home life, and it may justly be claimed for it that it contributes more than any other artificial means of communication towards mutual understanding and good fellowship, not only nationally but internationally.

Wireless in Every Home.

This being so, it is natural that those who have already experienced the satisfaction associated with the ownership and use of a broadcast receiver should wish their friends the same privilege at Christmas time. It should be the aim of every wireless user to further the distribution throughout the country of this inexhaustible source of entertainment and intellectual interest. Complete wireless sets are no longer to be regarded as an expensive luxury, but rather as an indispensable unit in the equipment of the home of every Englishman. To those who have become accustomed to wireless, either solely as listeners or as amateur constructors or experimenters, it must always be a matter of surprise that there should still be homes where wireless has not as yet penetrated. The returns for licences taken out go to show that as yet only a small percentage of British homes are benefiting from the new service which the introduction of broadcasting has made possible, and surely, after broadcasting has been established for some three years, it is high time that such a state of affairs should be remedied. We would like our readers to do all in their power to further the universal participation in broadcasting, and we believe that Christmas provides a splendid opportunity for carrying this into effect.

CONTENTS.

Wireless not an Extravagance.

Whenever the question of what Christmas gift to provide is raised, let wireless be given first place. Incidentally, wireless need not be regarded as an extravagant present, for even the most expensive sets, if given as a collective present to a household, will not necessarily involve a larger outlay than individual gifts, whilst for those with limited means the cost of a set of parts for the construction of a valve or crystal set need not be at all a heavy item. Let us therefore mark Christmas, 1925, by a collective effort to spread the gospel of broadcasting to every British home.

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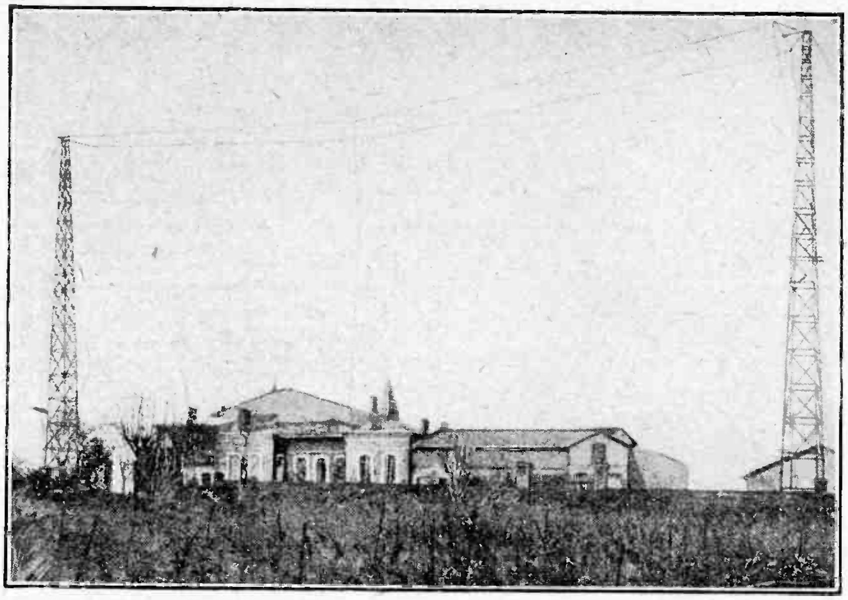
A MINISTRY OF BROADCASTING.

SO much interest is at the moment centred around the question of the future of the broadcasting organisation in this country, that no excuse seems necessary for introducing further comments here upon some possible lines along which we may look for developments to take place in the future. One suggestion which we have not seen put forward is that of the formation of a Ministry of Broadcasting to control the organisation in the same way that there exist Ministries of Education, Agriculture, etc., in other spheres of national activity.

Is it Premature ?

The question naturally arises as to whether broadcasting has yet assumed sufficient importance to justify such a distinction being conferred upon it. It must not be assumed from these remarks that we favour the control of broadcasting through a Government department; we prefer to believe that the present system, with certain modifications, would be difficult to better. How much the satisfactory operation of broadcasting in this country during the past three years is due to the system and how much to the responsible individuals of the Company on whom the burden has fallen, it would certainly be a difficult matter to decide. Suffice it to assure ourselves that neither the system nor the responsible officials alone deserve the credit, for both have contributed to success.



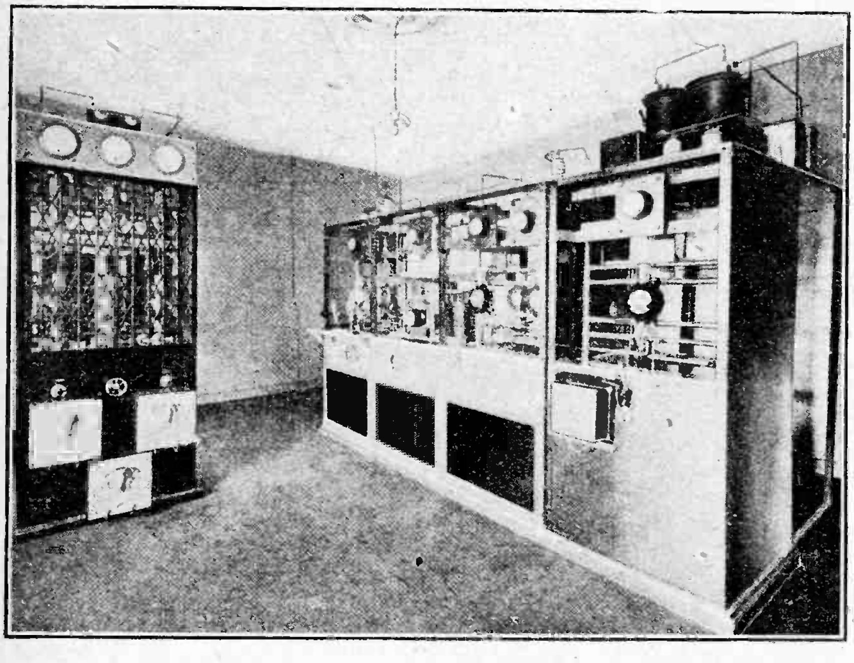
"Radio-Toulouse." An exterior view of the well-known French broadcasting station

"Leave Well Alone."

Whatever new suggestions for the future conduct of broadcasting may be forthcoming, it must not be forgotten that the present system has withstood the test of practical application, and any new scheme, however attractive it may appear in theory, has yet to undergo this test. There is an ancient saying, "leave well alone," which should not be forgotten by some of those who to-day are proposing drastic and revolutionary changes in the whole broadcasting system. The exhortation to "leave well alone" need not be interpreted as advocating a policy of stagnation, but rather one of extreme caution in putting forward any new proposals without some assurance that not in theory only, but also in practice, their adoption will leave no room for subsequent regrets.

Unfounded Reports.

It is unfortunate that, in certain sections of the daily Press, premature conjectures as to the recommendations of the Broadcasting Committee of Enquiry, now sitting, have been published with a semi-official atmosphere which is altogether misleading to the public. Until at least such time as the Committee has heard all the evidence forthcoming from the various interested parties, it is useless to conjecture what the findings of the Committee will ultimately be.



The transmitting apparatus at the "Radio-Toulouse" station

Readers' Views, Please.

The views of readers on this all-important question of the future organisation of the Broadcasting Service are welcomed for publication under Correspondence. The more individual views expressed at the present juncture, the better, since every piece of evidence is of value in assisting those responsible in arriving at a satisfactory decision. One point which we must earnestly desire to see emphasised is the desirability of the exclusion of all advertising matter from the microphone, and our readers' views on this subject in particular are solicited.

The findings of the Committee will most certainly not be regarded by the public as comprehensive unless this point of policy is dealt with in a manner which spells finality.

Four Valve Easy Tune Broadcast Receiver.

An Instrument Designed for the Experimenter and the Music Lover.

By N. P. VINCER-MINTER.

IF someone with a taste for statistics were to make an attempt to classify the many and varied types of radio receivers which are described from time to time in the various journals devoted to wireless technique, he would find that before he was able to classify the various instruments under the headings of the different types of circuit they employ, such as supersonic heterodyne, neutrodyne, reflex, etc., they would first have to be apportioned into two main divisions. The first of these divisions would include all those receivers in which provision was made for the reception of distant stations, with, of course, a necessary absence of simplicity; the second division including all those designed to receive the high-powered and local stations only, and possessing in a greater or lesser degree the simplicity of operation found in the household electric-light switch. The latter are frequently characterised by the irreverent with the appellation of "maiden aunt" sets, although appreciation of them is by no means confined to that virtuous if much-maligned relative, since frequently the loftier *soi-distant* highbrow will guiltily admit the possession of such a receiver, for use on such occasions as his soul craves for musical entertainment rather than the pleasure of bringing in unintelligible sounds from Omaha, Neb.

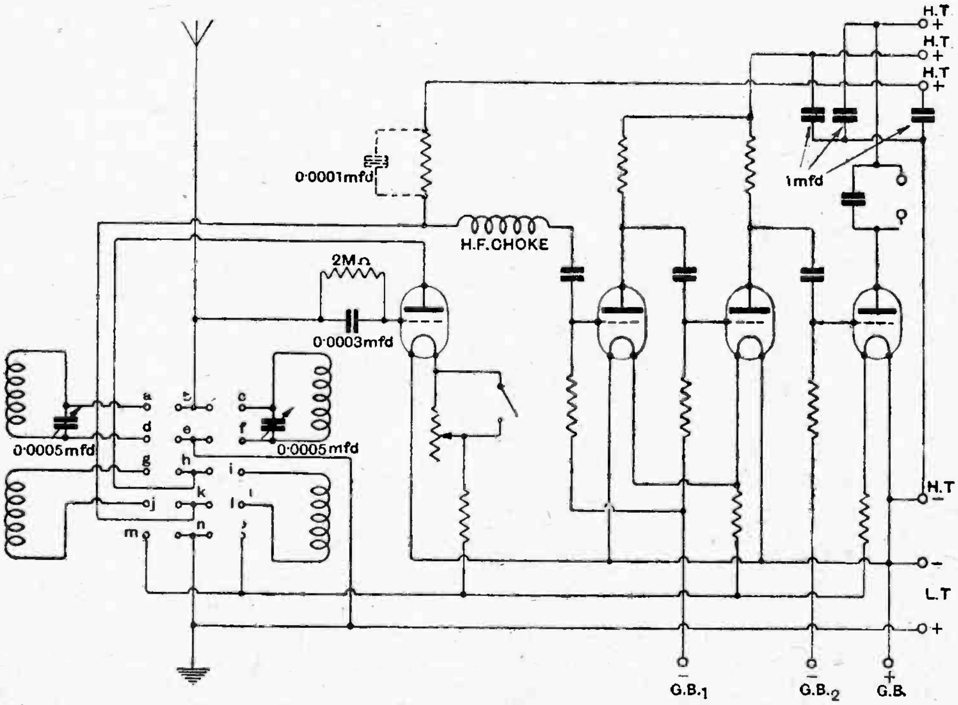


Fig. 1.—By placing the control switch in either direction Daventry or the local station may instantly be brought in on the loud-speaker, whilst other stations may be readily tuned in by careful manipulation of the reaction control. When the switch is left in the central position all battery circuits are automatically broken.

Quality and Distance.

Now, in spite of the praiseworthy efforts of Messrs. Armstrong and Hazeltine, the writer is still searching for the receiver which will give him the same musical enjoyment from other stations as he finds he can consistently obtain from the local and high-powered stations.

He has from time to time attended by invitation at the houses of various friends, for the purpose of receiving practical refutation of his opinion, but, being born under an unlucky star, he has been unfortunate on every occasion in arriving on an evening when the H.T. or L.T. batteries were off-colour, or some other equally subtle malady has smitten the receiver, which in every case "has never occurred before." He is therefore

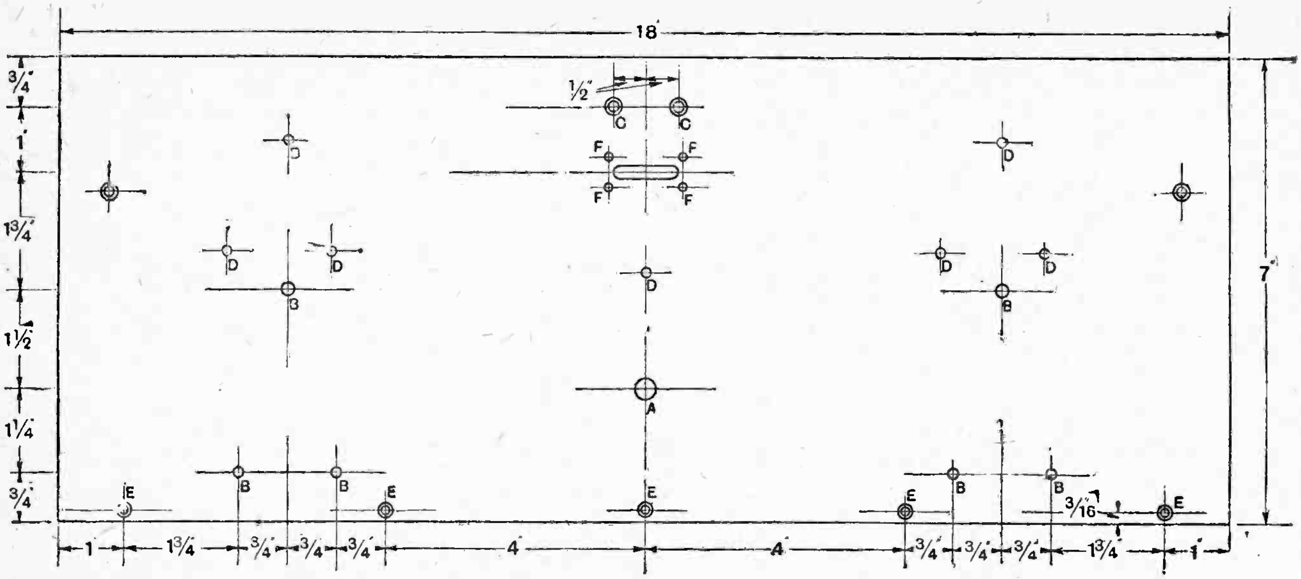


Fig. 2.—Dimensional details of front panel. Drilling sizes are as follow: A, 5/16in. dia.; B, 3/16in. dia.; C, 5/32in. dia., countersunk for No. 4 B.A. screws; D, 5/32in. dia.; E, 1/8in. dia., countersunk for No. 4 wood screws; F, 1/8in. dia.

stubbornly convinced that the simple receiver catering solely for the local and high-powered stations is very far from singing its swan-song.

Choice of a Circuit.

Careful enquiry has elicited the fact that the reason of the local receiver not enjoying a greater measure of popularity than it does is that the average family is sharply divided into two groups on the question of wireless reception. The one, usually the male section of the family, maintains that the pleasure obtainable from wireless lies not in its ability to bring good music into the house, but in its ability to satisfy a craving for conquering something, the something usually being the intractability and vagaries of a "distance-getting" receiver. This presumably represents the survival of the ancient hunting instinct in man, the joy being found in the hunting, and not in the ultimate possession of the quarry. The other section craves only for good music. Now, although a "long-distance" receiver can always, as occasion demands, be tuned to the local station, and thus be made to pacify the opposite camp, it is unfortunately not possible for the ordinary "foolproof" receiver to be used for more distant reception. The choice is therefore obvious. Of course, the most natural solution which occurs is that two receivers should be constructed, but it must be regretfully admitted that until the price of wireless components more nearly approaches the cost of mass production, such a course is usually too expensive for the average man. It occurred to the writer, therefore, that it might not be impossible to devise a receiver which could serve the dual purpose of a local and high-powered station receiver having the simplicity of an electric-light switch, and a receiver which could at will be used by those members of the family having a bent for "pulling 'em in," and he leaves the reader to judge with what measure

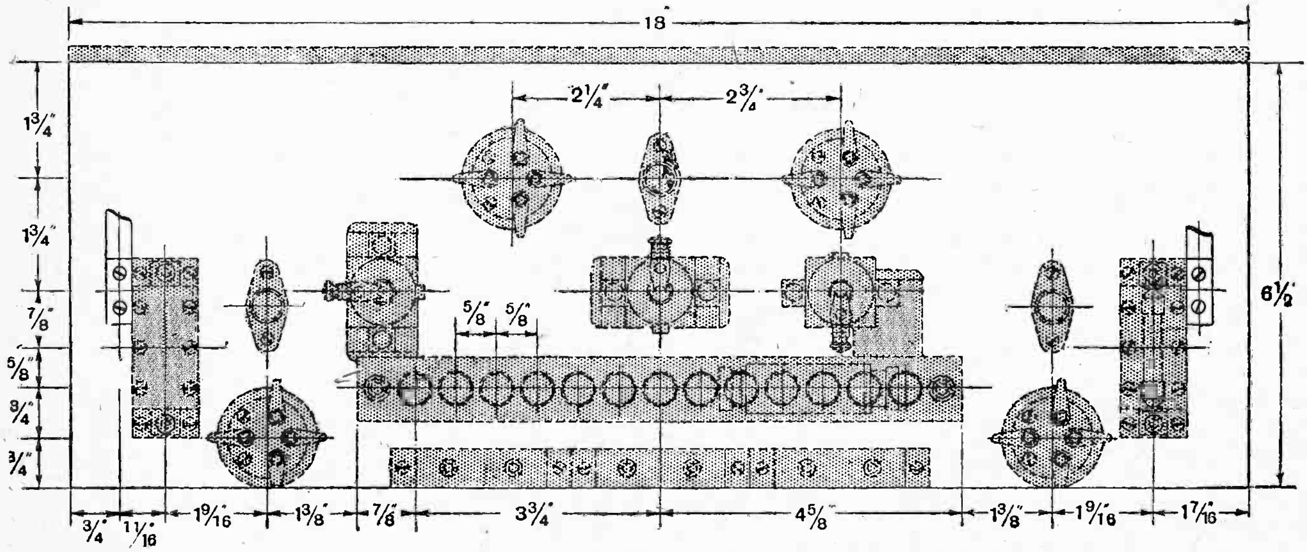
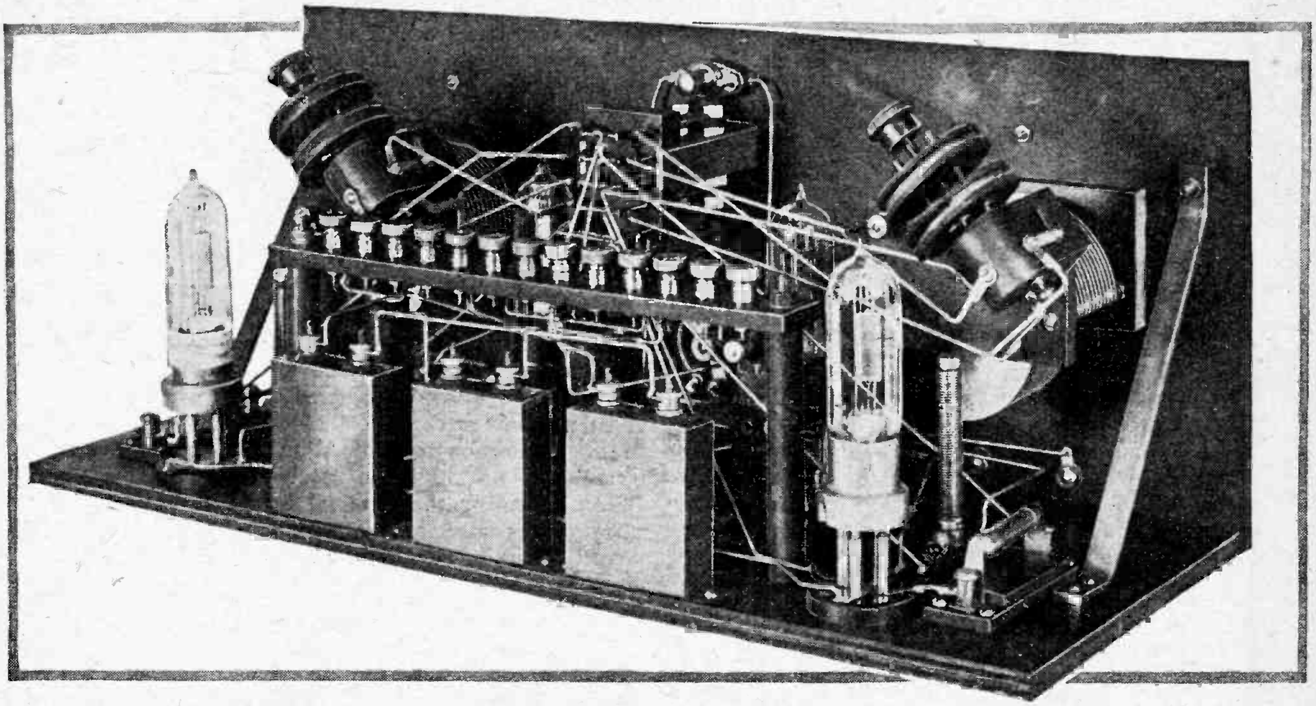


Fig. 3.—Details of baseboard layout.

Four-Valve Easy-Tune Broadcast Receiver.—
of success he has been rewarded in the present receiver. The problem seemed to be insoluble, and the writer was contemplating the construction of specially wound tuning units of small physical dimensions, when it came before his notice that such components were already upon the market, with the result that these were obtained and used with the greatest success.

Before proceeding to enter into constructional details, it were well to examine the theoretical circuit in Fig. 1. It will be seen that the circuit employed is quite a conventional one, there being two entirely separate tuners, either of which can be brought into use as desired by means of a two-way switch. It will be seen from photographs illustrating the back of the receiver that the "tuning coils" consist of an aerial and reaction coil arranged as a unit with four pins so disposed that the unit may be plugged into an ordinary valve holder, the "filament" pins forming the aerial coil connections and the "grid and plate" pins making connection to the reaction coil. This latter, which is the topmost coil, can be very finely adjusted in its relationship to the aerial coil by means of the knob shown, which operates a threaded rod. The units can be obtained in all wavelength ranges.



Rear view of the completed receiver. Direct wiring is employed in preference to other methods. It is important that the tuning units be inclined at an angle as shown.

Tuning Units.

If the photographs illustrating the receiver are carefully examined it will be noticed that the method of arranging the tuning units is one which gives the greatest possible ease of manipulation. It is proposed that if the receiver is to be left for operation by unskilled members of the family, it should first be "set" by some initiate in the family, one circuit being tuned to the local station and one to Daventry. The lid may then be shut down, and by moving the switch to the right the local station may be received, whilst moving it to the left brings in an alternative programme. When the switch is left in the central position all batteries are switched off. It is of course essential to use a switch with a central zero of the type actually used by the writer. When experimentally minded members of the family desire to search the ether the lid may be opened, and the usual adjustments carried out. It will be found that by resting the wrist of the right hand on the strip of wood running across the top of the cabinet a very easy position for delicate control of reaction is assured, the corresponding condensers being adjusted by the left hand. Owing to the threaded rod controlling the reaction coil it will be observed that a far finer control of reaction is obtainable than is the case with the ordinary two-way coil holder, and the coils cannot possibly be put out of adjustment by lifting or jarring the receiver. Geared dials, such as those produced by Messrs. Burndept and other high-class manufacturers, may of course be used with the condensers if desired, but a condenser with a single plate vernier is not advised, owing to the fact that it would be impossible to assign definite values to the dial readings for the local and high-powered stations. It is strongly recommended that a duplicate set of tuning units be obtained, since in this way two units can have their reaction coils definitely set once and for all for use on the local and high-powered stations, and the units can instantaneously be substituted by others when distant reception is to be carried out. In this manner tedious re-setting of the reaction coil every time it is desired to leave the receiver in a condition suitable for unskilled operation is entirely avoided. The inevitable question

Four-Valve Easy-Tune Broadcast Receiver.—
concerning the range of this receiver will undoubtedly be asked. Let it be said at once that the range is neither more nor less than that obtainable with any other type of receiver employing a regenerative detector in conjunction with L.F. amplification.

Constructional Details.

We can now proceed direct to constructional details of the instrument. It is first necessary, before commencing work, to obtain all necessary components, after which the drilling of the panel can be proceeded with. Having mounted the condensers on the panel so that the moving vanes pass downwards when rotating the shaft, a hole should be drilled in the left-hand top corner of the bottom end plate of each condenser, which in this case are of ebonite. These holes are for the purpose of affixing the valve holders used to carry the tuning units, these valve holders being of the one-hole fixing type. Needless to say, the two valve holders used must necessarily be of the type actually used by the writer. The coil units should be inclined at an angle of 45 degrees in the direction shown in the photograph illustrating the back of the receiver. The remaining panel components, namely, four terminals, the variable rheostat, and the switch, should be mounted, after which all baseboard components, with the exception of the first resistance-coupling unit, the H.F. choke and the terminal bridge, may be mounted. In order to affix the H.F. choke, the condenser portion of the resistance unit should first be removed by unscrewing the nuts securing it to the remainder of the instrument. It should then be re-attached, but one terminal of the condenser only should be so mounted (it does not matter which one), and this terminal should be mounted on to that position of the cylindrical portion of the instrument which is marked G. The condenser will pivot round on this mounting, and it should be placed at right angles to it and of course in the same plane as its normal position. Before the connection is made tight a small brass angle bracket should be placed with the shank of the screw projecting from the top of the fixed condenser, passing through the orifice in one of its limbs. The nut should then be made tight.

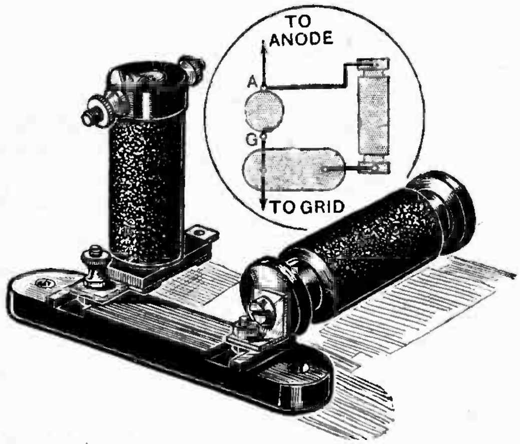
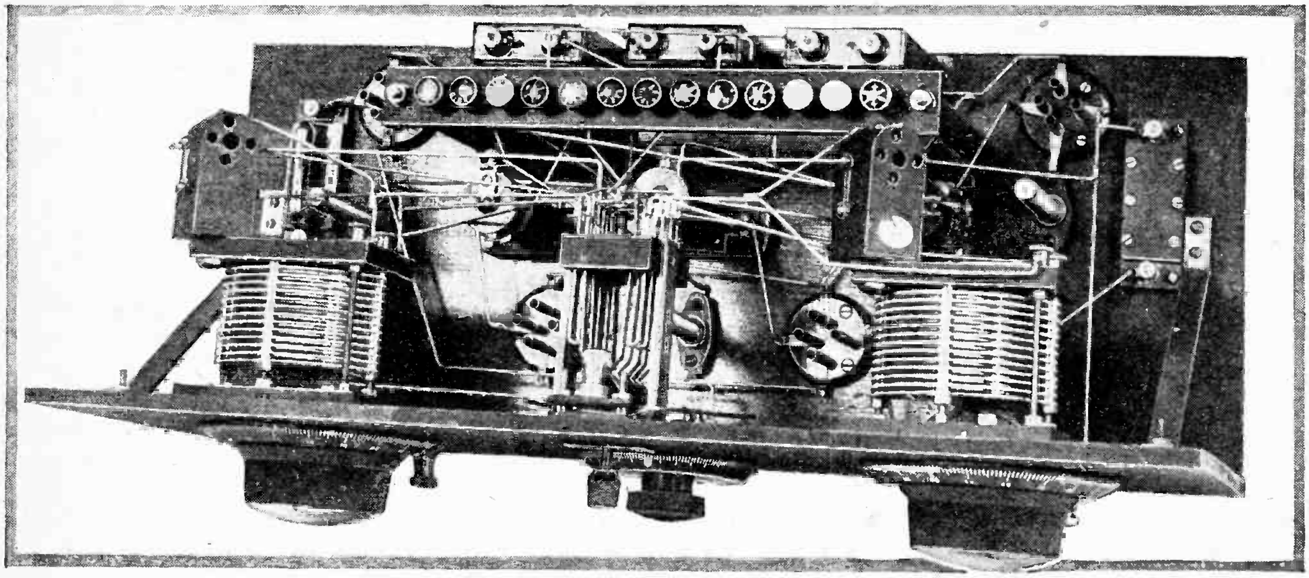


Fig. 4.—In this sketch details of attaching the H.F. choke to the resistance unit are clearly shown.

Mounting the H.F. Choke.

The H.F. choke is supported by means of a screw passing through the hole in the other limb of the angle bracket into its head, which is of course tapped for the reception of the screw. One end of the actual choke winding should now be soldered to that connection of the resistance unit marked G, the other end being connected to the connection marked A. The whole can now be mounted in the allotted position on the baseboard. Before mounting the terminal bridge it is necessary to carry out as much of the wiring as is possible. With regard to the terminal strip, it was thought more judicious to erect this in the form of a bridge inside the cabinet rather than in the more usual form of a strip


View of the instrument from above, showing the general disposition of components. Note specially the method of mounting the tuning units at the back of the variable condensers.

Four-Valve Easy-Tune Broadcast Receiver.—projecting through a slot in the back of the cabinet, partly because it was desired to render the receiver absolutely "safe" by having all bare connections within the cabinet completely out of harm's way, and partly because experience shows that either the amateur cannot or will not cut a good neat slot in the back of the cabinet for reception tubing, 3½in. in length, through which pass two 4½in. lengths of threaded No. 2 B.A. rod. The rods are firmly fixed in the baseboard by the process of splitting the ends and opening out the two split portions. The strip is affixed by means of two holes cut into it in the positions indicated in Fig. 2, through which pass the ends of the threaded rod which project from the top

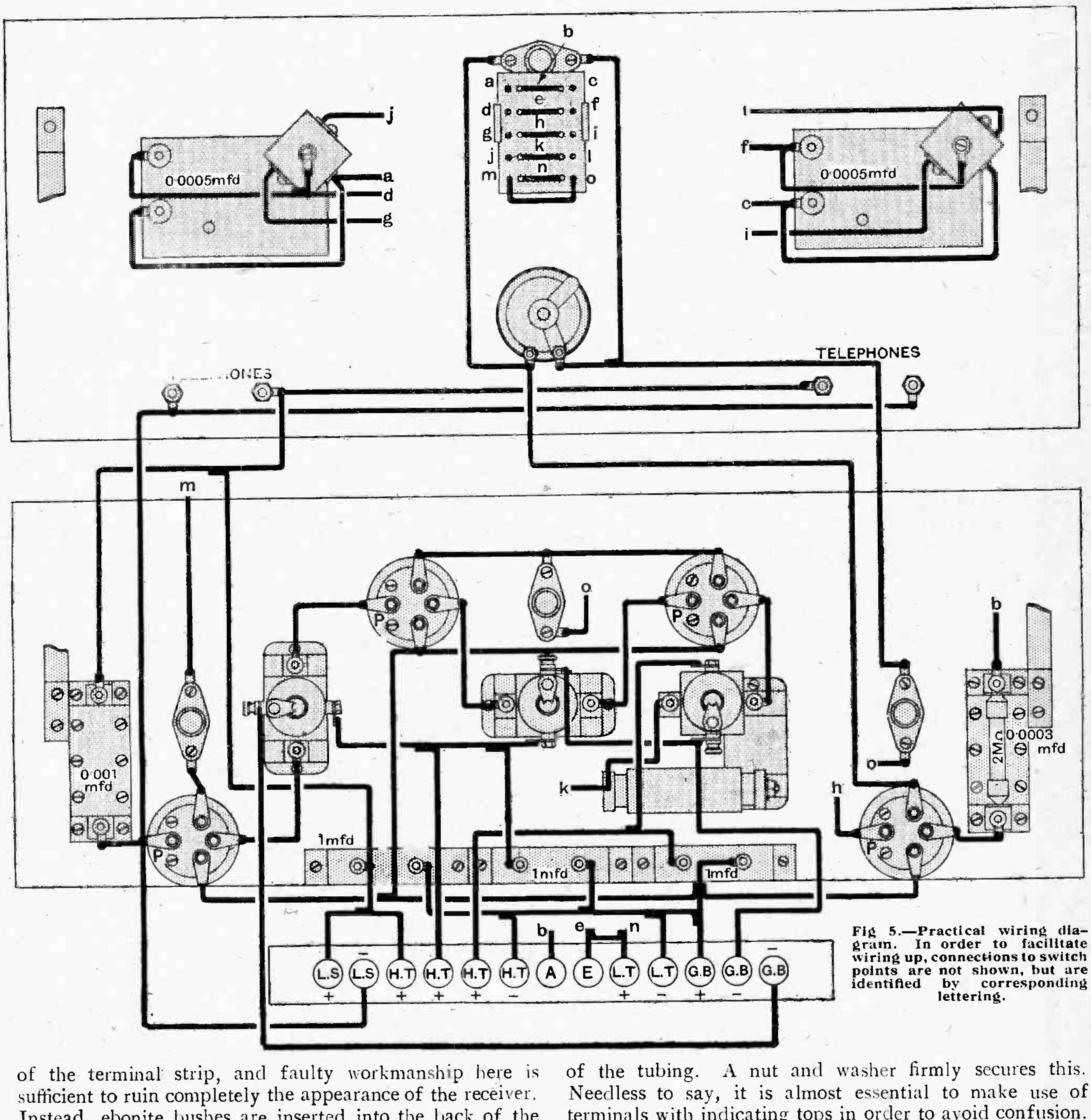


Fig 5.—Practical wiring diagram. In order to facilitate wiring up, connections to switch points are not shown, but are identified by corresponding lettering.

of the terminal strip, and faulty workmanship here is sufficient to ruin completely the appearance of the receiver. Instead, ebonite bushes are inserted into the back of the cabinet for the entrance of the external connecting wires. The cabinet, which is of standard size, may be obtained ready made in either dark oak or mahogany. The terminal bridge is supported by two pieces of ½in. ebonite of the tubing. A nut and washer firmly secures this. Needless to say, it is almost essential to make use of terminals with indicating tops in order to avoid confusion. Two terminals for loud-speaker connection are also included on the terminal bridge, it being thought by the writer that it would be convenient to have no wires at all attaching to the front of the panel under normal

Four-Valve Easy-Tune Broadcast Receiver.—

LIST OF COMPONENTS.

2 ·0005 variable condensers (W. & M.).
2 4in. ebonite dials (Ajax).
4 Base mounting valve holders (Burwood).
2 Back-of-panel valve holders (Decko).
2 Aerial reaction tuning units (Polar).
3 Resistance-coupling units (Polar).
1 H.F. choke (Cosmos).
4 Fixed resistor holders (Burndept).
3 Fixed resistors (Burndept).
1 Fixed resistor short-circuiting plug (Burndept).
1 5 ohm variable rheostat (Kra).
1 Five-point double-throw switch (Burndept)
1 ·0003 grid condenser and grid leak, 2 megohms (W. & M.).
1 ·001 fixed condenser (W. & M.).
3 1 mfd. fixed condensers (T. C. C.).
17 Indicating terminals (A. E., L.T.+, L.T.–, H.T.+, H.T.+, H.T.+, H.T.–, G.B.+, G.B.–, G.B.–, L.S.+, L.S.–, P.H.+, P.H.–, P.H.+, P.H.– (Belling & Lee).
1 Panel, 18in. × 7in. × ¼in.
1 Baseboard, 18in. × 6¾in. × ½in.
2 3½in. lengths of ½in. ebonite tubing.
2 4½in. lengths of threaded No. 2 B.A. rod and nuts.
1 Ebonite terminal strip, 9½in. × 1in. × ¼in.
1 Cabinet, mahogany or dark oak (Carrington Mfg. Co., 18, Norman Bldgs., Central Street, E.C.1).

conditions. When desiring to search for distant stations the telephones may be attached to either pair of terminals on the front panel, which are in parallel with each other and also with the loud-speaker terminals on the terminal bridge.

Choice of Valves.

With regard to the type of valves it is advisable to use in this receiver it may be said that the best results will be obtained by employing a low impedance power valve of the D.E.5 class in the initial and final positions, the intermediate position requiring valves having a high magnification factor such as the D.E.5B. For those readers to whom filament current economy is of vital importance a combination of D.E.3 and D.E.3B valves is recommended.

For the matter of H.T., although, of course, high voltage value is very desirable if it can be conveniently obtained, there is no call for three or four hundred volts as many suppose. Actually most excellent results can be obtained by having a maximum voltage of 120. This is partly explained by the somewhat low value of anode resistance employed, the value actually being too low for efficient working with high impedance valves, if technical considerations alone prevail. It is not contended by the writer that this type of resistance amplifier is by any means as efficient as those employing anode resistances of 120,000 ohms, and a proportionately high H.T. voltage, but he does, however, maintain that it is a very effective compromise between high efficiency and convenience, and that it forms a very practicable scheme indeed for the average man, who need have no hesitation whatever in adopting it as a sound and workable arrangement. The reason for using a H.F. choke in the position indicated has been given so often in the pages of this journal that it is not proposed to labour the point here. Readers who are in any doubt on this point are referred to page 535 of the issue of this journal for June 3rd, 1925.

Tests.

In order to test its effectiveness in tuning in distant transmissions the receiver was tested against a conventional three-valve receiver employing a regenerative detector using plug-in coils followed by transformer-coupled L.F. amplification, and it was found that it very readily equalled the achievements of this receiver, whilst distant stations were clearer and more intelligible owing to the complete absence of iron-cored intervalve couplings. Briefly put, it may be stated that the ratio between background noises and signal strength is undoubtedly better when using resistance coupling. Readers must not, however, suppose that the instrument is capable of achieving the same feats of distance obtainable with a receiver employing a properly designed H.F. amplifier, such as a good neutrodyne employing two H.F. stages, but it is maintained, however, that it is fully able to compete successfully with any other receiver of its class, the main intention of the writer being to design a dual-purpose receiver performing the function of either an experimental or a local and high-powered station receiver, and possessing no more difficulties in operation than an electric-light switch, and in this respect the desired objective has, it is claimed, been fully achieved.

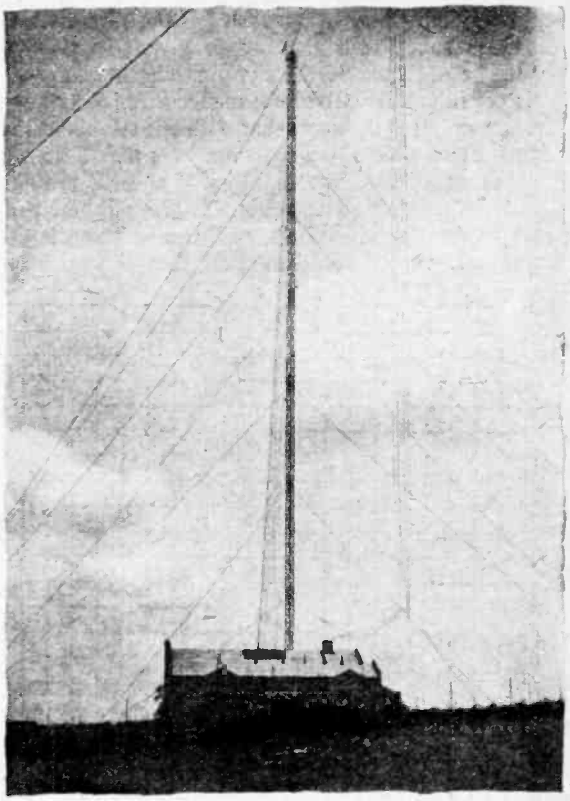
HORIZONTAL RADIATION TESTS.

INTERESTING tests with an experimental type of horizontal antenna are being conducted by the American broadcasting station WGY at Schenectady, New York. To assist in the tests, the engineers ask listeners to report on the comparative quality of transmissions with the old and new types of antenna, to be given on Monday and Tuesdays at midnight.

Each evening, beginning at midnight, entertainment will be broadcast for half an hour using the horizontal antenna; then, after a period of fifteen minutes required for the change over, a further transmission will be made on the ordinary vertical aerial system from 12.45 to 1.15 a.m. It is understood that the usual wavelength of 379.5 metres will be employed, with a power of 50 kilowatts. British listeners should, of course, remember that G.M.T. is five hours in advance of the times given above.

These experiments form part of a comprehensive scheme of transmitter development which is being carried out by the General Electric Company during the winter.

CRYSTAL RECEPTION from 5XX



Practical Measurements of Signal Strength.

By H. L. CAPE.

SINCE the opening of the 5XX (Daventry) high-power broadcasting station, greater use than ever appears to be made of crystal circuits.

It is the purpose of this article to discuss the signal strength from the station at Daventry as measured by the amount of rectified current through the telephone circuit. The experiments were made in close proximity to the 5IT transmission. The aerial system used for the reception tests is situated $1\frac{1}{4}$ mile from the 5IT aerial, its dimensions being as follow:—Horizontal span 45ft., height 35ft. above ground. The location is surrounded by buildings.

The Aerial.

It was found that in the space available the best results were obtained with an aerial of the inverted L, six-wire cage type, the multiple wires of the vertical portion reaching to within about 8ft. from ground level. The aerial had a fundamental wavelength of 147 metres.

A large buried zinc plate formed the earth connection, and for rectification a "Hertzite" crystal was used in circuit with 4,000 ohms telephones.

The circuits used are shown in Fig. 1, together with the inductance values; (*a*) is an ordinary directly connected set tuned with parallel capacity; (*b*) is inductively coupled with primary tuning capacity; and (*c*) inductively coupled with primary tuning inductance. The inductances L_1 and L_2 were composed of well-spaced windings supported between $\frac{1}{4}$in. ebonite end plates. Each of these inductances consisted of six slab type coils, $\frac{3}{16}$in. separating each slab. The windings are octagonal in shape, with layers spaced $\frac{3}{64}$ in. apart by narrow strips of cardboard placed at eight equidistant points. Various tapping connections were available, but the maximum inductance values indicated below Fig. 1 gave best results.

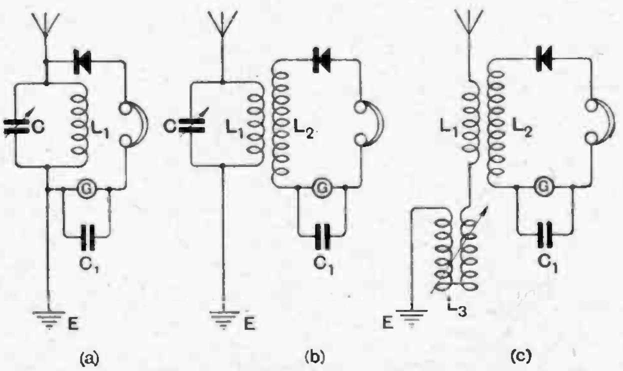


Fig. 1.—Circuits used in the experiments. The values of the fixed capacity and inductances are as follow: L_1, 1,030 mH.; L_2, 3,530 mH.; C_1, 0·001 mfd.

Tuning Coils.

Inductance L_1 consists of 120 turns of No. 32 S.W.G., S.S.C. copper wire, L_2 having a greater number of turns wound with No. 32 S.W.G. and No. 24 S.W.G. wire. These inductances were not made specially for this test, but were conveniently available, no "low-loss" claim being made. The variometer L_3 for tuning circuit (*c*), however, was of the "low-loss" type.

In the inductively coupled circuits (*b*) and (*c*), L_1 and L_2 were placed as close together as possible, the ebonite end supporting plates giving $\frac{1}{2}$in. separation between windings. The inductive coupling coefficient between primary and secondary of circuit (*b*) was 57 per cent., and in the case of circuit (*c*), at 1,600 metres, 11 per cent. The tuning capacity required in circuit (*a*) for maximum current was 232 micro-microfarads; in circuit (*b*) 330 micro-microfarads. The galvanometer used for the crystal circuit current measurements was a particularly sensitive and accurate instrument.

Crystal Reception from 5XX.—

The curves in Figs. 2 and 3 give the values of rectified current obtained when using each of the circuits. The circuits were tuned over the ranges given, so that some idea could be obtained of the signal strength when the receiver is considerably out of resonance with the transmitting frequency. It was found that with the telephones used a rectified current of 1½ micro-amp. was about the minimum which would give intelligibility of speech, taking the news bulletin reading as a standard. The minimum rectified current for the case of the 5IT transmission is about 1 micro-amp., which would suggest that the amount of mean modulation is of a higher proportion in the 5IT transmitter than in that of 5XX. This would be expected when the large difference in the two plants is considered. Using circuit (*a*) for 5XX reception, interference is experienced from 5IT; this, of course, is not surprising at the close range of reception. No interference can be detected at all when either circuit (*b*) or (*c*) is used; also, owing to the use of a secondary winding, the benefit of reduced circuit damping is obtained. It was found that with both 5XX and 5IT working, circuits (*b*) and (*c*) could be tuned to as low as 1,200 metres without any appreciable interference from 5IT. It will be observed that no tuning capacity is used in the secondary of either (*b*) or (*c*), as with the particular coils in use no advantage was gained with any degree of coupling tried or value of inductance. It is not suggested that secondary tuning could be dispensed with when best results are desired in all cases of reception.

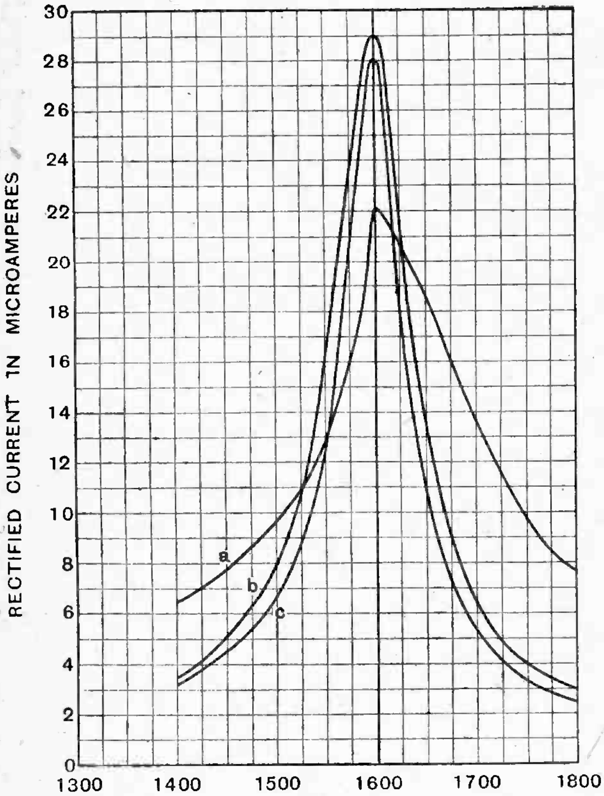


Fig. 2.—Results obtained from 5XX with circuits (*a*), (*b*) and (*c*). Curve (*a*) was taken when 5IT was not working, curves (*b*) and (*c*) being unaffected by the radiation from 5IT.

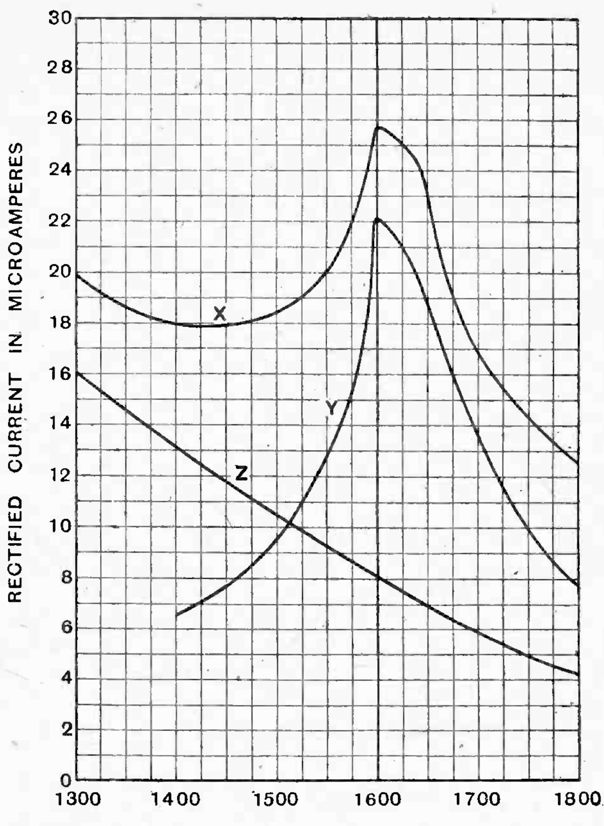


Fig. 3.—Rectified current in the galvanometer in circuit (*a*), Fig. 1; curve X, from 5XX and 5IT working simultaneously; curve Y, from 5XX alone, and Z from 5IT alone.

Loose-coupled Tuning.

The results given with the two-circuit arrangements here might prove of interest to those who have not had

CRYSTAL RECEPTION FROM 5XX.

MEAN RECTIFIED CURRENT OBTAINED FROM 5XX DURING THE LAST WEEK OF TRANSMISSION FROM CHELMSFORD.

Circuit Tuning. Metres.	Rectified Current—Micro-amps.					
	Circuit (*a*).		Circuit (*b*).		Circuit (*c*).	
	5XX only.	5XX and 5IT.	5XX only.	5XX and 5IT.	5XX only.	5XX and 5IT.
1,600 (1)	1.7 (2)	5 (3)	2.8 (4)	3 (5)	2.6 (6)	2.6 (7)

Crystal Reception from 5XX.—

experience with loose coupling, as, besides cutting out the undesired transmission, a general increase of signal strength is obtained, although this would not be necessarily so in every instance, so much depending upon individual reception conditions and circuit constants. The rectified current in circuit (*a*) due to 5IT when 5XX is not in operation is given in curve Z of Fig. 3, illustrating the likelihood of considerable interference with 5XX. The values given in curve X, Fig. 3, for the

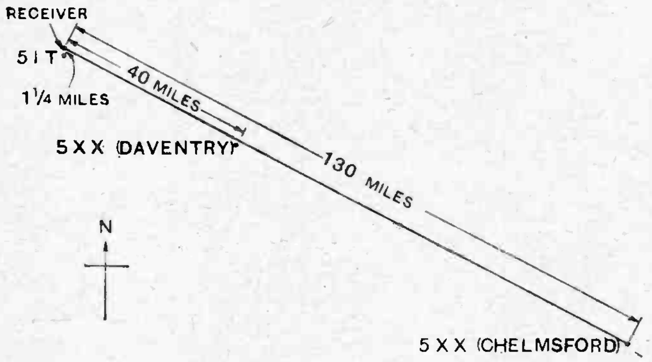


Fig. 4.—Diagram showing the distances of 5IT and 5XX from the receiver.

rectified current in circuit (*a*) with both transmissions working are not the arithmetical sum of those in curves Y and Z. The current values for circuits (*b*) and (*c*) given in curves (*b*) and (*c*) respectively of Fig. 2 represent those obtained, whether 5IT is in or out of operation.

Interference.

The current for the lower and higher tuning has not been included in the curves, as the range given from 1,400 to 1,800 metres is sufficient to give the general relation existing among the various values. In Fig. 2 are given the values for all three circuits, that with the lowest peak being for circuit (*a*) when 5IT is not working; the two higher curves are for the inductively coupled circuits. The curves in Fig. 3 are for circuit (*a*) in Fig. 1, X representing conditions when both 5XX and 5IT are working; Y, 5XX only, reproduced from Fig. 2, and Z with 5IT only. It will be seen that 5IT can be heard at fair strength at as high as 1,800 metres. It should prove interesting to observe the general shape of the various curves.

The table gives the maximum rectified current for the various circuits described, obtained from the 5XX Chelmsford transmission during the last week of its operation.

The diagram in Fig. 4 indicates the relative positions and distances between the various stations and the point of reception. The information is based on careful measurement of a large-scale map. It is interesting to notice that the Daventry station is located almost on the line which joins Chelmsford and Birmingham. The signal strength from Daventry is considerably greater than that from Chelmsford, much more than would be given by comparing the relative distances.

This greater relative strength is due to a variety of conditions, such as improvement in the plant.

Although the maximum 5XX signal strength has been regarded as at 1,600 metres, and all the other tuning values are based on this figure, actually the wavelength when measured carefully always appeared slightly higher, being, in fact, almost 1,610 metres, according to the instrument used in the tests. This is a small matter, but is mentioned in case 5XX does really differ from 1,600 metres.

Comparing Modulation and Quality.

The galvanometer which was used had a fairly long period of oscillation, so that a relative measure of the amount of modulation in the transmission could not be made for speech or music, but for the long, constant modulation of the tuning note, the increase of rectified currents was .1 to 1½ micro-amp., in circuits (*b*) and (*c*). It would be interesting to know just what amount of modulation actually takes place at the transmission for the tuning signal.

It would appear from the results in this article, that in most instances it would be reasonable to expect fairly reliable signals from 5XX up to, say, 200 miles from the transmission, using a good aerial system with the correct type of crystal receiver. Strong signals are not suggested at this distance. Greater distances are covered than the 200 miles mentioned, but the latter assumes that signals are sufficiently strong to be intelligible without undue strain on the listener.

It seems generally agreed that the quality of the Daventry transmission is very good, especially when all the factors are taken into consideration. The writer normally uses for the 5XX reception, the circuit (*b*), with the primary of an intervalve low-frequency transformer in place of the telephones, followed by a two-valve amplifier of suitable design, and low-resistance loud-speaker, which gives really loud and good reproduction. The usual rectified current in this receiver is approximately 35 micro-amps. As circuit (*b*) is capable of tuning 5IT to resonance, also, it has been interesting to compare the loud-speaker results obtained from 5XX with those of 5IT, during a simultaneous transmission. To make a proper comparison, the rectified 5XX current is noted, then 5IT tuned, and coupling weakened until the current is equal to that from 5XX. Before 5IT improved its transmission, the quality obtained from 5XX on this test was much superior and pleasing; also the general balance of effects was better than that given by 5IT.

Great care has been taken with all the results given, as it is thought that definite quantitative measurements of relative signal strength for the 5XX transmission, at a location where there is another broadcasting station, should prove useful.

GENEVA WAVELENGTH TROUBLES.

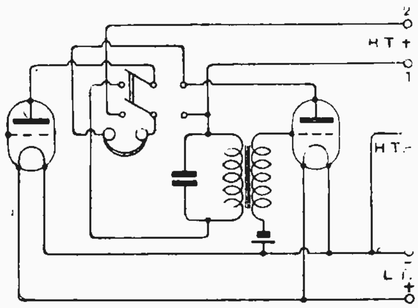
WIRELESS engineers at Geneva are discovering that the path of true broadcasting never runs smooth. During the transmitting tests with the new Geneva broadcasting station, which began operations on 1,000 metres, it was discovered that serious clashing took place with the Hilversum transmissions on 1,050 metres, and also with a harmonic of the Munchenbuchsee station.

Geneva is at present experimenting on wavelengths in the region of 800 metres.

A Section Devoted to New Ideas and Practical Devices.

SWITCHING L.F. VALVES.

The circuit diagram shows how a double-pole double-throw change-over switch may be employed to



L.F. amplifier switch connections.

switch off a low-frequency amplifying valve without changing the value of the H.T. voltage applied to the preceding valve.—J. H.

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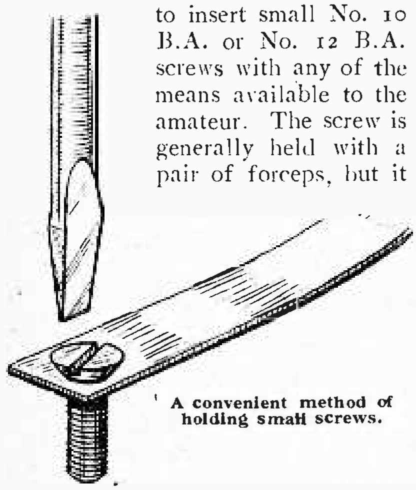
HANDLING SMALL SCREWS.

In reassembling delicate instruments such as voltmeters and galvanometers it is often found difficult to insert small No. 10 B.A. or No. 12 B.A. screws with any of the means available to the amateur. The screw is generally held with a pair of forceps, but it



A convenient method of holding small screws.

is very difficult to keep the screw vertical, particularly if provided with a countersunk head.

A very simple and effective way of overcoming the difficulty is to push the screw through the end of a strip of cartridge paper, as indicated in the diagram. This way of holding the screw has only to be tried to prove its superiority over any other method. —P. E.

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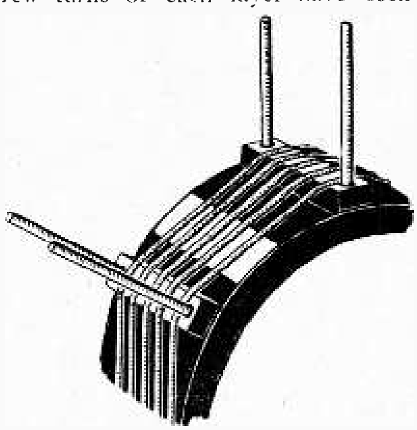
SPACED COILS.

One of the most efficient forms of multilayer coil winding is that in which narrow spacing strips running at right angles to the direction of winding are used to separately space single layers of wire. Until the first few turns of each layer have been

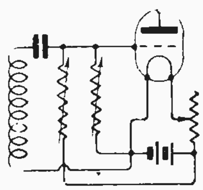


Assembling spacing strips

wound, however, there is difficulty in holding the spacing strip in position, and it is generally necessary to tie them down with a few turns of thread until the winding has been commenced. A much more satisfactory method is to screw vertical pegs into the centre former at each side. Holes are then drilled at each end of the spacing strips to correspond with the distance between the pegs which will then hold the spacing strips in position for each layer without the necessity of using any form of binding.—A. L. O.

GRID BIAS.

A very effective way of adjusting both the value and the sign of the grid bias applied to the detector valve is to use two variable grid leaks, one being connected to the positive and the other to the negative terminal of the L.T. battery. When a negative



Grid leaks connected to give a positive or negative grid bias.

bias is required the grid leak connected to give L.T. should be reduced in value, while the resistance of the other should be increased. By reversing this operation a positive bias will be obtained. It will be seen that the variation of grid potential is continuous, and that any desired value may be obtained by varying the ratio between the two resistance values. Both grid leaks should be capable of adjustment to values as high as 5 or 10 megohms, since the effective value of the grid leak is the resultant resistance given by the two resistances connected in parallel. The arrangement is essentially a potentiometer, but the current taken from the L.T. battery is very much less than that usually required for a wire-wound instrument.—N. S. C. P.

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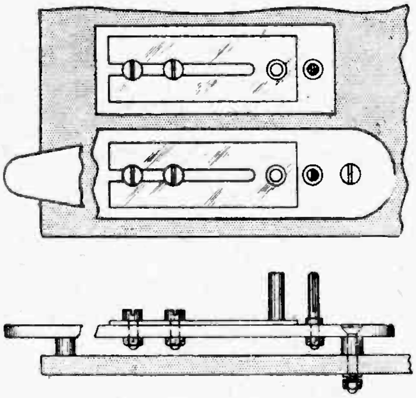
MOUNTING LOW-LOSS COILS.

In order to reduce self-capacity to as low a value as possible it is necessary to provide a spacing between the pin connections of short-wave coils greater than is usual in the case of plug-in coils for the broadcast band of wavelengths. This generally necessitates a coil holder of special design, but the method of construction shown in the diagram enables either type of coil to be used with equal facility. In both the fixed and moving coil holders the split pins are fixed while the sockets are mounted



Adjustable coil holder.

on adjustable brass slides. In the diagram the holders are shown adjusted for ordinary plug-in coils. By releasing the pairs of securing nuts and bolts the distance between the pins and sockets may be increased to take special low-loss coils with various spacing.—G. W. I. B.

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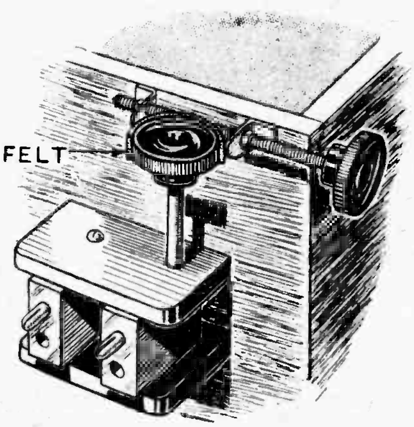
COIL HOLDER ADJUSTMENT.

The diagram illustrates a very effective vernier adjustment for a coil holder which is screwed to the side of a receiver cabinet. A length of No. 2 B.A. screwed rod is mounted in bearing brackets and provided at one end with an ebonite knob. The



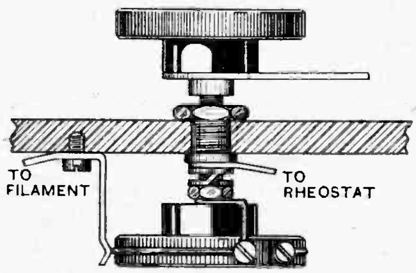
Fine adjustment for coil holders mounted on the receiver cabinet.

distance of the bearing holes above the surface of the cabinet is such that the screwed rod is in contact with a strip of felt glued to the edge of the adjusting knob on the coil holder. This arrangement produces in effect a worm gear providing a minute control over the movement of the reaction coupling. The felt should not be too thick if best results are to be obtained.—A. R. K.

o o o o

VERNIER RHEOSTAT.

A simple vernier rheostat for use in conjunction with an existing filament resistance may be constructed from two tuning knobs. The diagram shows that the knobs are mounted at each end of a screwed rod spindle passing through a bearing bush in the panel, the resistance element consisting of a single turn of wire wound round the milled edge of the lower knob. One end of the wire is free, while the other is connected to the spindle. A springy brass strip



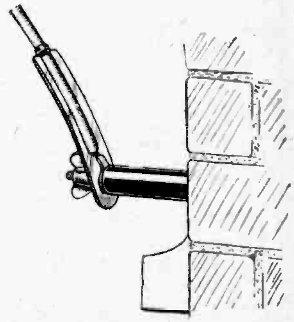
Single-turn vernier rheostat.

screwed to the underside of the panel is used to pick up contact with the wire.—A. F. F.

o o o o

LEAD-IN JOINT.

Through swaying in the wind the end of the lead-in wire frequently breaks off where it is clamped to the terminal of the lead-in tube. This trouble can be prevented by attaching to the wire a short length of brass spring strip in the manner indicated in the diagram. The end of the strip is drilled and clamped under the lead-in terminal, while the upper end is cut with a pair of shears to form two narrow strips, which are bent over the top of the wire to hold it in position.



Method of preventing breakage of the lead-in wire.

If any swaying takes place the bending will be distributed along the brass strip and will not take place at one point only. Consequently there will be less danger of breakage. Of course, the strip must not be too thick, otherwise the wire may break off where it is fastened to the upper end of the strip.—L. C. H.

o o o o

SOLDERING HINT.

The usual method of cleaning the iron is to dip in flux and then to apply a stick of solder to the tip of the copper bit. When the iron is very hot it becomes oxidised or the flux is burnt away before the solder can be applied, and the tinning of the iron is consequently uneven.

A better method is to obtain a shallow tin lid and to melt in it a few pieces of solder until they form a thin layer covering the bottom of the tin. A small quantity of flux is then melted and poured in to cover the layer of solder. If the soldering iron, whilst hot, is dipped into the flux and rubbed on the solder at the bottom of the tin the point will be cleanly and evenly tinned.—C. W.

o o o o

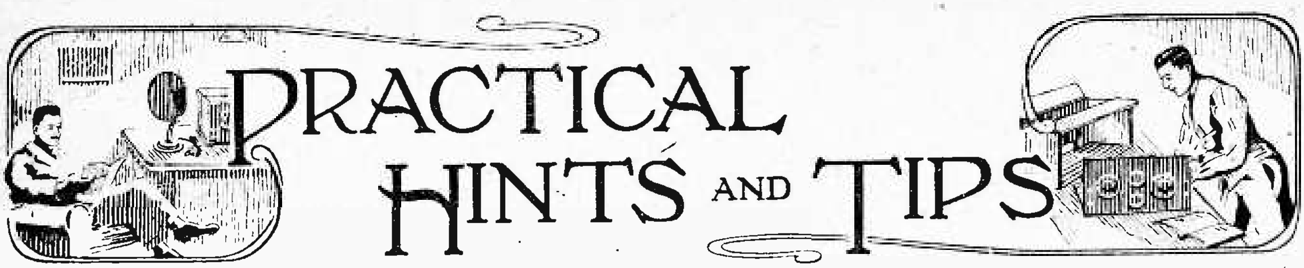
WIRING DIAGRAMS.

If a sheet of carbon paper is placed under the drawing paper with the carbon surface upwards, when making a wiring diagram, a reverse image of the diagram will appear on the underside of the paper. Thus diagrams showing the appearance of the wiring both on the front and the back of the panel will be obtained on the same piece of paper.—J. H. C.

Valves for Readers.

For every practical idea submitted by a reader and accepted for publication in this section the Editor will forward by post a receiving valve of British make.

PRACTICAL HINTS AND TIPS



A Section Mainly for the New Reader.

ALTERNATIVE CRYSTAL RECTIFICATION.

The problem of changing-over from valve to crystal rectification is not such a simple one as would appear at first sight, as the circuit arrangements for a crystal detector are, or should be, inherently different from those applicable to a valve in the great majority of cases.

Circuit diagrams showing how the change-over may be made by a fairly obvious method of substitution are often suggested, but such an arrangement generally gives rise to high damping and general inefficiency, although, for local work, the arrangement may be effective enough.

Referring to Fig. 1, it will be seen that the problem has been attacked from rather a different angle in this particular case. The receiver, as shown, consists normally of an H.F. amplifier, valve detector, and one L.F. stage. This circuit arrangement is obtained when the D.P.D.T. switch is "down," a grid condenser and leak of suitable values being connected in appropriate positions. When the switch is "up," the crystal detector is put into operation, and functions as a voltage rectifier, supplying rectified pulses to the grid-filament circuit of the second valve (which now becomes an L.F. amplifier) through the H.F. choke and grid condenser. The usual grid leak is fitted, a suitable bias voltage being applied through it. The values of both coupling condenser and leak are the same as used in resistance capacity L.F. couplings.

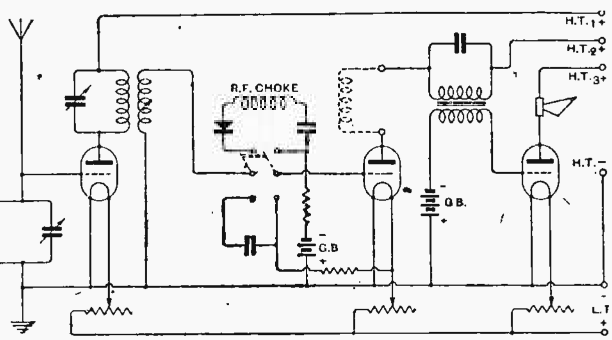


Fig. 1.—Valve or crystal rectification.

When crystal rectification is being used the reaction coil (shown in dotted lines) in the anode circuit of the second valve is either swung clear or, where possible, removed from its socket, which is then short-circuited. If reaction is still desired, arrangements must be made to introduce it between the anode and grid circuits of the first valve.

As practically no current is taken by either valve or crystal detector operating in this manner, the same type of H.F. coupling will be suitable for both alternative methods of rectification; in this lies the chief advantage of the circuit.

Needless to say, as the switch is at high oscillating potential to earth, it should be of the low-capacity type, and the very greatest care should be exercised in keeping the connecting wires to it as short and clear of each other as possible. The choke, which helps to keep H.F. voltages (which may escape rectification) off the grid of the second valve, should not be in inductive relation with other coils.

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THE SQUARE LAW CONDENSER.

Although unfortunately under ordinary working conditions the so-called square-law condenser does not give perfectly proportional dial reading in relation to the wavelength of the circuit of which it forms a part is tuned, there are nevertheless several very distinct advantages to be gained by its use.

In operating condensers with the ordinary semi-circular plates, it will be found that the lower part of the tuning scale is uncomfortably crowded; in other words, there is very little separation between the readings corresponding to various stations. In this respect the "square-law" type of instrument will be found to effect a considerable improvement, as stations are much more evenly distributed round the scale. Another very real advantage lies in the fact that, due to the shape of the vanes, these condensers usually have a very low minimum capacity. This is an important matter, as a larger wavelength range may be covered with a single inductance coil.

oooo

NEUTRODYNE RECEIVERS.

It should be pointed out that, unless a receiver will normally oscillate without some artificial stabilising device the addition of a neutralising condenser is quite unnecessary.

It will generally be found that a "direct-coupled" receiver (with aerial connected to the grid end of the tuning inductance), having only one stage of high-frequency amplification, will not oscillate unless reaction is introduced. In this case, therefore, there exists no need for the adoption of the "neutrodyne" system, which in itself does not add to the efficiency of a receiver, but merely enables the inherent tendency towards self-oscillation in lightly damped circuits to be overcome in a very effective manner.

In the case mentioned, the grid circuit will be sufficiently damped by the load imposed by an aerial of normal dimensions, but where an excessively small aerial or a frame is used, the neutralising arrangement is of great practical value.

Under modern conditions, with an increasing need for high selectivity, there is a growing tendency towards the use of a loose-coupled aerial circuit, which, if sufficiently loose to be effective, will generally introduce the necessity for stabilising.

○○○○

REDUCING AERIAL DAMPING.

The grid circuits of the first valve of "neutrodynes" (and of some other receivers) need to be lightly damped, thus generally ruling out the usual direct aerial connection. Readers who wish to experiment on these lines and who do not care to go to the trouble of constructing or connecting up a loose coupler, will find that a similar effect may be obtained by inserting a very small condenser (generally 0.0001 mfd. or less) in series with the aerial circuit. Tuning will be carried out in the usual manner by means of a variable condenser across the grid coil; this latter will have to be somewhat larger than the one used when the series condenser is not in circuit.

○○○○

TESTING A VARIABLE CONDENSER.

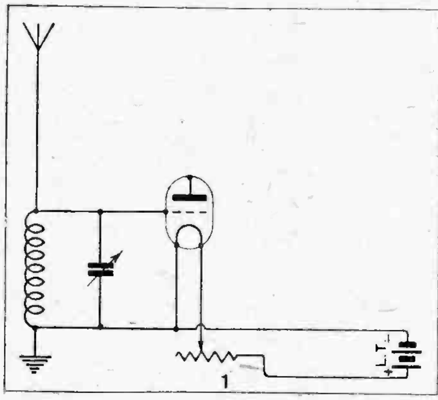
Purchasers of variable condensers fitted with any form of reduction gear designed to give a slow motion to the moving vanes should beware of "backlash." If this exists to any appreciable extent the whole object of the design is defeated.

To test for the presence of backlash, the moving plates should be securely held, and if it is possible even slightly to move the dial without transmitting a corresponding movement to the plates, it is unlikely that the condenser will give satisfactory service. Where a friction drive is used this test may be misleading, due to slipping of the driving surfaces, but it will be fairly easy to see if this is the cause of any free movement of the dial which may be detected.

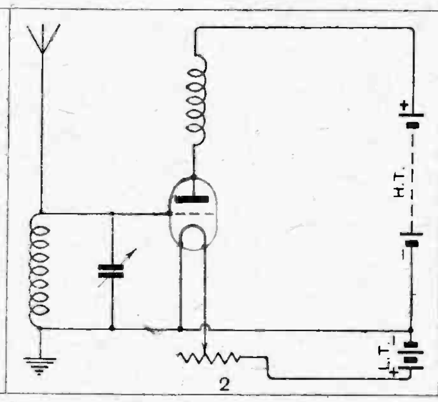
DISSECTED DIAGRAMS.

No. 9.—An H.F. Amplifier with Crystal Detector.

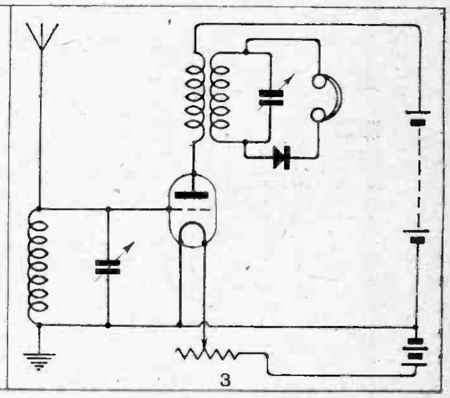
For the benefit of those who have not yet acquired the simple art of reading circuit diagrams, we are giving weekly a series of sketches, showing how the complete circuits of typical wireless receivers are built up step by step.



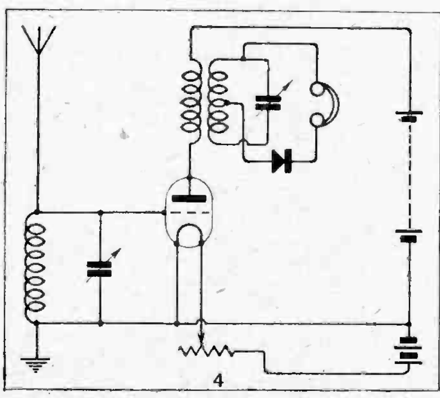
A tuned oscillatory circuit connected to aerial and earth. Voltages built up across it are applied between grid and filament of a valve, the filament of which is heated by an L.T. battery.



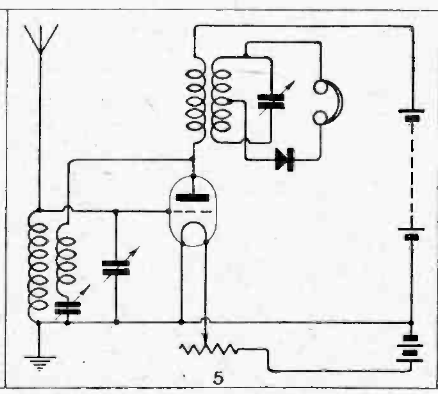
The anode circuit is completed through the primary windings of an H.F. transformer and H.T. battery. Note that in every valve receiver the positive end of this battery is connected to the plate or anode.



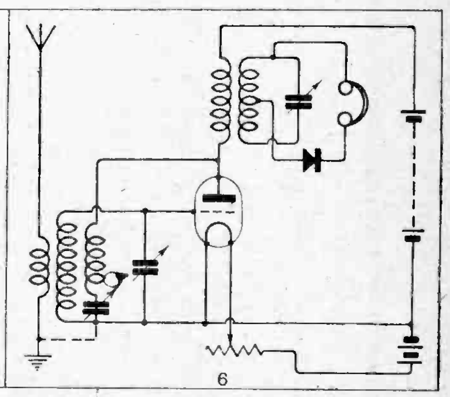
Varying currents in the primary induce voltages into the tuned secondary circuit. These voltages are rectified by the crystal, and the telephones are operated by fluctuating D.C. currents which are passed through their windings.



The arrangement shown in the previous sketch will probably suffer from flat tuning and general inefficiency; here damping is reduced by connecting the crystal and telephones across only a part of the secondary coil.



Here reaction is introduced on the "Weagant" principle, by passing a proportion (amount controlled by the reaction condenser) of the anode H.F. currents through the reaction coil, which is inductively coupled to the grid coil.



Selectivity is improved by the addition of a coupled aerial circuit. The arrangement shown above will very probably need some form of artificial stabilising, due to reduction of the aerial load. This may be done by reversing the connections of the reaction coil.

INTRODUCTION TO WIRELESS THEORY

Capacity and Inductance in Alternating Current Circuits.

By N. V. KIPPING and A. D. BLUMLEIN.

In this the concluding article of the series the authors explain the principles underlying the tuning of wireless receivers. Previous articles appearing in the issues of October 21st, 28th, November 4th, 11th, 18th, and December 2nd, have dealt with all the more elementary aspects of electrical theory, and form an excellent introduction to the technical articles appearing from time to time in the pages of this journal.

THE effect of a condenser in an A.C. circuit is in many respects the exact opposite of the effect of an inductance. With an inductance the reactance offered to the current is less with small frequencies than with high frequencies. A condenser offers a higher impedance at low frequencies than at high frequencies.

It is easy to remember the way this rule goes, for we know that D.C. passes easily through inductance, but not through capacity. The further away we get from D.C. (that is, the higher the frequency of our A.C.), the further we get from the easy passage of current through inductance and its difficult passage through capacity. The idea of thinking of capacity as an elastic diaphragm in the circuit has already been suggested, and from this idea it was easy to see that if a steady pressure were suddenly applied to it the diaphragm would stretch more easily for the first part of its total movement than for the latter part. To put this into electrical terms is to say that current will flow into a condenser more easily for the first part of its charge than for the latter part. In fact, the time comes when it is so difficult to overcome the back pressure exerted as a result of the elasticity of the condenser that for a given voltage pressure no more current will flow into the condenser. At this point the back pressure of the condenser is equal to the charging pressure of the voltage.

Alternating Current in Condensers.

Let us, then, analyse what happens when an alternating e.m.f. is applied to a condenser.

In Fig. 1 is drawn a picture of an alternating e.m.f. wave. At A the e.m.f. is supposed to have been switched on. Assuming that inductance is negligibly small in the circuit, current will commence to flow immediately, and

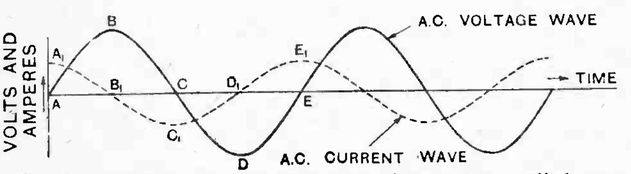


Fig. 1.—Relation between the alternating voltage applied to a condenser and the current produced.

its value will depend upon the *rate* at which the e.m.f. is increasing, because as the e.m.f. increases it "stretches" the condenser, so causing a current to flow. Now the rate of increase of e.m.f. is a maximum at A, so that the current is correspondingly a maximum at A_1. As B is approached the rate of increase of e.m.f., and consequently the value of the current, gradually decreases. At B the e.m.f. is steady and is exactly counteracted by the back pressure of the condenser, and as no stretching or contracting is taking place no current flows. As soon as B is passed the e.m.f. begins to decrease, and as the condenser restores itself to its normal state it forces current to flow in the opposite direction to the stretching current. This continues more and more rapidly until C, where the condenser starts stretching in the other direction, as a result of the reversal of the

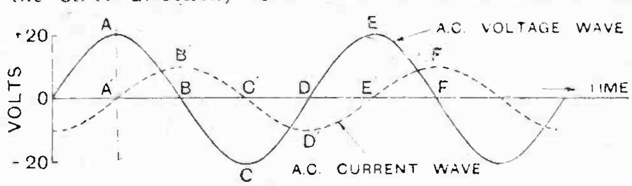


Fig. 2.—Alternating voltage and current in an inductive circuit In this case the current lags behind the voltage.

e.m.f. Over the points C, D, and E the process is repeated, only in the reverse direction.

This analysis shows that through a condenser the current flowing leads in front of the e.m.f. which is driving it. This is, of course, the exact reverse of the current through an inductance, which always lags behind the driving e.m.f.

Capacities, because of their elastic nature, impede the flow of currents, just as do resistance and inductance, and this "impedance" can be measured in ohms. It is already clear that this impedance becomes less as the frequency of the A.C. increases. In fact, the reactive ohms X, for a condenser, follow the expression :—

$$X = \frac{1}{2\pi f c}$$

where $\pi = 3.14$, etc.,

f = frequency in cycles per second.

c = capacity in *farads*.

Introduction to Wireless Theory.—

Reactive ohms, when representing the impeding effect of a capacity, are often referred to as negative reactive ohms, and a capacity is referred to as a negative reactance. Positive reactance relates to the effect of an inductance. To show why it is necessary to distinguish between these two kinds of reactance by giving them different names, it is necessary to remember that not only does each reactance cause a reduction in the current flowing, but each has a different effect on what is called the "phase" of the current and voltage. The word "phase" is used in connection with all kinds of waves, not merely alternating current and alternating voltage waves. When we say that two waves are in phase, we mean that they are absolutely in step, that each reaches its maximum positive value at the same time, and each its maximum negative value at the same time. The meaning of the word phase is "time," and this perhaps provides the best way of thinking of it. We usually speak of soldiers as marching in time. It would be equally accurate to say that they were marching in phase. If one man was marching exactly out of step, we might say that he was 180° out of phase, or that he and the remainder of the men were 180° apart in phase. If he was half out of step, or was marching half a pace late, we might say he was 90° out of phase.

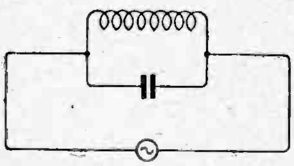


Fig. 3.—Alternating voltage applied to a condenser and inductance in parallel.

Resonance in Tuned Circuits.

From Figs. 1 and 2 we see that the current and voltage waves shown are not in phase. In fact, in each case they are 90° apart in phase, but in Fig. 2 the current wave is ahead of the voltage wave, while in Fig. 1 the reverse is the case. This will explain why we say that inductance causes current to lag, and capacity causes current to lead the voltage. Both inductance and capacity reduce the total current, but also alter its phase relative to the driving voltage wave. In the cases we have chosen for discussing the effects of inductance and capacity, we have assumed no appreciable resistance to be in circuit, and we have found the effects in each case to be a change in phase of the current waves of 90°. We have previously seen that resistance alone, in the absence of appreciable inductance or capacity, causes no change in phase. It is easy to see without discussing it separately, that a mixture of inductance and resistance or capacity and resistance will cause a change in phase less than 90°, the exact angle depending upon the relative proportion of reactance and resistance.

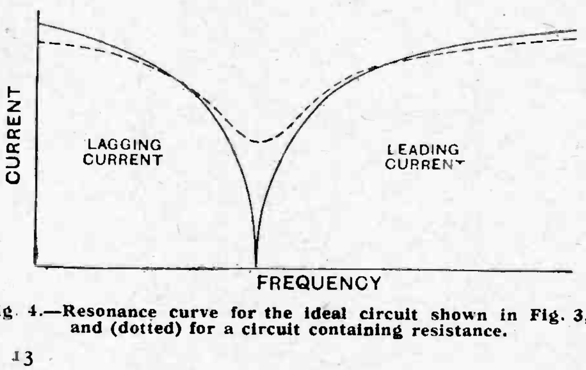


Fig. 4.—Resonance curve for the ideal circuit shown in Fig. 3, and (dotted) for a circuit containing resistance.

It is, in fact, easily possible so to choose capacity and resistance or inductance and resistance as to get any phase difference we may wish.

If a circuit has both inductance and capacity, as well as resistance, the lagging or leading effects of each add together, and the nett result may be either a lagging current or a leading current. A circuit whose nett effect is to cause a current to lag is said to have positive reaction. A circuit whose nett effect is to cause a current to lead is said to have negative reaction.

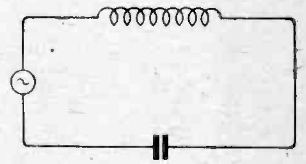


Fig. 5.—Series resonance or acceptor circuit.

The "impedance" of a circuit is its total reducing effect on current whether due to resistance, reactance, or a mixture of the two. It is measured in ohms, but takes no account of the phase.

This question of the combined effect of individual negative or positive reactances is of the greatest importance. It provides the underlying principle of tuning in a wireless set, and of what is called "resonance." The meaning of this word will become clear from a consideration of Fig. 3, in which an A.C. potential is connected across an inductance and a capacity in parallel.

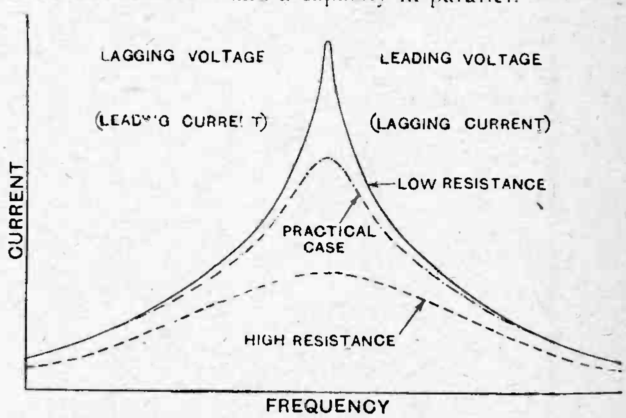


Fig. 6.—Resonance curves for the circuit in Fig. 5.

If the A.C. has a very low frequency, we know that it will be easier for it to pass through the inductance than through the capacity, because the former has a low impedance at low frequencies. An A.C. of high frequency, however, will pass more easily through the capacity, which has a low impedance at high frequencies. There must obviously be some frequency at which the current will pass with equal ease through both of them. This frequency is called the resonant frequency of the circuit.

Supposing that the A.C. source could be adjusted for frequency, and that the resonant frequency could be found for a particular circuit; we know that the current passing through the inductance and capacity would be of the same magnitude, but would lag and lead respectively. If we had no resistance in circuit (a condition impossible to attain in practice), the currents would each be 90° out of phase with the driving e.m.f., but in opposite directions. That is to say, the currents in the two arms would

Introduction to Wireless Theory.—

be 180° apart in phase—*i.e.*, completely out of step—and would completely neutralise each other, and no current would flow through the source of A.C. In other words, the impedance of the inductance and capacity in parallel would be infinite at that frequency and act like an open circuit. Actually, in practice each has resistance, and the currents never absolutely neutralise each other, because they are never completely out of step. If the frequency of the A.C. generator in Fig. 3 were gradually increased, the current flowing through it would take the form shown in Fig. 4.

Resonance Curves.

The full-line curve represents the case of an ideal circuit having no resistance, while the dotted curve represents a case which might be met with in practice. The resonant frequency is the more sharply defined the less resistance there is in circuit.

Such a circuit as that in Fig. 3 may be used to hold back and stop the flow of a current of any frequency from a branch of the circuit, though permitting currents of other frequencies to pass. In a case like this, we are presented with a source of fixed frequency, and we must adjust the capacity or inductance so that resonance occurs at the frequency of the source which we wish to suppress. To do this we may use either a variable inductance or a variable condenser. Many devices of this nature are on the market, and are known as tuning devices—tuning inductances (or variometers) and tuning condensers.

Resonance circuits are of two kinds. That described, where the inductance and capacity are in parallel, is sometimes called a rejector circuit, as it prevents the passage of a certain frequency. The other type, in which the inductance and capacity are in series, is known as an acceptor circuit, as it provides a far easier path for currents of its resonance frequency than for other frequencies. Such a circuit is shown in Fig. 5.

This being a series circuit, the current through the inductance and capacity is the same. The A.C. current through the inductance lags behind the A.C. voltage across the inductance, and the current through the capacity leads the voltage across the capacity.

As the current through the inductance and capacity is the same, it is easier to think of the voltage phases relative to this fixed current. (In the parallel case, Fig. 6, the voltage was the same across each.) This may be then stated that the voltage across the inductance leads the current (since the current lags), and the voltage across the capacity lags behind the current (since the current leads). These voltages, when added up, tend to neutralise each other. At resonance this neutralisation is more or less complete, according to the resistances in the circuit. At resonance, then, only a small voltage is required to drive the current through this circuit, whose impedance drops to a minimum at the resonance frequency.

Selectivity.

The acceptor circuit (or series resonant circuit) has exactly the reverse effects to the rejector circuit (or parallel resonance circuit).

The series circuit may be made from the same types of apparatus as are used for the parallel circuit.

The acceptor circuit can be used to select an A.C. of one definite frequency, which we may want to separate from others of different frequencies, because it may be tuned to pass the required frequency far more easily than the unwanted frequencies.

If the tuning circuit is not very sharply selective, such as the high resistance curve in Fig. 6, it will permit a considerable amount of current of unwanted frequencies from other stations to get into the receiving circuit, causing interference. If commercial receiving sets had very sharp tuning circuits (low resistance), there would be little risk of jamming, due to stations of not very different frequency both getting into the receiving set, but as this is difficult to achieve without great cost, it is necessary for stations in the same neighbourhood to use widely different frequency.

TRADE NOTES.

New R.I. Showroom.

Of interest to Scottish readers is the announcement that Messrs. R.I., Ltd., have appointed as their representative in Scotland Mr. Michael Black, of 11, West Nile Street, Glasgow. A special showroom, exclusively devoted to "R.I." products, has been opened on the first floor of these premises.

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Supersonic Components.

For the Christmas Season Messrs. L. McMichael, Ltd., are issuing an attractive box containing their Supersonic components. The contents are comprised of the autodyne unit with reactor, the tuned filter, and the three tuned intermediate transformers. Each box will contain a comprehensive blue print layout diagram and a new book of instructions.

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A Daring Burglary.

Messrs. The Formo Company were the victims of a particularly daring burglary which took place on a recent Saturday evening at their works in Cricklewood Lane, N.W.2. The offices were ransacked, but fortunately the large office safe defied attempts to open it. A number of wireless transformers were taken.

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A Fire and a Wager.

A remarkable building feat was referred to by Mr. C. W. Hayward, joint managing director of the A.J.S. Radio Branch at a dinner held at the Victoria Hotel, Wolverhampton. On July 10th of this year, the A.J.S. Radio Branch suffered a disastrous fire, the area destroyed amounting to 25,000 super feet. The reconstructional work was placed in the hands of Messrs. Speake and Sons, who undertook to complete the work within six weeks. This task formed the subject of a wager between Messrs. Speake and Hayward. Within six weeks the re-erection was complete, new machinery was installed, and production was in hand. The dinner was the outcome of the wager!

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A Battery Guide.

The perplexing problem of choosing a suitable accumulator has been simplified in an ingenious manner by the Exide Guide to Wireless Batteries. By means of a cardboard disc rotated behind a card provided with "windows," it is possible to see at a glance the suitable Exide battery for varying conditions, such as the current in amperes required, and the number of burning hours. The price of each battery is also shown.

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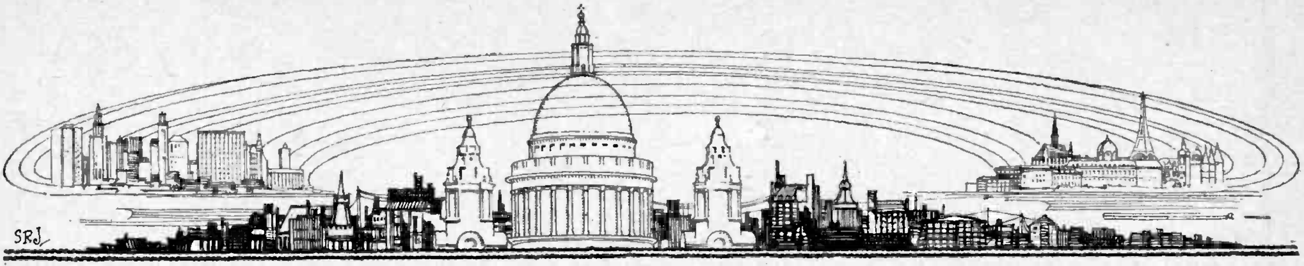
Mullard's at Newcastle.

A new depot for all Mullard stocks has been opened at 30, Handyside Arcade, Perry Street, Newcastle-on-Tyne.



CURRENT TOPICS

Events of the Week in Brief Review.

RUSSIAN TELEVISION CLAIM.

Dr. Popoff, the eminent Russian research worker, has invented a device which he claims will transmit photographs of moving objects by wireless. The process is completed in a few seconds.

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CAUTIOUS NEW ZEALAND.

Before erecting a powerful wireless station for overseas communication, the New Zealand Government has decided to wait a year in view of the important technical discoveries taking place.

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SPEECH AMPLIFIERS IN LONDON COUNTY HALL

The Council Chamber of the County Hall, Westminster, notorious for its poor acoustic properties, has been fitted with the Marconiphone speech amplification equipment.

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AMPLIFIERS IN THE COMMONS ?

Replying last week to a question in the House, Mr. G. Locker - Lampson (Under-Secretary of the Home Office) stated that he was not aware of any general desire for sound-amplifying apparatus in the House of Commons, the acoustics of which were much better than those of the House of Lords.

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INDIAN BROADCASTING AND LANGUAGE DIFFICULTY.

Before his recent departure for India, Major J. E. Monins, a director of Burndept Wireless, Ltd., suggested that India and Ceylon will be equipped with ten stations within the next five years.

"The language difficulty," he remarked, "appears to provide a great obstacle to a wide broadcasting scheme in India, but broadcasting knows no lingual barrier. Each item broadcast may have to be translated into thirty-two different languages."

LANGUAGE TALKS BY WIRELESS.

The increasing recognition of the value of broadcasting as a medium for teaching languages is clearly shown in some interesting statistics compiled by a *Times* correspondent. The list, which is appended below, refers to language talks from Continental stations during an average week.

English ..	9	lessons from	4	stations in	4	countries.
Esperanto	12	,,	10	,,	5	,,
French ..	4	,,	3	,,	3	,,
Spanish ..	2	,,	2	,,	1	,,

S.B. IN AUSTRALIA. Mr. J. R. Collins, Secretary to the Australian Treasury, recently broadcast a Conversion Loan appeal through several stations simultaneously. The photograph shows the engineers operating the "S.B." apparatus during the speech.

SITUATION SAVED BY CARRIER CURRENT.

Following a cloudburst and flood which recently destroyed railway telegraph and telephone lines at Wenatchee, Washington, communication was maintained with the outside world by means of a carrier current telephone system utilising the electric power lines to Seattle.

NEW DE FOREST INVENTION.

The discovery of a new sound wave reproducer is announced by the famous American wireless worker, Dr. Lee de Forest. The device is understood to consist of a curved membrane which reproduces undistorted sound by the application of an electro-magnetic telephone unit to its edges.

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OUT OF PRINT.

We regret that many readers who have recently applied for a copy of *The Wireless World* for July 1st last, containing the article on the Roberts reflex two-valve neutrodyne receiver, have been disappointed. This issue is now out of print.

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PROBLEMS FOR PETIT PARISIEN.

Interference problems are still perplexing the engineers of the *Petit Parisien* broadcasting station, who have recently been experimenting with small changes of wavelength between 344 and 347 metres. According to *La T.S.F. Moderne*, the 347-metre wavelength is the most successful, though reception is still far from perfect.

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BROADCAST PLANS IN PERSIA.

An ambitious scheme in regard to broadcasting is being pursued in Persia, following upon the raising of the ban which hitherto vetoed all suggestions for establishing a broadcasting service. A $1\frac{1}{2}$ kilowatt station has already been constructed at Teheran, and plans are proceeding for the installation of six relay stations in different provinces.

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PUBLIC RECEPTION IN BOMBAY.

Great success is rewarding the enterprise of the Bombay Municipality in setting up loud speakers in the Malabar Hill and Victoria Gardens (writes a correspondent). Three times a week the Gardens are thronged by thousands who come to enjoy programmes broadcast by the local station for their special benefit.

RELAY BROADCAST EXPERIMENTS.

According to engineers of the General Electric Company, New York, comparatively high wavelengths are more suitable for broadcast relay purposes than those in the ordinary broadcast band. Station WCAD, St. Lawrence University, Canton, N.Y., has picked up and re-broadcast the 1,560-metre transmissions of WGY with marked success. For several months past WGY's programmes have been transmitted on four different wavelengths, viz., 41.88, 379.5, 109, and 1,560 metres, but experiments have shown that the highest wavelength is always the easiest to relay.

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"BEAM" COMMUNICATION WITH CANADA.

With the opening of the new "beam" station at Montreal at the end of the year, practically instantaneous wireless communication will be in operation between Canada and the British Isles at any of the 24 hours.

According to the contract with the British Government, the Canadian Marconi Company has to guarantee a service of 100 words of five letters each per minute. Tests which have already been made, it is stated, have given a much higher rate.

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WIRELESS CONTROL FROM THE AIR.

The idea of a wireless-controlled aeroplane has long exerted the imaginations of enthusiasts, but the notion of directing the movements of a ground vehicle by wireless impulses from an aeroplane is a novelty which has just been carried into effect in America.

A "radio-car," equipped with a wireless receiver capable of operating certain controls, was manœuvred to and fro in McCook Field, Dayton, Ohio, in response to signals from an aeroplane flying at a height of 2,000 ft. Attempts are shortly to be made to control the car from higher altitudes.

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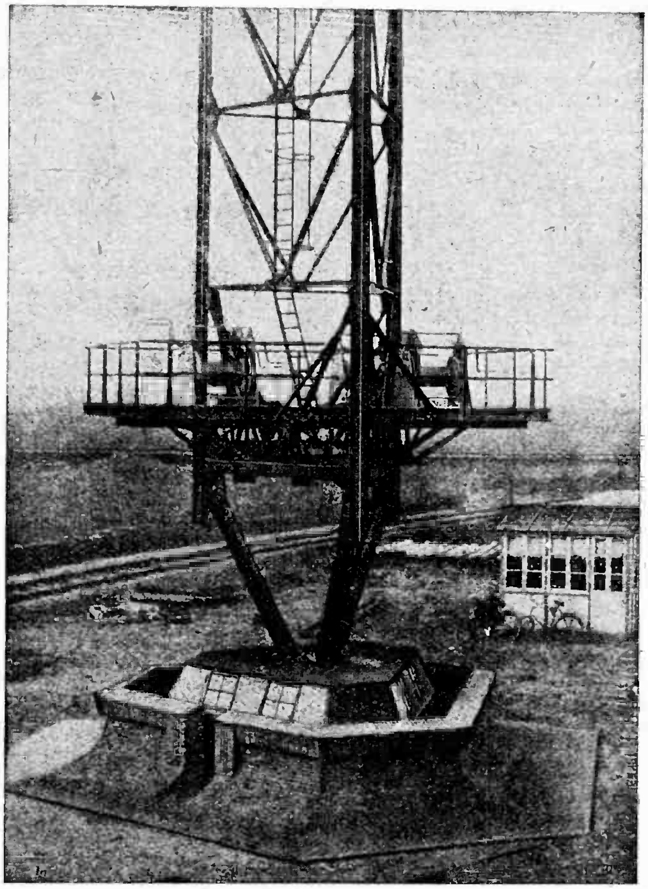
SCHOLARSHIPS IN ENGINEERING.

The Governors of Loughborough College, Leicester, invite applications for the award of five open scholarships in the Faculty of Engineering, each of the value of £75 per annum. The scholarships are open to British subjects situate in any part of the Empire, and are tenable for the period of the full diploma course. The closing date for applications is March 1st, 1926. Further particulars of the scheme are obtainable from the Registrar, Loughborough College, Leicester, England.

THE WIRELESS BAN ON THE RHINE.

Great disappointment is being felt among the inhabitants of the Rhine district that the removal of the present restrictions on wireless receivers was not discussed at the Locarno Conference.

The granting of some mitigation of existing regulations (says a *Times* correspondent) would be a graceful and appropriate concession which should not now be difficult to make. There would appear to be very little justification for a policy of wireless isolation in this area, when the air is throbbing with wireless messages in all directions.



A HIGH POWER DUTCH STATION. A new photograph of the base of one of the massive German masts, 210 feet high, at the Koolwijk station, which maintains touch with Java.

RECORDS AND DISCORDS.

Peace reigns once more at Osaka, Japan, after a particularly bitter conflict between the broadcasting and gramophone interests. A gramophone company at Osaka recently startled their customers by offering at surprisingly low prices a number of records of Japanese music by well-known musicians and bands. The gramophone "boom" thus created alarmed the Osaka broadcasting authorities, who, on inquiry, discovered that the records had been made from actual broadcast performances. A stern legal controversy ensued, which was only ended when the contending parties arrived at a compromise to the effect that no further wireless records would be made without consent from the Osaka Station.

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NORTH ATLANTIC DIRECTIONAL STATION.

A new directional wireless station, working continuously throughout the twenty-four hours, has been installed at Belle Isle at the northern entrance to the Gulf of St. Lawrence. The new station uses a wavelength of 800 metres with the call sign VCM. It should prove of special value to vessels on the Northern Transatlantic route.

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U.S. WIRELESS EXPANSION.

American radio manufacturers estimate that in 1925 they will have sold 3,000,000 wireless sets and 20,000,000 valves, in addition to accessories and components to the value of £30,000,000. The receipts for the year throughout the industry are expected to exceed £100,000,000, constituting an advance of £40,000,000 on last year's figures.

oooo

BROADCASTING IN BOLIVIA.

The President of the Bolivian Republic has promulgated a decree permitting the erection of broadcasting stations and setting forth a code of regulations. The broadcasting system will be under the control of the Director General of Telegraphs, and a nominal tax will be levied on all receivers to cover the cost of administration.

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THE BROADCAST ENQUIRY.

Mr. J. C. W. Reith, managing director of the B.B.C., was the only witness called at the first open meeting of Lord Crawford's Committee on Broadcasting, which met at House of Lords on Thursday last.

Before being questioned by members of the Committee, Mr. Reith read extracts from a lengthy and exhaustive memorandum setting forth the present position and outlook of the British Broadcasting Company. Among the points raised were the Company's friendly relationship with the Press, and the need for better news facilities, the rapid development in broadcast education, and the problem of the most desirable form of control. It was emphasised that even under unified control the B.B.C. had evolved a system of considerable elasticity, encouraging rivalry among local stations and the initiative of the individual. A problem which now engaged attention was the provision of adequate alternative programmes. The solution would involve the erection of regional transmitting stations, replacing to some extent the present system of purely local stations.

Dealing with the finance, the memorandum stated that up to September, 1925, working on a cash basis, there was shown a surplus of income over expenditure of £55,481. Taking into account sums appropriated for income tax and staff provident fund, this was reduced to approximately £10,000. After exploring the fields of possible future expenditure the memorandum went on to state with regard to future capital that it could not be provided out of revenue any longer.

Examined in turn by all the members of the Committee, Mr. Reith stated, in reply to Sir Thomas Royden, that, with a free hand, it would be possible to give the listener a better news service. In further replies it was stated that the trend was in the direction of more high-power stations and the elimination of small stations. The Company desired more freedom within their own wave band to fix their own wavelength, whereas the Postmaster-General, at present, retained the power to refuse to sanction wavelength changes.

In conclusion, Mr. Reith said that in the event of the B.B.C. becoming a Government agency they believed there must be a considerable element of Government control, but there must be responsibility, discretion and impartiality in the hands of the executive official.

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WIRELESS SAFEGUARD ON AMERICAN TRAINS.

A wireless device designed to check the speed of locomotives automatically when approaching danger was tested recently over a 10-mile stretch of the Pere Marquette Railway (says *The Engineer*). The inventor is Mr. Thomas E. Clark, of Detroit, who explains that the device depends for its operation on the propagation of electromagnetic waves in the track rails with varying wavelengths, which actuate a visual signal in the engine cab. Should a train be occupying a block, the rest of the rail surface within that block becomes automatically demagnetised, and another train entering the block from the rear or front will receive the danger signal and an automatic application of the brakes.

The preliminary tests are reported to have been successful, and it is stated that the Michigan Central Railroad has equipped 10 locomotives with the Clark device.

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THE WIRELESS OPERATORS' STRIKE.

At the time of going to press no solution seems forthcoming to end the strike of sea-going wireless operators which was declared at very short notice on November 26th. A week later, it was stated, 600 operators had refused to sign articles at the reduced rates of pay, under which wages are lowered to the extent of 22s. 6d. per month. The Board of Trade has permitted a number of vessels to sail without operators.

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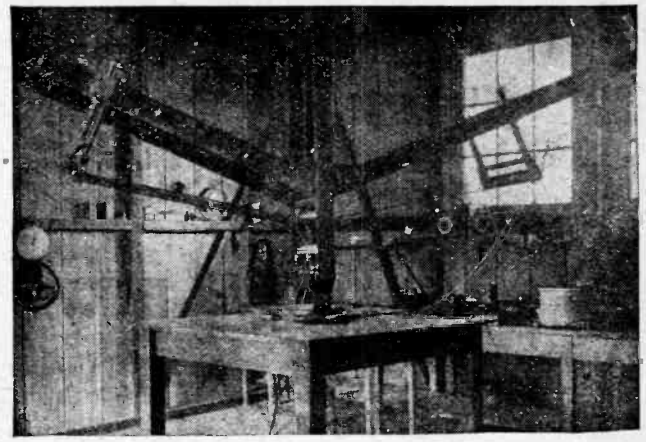
GERMAN AMATEUR DEVELOPMENTS

Work is proceeding fast in organising the German branch of the International Amateur Radio Union on the same lines as the American Radio Relay League. A set of rules has been formulated governing the activities of transmitters, who have organised an exchange of technical ideas by means of a new periodical entitled "Q.S.L." This publication is prepared on the same model as "QST," the famous organ of the A.R.R.L.



WIRELESS IN THE ARGENTINE. An interesting frame aerial used for reception purposes at the high-power station at Monte Grande

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NEUTRODYNE EXPERIMENTS IN INDIA.

Experimenters in India are keeping fully abreast of Western developments, if we may judge from recent reports. A series of tests has been carried out in Bombay, writes a correspondent, with a six-valve Thompson neutrodyne receiver, excellent loud-speaker results being obtained on low power transmissions at a distance. In one case, during the afternoon, signals were heard on the loud-speaker from a distance of 280 feet, the transmission emanating from a 100-watt station ten miles away.

THE WIRELESS ANNUAL FOR 1926.

THE very comprehensiveness of *The Wireless Annual for* 1926,[1] catering as it does for every class of wireless amateur and experimenter, renders the task of singling out its most important features somewhat difficult. The broadcast listener, the amateur constructor and experimenter, the advanced student, and the transmitting enthusiast will all find abundant interest in these closely packed pages.

Special mention must be made of the Directory of Experimental Transmitting Stations in all parts of the world. There can be little doubt that this list is the largest yet published, and its up-to-date information should prove of the greatest value not only to transmitters, but to everyone who takes a delight in searching the ether. In addition to European stations, the directory includes lists from South Africa, India, Australia, Argentine, and other far-flung corners of the world.

Interesting articles on the work of the International Broadcasting Bureau (contributed by A. R. Burrows), broadcasting regulations throughout the world, and the general trend of development in 1925 will appeal to all readers, while everyone who seeks to obtain working knowledge of modern wireless reception will profit by the article on "Valves, Their Uses and Characteristics." As an appendix to this article is a valuable table of valve data relating to all the well-known makes. A number of useful pages are devoted to circuits for broadcast reception and amateur transmission, and a further valuable section deals with finding and rectifying faults in receiving sets. Other features include a list of regular transmissions throughout the world during the twenty-four hours, useful tables and data, calibration signals, a chart of regular broadcast transmissions, and a glossary of technical terms. Finally, no survey of the book would be complete without a reference to the Classified Directory of Manufacturers, which should prove of inestimable value to the amateur who wishes to make a careful choice of makes before purchasing his apparatus.

The Wireless Annual for 1926 can be regarded as an indispensable addition to the wireless enthusiast's workshelf.

[1] "The Wireless Annual for Amateurs and Experimenters, 1926." (London: Iliffe & Sons Limited, Dorset House, Tudor Street, E.C.4. Price 2s. 6d., post free 2s. 8½d.)

EUROPEAN BROADCASTING STATIONS.

Wavelengths, Power and Location.

With this issue of "The Wireless World" we are presenting a Map of the Broadcasting Stations of Europe, in which the normal transmitting power is indicated in accordance with the key printed below.

The following list of stations has been carefully compiled and the wavelengths corrected to date; but, as our readers are aware, the adjustment of wavelengths is not yet completed, and almost daily alterations are made in an endeavour to obviate interference.

The difficulty of this problem is even greater than would appear from a casual inspection of the Map, as only the towns are shown and not the individual stations. Thus Paris has four separate broadcasting stations, and many towns in Spain have two or three each.

KEY TO POWER OF STATIONS SHOWN ON THE MAP.

○ BELOW 1 kW. ● 1 kW. TO 5 kW. ◎ 5 kW. TO 20 kW. ◉ ABOVE 20 kW.

GREAT BRITAIN AND IRELAND.

Daventry	5XX	1,600 metres	25.0 kW.
Aberdeen	2BD	495 „	1.5 „
Belfast	2BE	440 „	1.5 „
Birmingham	5IT	479 „	1.5 „
Bournemouth	6BM	386 „	1.5 „
Cardiff	5WA	353 „	1.5 „
Glasgow	5SC	422 „	1.5 „
London	2LO	365 „	3.0 „
Manchester	2ZY	378 „	1.5 „
Newcastle	5NO	404 „	1.5 „
Dublin	2RN	390 „	1.5 „

Relay Stations.

Bradford	2LS	321.5 metres.	—
Dundee	2DE	331 „	0.2 kW.
Edinburgh	2EH	324.5 „	0.2 „
Hull	6KH	335 „	0.2 „
Leeds	2LS	321.5 „	0.2 „
Liverpool	6LV	315 „	0.2 „
Nottingham	5NG	323 „	0.2 „
Plymouth	5PY	338 „	0.2 „
Sheffield	5FL	301 „	0.2 „
Stoke-on-Trent	6ST	306 „	0.2 „
Swansea	5SW	482 „	0.2 „

FRANCE.

Paris, Eiffel Tower	FL	2,650 and 2,200 metres.	5.0 kW.
Paris Radio Paris	CFR	1,750 metres.	1.5 „
Paris, Ecole Superieure	FPTT	458 „	0.45 „
Paris, Petit Parisien	—	347 „	0.45 „
Lyons (Radio Lyon)	—	280 „	2.0 „
Toulouse (Radio du Midi)	—	274 „	2.0 „
Toulouse (P.T.T.)	—	315 „	2.0 „
Lyons (La Doua)	—	480 „	0.5 „
Mont de Marsan	—	365 „ (*testing*).	0.3 „
Marseilles (P.T.T.)	—	350 „	—
Pic du Midi	—	350 „ (*testing*).	—
Caen	—	332 „	—
Agen	—	318 „	0.25 kW.
Toulouse (Radio Toulouse)	—	431 and 441 metres.	2.0 „
Grenoble (P.T.T.)	—	875 metres.	—

BELGIUM.

Brussels (Radio Belgique)	SBR	262 metres.	25.0 kW.
Brussels (Haeren)	BAV	1,100 „ (*Weather only*).	0.25 „
Liége (Radio Wallonie)	—	285 „ (*testing*).	—
Liége (Radio Central)	—	205 „	—
Liége (Seraign Radio)	—	195 „	—

HOLLAND.

Hilversum	HDO	1,050 metres.	1.5 kW.
Amsterdam (Vaz Dias)	PCFF	2,125 „	2.0 „
Amsterdam (Smith & Hooghouldt)	PA5	1,050 „	0.5 „
Amsterdam	PX9	1,070 „	0.4 „
Bloemendaal	—	315 „	0.4 „
Ymuiden	PCMM	1,050 „	1.5 „
The Hague	PCGG	1,070 & 25 metres.	1.0 „
The Hague	PCUU	42 metres.	—

GERMANY.

Berlin (Konigswusterhausen)	AFT	1,300 metres.	10.0 kW.
Berlin (Voxhaus)	B (*In Morse*)	576 „	10.0 „
Berlin (Witzleben)	B (*In Morse*)	505 „	4.5 „
Breslau	—	418 „	10.0 „
Frankfurt-on-Main (Sudwestdeutsche Rundfunk)	—	470 „	1.5 „
Hamburg (Novag)	HA	395 „	1.5 „
Hamburg	(*In Morse*)	317.5 „ (*testing*)	—
Konigsberg (Ostmarke Rundfunk)	—	463 „	1.5 „
Leipzig	—	454 „	1.5 „
Munich (Deutsche Stande in Bayern)	—	485 „	1.5 „
Münster (Westdeutsche Funkstunde)	MS (*In Morse*)	410 „	1.5 „
Stuttgart (Suddeutsche Rundfunk)	—	443 „	1.5 „
Elberfeld	—	259 „	1.5 „
Nauen	—	26—100 „	—
Dortmund	—	283 „	1.5 „

GERMANY.—(*continued.*)

Relay Stations.

Bremen (Relays from Hamburg) ...		270 metres	1.5 kW.
Cassel (Relays from Frankfort)		274 „	1.5 „
Dresden (Relays from Leipzig)		224 „	1.5 „
Gleiwitz (Relays from Breslau)		251 „	1.5 „
Hanover (Relays from Hamburg) ..		296 „	1.5 „
Nuremburg (Relays from Munich) .		340 „	1.5 „

Under Construction.

Stettin (Relay).
Kiel (Relay) *testing.*
Berlin (20 kW.).
New station between Cologne and Dusseldorf (20 kW.).
Herzogstrand (Bavaria), 100 kW.

AUSTRIA.

Graz (Oest Radio-Verkehre)	—	404 metres	0.5 kW.
Vienna (Radio Wien)	—	530 „	1.5 „
Vienna (Radio Wien)	—	400 „ (*testing*).	—

Under Construction.

Innsbrück (Relay)....	—	—	0.5 kW.
Salzburg (Relay)	—	—	—
Klagenfurt (Relay) ..	—	—	—

HUNGARY.

Buda Pesth	—	588 metres	2.0 kW.

DENMARK.

Lyngby	OXE	2,400 metres	1.5 kW.
Ryvang	—	1,150 „	1.0 „
Copenhagen	—	337 & 308 metres	0.7 „

Relay Stations.

Copenhagen (Odense)	—	950 metres	0.2 kW.
Hjorring	—	1,250 „	0.5 „

NORWAY.

Oslo	—	382 metres	1.0 kW.
Aalesund	—	515 „ (*testing*).	—

SWEDEN.

Stockholm	SASA	427 metres	1.0 kW.
Falun (Radio Club)...	—	370 „	0.25 „
Karlstadt	SMXC	355 „	0.25 „
Linkoping	—	467 „	0.25 „
Trolhatten	SMXQ	345 „	0.25 „
Gefle	—	325 „	0.25 „
Norrkoping..........	SMVV	260 „	0.25 „
Eskilstuna	—	243 „	0.25 „

Relay Stations.

Boden	SASE	1,350 metres	1.5 kW.
Goteberg	SASB	290 „	1.0 „
Jönköping	SMZD	265 „	0.25 „
Karlsborg	—	1,250 „	25.0 „
Malmö	SASC	270 „	1.0 „
Sundsvaal	SASD	545 „	1.0 „

FINLAND.

Helsingfors (Helsinki).	—	380 metres	1.0 kW.

POLAND.

Under Construction.

Warsaw.............	—	—	15.0 kW.
Cracow	—	—	2.0 „

RUSSIA.

Leningrad	—	940 metres	2.0 kW.
Moscow	RDW	1,450 „	12.0 „
Moscow (Soloniki) ...	—	1,010 „	2.0 „
Tuapse	RAW	1,800 „	4.0 „

LATVIA.

Under Construction.

Riga	—	488 metres (*testing*)	2.0 kW.

ESTHONIA.

Reval	—	425 metres	—

ICELAND.

Reykjavik (*Projected Station*)	—	—	1.0 kW.

SWITZERLAND.

Zurich (Genossenschaft)	—	515 metres	0.5 kW.
Lausanne (Soc. Romande de Radiophone)	HB2	850 „	0.6 „
Geneva (Radio Geneva)	—	1,000 „	—
Geneva (Champ de l'Air)	—	1,100 „	1.5 kW.
Geneva	—	432 „	—
Berne	—	302 „	6.0 „
Müchenbuchsee	—	250—300 metres.	—

CZECHO-SLOVAKIA.

Brunn (Komarov) ...	OKB	1,800 metres	1.0 kW.
Prague (Strasnice)....	—	546 „	0.5 „
Prague (Kbely)	—	1,150 „	—

ITALY.

Rome (Unione Radiofonica Italiana)	IRO	425 metres	3.0 kW.
Milan	IFL	495 „	1.5 „

YUGO-SLAVIA.

Belgrade	—	1,650 metres	2.0 kW.

SPAIN.

Barcelona (Radio Catalana)	EAJ 13	460 metres	1.0 kW.
Barcelona (Radio Barcelona)	EAJ 1	325 „	1.0 „
Barcelona	EAJ 18	300 „	1.0 „
Bilbao (Radio Club de Vizcaya)	EAJ 9	415 „	1.0 „
Bilbao (Otero)	EAJ 11	383 „	2.0 „
Madrid (Radio Iberica)	EAJ 6	392 „	3.0 „
Madrid (Unione Radio)	EAJ 7	408 „	6.0 „
Madrid (Lamparas Castilla)	EAJ 4	305 „	1.5 „
Madrid (Radio Espana)	EAJ 2	310 „	3.0 „
Madrid (Radio Espanola)	EAJ 15	490 „	1.0 „
San Sebastian	EAJ 8	346 „	3.0 „
Seville (Radio Club Sevillano)	EAJ 5	350 „	1.5 kW.
Seville	EAJ 17	300 „	1.0 „
Seville	EAJ 21	300 „	1.0 „
Cadiz (Radio Cadiz) ..	EAJ 3	360 „	1.0 „
Cadiz (Lehera)	EAJ 10	330 „	1.0 „
Cartagena	EAJ 16	335 „	1.0 „
Valencia	EAJ 24	360 „	1.0 „
Valencia............	EAJ 14	400 „	1.0 „
Malaga	EAJ 25	325 „	1.0 „
Saragossa	EAJ 23	325 „	1.0 „
Oviedo (Cima)	EAJ 19	400 „	1.0 „
Salamanca	EAJ 22	290 „	1.0 „

Under Construction.

Asturias	EAJ 12	345 metres	1.0 kW.

NEWS from the CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Inland Revenue Radio Society.

A lantern lecture dealing with the manufacture of condensers was delivered before an appreciative audience on November 20th by Mr. Haywood, of the Dubilier Condenser Co. (1925), Ltd. The lecturer dealt very comprehensively with his subject, first taking his hearers to the mica mines in India, and then carefully explaining the various stages of manufacture which ultimately produce the finished product. Methods of testing were also illustrated, and photographs were shown of a wide range of instruments from the small receiving type to that used in the new high power station at Rugby.

Hon. Secretary: Mr. W. J. Tarring (G5TG), Room C2, York House, Kingsway, W.C.2.

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Muswell Hill and District Radio Society.

On November 25th a popular subject was dealt with by Mr. J. C. Bird (G2JB), who lectured on "The Problem of H.T. Supply for Radio Uses." A large amount of apparatus served to illustrate the lecture, including an M.L. anode converter, H.T. accumulators, and a hand generator manufactured by Evershed and Vignoles. Many interesting comparisons were drawn between the different methods of H.T. supply, and much valuable information was obtained by the members.

Full particulars of membership can be obtained from the Hon. Secretary: Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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Golders Green and Hendon Radio Society.

Mr. Maurice Child, delivering his fourth lecture on "The Fundamental Principles of Radio Reception" on November 18th, dealt with the properties of self and mutual inductance, and gave a very clear explanation of the propagation of wireless waves and their detection by means of a crystal receiver. The latter part of the evening was devoted to a very interesting lecture on superheterodyne and neutrodyne receivers by Lieut. Walker, an engineer of the B.B.C.

Hon. Secretary: Mr. W. J. T. Crewe (G5CT), "The Dawn," 111, Prince's Park Avenue, N.11.

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Sheffield and District Wireless Society.

"Formulæ, and Where They Fail," was the title of a lecture which drew a large gathering of members on November 20th. The lecturer was Mr. J. Hollingworth, M.A., of the National Physical Laboratory.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 9th.
Radio Society of Great Britain.—Informal meeting. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Talk on "The Acoustics of the Headphone and Loud-speaker," by Mr. A. E. Bawtree, F.R.P.S.

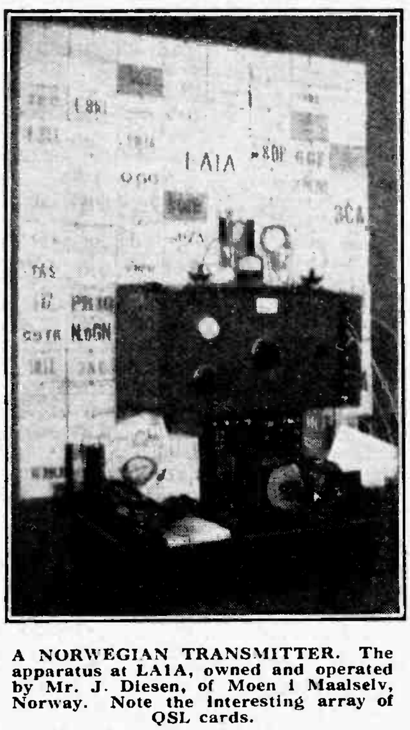
THURSDAY, DECEMBER 10th.
Walthamstow Amateur Radio Society.—Lecture with demonstration: "My Ideal Receiver," by Mr. Martin.

FRIDAY, DECEMBER 11th.
Radio Experimental Society of Manchester.—At 7.30 p.m. At the Athenæum, Princess St. Lecture: "Distortion and Tone Control in Receivers," by Mr. J. Cooper (of the B.B.C.).
Sheffield and District Wireless Society. At 7.30 p.m. At the Dept. of Applied Science, St. George's Square. Lecture: "Transformers for Radio and Audio Frequency," by Mr. W. Burnet.

MONDAY, DECEMBER 14th.
Hackney and District Radio Society.—At 8 p.m. Short Wave Sets and Their Working.
Swansea Radio Society.—Competition Night: Single Valve Sets

TUESDAY, DECEMBER 15th.
Lewisham and Bellingham Radio Society.—"The Construction and Care of Accumulators."

Many formulæ in wireless work, stated the lecturer, contained at least one factor which could be varied to suit the experimental results obtained, and that it would be difficult to find more than half a dozen formulæ which could really be relied upon. The formula dealing with aerial radiation was instanced, where "h," the effective height, was always a doubtful quantity. Mr. Hollingworth later gave details of some interesting experimental work he is carrying out dealing with the measurement of signal strength as received from UFT and VA, and mentioned that at certain times the strength at York is only one-tenth of that at Aberdeen.



A NORWEGIAN TRANSMITTER. The apparatus at LA1A, owned and operated by Mr. J. Diesen, of Moen i Maalselv, Norway. Note the interesting array of QSL cards.

The lecture was followed by a lively discussion.

Hon. Secretary: Mr. T. A. W. Blower, Dept. of Applied Science, St. George's Square, Sheffield.

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Tottenham Wireless Society.

At the recent annual general meeting satisfaction was expressed at the excellent programme of lectures arranged for the present session.

On November 21st an instructive visit was paid to the Osram valve works at Hammersmith, over which the members were conducted by Mr. Davies. Interesting visits were paid to the departments concerned with the manufacture of ordinary receiving valves, power valves, and transmitting valves, and particular attention was paid to the arrangements whereby each valve receives an exhaustive test before despatch. A glance through the wire drawing department concluded a very interesting afternoon.

Many difficult problems in connection with accumulators were cleared up on November 25th, when a talk on this subject was given by Mr. F. J. A. Hall. The many makes of accumulator, their care and maintenance, were dealt with in an interesting manner, and much was learnt as to the best methods of keeping accumulators at their maximum capacity.

Hon. Secretary: Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

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Lewisham and Bellingham Radio Society.

Lively interest was taken in the society's exhibition of valve sets which was held at headquarters on November 24th. A representative collection of receivers was on view, and a demonstration of each was given by its constructor. As a result of a ballot among the members, the set constructed by Mr. Riches was adjudged the most efficient.

Hon. Secretary: Mr. C. E. Tynan, 62, Ringstead Road, Catford, S.E.6.

D.C. MAINS RECEIVER.

The Use of a Floating Battery for Smoothing the L.T. Supply.

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

WHILE it is now becoming increasingly general to supply the H.T. for a radio receiving set from the electric lighting supply mains when these are D.C., it is much rarer to find the whole set operated from the mains. There are great advantages in this from an operating point of view, particularly for the reception of broadcasting, since it permits of a very simple control well adapted for use by any member of the household, however unskilled in the art. Moreover, for the reception of the local station, or of Daventry, the tuning can be left fixed so that the set can be turned on and off by a simple switch, and there is no worrying about whether the accumulator will or will not last out the evening's programme. It may, therefore, be of interest to describe an installation which has given perfectly satisfactory service for a prolonged period.

There are two main difficulties in adapting a supply from the D.C. mains for lighting the valve filaments of any ordinary type of radio receiver owing to the large current required by the filaments. With low-current dull-emitter valves this method is more feasible, but these valves are more sensitive to ripple and other noises emanating from the mains than are bright valves taking a larger current. This difficulty may be overcome by connecting the valve filaments all in series, so that a common current flows through all of them.

L.T. Supply Circuit.

The arrangement of a "straight" three-valve set on these lines is shown in the diagram, this scheme operating very satisfactorily in practice. Many D.C. supply mains have a very bad ripple which makes the supply noisy when used for H.T., unless an efficient filter is used; but when it is used for L.T. as well, it is not easy to secure an effective filter, since the filament voltage is low and the current is large compared with the H.T. anode current.

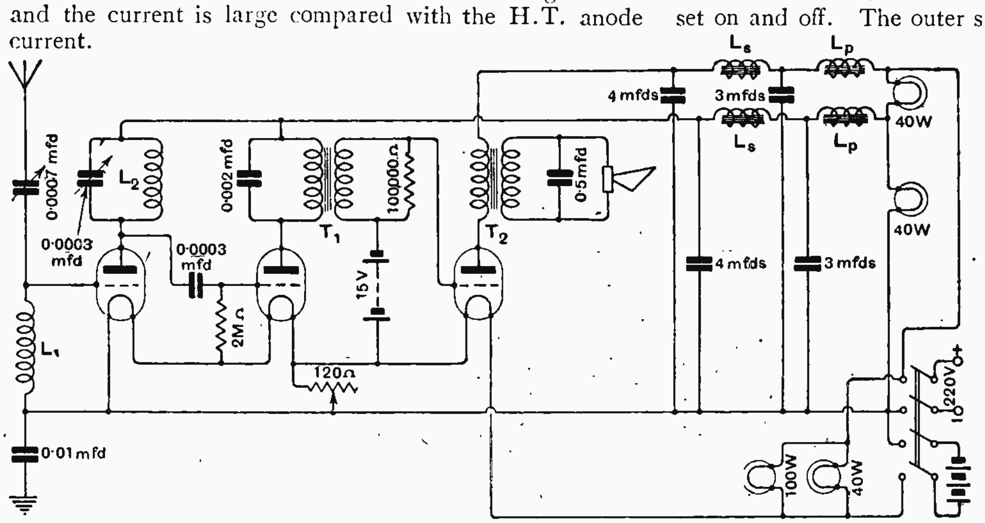
In the arrangement shown in the diagram a floating battery is used to smooth out the ripple from the L.T. circuit, its voltage being chosen as approximately equal to the normal operating voltage across the three valves in series. The actual current required to light the filaments is drawn from the supply mains through lamp resistances, so that the floating battery contributes nothing to the filament current, and so does not become exhausted. As regards any alternating component, or ripple, in the current, the battery acts as a very effective short circuit, and so keeps these noisy components away from the valve filaments. The use of this battery is found to bring about an enormous reduction in the "hum," and with the arrangement illustrated no objectionable hum is heard at all. When there is no transmission a very slight sound is audible from the loud-speaker, but under normal conditions it is quite unnoticeable. A slight increase in this sound is noticed if the set is used in the daytime, when the load on the supply mains is light, and the intensity of the ripple is greater.

Receiver Connections.

The first valve is a high-frequency amplifier, with a tuned anode coupling to the detector. Ediswan "A.R." valves are used for these two stages, and an Osram "L.S.5" for the power amplifier. These two types of valves operate satisfactorily with almost identical filament currents; but it has been found convenient to shunt the two "A.R." valves with about 120 ohms—this being an adjustable potentiometer resistance. This resistance by-passes a small fraction of the current from the "A.R." valves, and allows the full current to pass through the "L.S.5."

A four-pole coupled tumbler switch, shown in the bottom left-hand side of the diagram, is used to switch the set on and off. The outer switches are connected directly to the supply circuit—through, of course, the fuses of the usual distribution fuse-board; while the central switches are connected to six accumulator cells which are installed in another room in the house, away from the set.

The correct filament current for these valves is obtained by a 100-watt gas-filled lamp in parallel with a 40-watt vacuum lamp, both being 220-volt lamps. The current drawn from the mains is thus $\frac{140}{220} = 0.636$ amp. The same switches also close the circuit of two 40-watt lamps connected in



Circuit diagram of the receiver, showing connections of lamp resistances and smoothing condensers and chokes.

D.C. Mains Receiver.—
series across the supply, the mid-point of these lamps providing the H.T. potential for the H.F. and detector valves, while the full potential across the supply is used for the power valve. There is some drop in voltage in the choke coils of the filters used in these two H.T. circuits, so that the actual anode voltages on the valves are somewhat less than these figures.

Smoothing Chokes and Condensers.

Both H.T. supplies are passed through filter circuits consisting of double chokes L_p and L_s and double condensers. These are 3- and 4-mfd. capacity respectively. For the chokes ordinary intervalve transformer windings have been used satisfactorily, the primary windings being used for the chokes marked L_p and the secondaries for those marked L_s. The two windings on each transformer are connected in series, so that their magnetic fields assist each other. This result is achieved by joining OP to IS for the common connection between L_p and L_s.

In order to prevent any accidental earthing of the supply mains (one or other pole of which is usually earthed at the supply station) which would cause a short-circuit, a condenser of 0.01-mfd. capacity is joined in the earth lead. This condenser must be perfectly safe for operation continuously at the supply mains voltage, and a Dubilier Type 577 condenser is employed. The two tuning coils L_1 and L_2, one of which tunes the aerial circuit and the other the tuned anode circuit, are ordinary plug-in coils (No. 50), and they are inserted in a two-coil holder. As a matter of fact, the two coils are generally kept at right angles to one another so that the coupling between them is small, the intervalve capacities, etc., providing sufficient reaction effect. Stability of the H.F. valve is secured by keeping the capacity of the tuning condensers across the tuned-anode coil fairly large; and, if any tendency for this valve to oscillate is found, a smaller coil and larger condenser will usually cure the trouble.

Receiver Components.

The intervalve transformer T_1 is of the Burndept "low-ratio" type, and its secondary circuit is shunted by a 100,000 ohm anode resistance. This resistance value is by no means critical, and anything up to about one megohm can be used. This helps to improve the quality of reproduction, although it entails a slight loss of volume. Grid bias for the L.S.5 valve is provided by a 15-volt H.T. battery using fairly large dry cells (Siemens), and as the grid current is normally very minute, or absent, this battery lasts for a very long period.

An output transformer T_2 (Burndept) is employed with 120-ohm loud-speakers, since comparatively long wires are employed for the loud-speaker circuits which run into several rooms of the house. Normally three loud-speakers are employed, connected in parallel, but more can be operated from the set without difficulty.

When the set was first installed, a reaction coil was employed connected in the anode circuit of the detector valve, since at that time the signal strength from the old 2LO was poor (at Richmond, Surrey), and required a considerable amount of reaction—frequently almost up to the limit—to obtain sufficient volume for good loud-speaker reproduction, even with the H.F. valve, and at one time an additional L.F. stage also was needed. With the new 2LO the signal is much stronger (although still much less than at an equivalent distance in other directions), and reaction has been dispensed with; but the H.F. valve is still useful. Under normal conditions with this set the tuning is left untouched from day to day, and the set is merely turned on and off by the switch (unless wavelength changes are made at the transmitter), but occasionally it is used for Daventry as an alternative, the signal strength from that station being fully as good as from London.

The Floating Battery.

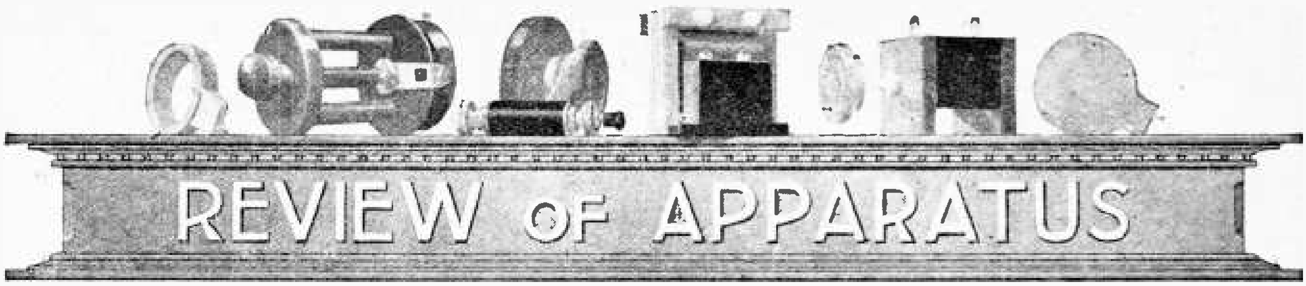
No specially good accumulator is required for the floating battery with this arrangement, since it has no actual work to perform. As a matter of fact, with the installation described, six old cells which had been discarded for useful work, owing to buckling of the plates, are employed, and quite satisfactory operation is obtained. The terminal voltage of these cells drops to quite a low figure soon after the set is switched off, owing to internal discharges taking place across the paste of the plates, but the voltage comes up again almost immediately the switch is closed. The full volume of reproduction is not obtained at once, since the battery diverts some of the mains current from the valves in order to charge it up, but quite normal operation is obtained within a few seconds as the battery voltage rises. The method, in fact, forms quite a good means of putting old accumulator cells to some useful purpose when their days of normal work are over.

RECEPTION DIFFICULTIES IN BRAZIL.

THE development of broadcasting in Brazil is suffering under a severe handicap due to the prevalence of atmospherics during the greater part of the year. In a recent interview, Mr. J. J Harrinan, Assistant Trade Commissioner of the U.S. Department of Commerce, remarked that, even during the cooler months from about May to August there is as much atmospheric disturbance in Rio de Janeiro as in the United States during the early autumn. Conditions are better in South Brazil, and it is probable that most progress will be made in this part of the country.

A broadcasting station is now under construction at Sao Paulo, consisting of American equipment with a power of one kilowatt.

Artificial disturbance is a powerful factor in the Rio de Janeiro district, where light and power lines abound and insulation is poor. The tramway systems are all served by overhead wires, and in the suburban districts, where heavy gradients are encountered, step-up transformers are necessary. These create considerable interference to radio reception. The frame aerial is being much resorted to in the hope of improving reception conditions.

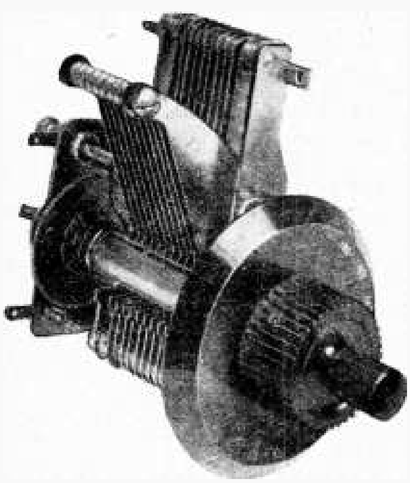


Latest Products of the Manufacturers.

BRITISH STRAIGHT LINE FREQUENCY CONDENSER.

The new variable condenser of the Service Radio Co., Ltd., 67, Church Street, Stoke Newington, London, N.16, is probably the first tuning condenser of British manufacture in which plates specially shaped to give straight line frequency tuning are employed. In other respects the condenser is a very attractive job. All metal parts are made of brass, finished bright, while the method of supporting the fixed plates is entirely original. A brass frame with thick end pieces gives rigid support to the fixed plates, and thus held rigidly together are attached to the main end pieces of the condenser through substantial ebonite pillars of liberal length.

The accompanying illustration does not show the detailed construction of this instrument, and to thoroughly appreciate its merits it should be viewed from the lower end, where pinions are fitted for giving a fine adjustment through a 100 to 1 reduction gearing. An auxiliary shaft and pinion is made use of to produce this high reduction gear ratio, whilst by means of a pair of well-designed friction washers, quick movement of the plates is given by the main condenser knob. A spiral bronze ribbon makes contact with the moving plates, whilst the terminal attached to the fixed plates is carried on a strip of metal which is actually in soldered contact with every plate.



The Service low-loss condenser, fitted with specially shaped plates to produce straight line frequency tuning and a reduction gearing of 100 to 1.

The condenser is heavily constructed, and is a highly attractive piece of work, and is supplied in four sizes, having capacities of 0.0002, 0.0003, 0.0005, and 0.001, with 3in. or 4in. dials, and a large operating knob if desired. The design incorporates one-hole fixing. In view of the large amount of detailed work, the prices of the various models are quite reasonable.

New R.I., H.F. anode reactance unit with a tuning range of 200 to 4,000 metres.

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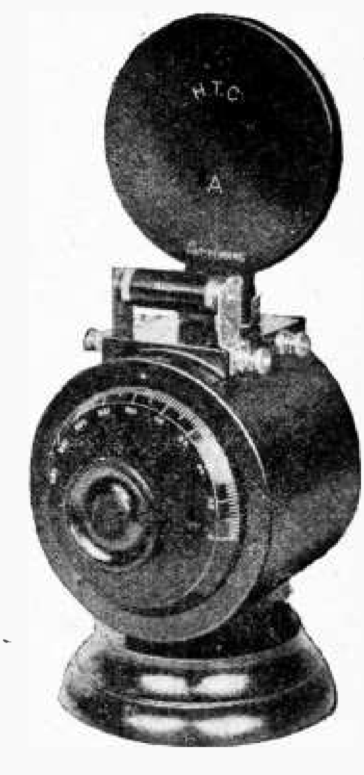
THE NEW R.I. RADIO-FREQUENCY INTERVALVE COUPLING UNIT.

The tuned anode method of intervalve coupling is undoubtedly the most popular, and is almost universally adopted in home constructed receiving sets. Interchangeable plug-in coils are frequently made use of, but the new R.I. unit, which covers a tuning range of 200 to 4,000 metres, in conjunction with a 0.00025 mfd. tuning condenser, is certainly more convenient both to fit and to operate over a wide tuning range, and moreover is less expensive.

The turns of wire comprising the tuning inductance are wound in slots on an ebonite former of small diameter, and by means of six studs five tapping points are obtained for the switch arm bridges, two of the studs thus short-circuiting and so screening that portion of the winding which is not in circuit.

The workmanship is of a high grade, and is typical of R.I. components. A sub-base, which is mounted behind the instrument panel, accommodates the studs over which the stud arm moves, while a substantial bracket carries a threaded aluminium bush to provide one-hole fixing, and a brass bush of liberal dimensions serves as a bearing for the spindle of the switch arm itself. A polished engraved scale is clamped down under the centre nut, and, appearing on the face of the panel, indicates the tuning range to which the switch arm is set. All metal parts are polished bright and lacquered, and the ebonite operating knob is cleanly cut and polished.

The use of this component is one of the simplest methods for adding a high-frequency amplifying stage to an existing receiver, as it provides easy operation and is extremely compact.

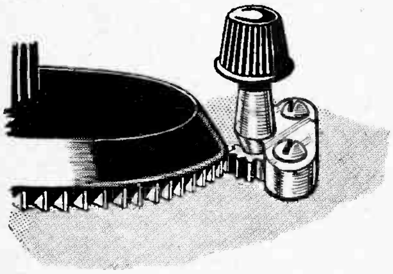


H.T.C crystal receiving set.

TORVIC VERNIER DIAL.

A very simple device for obtaining critical adjustment is now manufactured by Autogears (Leeds), Ltd., 55c, North Street, Leeds, and consists of a small pinion carried by a bearing piece which is attached to the instrument panel, and a toothed fibre wheel secured to the underside of the condenser dial.

Providing the condenser spindle projects sufficiently above the instrument panel, the geared dial may be easily fitted.

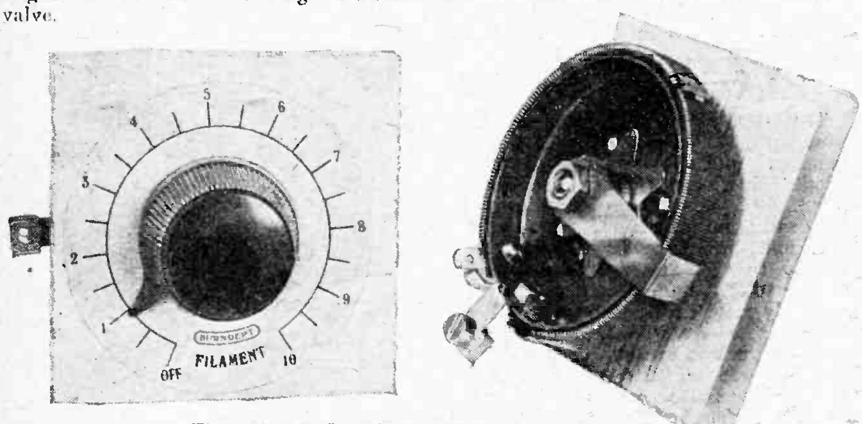


Torvic fine tuning control, consisting of a small brass pinion engaging in a toothed fibre wheel, attached to the underside of the condenser dial and producing a simple yet reliable method for obtaining critical adjustment.

NEW TYPE BURNDEPT RHEOSTATS.

Burndept products invariably incorporate some points of originality in design, and the rheostats recently introduced are a new departure inasmuch as the body of the resistance consists of a metal plate.

The wire is wound on a fibre strip in the usual manner, and is insulated from the metal supporting ring by means of a thin piece of fibre. The coil of wire is well ventilated to provide suitable cooling, whilst heat is readily conducted away. A new design of operating knob is fitted, held in position on a plain shaft with a grub screw, while an attractive dial with silvered surface is supplied. This calibrated dial is particularly useful, and becomes essential when the rheostat is used to control the filament brightness of an oscillating detector valve.



The new type Burndept rheostat.

The accompanying illustration shows the dual model consisting of resistance wires, suitable for use with bright or dull emitter valves, whilst other types are obtainable with windings suitable for controlling one, two, or three valves, in addition to which a fine wire winding is also supplied for use as a potentiometer.

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H.T.C. CRYSTAL RECEIVER.

A crystal set which is becoming very popular is the H.T.C. receiver manufactured by the H.T.C. Electrical Co., Ltd., 2, Boundaries Road, Balham, London, S.W.12.

Durability and robustness of construction have obviously been the primary aim in the design of the set, for a substantial moulding is employed to totally enclose the tuning condenser and to provide a bracket for the connecting terminals, the plug-in coil holder, and the crystal detector. The tuning principle is a usual one, and the best that can probably be adopted, but is somewhat expensive to produce, as it makes use of a variable tuning condenser. The circuit consists of an inductance tuned with a parallel condenser, and the usual connections to telephones and detector. Any wavelength can be tuned to by the use of the interchangeable coils, which consist of large diameter basket-wound inductances mounted in protecting celluloid cases. The crystal detector is of the permanent type, and is arranged to clip in very much on the same principle as grid leak resistances.

In view of the difficulty of adjusting the detector, attempts have been made from time to time to produce permanent detectors which can be relied upon to retain their adjustment. Whilst detectors in which no provision is made for adjustment are in general not to be recommended, careful consideration has obviously been given to the design of the detector employed with this set. The crystals used are zincite and bornite, which can be relied upon to retain a sensitive adjustment, providing the spring which holds them in contact exerts a suitable pressure, and a coiled spring is used in this instance to exert the necessary critical pressure between the crystals. When connected to an aerial and earth it was found that the crystal detector fitted to the set which was examined, and which had been roughly handled over a period of a fortnight, was still sensitive and gave good signal strength. The detector being mounted in clips can readily be substituted, and by means of comparison it is at once evident when a detector loses its adjustment.

The H.T.C. is an entirely reliable crystal set, making use of components and a circuit arrangement that will produce maximum signal strength, and, moreover, it is designed so that it can be operated by the unskilled wireless user.

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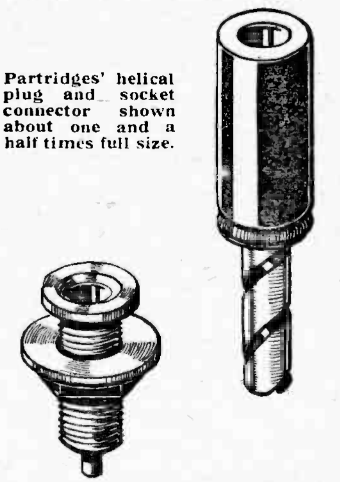
NEW TYPE PLUG AND SOCKET CONNECTOR.

A connector of entirely new design is now marketed by Partridges, Ltd., 115, Northwood Street, Birmingham. It is shown in an accompanying illustration, and will be seen to consist of two stiff

Partridges' helical plug and socket connector shown about one and a half times full size.



helical spirals, consequently possessing the spring action of the split pin connector, and in addition providing a slight degree of flexibility when forcing the plug into the socket. A special feature is that when the end of the plug becomes slightly closed the next coil opens, thus increasing the contact pressure. The sharp edges of the spiral, moreover, keep the inside surface of the socket clean.

It is one of the most ingenious forms of plug and socket connector yet produced, and possesses many points of definite merit. Indicating washers are also supplied for insertion under the socket. The helical plug principle can, of course, be applied in a number of other ways, such as for coil holders, valve pins, etc.

CATALOGUES RECEIVED.

"Marconiphone Co., Ltd." (210-212, Tottenham Court Road, W.1). Art catalogue descriptive of "Sterling" receivers, loud-speakers, and general components and accessories.

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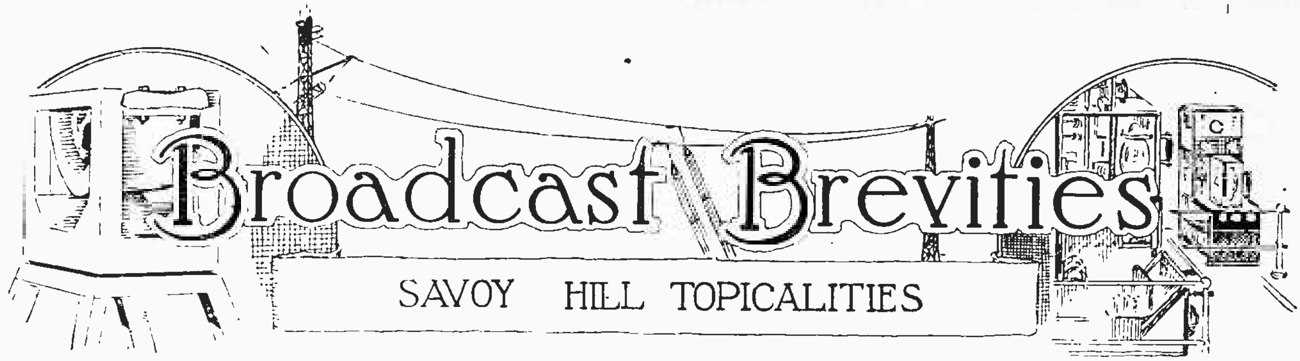
"Burndept Wireless, Ltd." (Aldine House, Bedford Street, Strand, W.C.2). Publication No. 278, providing descriptions and operating dates of Burndept valves. Publication No. 280, dealing with Burndept receivers, amplifiers and accessories.



Broadcast Brevities

SAVOY HILL TOPICALITIES

By Our Special Correspondent.

The Future of Broadcasting.

To all who are interested in the future of broadcasting it must have afforded no little amusement to read of the various fates ordained by the prophets for the B.B.C. as a result of the meeting of Lord Crawford's Committee on Broadcasting.

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Somewhat Premature.

At these committees, it is generally known, the first meeting is usually in the nature of a gathering together of the forces and a layout of the campaign. It was therefore somewhat startling to be told that after their first meeting the Crawford Committee had recommended Government ownership of broadcasting without hearing further evidence.

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Engineered.

This report appears to have been engineered by a political correspondent.

Sub Judice.

In case other reports of a similar nature should be circulated within the next week or two, it is as well that listeners should be warned that Government Committees do not work along the lines of supplying advance information to any particular newspaper correspondent, although it is, of course, the work of newspaper correspondents to try to pump some member or other of such Committees. The writer is able to say from personal experience that as a rule such enquirers get very little change out of it.

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Making the Report Public.

The Crawford Committee's Report will be presented to the Postmaster-General, who will then decide the form in which he will make its contents public, but it will almost certainly first be issued to the general public in the form of a White Paper, and that may not be until two or three months hence.

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Oscillation.

Oscillation is again rampant, and I have received letters of complaint from very many districts round London within a radius of fifty miles. Whether the increased popularity of the superheterodyne and neutrodyne sets have any bearing on the trouble is a point worth considering. If it has any bearing the need is shown of an intensive educational campaign among users of these sets.

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The B.B.C. Pamphlet.

Apart from Post Office action, all listeners who suspect a neighbour of oscillation might do worse than get a copy of the B.B.C.'s pamphlet on the subject and send it to the suspected offender. The pamphlet can be had free of charge.

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The Countess of Oxford to Broadcast.

The Countess of Oxford is expected shortly to appear before the microphone at 2LO.

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The Sincerest Form of Flattery.

After one year's existence, the Vienna Broadcasting Company, which already had a small station in Vienna, is building a more powerful transmitter in the vicinity of the capital. The daily programmes will be very similar to those broadcast by the B.B.C., whose methods are being adopted, both as regards programme matter and the design of the apparatus. A new studio has just been built on the lines of those used in Great Britain.

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Lord Beatty to Broadcast.

Lord Beatty will broadcast from 2LO on December 17th in connection with the "Implacable" appeal.

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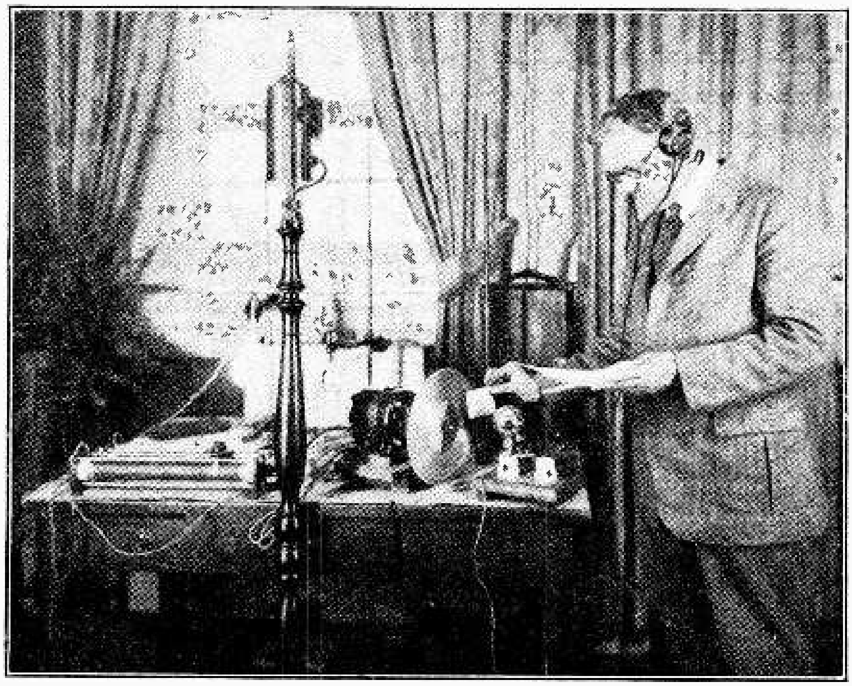
Good and Bad Wavelengths.

Broadcasting engineers, both in Great Britain and America, are faced with the problem of discovering some means of stabilising good wavelengths against bad; but America is also going all out for high power.



ELECTRON PHENOMENON BROADCAST. An interesting experiment being carried out before the microphone of WGY, Schenectady, by Professor P. I. Wold. By means of a photo-electric cell connected to the broadcast circuit, and a perforated disc placed between the cell and a source of light, musical notes were emitted which could be altered in pitch by changing the speed at which the disc was rotated.

A Problem and the Best Solution.

The British engineer is in a much more difficult position. He could cover the whole country by means of one station working on 100 kilowatts and with a wavelength of 1,600 metres; but obviously the drawback is that there would be only one programme. If he were to work to shorter wavelengths than those at present used he could get a lot of stations in; but the disadvantage would be in night distortion. A reduction in the number of stations from the present twenty-one to, say, sixteen, *i.e.*, ten main regional stations working on twenty kilowatts, five on about one kilowatt, and one on very high power for linking up with the Dominions, the United States of America and other countries will therefore be in all probability the best solution. No considerable alteration in the wavelength band is contemplated.

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Rearrangement of Wavelengths.

What has become of the scheme for the rearrangement of wavelengths, which was to have been brought into operation in November or December as the result of the further conference of broadcasters, held at Geneva at the beginning of October last?

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Fewer Stations.

It will be recalled that, arising out of that conference, a hint was given that future development lay in the direction of cutting down the number of broadcasting stations and increasing the power of those which remained; and pending the realisation of such a project, a reallocation of wavelengths would take place on the basis of geographical situation, population, language, etc.

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A New Scheme Under Consideration.

I am informed that fresh counsels are shortly to take place at Geneva, and, in the meantime, no general alteration will be made in the wavelengths of European broadcast stations. Wireless experts of the various broadcasting countries are to discuss an entirely new plan for clearing the ether, and this plan will not take precisely the form of preventing different stations from working on identical wavelengths. That seems a rather ambiguous, but it is a factual, statement; and I am sorry that I cannot extract further information at the moment.

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Will it Succeed?

Whether the proposal will be effective or not in finding room for 150 broadcast stations in a waveband which is more adequately suited to 100 stations is an open question. Even if the new plan should prove to be the solution, some time must elapse before it can be put into execution; and in the meantime interference will, unfortunately, continue to be experienced by listeners.

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Too Many Talks?

I have never personally undertaken a careful analysis of broadcast programmes, but whenever I have made enquiries respecting the number of talks, which seem to take up a good deal of programme time, I have been told by the B.B.C. staff that, in fact, talks average 16½ per cent. only of the matter broadcast.

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A Six Weeks' Analysis.

A listener who has made a commendable effort to arrive at an accurate estimate has ascertained that during six weeks the transmissions from 7 p.m. were made up of orchestral, vocal, and instrumental music, 29.7 per cent.; talks, 16.7 per cent.; dance music, 11.5 per cent.; news, 11 per cent.; humour (entertainers, etc.), 10.2 per cent.; opera relays, 6.2 per cent.; drama and poetry, 5.6 per cent.; religious, 4.6 per cent.; relays of plays, musical comedies, and ballet music, 2.3 per cent.; "stunts," 2.2 per cent.

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A Small Proportion.

Not many of those, I ween, who gird against the alleged preponderance of talks would have been able to gauge offhand the exact proportion which they bear to music and entertainment of a lighter character.

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Radio Revel.

On Radio Revel evening, December 15th, some of the well-known wireless artists who will be appearing in person at the various halls where revels are taking place later in the evening will contribute to the variety programme at 2LO from 8 to 9 p.m.

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Britain's Biggest Ball.

Among the revels which are to be held in London and many provincial towns on that evening, the principal gathering will be at Olympia, London, where there is accommodation for four thousand dancers. This will be the centre for broadcasting all dance music for listeners in their own homes for the revels, which are to take place simultaneously throughout the British Isles. The revellers in provincial towns will dance to their own bands.

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Dance Music from Abroad.

A feature of the evening will be dance music specially arranged and transmitted from foreign countries. The Olympia revel will continue from 9.30 p.m. until 4 a.m. the following day, and in addition to the dancing a Pageant of Art throughout the Ages has been arranged by the Faculty of Arts, which will include representations from prehistoric times and will even venture into the future.

Tickets for the Olympia revel, to include buffet refreshments, can be obtained, price one guinea, from the Radio Revel office, B.B.C., 2, Savoy Hill, W.C.2; the Faculty of Arts, 10, Upper John Street, Golden Square, W.1, and the usual agencies.

FUTURE FEATURES.

Sunday, December 13th.

LONDON.—3.30 p.m., Light Symphony Programme conducted by Maurice Besly. 8 p.m., Service from St. Martin-in-the-Fields.

BIRMINGHAM.—3.30 p.m., Light Classical Programme.

BOURNEMOUTH.—3.30 p.m., Symphony Concert.

CARDIFF.—3.30 p.m., Wagner Programme.

Monday, December 14th.

LONDON.—8 p.m., "The Belle of New York."

MANCHESTER.—10.30 p.m., Pianoforte Recital by Leff Pouishnoff.

GLASGOW.—10.30 p.m., "The History of Mrs. Gamp."

Tuesday, December 15th.

LONDON.—9 p.m., Dance Music from "Radio Revel," Olympia.

MANCHESTER.—8 p.m., An hour of Manchester's "Radio Revel" relayed from the Belle Vue Ball Room.

NEWCASTLE.—3 p.m., "Radio Revel."

GLASGOW.—8 p.m., "Radio Revel" relayed from Plaza Palais de Dance.

Wednesday, December 16th.

LONDON.—9 p.m., Beethoven Commemoration Programme, conductor, Sir Landon Ronald. 10.30 p.m., Harold Samuel playing the Emperor Concerto.

BIRMINGHAM.—8 p.m., Military Band Programme.

NEWCASTLE.—8 p.m., Symphony Concert. 9 p.m., A Sims Reeves Programme.

GLASGOW.—8 p.m., A Russian Programme.

Thursday, December 17th.

BOURNEMOUTH.—8 p.m., Popular and Varied.

MANCHESTER.—7.30 p.m., "The Messiah" relayed from the Hallé Concert at the Free Trade Hall. S.B. to other stations.

ABERDEEN.—8.30 p.m., Concert by the Peterhead Choral Union, relayed from Peterhead.

Friday, December 18th.

BIRMINGHAM.—8 p.m., Musical Comedy.

CARDIFF AND 5XX.—8 p.m., "The Romance of Owen Glendower."

BELFAST.—7.30 p.m., "The Messiah" by Belfast Philharmonic Society.

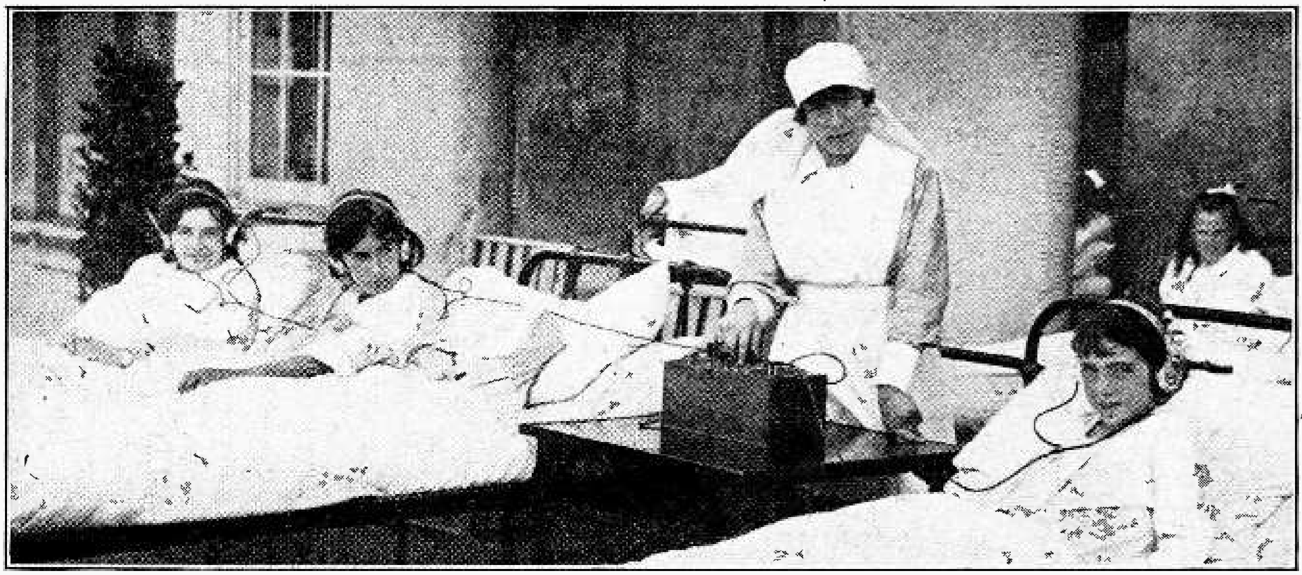
Saturday, December 19th.

LONDON.—8 p.m., A Gather Round.

BIRMINGHAM.—9 p.m., Chamber Music.

ABERDEEN.—9 p.m., Light and Humorous Orchestral Hour.

BELFAST.—7.30 p.m., Part I. "Elijah" performed by the Belfast Philharmonic Society.



WIRELESS IN HOSPITALS.

A Description of the System Used in the General Hospital, Birmingham.

By J. R. RATCLIFFE, M.B., C.M.

RECENTLY there has been installed in the General Hospital, Birmingham, a system of wireless, the result of some experiments I carried out during the summer, which has decided advantages over the usual loud-speaker set.

It is a system which can be easily fitted up in any hospital in or near any of the towns where a B.B.C. station exists.

A great deal of trouble and expense has been incurred in fitting up many of the hospitals with loud-speaker sets. These in many cases have not been the success that was anticipated for the following reasons :—Either each ward has had to have a frame aerial multivalve set, which entails a great expense, or a portable set which only one ward can have at a time; or a central set may be used with complicated and expensive wiring to each ward.

Reception under Hospital Conditions.

Such sets cannot be managed by the nurses in the wards; they presume an electrician, who may have to be fetched from other work to manipulate them.

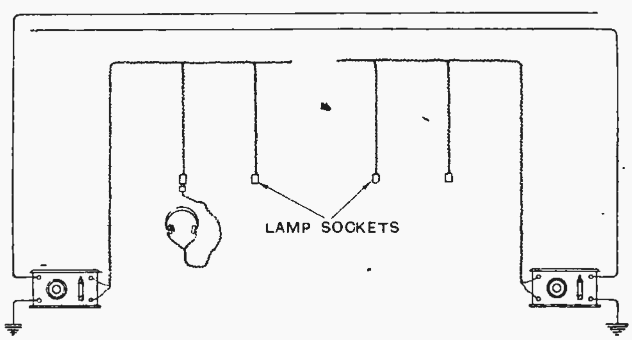
Loud-speaker sets are very unsuitable for the wards of busy hospitals, as there are nearly always patients who are seriously ill or just recovering from an operation, and to whom the noise is an infliction.

Other patients may want to be quiet and read. Again, the loud-speaker cannot be used when a physician is in the ward and is listening to a patient's heart or chest.

The consequence is that the set is less and less frequently used, and if it gets out of order it is left so.

The installation which has been put in here through the generosity of the readers of the *Birmingham Gazette* has none of these drawbacks. It consists of two or four crystal sets in each ward, with telephone plug-in leads to each bed. It is always on when there is a local transmission, and there are no filaments to switch off when broadcasting ceases. All the patient has to do is to ask the nurse for a pair of phones, which are plugged in, and listen without any annoyance to anybody else, or even if the doctor is examining a patient in the next bed.

The aerials consist of rubber-insulated stranded wire, fixed on the wall near the ceiling of the ward. This rubber insulation permits of the aerial being sponged over with a disinfectant when the ward is cleaned down. In the small wards there is an aerial on each side going to a crystal set at each end of the ward. The earth connection from each receiving set is taken to the waterpipe of the ward kitchen. In the larger wards, containing twelve beds on each side, there are two aerials on each side, and a crystal set in each corner of the ward, so that each set serves six beds. From each set the tele-



Arrangement of aerial, earth and telephone connections to the duplicate crystal sets installed in wards of the General Hospital, Birmingham.

Wireless in Hospitals.—

phone leads are taken just above the windows, with leads wired in parallel to each bed. The latter end in a lamp socket. The tags are taken off the telephone leads and an adaptor substituted, and this plugs into the lamp socket.

This method of wiring overcomes the objections to the loud-speaker installation :

(1) It is easily fixed.

(2) It causes no annoyance.

(3) It is always there and working if there is a transmission.

(4) Any nurse can adjust a catwhisker.

(5) It is not expensive, costing about £1 per patient.

It is found that about four patients out of the six supplied by each set listen in, so that there is good reception. Our hospital is situated near to 5IT's transmitting station, so that its indoor aerials score, but I do not think there would be any difficulty in any hospital where there is a B.B.C. station in the town, and I have ventured to write this in the hope that it may be a help to any hospitals intending to install wireless in their wards. If there are any who are considering and have not made up their minds, let me urge them to do so, as wireless relieves the pain and helps the recovery of many patients.

THE BROADCASTING MONOPOLY.

The Present System Favoured in Debate.

An interesting evening was spent by wireless enthusiasts at the Palm Court at Messrs. Selfridge's on Thursday, November 26th, when, following an exhibition of talking motion films by Mr. C. F. Elwell, there was a debate on the motion "That the present system of Broadcasting, as represented by a single monopoly, is the best for this country." The meeting was arranged by the Radio Society of Great Britain, in conjunction with the Selfridge Radio Society. Dr. W. H. Eccles presided.

Is the B.B.C. a Monopoly?

Mr. J. F. Stanley, who proposed the motion, did not like the word "monopoly," because he felt that the present system of broadcasting was not a commercial monopoly in the ordinarily accepted sense; he preferred the expression "centralised control." One could not call the programmes which were sent out by the British Broadcasting Co., for 10s. a year, an ordinary kind of sale. He pointed to the powers of the Postmaster-General to annul the licence of the B.B.C. at any time if the conditions imposed upon it were broken in order to support his view that the B.B.C. did not hold a monopoly. After pointing out that the B.B.C. had to meet competition from gramophones, theatres, and Continental broadcasting stations, he pictured what would happen if three or four private firms were sending out programmes. Immediately the artists' fees would go up, and it would be found that no private concern would have sufficient financial backing to pay the enormous fees which would be demanded. It was only by pooling funds, as under the present system, that the almost exorbitant fees now demanded could be paid. After a reference to the system in the United States, where there was a large number of stations, and where revenue was obtained from the broadcasting of advertisements, he said that this country was too small to allow of private enterprise and competition. Again, the United States could not be compared with this country, because of the difference in size between the two. The United States must be compared with Europe; the best arrangement was to divide Europe into divisions, and one of those divisions was Great Britain. There was no room for more than one central authority in this country. He drew a comparison between Great Britain, Germany, and Sweden, on the one hand, where broadcasting stations were fairly evenly distributed, and France and Spain on the other, where a number of stations were concentrated in Paris and Madrid. In the first three countries broadcasting was subject to control, whereas in the other two it was not. In Madrid each station had to broadcast in turn, and then close down so that each of the others could broadcast. The B.B.C. knew what the public wanted, and were in a position to cater for it, and, although there was central control, it was not autocratic; it was not run by a few despots, but by people who knew their job. As an example, he referred to the Committee responsible for the programme broadcast during the children's hour, and said that if there were competing broadcasting authorities it would be impossible to get such committees, representative of interested organisations, to serve the public. His final point was the value of simultaneous broadcasting in the case of a national emergency. Under the present system, on such an occasion it would be possible to broadcast a message simultaneously throughout the country within, say, three minutes. Under private enterprise, on the other hand, there would be all sorts of formalities to go through in order to have all the stations linked up.

Mr. L. F. Fogarty, who seconded, was not concerned as to which authority was responsible for broadcasting so long as broadcasting was in the hands of one authority, and controlled by the Government, and he pointed to the disturbances experienced and the very sorry speeches and music which were inflicted upon listeners before broadcasting was controlled. If there were a number of broadcasting authorities there would be squabbles, in the first place, because each would want the most densely populated, and consequently the most remunerative, part of the country to deal with.

Number of Stations Limited by Available Wavelengths.

Again, there would be difficulty in the working out of the wavelengths, and the 250-500 metre wave band was at present overloaded. It could be said without fear of contradiction that the technical quality of transmission in this country was as good as, if not better than, that of any other country in Europe, and where Continental transmission was good the equipment had been either designed or purchased in this country, or the Continental designers were indebted to the B.B.C. for having placed useful information at their disposal. The high degree of technical perfection in this country had only been obtained at great expense to the B.B.C., and could not have been obtained if the big interests had not pooled their knowledge and resources. After emphasising the point made by Mr. Stanley, that the facility of simultaneous broadcasting might be invaluable in the case of a national emergency, he said that competition was perhaps an excellent thing in the right place, but, despite its alleged stimulating effects, it did not always operate to the public good. In the case of broadcasting it would introduce technical difficulties, and would curtail research.

Mr. Maurice Child, opposing the motion, said he was quite convinced that the present system of broadcasting as represented by a single monopoly was not the best thing for this country. The fact that, after a little over three years of broadcasting, we had to-day only one station—and that a very powerful one—for six millions of people within the London area, was a disgrace; it was a disgrace technically. There was no reason at all, so far as he could see, why we should not have several stations for supplying those six million people with all varieties of programmes.

Extending the Broadcasting Band of Wavelengths.

It was simply a question of properly regulating the power of the stations and the wavelengths employed. In New York, where there were a number of small-power stations working on relatively short wavelengths, the listeners

The Broadcasting Monopoly.—
in that fairly congested area—more congested in some respects than London—could switch on from one to the other and get the programme they wanted. That was a technical achievement which we ought to be able to attain. Taking a figure of 20 kilocycles distance between each wavelength, he had found that, if we started with a minimum wave of about 60 metres, which was quite a feasible proposition, and went up to 300 metres, we could put in approximately 200 stations. That was a very big figure, but we could easily double it if we wished to, technically by reducing the number of kilocycles between the wavelengths, and we could increase the number still further by reducing their effective radius of operation. He saw no reason at all why we should not, in the large cities in this country, have quite small-power stations working on short wavelengths, capable of supplying the necessities of the population in the particular areas, and, in the country districts, a few stations dotted here and there, with considerably greater power and possibly longer wavelengths, for the benefit of the more distant people. Dealing with the question from the point of view of the manufacturing industry, he said that the present system—by which, whatever one might say, broadcasting was practically controlled by about half a dozen large manufacturing interests, not only in wireless apparatus but in other directions also—was fundamentally bad from the point of view of scientific progress. If, for instance, the motor car industry had been under the control of half a dozen manufacturers, motor car construction to-day would not have reached anything like the standard of mechanical efficiency that had been obtained, owing to the regulation of design, etc., which that control would have involved. The B.B.C. practically controlled the standard of wireless apparatus and the wavelengths over which it was to be adjusted by fixing definite wavelengths and powers for their stations. That had a very definite effect upon manufacture. A manufacturer was not out all the time to make experiments in radio telegraphy and telephony, but to make apparatus and sell it. He had to make apparatus which would respond efficiently to the existing stations, and at a certain price, and he had not sufficient scope. We in this country had to keep abreast of the times, and to take care that we do not establish a system which would be so rigid in its form that it will not allow of use being made of valuable scientific discoveries as they occurred in the future. Reverting to the American system of having a large number of broadcasting stations in close proximity to each other, he said this had resulted in highly selective receivers being designed, and he had heard Captain Eckersley admit that the Americans had wonderful sets—better than anything we had ever heard of. That alone, in his opinion, was a very strong argument in favour of our present system being altered.

Mr. H. Bevan-Swift, who opposed the motion from the point of view of the listeners, said that they were the people who paid for the programmes, and should have good ones; they were not getting the best under the present system of monopoly.

More Stations and More Programmes.

The subject matter for broadcasting was very wide, and he divided it into two broad headings, namely, information and entertainment. There were many classes of each, and such a vast field could not be covered by a single programme. He had every sympathy with the B.B.C., who had a tremendous market to fill, but it was almost an impossibility for them to fill it alone and to give satisfaction to everybody, because we all had different tastes. In a plea for alternative programmes broadcast by different stations over the same area, to suit the various tastes, he gave an amusing word-picture of a man who appreciated good music switching on his set under present conditions and hearing Radio Revue; then he tried an alternative station and found they were doing the same thing; then he switched on some high-frequency valves in order to hear what was going on on the Continent, and found that 50 per cent. of the listeners were all trying to do the same thing, resulting in oscillations, screams and howls. Under such circumstances the part of his set which he appreciated most was the turning-off switch. We wanted a number of stations, each specialising in its own class of entertainment. Dealing with the educational value of broadcasting, he said that there were many pieces of music which were once regarded as classics, but which were becoming light pieces simply because they had been played in cinemas, and he suggested that it would be interesting to broadcast a programme of classical music, and to leave out the names of the various pieces. If the listeners were then asked to give the names the result would be a revelation. Broadcasting offered enormous possibilities of educating the people to appreciate good music.

Mr. D. S. Richards, in support of the motion, likened a broadcast system without adequate financial support to a nut without a kernel or milk without the cream. At present, out of the 10s. licence fee which all "self-respecting" listeners paid, 7s. 6d. was handed to the B.B.C. to meet their heavy expenses; if there were four broadcasting companies, each receiving 2s. 6d., what could they do with the money? There must be financial stability if broadcasting was to be carried out efficiently, and we should not get an adequately financed and efficient system without a central organisation.

The International Aspect.

By interchange of programmes there would be brought about a better understanding between the nations, and wireless would be one of the soundest means ever devised for doing away with international strife. If there were a number of broadcasting stations giving different programmes, what would happen to the unfortunate person with the crystal set? The science had not yet reached the stage in which it was possible for a crystal set to cut out a powerful station. Coming back to the question of finance, he had a gibe at the Post Office, who, he said, might apply some of the money received from wireless licences to the improvement of some of their commercial stations, which caused a lot of trouble. Dealing with the international aspect of radio transmission, he said there was no question of more importance to the world than this.

Mr. H. A. Epton (who opposed) approached the matter from the financial point of view, put forward the conclusions he had drawn from an examination of the B.B.C. balance sheet, and criticised the constitution of the company.

Finance.

Though the company would say that they had 1,500 or 2,000 shareholders, a glance at the balance sheet showed that the bulk of the capital was in the hands of six companies, and by no possible means could the remainder of the shareholders ever have a controlling interest or hold an equal proportion of the capital. The nominees of the six companies were on the Board of Directors, and he would have thought that that was sufficient to show that broadcasting was a monopoly. He could see no difference between a broadcasting and any other commercial monopoly. Of the £500,000 income of the company last year, the Post Office had received £120,000 or £130,000, but what did the Post Office do to earn the money? The expense involved in the collection of the money was, perhaps, £20,000, or maybe less, so that they had £100,000 to play with.

How Does the Post Office Dispose of the Profits?

Probably they would use the money for the same purpose as that for which the Road Fund was to be raided—to make the listeners pay for the iniquity of others. The listeners found half a million of money, but had nothing to say with regard to the programmes they received for it. They had to pay their money in advance, and trust to luck. The fact was that they were getting taxation without representation.

Mr. L. J. Hibberd, supporting the motion, held that listeners could get what they paid for if they would only notify the B.B.C. as to what they wanted, because the B.B.C. were doing their best to give them what they wanted, as reflected by the letters it received. The majority of people, however, merely told their friends what they wanted, and did not tell the B.B.C. If there were a multi-broadcast system, it was obvious that listeners would get inferior entertainment.

Inferior American Programmes?

Discussing the American system, he said that recently he had listened in to the Philadelphia station; he had heard a fine speech from Mr. Coolidge, good music, etc., but there was also thrown in, during the course

The Broadcasting Monopoly.—

of the programme, such remarks as "Have you tried Randall's boots, from Third Avenue?" That was the sort of thing which would result if we had a multi system in this country. As a minimum, the B.B.C. sent out 365 programmes a year, and that worked out at about 60/73rds of a farthing per programme. We should not get programmes at that price from gramophone records, even though bought from Woolworths. (Laughter.) The only way for the B.B.C. to cater properly for the public was to meet the needs of the majority, and that they endeavoured to do, using as a guide the letters they received. The educational aspect of broadcasting was very important, and wanted careful handling, because broadcasting had a greater influence than the Press; it reached the ignorant as well as the intellectual, and under the present system it was not influenced in its views by any newspaper combine or political or religious party. It took up a national, and very often an international, attitude, and, so far as he could see, some day it would have a greater influence than the League of Nations, if properly handled. The B.B.C. were not autocratic, but were willing to consider any views or ideas put before them.

Centralised Control.

With multi stations we should have cheap and nasty programmes, but we wanted something of a very high standard, which could only be obtained by centralisation of thought, equipment, and finance. In conclusion, he quoted an extract from a speech by Mr. Hoover, the Secretary of Commerce in U.S.A., at the opening of the National Radio Conference in Washington, in which he had given figures as to the number of stations in the U.S.A., and had expressed the opinion that the time had clearly arrived to abandon the policy of freedom of the air.

Mr. C. H. Keeling was the final speaker, and he opposed the motion, and said that if ever there was a thinly veiled dictatorship dominating the minds of men and women it was the present system of broadcasting, and he acclaimed it as an autocracy foisted upon a long-suffering humanity.

Broadcasting and Politics.

It was a gigantic weapon wielded by a few; it could easily lend itself to abuse—and it did. With regard to the statements that listeners could get what they wanted by writing to the B.B.C., he referred to an occasion on which he had written, suggesting that, instead of broadcasting the views of one side in religious matters, there should be a debate, in which the views of both sides were set forth. He had offered to procure eminent men on both sides, but his offer had been declined with thanks. In America, advertisements were broadcast; it was also done here, but in a more subtle fashion. Propaganda was not merely the advocacy of certain views; it might be the mere statement of certain facts and the suppression of others. With regard to political propaganda, Mr. Keeling's reference to the refusal to allow the Communist Party to broadcast on the occasion of the last General Election, whereas other parties had done so, brought a protest from the meeting, and there was prolonged clapping, accompanied by admonitions to stick to the question under discussion. After it had subsided he retorted that he had been asked to speak on the political side, and he was going to get on with it. He claimed that the B.B.C. were definitely allied to the political organisation at present in power.

Mr. Stanley then replied briefly to the discussion, and asked whether we were purely and simply idealists, or whether we were trying to get a good system of broadcasting which we knew to be possible. If we were idealists some of the ideas expressed were excellent, but we could throw away our wireless sets. With regard to America, he said that, although the sets were selective, they were not so good on the low-frequency side, and they might not give the same good quality of reproduction. We in this country wanted good quality reproduction, and were not so frightfully anxious to get to the other side of nowhere. Speaking of the constitution of the B.B.C., he said that was quite beside the point. It was known that certain modifications would have to be made. What the meeting was concerned with was one central authority, and what its constitution was to be would be decided when the Government Broadcasting Committee had completed its deliberations. A start had to be made, and he considered it was better that broadcasting should be in the hands of a private concern rather than the Post Office. There were great financial risks, and obviously the people to take them were those commercially interested in broadcasting and who could put up the money.

The motion was then put to the meeting, and was carried by an overwhelming majority.

Calls Heard.

Extracts from Readers' Logs.

Cromer.

Great Britain: 2JB, 2PV, 2DY, 2UV, 2VN, 5SK, 5ZB, 5DA, 5IV, 5NJ, 5KY, 5LF, 5ID, 5IU, 6YC, 6BB. France: 8DD, 8CA, 8FD, 8VJ, 8XP, 8FW, 8JD, 8TH, 8TS, 8BE, 8JMP, 8UDI, 8NNN, 8OGA, 8ZAE, 8AEB, 8BUI, 7IX, FL. Holland: OBB, OBC, OKD, ORA, OZE. Germany: Y1, R4, K4, B5, K5, M9, 4PFG, KWSM, KJH, KPL, KVPF. Belgium: K3, F4, K5, 4KR. Italy: 1AS, 1GB, 1LP. Sweden: SMFF. Brazil: WJS, 1AB. Spain: EAR21. South Africa: OFM. Swiss: 9NAZ. Unknown: CRX, GHSI.

(0-v-0.) 25-100 metres.

A. A. Barrett (G2BJP).

Ludlow, Salop.

(October 12th to 30th.)

British: (G)2OD, 2NB, 2SZ, 2NM, 2DX, 2OQ, 2RY, 2IH, 2II, 2COS, 2YQ, 2AK, 2YV, 5PM, 5FS, 5NJ, 5SZ, 5SI, 5LF, 5KTM, 5DH, 5AR, 5BY, 5MO, 5YK, 5RB, 5XO, 5GS, 5RQ, 6BD, 6TM, 6JK, 6VP, 6GL, 6PF, 6FG, 6QB, 6TD, 6RM, 6YU, 6FA, 6OH, 6CC, 6LJ, 6US, 6TW, 6FW, 6AH. French: (F) 8PP4, 8CA, 8CZ, 8DY, 8YB, 8IK, 8TOK, 8PAX, 18GR, 8BP, 8TK, 8GRA, 8JMP, 8RLH, 8DTD. Belgium: (B) U5, S2, W3, 4SR, 4AU, P11. Dutch: (N) 2PZ, PC7, NOHB, OWC, PCLL, PC2, PB8, OES, OKW. Scandinavia: 2NM, SMTX, SMTN, 2NX, SMUK, SMXU, 2CO, 2ND, D7EC, LA4X, SMYH. Italian: 1AS, 1GW, 1AC, 1AU. Iceland: BG1. Argentine: A1. Australia: 2YI. Brazil: 1AX, 1BD. Chile: 9NC. South Africa: A4Z. Palestine: 66X. Swiss: 9BR, 9AD, 9WWZ. German: KXH, KX5, 4LV. American: 1MY, 1AW, 1ARH, 1CH, 1SW, 1AF, 1AAO, 1CMP, 2KU, 2CVS, 2CXL, 8BGN, WIR, WQO, NKF, NGI, ERV.

(0-v-1) 35-90 metres.

A. E. Livesey.

All pure C.W.

Rawalpindi, Punjab, India.

Great Britain: 5DH, 2LX, 5AN, 5WC (?), 5ZK (?), 6DO, GCS. France: 8CK, 8CB, 8AL, 8BO, 8DE, 8BEW, 8HU, F.W. U.S.A.: NKF, WIR, 1XM, KDKA. Holland: PCJJ, OCML, PCMM, ONM. Australia: 6AG. Belgium: Z7, T2.

Rex A. Coates (cpl.).

TRANSMITTERS' NOTES AND QUERIES.

Dutch Station Closes Down.

M. C. J. Gouwentak, who until recently was actively operating Station N-OKW, and whose call sign is known to many British transmitters, states that he has now closed down. His call sign has been re-allotted to M. F. Welda, another Dutch amateur. For this information we are indebted to Mr. Ernest Robinson (G5YM), of Pirbright, Surrey.

oooo

Listen for OANE2, Java.

No permits for reception or transmission are at present available in Java, but this fact need not deter readers from listening for signals from the Dutch Colony, with the call sign OANE2.

M. Gouwentak, referred to above, is journeying to Java in about three months' time, taking his transmitting apparatus with him. He hopes to be heard in Europe. He will use the above call sign with "ei" as an intermediate.

DICTIONARY OF TECHNICAL TERMS

Definitions of Terms and Expressions commonly used in Wireless Telegraphy and Telephony.

This section is being continued week by week and will form an authoritative work of reference.

Laryngophone. A kind of *microphone transmitter* which takes up the voice vibrations by direct connection with the exterior of the throat, through a pad pressed to the throat, and not from the sounds issuing from the mouth.

Lead. A wire or cable, usually flexible, for carrying current from one piece of apparatus to another; *e.g.*, telephone lead.

Lead Accumulator. The ordinary type of *accumulator* in which the plates are made of lead, carrying certain lead oxides which change their composition on charging and discharging of the cell, the electrolyte being sulphuric acid and water at a *specific gravity* of about 1.200.

Lead-in. The wire which joins the main part of an aerial outside a building to the apparatus inside the building, being brought in through an insulating tube known as a "leading-in tube."

Leading Current. An *alternating current* which reaches its maximum positive value some fraction of a half-cycle before the voltage producing it passes through its maximum positive value. A condenser takes a current which leads by exactly one-quarter cycle or 90°. See PHASE DIFFERENCE.

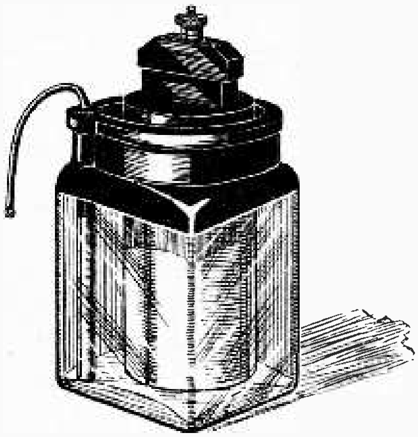
Leading-in Tube. A tube made of porcelain, ebonite or other insulating material, through which the leading-in

Leading-in tube.

wire from the aerial to the instruments of a wireless set is brought from the outside to the inside of the building.

Leak. See GRID LEAK.

Leclanché Cell. A *primary cell* with carbon and zinc electrodes. The carbon electrode is placed inside a porous earthenware pot which is filled with manganese dioxide, the latter being the depolariser. The porous pot is stood in an outer glass vessel filled with a solution of ammonium chloride (sal-ammoniac) in which is immersed the zinc rod. See DRY CELL.

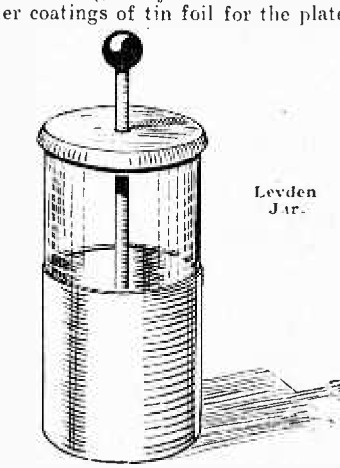


Leclanché cell.

Lengthening Coil. See LOADING COIL.

Lenz's Law. The E.M.F. induced in an inductive circuit by variation of the current therein is in such a direction as to oppose the change of current. See SELF-INDUCTANCE.

Leyden Jar. A *condenser* made in the form of a glass jar with inner and outer coatings of tin foil for the plates.



Leyden Jar.

L.F. Abbreviation for *low-frequency* or *audio-frequency*.

Lightning Switch. A throw-over switch for disconnecting the aerial of a wireless installation from the apparatus and connecting it to the earth wire as a protection against lightning. An aerial connected to a good earth system is a protection to the building as well as to the apparatus, especially if the down lead goes straight to earth without bending round any corners. It is preferable for the lightning switch to be on the outside of the building. An aerial is more of a protection than a danger to a house during a thunderstorm provided it is well earthed.

Line. The name commonly given to the electromagnetic C.G.S. units of both *magnetic force* and *flux*. For instance, a field is said to have a strength of so many "lines per square centimetre." See LINES OF FORCE.

Lineal Decrement. The difference between the amplitudes of successive half-waves of a damped oscillation of such a nature that this difference is constant. Cf. LOGARITHMIC DECREMENT.

Linear Amplification. *Amplification* by means of a *three-electrode valve* where the change of plate current is directly proportional to the change of applied grid potential, *i.e.*, by operation over the straight portion of the plate current—grid voltage characteristic curve of the valve. This is a necessary condition for distortionless amplification.

Lines of Force. Imaginary lines in an *electrostatic* or *magnetic field* along which the respective forces act. For example, a line of force in a magnetic field is the path a free magnetic North pole would travel along if set free. Thus the tangent to a line of force at any point is parallel to the direction of the field at that point. The intensity of a field is sometimes spoken of as so many lines of force per unit area of cross-section of the field. The electrostatic and electromagnetic systems of units are based on the laws of attraction and repulsion between two point charges or two magnetic poles respectively. Thus a unit North pole repels a similar pole with a force of one *dyne* when the distance between them is one centimetre, and since field strength is defined as the force in dynes exerted on a unit North pole, it follows that the number of lines of force issuing from a unit pole must be 4π, because the field strength all over the surface of a sphere of one cm. radius with a unit pole at the centre must be one line per square centimetre and the surface of such a sphere is 4π square centimetres. A better name for lines of force when taken quantitatively is "Tubes of Force."

Dictionary of Technical Terms.—

Lines of Induction. See Lines of Force.

Line Linkages or Linkage. When a magnetic field passes through closed loops or turns of a circuit the field is said to be "linked" with the circuit, and the product of the number of lines of force and the number of loops through which the field passes is called the "linkage," or "line linkages," or "flux turns." An E.M.F. is induced in the circuit whenever the linkage is changing. See Induced E.M.F.

Litzendraht Wire. A conductor for *high-frequency* currents, being made up of fine strands of copper wire, each insulated from the other with silk and twisted together, there being perhaps fifty or more strands in the conductor. The *high-frequency resistance* of such a conductor is very low compared with a solid conductor of equal cross-section, because *skin effect* is almost entirely eliminated. See High-Frequency Resistance.

Loaded Aerial. An aerial with inductance connected in series for the purpose of increasing the *wavelength* to which it will respond. Capacity is sometimes connected in parallel with the inductance to increase the wavelength still further. See Loading Coil.

Loading Coil. An extra inductance, besides the main tuning inductance, connected in series with an aerial to increase the wavelength.

Local Oscillations. High-frequency oscillations, either desired or undesired, produced in a wireless receiver by *regeneration* or by means of a *separate heterodyne*. Local oscillations are necessary for *beat reception*, but must not be present when receiving telephony. See Beat Reception and Self-Oscillation.

Local Oscillator. See Separate Heterodyne.

Logarithmic Decrement. In a train of *damped oscillations* the Napierian or natural logarithm of the rattle of the amplitudes of two successive waves is called the "logarithmic decrement," or "decrement" for short. For continuous waves the decrement is zero. In a damped train of oscillations the oscillations die away at a rate proportional to their amplitude, so that the ratio of the amplitudes of any two successive waves is the same, and a curve drawn through the crests of the waves is a logarithmic curve, commonly called a "die-away" curve. See Damped Oscillations.

Loop Aerial. See Frame Aerial.

Loops. See Nodes and Loops.

Loose Coupler. A *coupler* in which a low *coefficient of coupling* can be obtained between the two coils and where the coupling is variable. The term usually applies to the type in which one cylindrical coil slides inside another. Compare Vario-Coupler.

Loose Coupling. *Inductive coupling* between two coils where the *mutual inductance* between the two coils is small compared to the product of their *self-inductances*, i.e., *where the coefficient of coupling* is small. Compare Tight Coupling.

Loud-speaker. A special form of telephone receiver designed to operate on a relatively high power and render signals or speech sufficiently loud to be heard at a distance.

Low Frequency. Term usually employed in wireless to denote a frequency within the audible range, i.e., within a range of about 25 cycles per second to about 10,000 cycles per second. See Audio-Frequency.

Low-frequency Amplification. Amplification of wireless signals after they have been *rectified* by the *detector* and thus converted to an audible frequency.

Low-frequency Amplifier. An amplifier which is used to increase the strength of signals after they have been *rectified* by the *detector* of a wireless receiver. Three-electrode valves are used for the purpose in almost every case, and they are connected in *cascade* by means of *resistance-capacity coupling*, choke-capacity coupling, or by means of *intervalve transformers*. See Microphone Amplifier.

Low-frequency Resistance. A term sometimes used for the ordinary *ohmic resistance* of a conductor or circuit because at very low frequencies the resistance differs very little from that offered to a steady direct current. Cf. High Frequency Resistance.

Low-frequency Transformer. See Intervalve Transformer.

Low Tension. A term used to imply low *voltage*, but in wireless it refers in particular to the low voltage which is applied to the filaments of *thermionic valves* to drive the necessary heating current through them.

Low Tension Battery. The battery of cells, usually accumulator cells, used for heating the filaments of *thermionic valves*. Cf. High-Tension Battery.

Low Side Band. See Side Bands.

L.T. Abbreviation for *low tension*.

Lumped Characteristic. See Total Characteristic.

Lumped Voltage. If the amplification constant of a *three-electrode valve* is denoted by m, a change in the *grid voltage* from zero to Vg volts will have the same effect as changing the *plate voltage* Va by mVg volts. The quantity ($Va+mVg$) is called the "lumped voltage," and represents the actual plate voltage which would have to be applied to produce the same plate current if the grid voltage was again made zero. See Total Characteristic.

M

"M." The usual symbol for *mutual inductance*.

Magnet Wire. A term sometimes used to denote ordinary instrument wire, either cotton-covered or silk-covered copper wire.

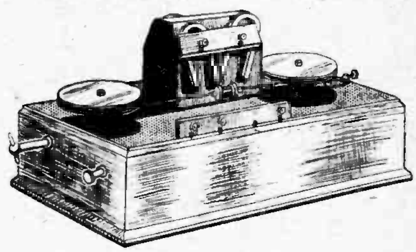
Magnetic Circuit. The path traversed by *magnetic flux* in any given piece of apparatus, such path consisting mostly of iron or special iron alloy of good magnetic qualities. See Magnetomotive Force and Reluctance.

Magnetic Component (of wireless waves). That part of the *radiation* produced by the oscillation current in the transmitting aerial, being the magnetic waves emitted by the aerial. Cf. Electrostatic Component and see Waves (electric).

Magnetic Curve. See B-H Curve.

Magnetic Damping. Measuring instruments are often made *dead beat* by having a small metal disc which rotates with the moving part and passes between the poles of a permanent magnet. The movement of the disc through the field induces *eddy currents* in the disc, and these eddy currents, reacting on the magnet, have a damping effect which brings the pointer to rest without oscillation about the final position. In *moving coil instruments* the coil is usually wound on a light metal frame which has the damping currents induced in it when the coil rotates between the poles of the permanent magnet.

Magnetic Detector. An early form of *detector* of wireless signals. In one form a moving band of steel is magnetised by being passed through a steady magnetic field produced by a permanent magnet, and this magnetism is neutralised in places by the incoming trains of high-frequency oscillations. The band then passes through a coil to which a telephone is connected, and the varying strengths of the magnetism left in the band induce currents which make audible sounds in the telephone.



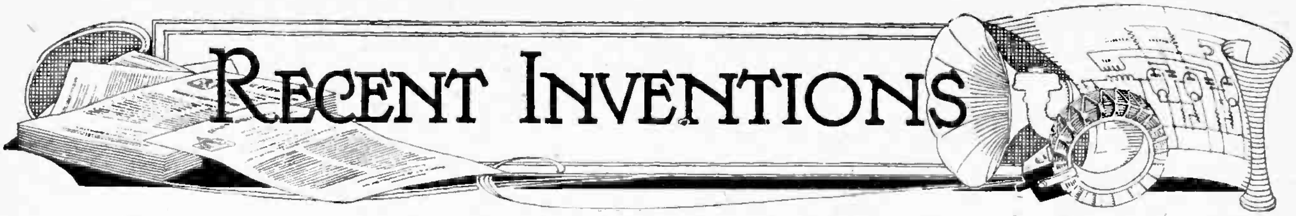
Magnetic Detector.

Magnetic Field. A region where magnetic forces can be detected or where magnetic *lines of force* are present, for instance in the neighbourhood of a magnet or a coil carrying a current.

Magnetic Flux. A term denoting the total number of *lines of force* passing through a *magnetic circuit*. See Flux Density.

Magnetic Force. The force at any given point in a *magnetic field* which would be exerted on a *unit pole* placed at that point, *i.e.*, the *field strength* at that point. Cf. Magnetising Force.

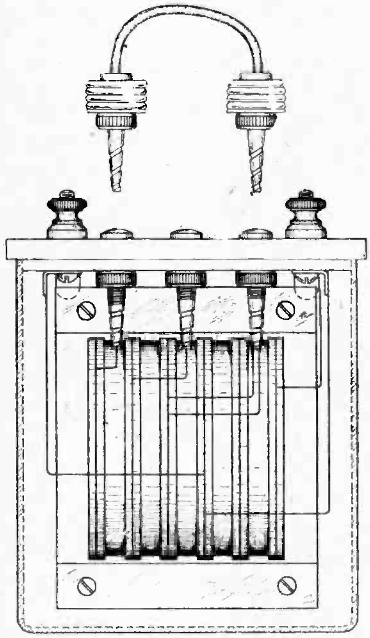
Magnetic Induction. A term used to denote the *flux density* at any part of a magnetic circuit, *i.e.*, the number of lines per unit area of cross-section of the magnetic circuit. This expression usually refers to the iron part of a magnetic circuit and is sometimes called "induction density." Cf. Electro-magnetic Induction.



Brain Waves of the Wireless Engineer.

Low-frequency Transformers.
(No. 240,212.)

Patent No. 240,212, granted to M. Cooper, describes a low-frequency transformer in which the various ratios between the primary and secondary windings are separately available by



Transformer with tapped windings.

subdividing the windings into a number of flat sections disposed side by side on the transformer core, connecting the end of one section to the beginning of the next and taking these connections to sockets and the extreme ends to terminals.

One terminal is also connected to a socket so that a flexible lead with a plug at each end may be used to connect up any desired ratio. The drawing shows a side view of the transformer with its case cut away to show the sections of the windings, the sockets and terminals.

In this transformer the secondary winding only is tapped.

○○○○

Resistance Units.
(No. 239,926.)

There is at present in general use a compact form of protected resistance unit which consists of a tube of unglazed porcelain wound with bare resistance wire, which is sometimes oxidised, and coated with vitreous glaze.

In the process of glazing, the tube is heated to a very high temperature so that no insulating or protective covering, such as silk or enamel, can be used on the wire, and the metal employed for the wire must be such that it can be heated to this temperature without melting or changing its character. The number of resistance alloys which can be employed for this purpose is, therefore, strictly limited, particularly when wires of very small gauge are used, and it is found that alloys which have a very low or negligible temperature coefficient cannot be employed.

The porcelain tube and the finishing glaze are both porous, so that the effective resistance, particularly of the high resistance units, varies with the moisture absorbed.

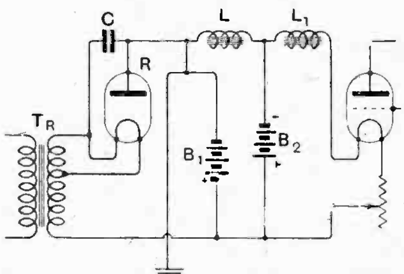
The glaze as it is heated loses its insulating properties, and as in the process of manufacture the wire sometimes alters its position on the tube, and the oxide coating, if employed, is not a perfect insulator and is often patchy in character the winding suffers from short-circuited turns.

Messrs. H. M. Dowsett and H. B. Tilly, in their Patent Specification No. 239,926, have obviated these disadvantages by winding an enamelled wire covered with absorbent material, such as silk or cotton, about a body of refractory material, impregnating the resistance unit so formed with enamel, and stoving it at a temperature between 130° C. and 170° C., and subsequently applying a final coating of enamel to the resistance unit and stoving it at a temperature between 230° C. and 270° C.

○○○○

Supplying Valve Filaments with Direct Current from A.C. Mains.
(No. 239,939.)

According to the above patent specification an apparatus has been devised having one flexible connection which is adapted to be connected to an alternating source of current, and another flexible



Circuit for obtaining D.C. filament current from the A.C. mains. (No. 239,939.)

connection adapted to be connected to the filaments of a valve set.

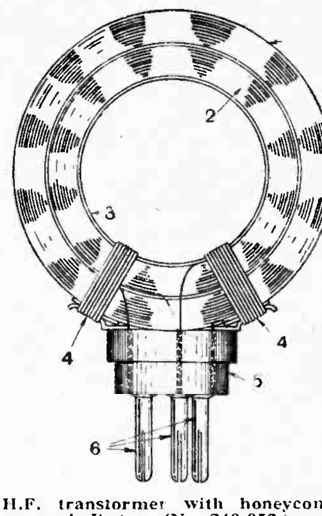
Inside the apparatus is a step-down transformer Tr, a Tungar rectifier R, specially constructed storage cells B_1 and B_2, high-impedance coils L and L_1, and a condenser C.

The circuit connections are shown in the drawing. The object of the impedance coils L and L_1 is to prevent the pulsating direct currents which charge the batteries B_1 and B_2 from flowing in the filament circuit, while the condenser C prevents current variations in the rectifier from flowing in the filament circuit.

○○○○

High-frequency Plug-in Transformer.
(No. 240,953.)

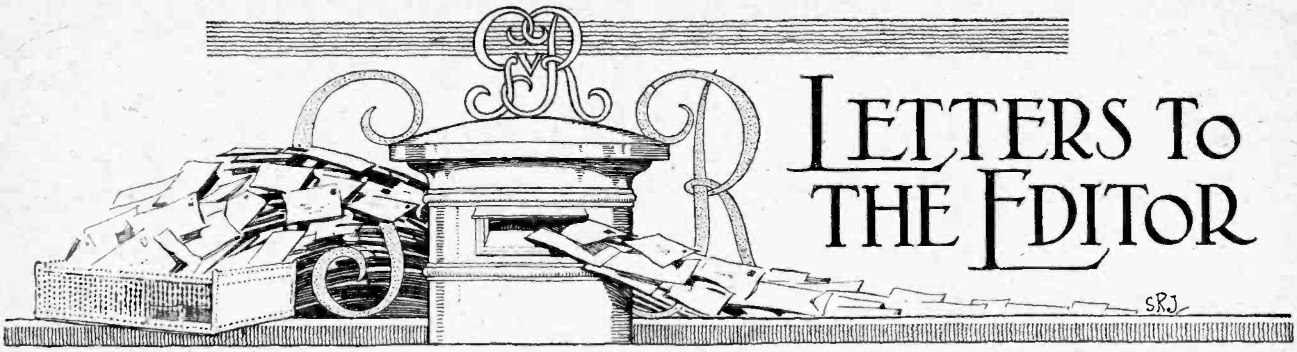
The above patent granted to Messrs. Igranic Electric Company and A. E. Curtis describes a high-frequency transformer comprising two laterally unsupported inductance coils of the honey-



H.F. transformer with honeycomb windings. (No. 240,953.)

comb type wound in close inductance relationship either concentrically one within the other or co-axially side by side, or in so-called twin fashion, and a plug-in terminal connection for supporting the coils. The drawing shows a side elevation of one form of transformer having one winding within the other. The inner coil 2 is preferably wound on a light former 3 of the perforated or crinkled type.

Lashed by means of the cords 4 to the transformer coils 1 and 2 is a terminal connection device 5 carrying four terminal pins or legs 6 arranged to fit standard valve holders.



LETTERS TO THE EDITOR

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

THE FUTURE OF THE B.B.C.

Sir,—As is usual when a committee is sitting, Dame Rumour immediately gets busy. In the case of the Broadcasting Committee we are told that the Post Office are to take over the B.B.C. The fact that the Post Office have had control of wireless telegraphy since 1904, and they are not yet operating a station as capable as those in Germany, France, and elsewhere is, I think, sufficient to see what would happen to broadcasting if it were transferred to the Post Office. On the other hand, I do not believe the present scheme under which the B.B.C. is controlled by the manufacturers of wireless material is ideal.

I therefore suggest that since the Post Office is the department to issue the licences both to the B.B.C. and its patrons, the listeners, who provide the necessary revenue for the operations of the B.B.C., the licensed listeners and the Post Office should jointly control the B.B.C.

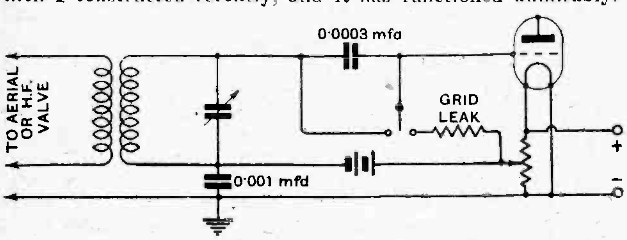
To attain this object the shares held by the manufacturers should be repurchased from them at par. The capital of the B.B.C. in future to be held as 40 per cent. by the Post Office and 60 per cent. by licensed listeners, the latter only to be entitled to hold 100 shares per licensed holder. The present Board to retire and a new Board to consist of ten members, of whom four shall be appointed by the Post Office, and shall not be subject to re-election, five to be appointed by the holders of the other 60 per cent. of the shares, the remaining seat to be occupied by the managing director of the B.B.C., who would, of course, be appointed by the Board in the usual way. The dividend to be fixed as at present.

Such alterations as may be necessary in the organisation, programmes, etc., could then be carried out by a Board fully representative of the two sides most interested in the progress of the B.B.C. E. M. B.

London, W.C.1.

GRID AND ANODE AMPLIFICATION.

Sir,—The accompanying circuit may prove of interest to your many readers. It provides for changing from cumulative grid to anode bend rectification by means of a simple two-way switch. I incorporated this arrangement in a four-valve set which I constructed recently, and it has functioned admirably.



When receiving good strong signals, as from Bournemouth or Daventry, there is no loss of volume when using the anode method of rectification, and the quality is appreciably better. As you will see, in both positions of the switch the grid potential is controlled by the potentiometer, which is an advantage with many valves. J. D. HERRING.

Salisbury.

THE NORTHOLT MUSH.

Sir,—May I take the liberty of making a suggestion on the matter of the requests made to amateurs for reports on special transmissions such as we had early to-day from the new high-power American station?

The B.B.C. could easily ascertain whether Northolt will be working at the time of the tests, and could warn all experimenters in North-West London and Middlesex that it will be useless to make any attempts at reception.

I myself wasted half an hour and more with a "super-het" embodying four stages of tuned H.F. and three different types of aerial in endeavouring to search for signals amidst a positively appalling pandemonium. I know of several others who might have been spared this waste of time had the necessary warning been given. E. T. PIERCE.

Pinner.

November 26th, 1925,

THE B.B.C. AND ADVERTISING.

Sir,—Are the talks given over the microphone drafted by their authors to interest the public or are they not occasionally inspired by commercial enterprise? Your recent editorial, A B.B.C. Obligation," goes right to the point, and draws timely attention to this important matter.

Advertising is permitted in America, and I am of opinion that the B.B.C. is often the innocent victim of an advertising campaign, the announcements perhaps being more subtle though equally effective. The American announcer does not interpose his remarks advising his listeners that "Bevers' soap is made specially to save work," as might be supposed, but the manufacture of soap is described in an entertaining manner by one of Bevers' chemists, or, on the other hand, Bevers' band may broadcast from Bevers' private studio.

Any transmission associated with the name of a commercial enterprise is surely provided for the obvious purpose of advertising. Business men are not philanthropists in the matter of broadcasting, and judging from recent programmes they must have given considerable thought to devising schemes for providing items in broadcast programmes which will either influence their market or boldly give mention of the commodity they handle. D. L. B.

Dalston, London, E.8.

THE PROGRAMMES FROM DAVENTRY.

Sir,—Is it not time that Daventry displayed a little more originality? At present this high-power station, which was intended to supply as many listeners as possible with an alternative programme, does little more than relay the transmissions from London, with an occasional provincial programme thrown in. This state of affairs is particularly unfair to the Londoner who, owing to the comparatively high power of 2LO, can resort to only one other transmission, *i.e.*, that of 5XX.

If, indeed, paucity of funds is responsible for the fact that Daventry no longer transmits programmes of its own, it seems to me that variety could still be obtained if 5XX were to relay programmes from each of the provincial stations in turn. T. C.

Stoke Newington, London, N.16.

READERS PROBLEMS

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

The "Wireless World" Information Department conducts a free service of replies to readers' queries.

Increasing the Range and Volume of a Crystal Receiver.

Being in possession of a very efficient crystal receiver from which I obtain every satisfaction, I wish to extend both my range and my volume, but do not wish to build a separate valve receiver. I understand that I can add units to this receiver for obtaining the results I desire. Can you please indicate a suitable circuit? My crystal receiver employs a plug-in coil with a parallel tuning condenser. P.C.R.

You can either build a separate H.F. and a separate L.F. unit and connect them to your existing crystal receiver in accordance with Fig. 1, or you can build a dual amplifier unit as shown in Fig. 2. In the case of Fig. 1, you can use the L.F. unit only at such times as you desire to increase volume from the stations you already receive with your crystal receiver, and if requiring an extension of range without volume increase on your local transmission, you can use the H.F. unit only. If desiring to increase both range and volume simultaneously, you can use both units together, operating from the same H.T. and L.T. batteries. In the case of using the L.F. unit only, no alteration in the value of the coil used in your crystal receiver is necessary, but if using the H.F. unit or both units simultaneously you should use a No. 50 coil in the crystal receiver and a No. 35 for tuning the grid circuit of the H.F. valve. If you desire to economise in the number of valves used, you can increase both range and volume by building a dual amplification unit as shown in Fig. 2, in which the valve amplifies at both high and low frequencies simultaneously. The H.F. choke may be obtained from advertisers in this journal for a comparatively small sum, and is suitable for all the B.B.C. wavelengths and upwards to a maximum of about 4,000 metres and so need not be interchangeable. In order to obtain good results it is essential that this choke be of an efficient type. The remarks made concerning the values of plug-in tuning coil in respect of the separate H.F. unit apply equally in the case of this reflex amplifier unit. When desiring to receive Daventry, the coil tuning the aerial circuit should be a No. 150, the coil associated with the crystal circuit being a No. 250. If carefully constructed, these units will be found to be very effective indeed. In the case of the H.F. unit it will be noticed that no H.T. terminal has been included. When both H.F. and L.F. units are in use together it will be found that no H.T. terminal is needed, since the negative connection to the H.T. battery is formed automatically by the L.T. bus bar. When using the H.F. unit alone the negative of the H.T. battery may be connected to the L.T. terminal, or, of course, an H.T. terminal may, if desired, be included as shown by the dotted lines in Fig. 1.

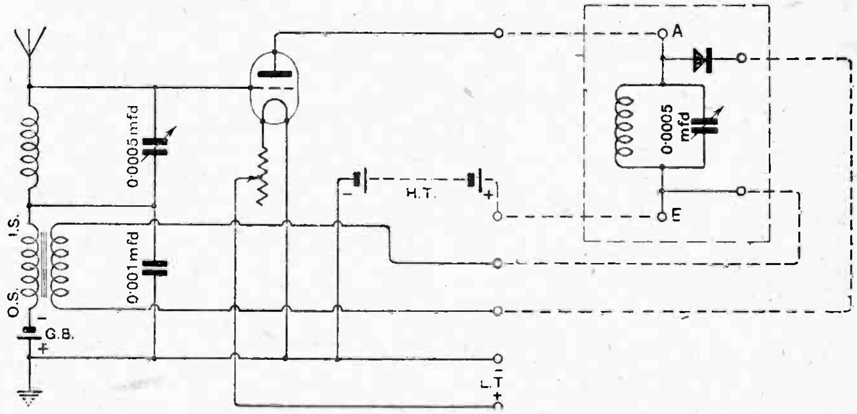


Fig. 2.—Single-valve dual amplifier for addition to an existing crystal set.

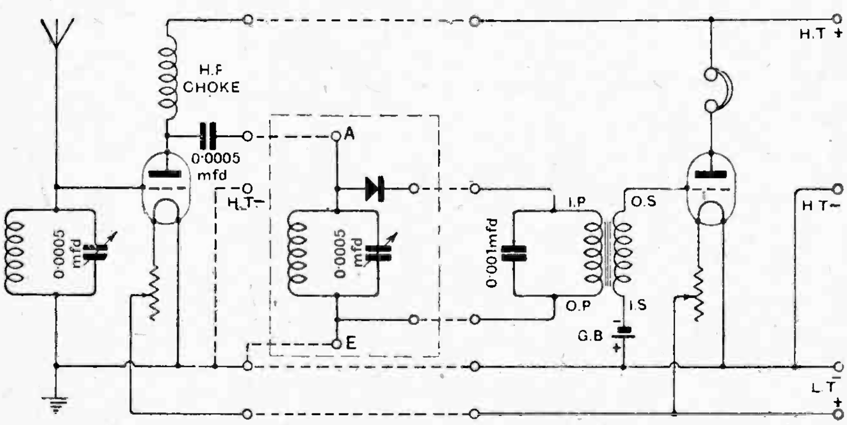


Fig. 1.—Adding H.F. and L.F. amplifier units to a crystal receiver.

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Testing Transformers.

My 3-valve receiver (0-v-2), which has hitherto given excellent loud-speaker results, has suddenly commenced to produce excessive crackling noises, accompanied by a great loss of signal strength. On switching out the final stage, however, the instrument functions normally. I have tried changing valves and batteries and all connections appear to be intact. Can you suggest the possible cause of the trouble? S.J.K.

From the symptoms you describe it would appear that the transformer in your final stage has become defective. The most common cause of failure in a transformer is an actual breakdown in the windings, or failure of insulation, although, of course, there are other more obscure causes of trouble, such as short-circuited turns. A rough-and-ready, but none the less effective, test may be made as follows :—Remove all external connections to the transformer and connect a pair of telephones and a low-voltage battery, such as your accumulator, in series with the primary winding. In the case of a healthy transformer a loud and sharply defined "click" should be heard on "making" the circuit, followed by complete silence until the circuit is broken, when another sharply defined click should be heard. Upon testing the secondary in the same manner a considerably more subdued and somewhat muffled click will be heard. Assuming, however, that the primary winding has broken down, a very faint click will be heard on making and breaking the circuit instead of the normal healthy click, and upon testing the secondary in the same manner a scarcely perceptible click will be heard. If, however, the windings are intact but insulation has become faulty, a normal click will be heard on "making" the circuit, but instead of silence there will be heard a persistent undercurrent of noise, reminiscent of the far-off murmur of a distant multitude. It should be pointed out that it is almost invariably the primary winding which thus defaults, owing to the passage through it of the steady anode current. In either case a new transformer is called for, although in cases of slight insulation breakdown, or in cases of elusive crackling noises in an L.F. amplifier, not traceable to a senile H.T. battery or other customary causes, a wonderful improvement, and sometimes a complete cure, is brought about by heating the transformer slowly over a prolonged period in an oven. Defective L.F. chokes are productive of the same symptoms as a faulty transformer, and should be tested and dealt with in the manner indicated.

oooo

Obtaining Reaction by the Tuned Plate Method.

Recently perusing some old American technical periodicals, I noticed that in their regenerative receivers regenerative effects are obtained by merely tuning the plate circuit of the detector valve, no reaction coil being coupled to the aerial coil. Very smooth reaction control was claimed for this method, but on testing it out I found that in no way was I able to get my receiver to oscillate. I tried tuning the plate circuit both by means of a variometer and a coil and variable condenser. Can you indicate any possible error?
G.J.H.

The trouble you have been experiencing in not being able to bring about oscillation is probably owing to the fact that you have been using a direct-coupled aerial circuit. In cases where such direct coupling is used, it usually requires strong magnetic coupling between grid and plate coils to produce oscillation, owing to the comparatively heavy damping of the aerial. The Americans almost invariably employ a variocoupler when using this method of regeneration, thus considerably lightening the damping imposed on the grid circuit. Oscillation is then easily produced, and can be made so smooth that the valve glides almost imperceptibly in or out of oscillation, with a marked absence of backlash. It is perhaps regrettable that in this country the amateur clings so tightly to the old-fashioned direct-coupled circuit with its heavy damping, which it often requires a large closely-coupled reaction coil to overcome, instead of employing a comparatively

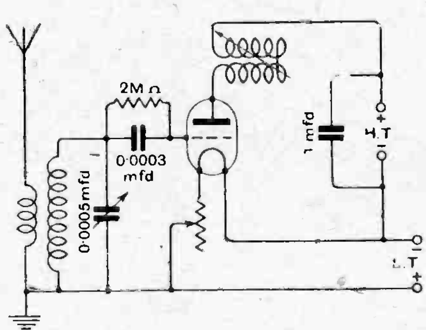

Fig. 3.—Regenerative single-valve receiver with tuned plate circuit.

lightly damped grid circuit with the form of reaction control mentioned. We give in Fig. 3 an adaptation of the American circuit which is suitable for English amateurs. It is advised that the aerial transformer be constructed strictly in accordance with the one specified for use in the neutrodyne unit described in our October 21st issue, which should be entirely suitable for this circuit. The variometer should be of sufficient size to tune the plate circuit to the B.B.C. wavelength, and it is advised that one of the specially large type of variometers, usually sold under the name of anode variometers, be obtained.

A Question of Priority.

A friend and myself were recently discussing the progress of wireless, and the question arose concerning the invention of the valve. The question in dispute which we wish you to settle is by how many years did the crystal precede the invention of the valve?
G.B.S.

The crystal did not precede the valve, the latter actually preceding the former by four or five years. The Fleming two-electrode valve was first produced late in 1904, as an improved method of detecting electromagnetic waves over that afforded by the magnetic detector, which had itself superseded the coherer. It was not until 1908 or 1909 that crystal rectifiers came into general use, only to be superseded a few years later by the resurrected valve, with the addition of a third electrode between filament and plate. From time to time attempts were made to substitute the crystal by an electrolytic detector, but no great measure of success was obtained. At present the three-electrode valve is supreme, despite abortive attempts to cause it to yield place to the four-electrode valve.

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Charging H.T. Accumulators at Home.

I have 240 volts D.C. mains in my house. Is it possible to charge ECONOMICALLY *my 60-volt 1-amp.-hour accumulator at home?*
J.S.H.

It is economical, and at the same time quite simple, to charge the accumulator at home. The normal charging rate of the accumulator is 0.1 amp. Therefore, if we connect it to the mains in series with a 240-volt 30-watt lamp, we shall have a charging current slightly under this value. Therefore, assuming the average cost of current to be 6d. per unit, the cost of recharging will be approximately 1½d., and as in normal use it should not require recharging more than four or five times per year, it is undoubtedly economical to charge the unit at home rather than to dispatch it to a garage, where a charge of 2s. 6d. will probably be made for ruining it.

oooo

Designing Small Power Transformers.

I am thinking of constructing a small power transformer for the purpose of charging accumulators from my house mains, which are A.C. I have been informed that the supply in my district is 240 volts 3-phase. Shall I therefore require to construct a special transformer having a winding for each phase?
H.P.D.

It will be quite unnecessary for you to construct a special transformer, since although the district supply is 3-phase, you will have only single-phase in your house. Into each house two wires are taken, one being the common neutral and the other one of the phase wires. In all probability in the next street to your residence the common neutral and the other phase wire is taken into each house, thus equalising the load on each phase main leaving the generating station.

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The Wireless World AND RADIO REVIEW

(13th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

THE BROADCASTING SYSTEM.

THE sitting of the Government Broadcast Committee to enquire into the future organisation and conduct of broadcasting in this country seems to have provided the occasion for outbursts in every section of the Press. In fact, wherever it has been found possible to give publicity to opinions, there have been criticisms of almost every branch of the activities of the present broadcasting system.

Futility of Current Criticisms.

We have made it our business to sift through a very large amount of the information which has thus come into our possession, but with results which are sadly disappointing. One would have expected that with so many minds centred on the problem, outside those represented on the Committee of Enquiry, some tangible schemes would by now have been evolved, or, at least projected, by one or two of those who have had so much to say on the subject. But instead we find that far more attention has been paid to criticism of points which are merely petty in comparison with the main issues, and up till now we have seen practically nothing put forward in the way of constructive suggestions which are not impracticable for some obvious reason which the proposer has apparently overlooked or has been insufficiently informed to recognise.

The Question at Issue.

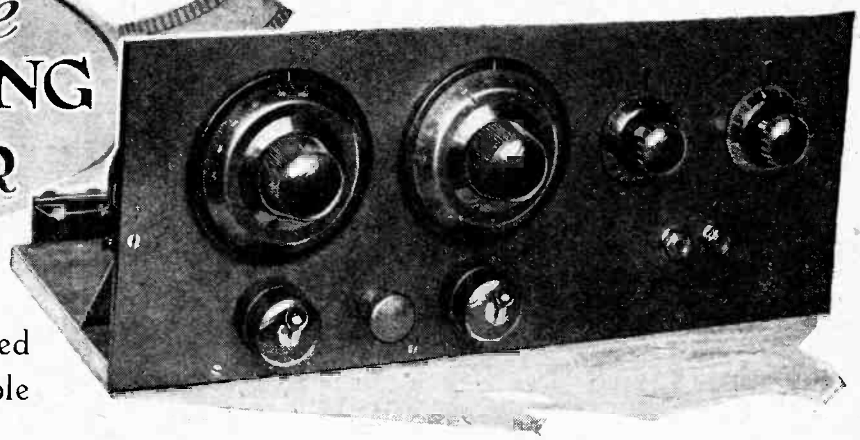
We are inclined to think that a little too much attention is being paid to the question of the mechanism to be established for conducting broadcasting. We feel that the main consideration is whether or not broadcasting as at present organised is meeting with the wishes of the majority of the public. After all, does the average citizen care whether broadcasting is run as a Government concern, or along the present lines, or is purely a private enterprise? Can it really matter to the public, provided that the very best use is made of the possibilities which the broadcasting service has opened up? When we eat a loaf of bread how many of us stop to worry about where the flour comes from, and whether the bread is baked in a coal, gas, or electrically heated oven, so long as the bread is good? In broadcasting, the question of paramount importance is the quality of the programmes and the policy which directs their compilation.

Microphone Advertising.

Amongst the questions of policy, one of outstanding importance, which has apparently been overlooked by many critics who have torn to pieces the programme policy from almost every other point of view, is the question of advertising over the microphone. This is a matter which should receive the closest consideration of the Committee of Enquiry, for sooner or later (unless the policy with regard to advertising is comprehensively defined) the whole character of the programmes must undergo change by the gradual introduction of more and yet more matter which is inspired either directly or indirectly by publicity interests, and the possibility of effecting a remedy in an advanced stage of the disease would be very remote.

CONTENTS.

Two Valve ARMSTRONG RECEIVER



Super-Regeneration Combined with Easy Tuning and Stable Operation.

By F. G. FROST.

RECEIVERS incorporating the Armstrong super-regenerative principle have been described from time to time, but nearly all of them have been purely experimental sets, their operation being very difficult, and the results, although in most cases remarkable, were very uncertain of attainment.

The Armstrong set here described was evolved as the result of experiment with the object of producing an easily operated set as free as possible from the disadvantages usually associated with circuits of this type, and the aim has been certainty of operation with good average results, rather than exceptional performance with erratic behaviour.

Features of the Design.

When working with a frame aerial the set will be found to be very stable and quite free from hand-capacity effects. In fact, the hand may be placed quite close to the frame or other parts of the instrument without upsetting the tuning to any marked degree.

The quenching whistle will not be found objectionable, as it is very highly pitched, and it is not, apparently, amplified by the last valve for this reason.

As only two valves are employed, with a consequent low filament current consumption, the set may be made portable by fitting it into a cabinet of suitable design in which all batteries, etc., are contained.

The circuit diagram appears in Fig. 1, and the system consists of a single super-regenerated valve followed by a stage of transformer-coupled low-frequency amplification.

In passing, it may be mentioned that the application of L.F. amplification to the majority of single-valve Armstrong sets has not been practicable, partly on account of the position of the phones and one of the quenching coils in the plate circuit.

Leaky grid condenser rectification is used with the usual values of capacity and leak, although the latter should be of higher value when receiving on wavelengths below about 200 metres.

Capacity reaction is employed in a manner similar to that in the now well-known Reinartz circuit.

One of the quenching coils, represented by L_4, Fig. 1, also acts as a H.F. choke in the plate circuit of the detector valve. This coil functions quite satisfactorily in its dual capacity, and is eminently suitable as a choke for this purpose on account of its high inductance value.

This coil L_4 is tightly coupled to the coil L_3, resulting in the production of oscillations on a very long wavelength corresponding to a frequency just within audibility.

This has the effect of preventing continuous self-oscillation of the valve on the lower wavelength to which the circuit L_1C_2 is tuned, thereby permitting the use of a greater degree of reaction than could otherwise be used, with a consequent increase of signal strength.

For a fuller explanation of the fundamental principles of the Armstrong circuit the reader is referred to back numbers of this journal.[1]

Plug-in coils are used for the aerial-grid coil and reaction coil, a small fixed condenser, C_1, being connected in series with the aerial to reduce the damping of this circuit when using the set as a "straight"

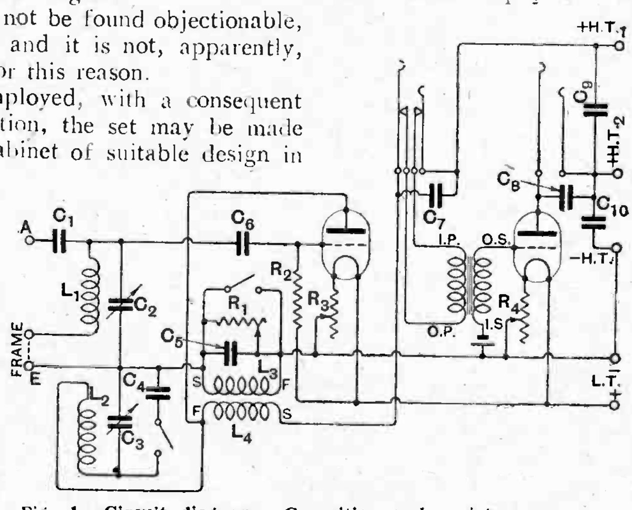


Fig. 1.—Circuit diagram. Capacities and resistances are as follow: C_1, 0·0001 mfd.; C_2, 0·00025 mfd.; C_3, 0·0005 mfd.; C_4, 0·0004 mfd.; C_5, 0·006 mfd.; C_6, 0·0003 mfd.; C_7 and C_8, 0.002 mfd.; C_9 and C_{10}, 2 mfd.; R_1, 10,000 to 100,000 ohms; R_2, 2 megohms.

[1] E. V. Appleton, *The Wireless World*, May 7th, 1924; D. F. Stedman, *The Wireless World*, Nov. 21st, 1923.

Two-Valve Armstrong Receiver.—arrangement with an outdoor aerial, as difficulty is sometimes experienced in producing reaction when the aerial circuit damping is too high. This series condenser also improves selectivity.

A single-valve Armstrong resembles a reflex circuit in some respects, since the valve is performing two functions simultaneously by oscillating at the frequency of the station being received, and also at the quenching frequency. This calls for much the same considerations as obtain in reflex circuits proper, namely, suitable control of both frequency components.

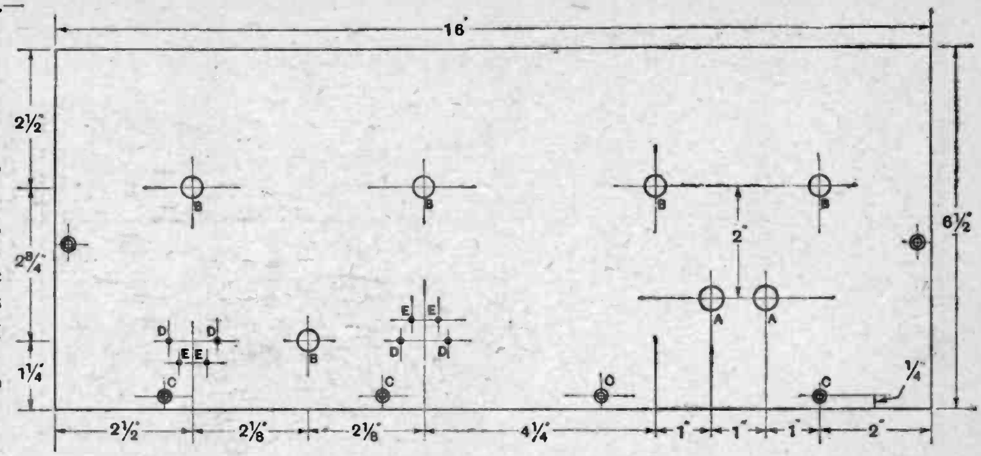


Fig. 2.—Drilling details of the front panel. Sizes of holes are as follow: A, 3/8in. dia.; B, 7/16in. dia.; C, 1/8in. dia., countersunk for No. 4 wood screws; D, drilled and tapped for No. 6 B.A. screws; E, 1/16in dia.

In this circuit the strength of the quenching oscillations is controlled by means of a high variable resistance (R_1, Fig. 1), shunted across the coil L_3. This has a similar effect to loosening the coupling of L_3 and L_4, but is a much more convenient method.

The frequency of the quenching oscillations may be varied by means of the condenser C_5, but a value of 0.006 mfd. is found to give the most satisfactory results.

When not required, the L.F. valve may be cut out of circuit, and this is accomplished by means of plugs and jacks, a "double-circuit closed" jack being used for the detector valve and a "single-circuit open" jack for the L.F. stage. For the sake of simplicity the filament circuits are not included in the jack switching.

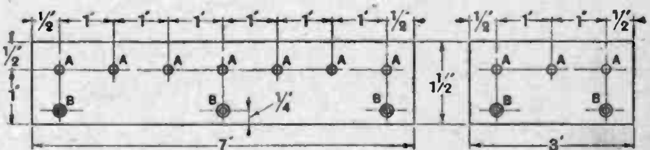
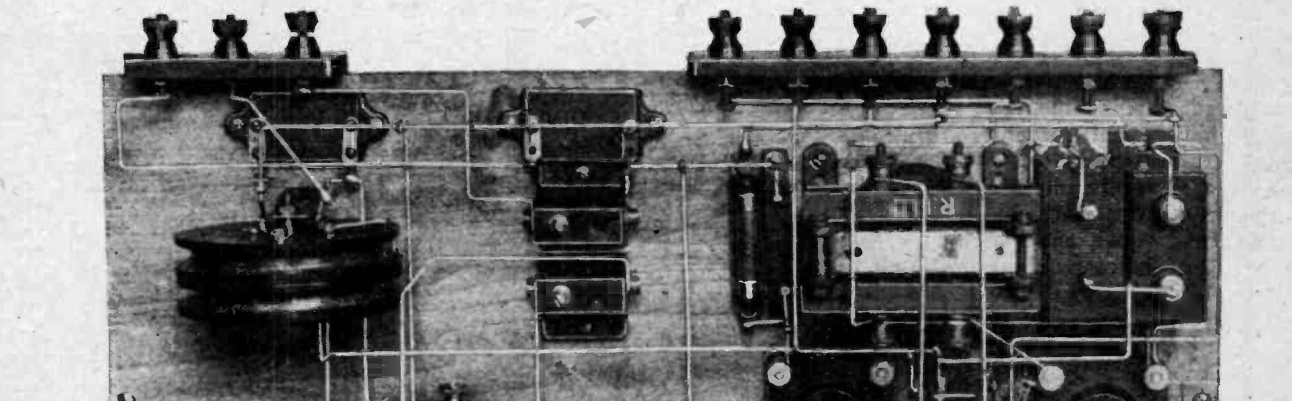


Fig. 3.—The terminal panels. A, 5/32in.; B, 1/8in. countersunk for No. 4 wood screws.



Plan view of the receiver, showing the wiring and layout of components on the base.

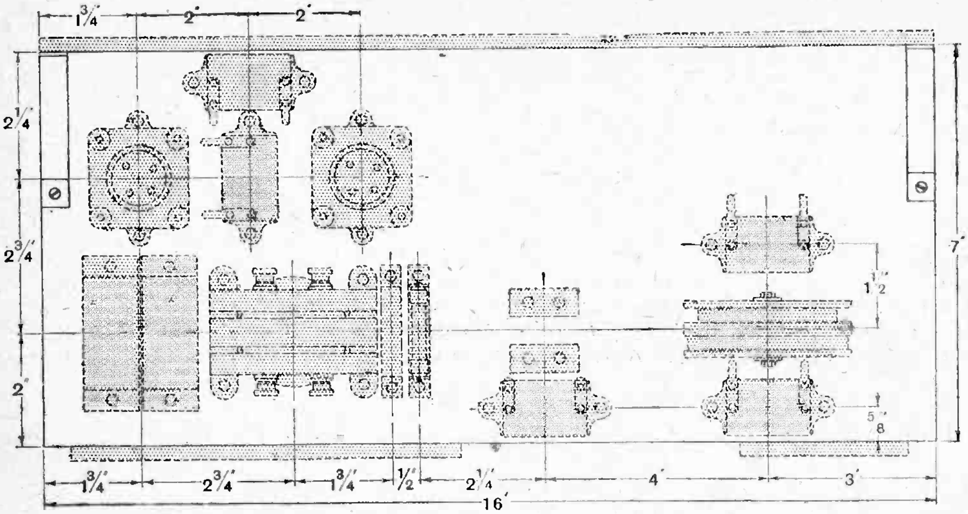


Fig. 4.—Relative positions of components on the baseboard.

A small single-pole switch of the black moulded enclosed variety is connected across the coil L_3 for the purpose of shorting this coil when it is desired to use the straight circuit.

A second small switch of the same type is used to connect the condenser C_4 in shunt with C_3 to provide extra reaction when using the Armstrong circuit.

The condenser C_4 is of 0.0004 mfd., thus giving an overlap of capacity.

This method is preferable to using a 0.001 mfd. variable condenser, as the reaction adjustment would then be rather too sharp.

Fig. 2 gives the dimensions for marking out the ebonite front panel, and the diameters of holes required for securing the various components.

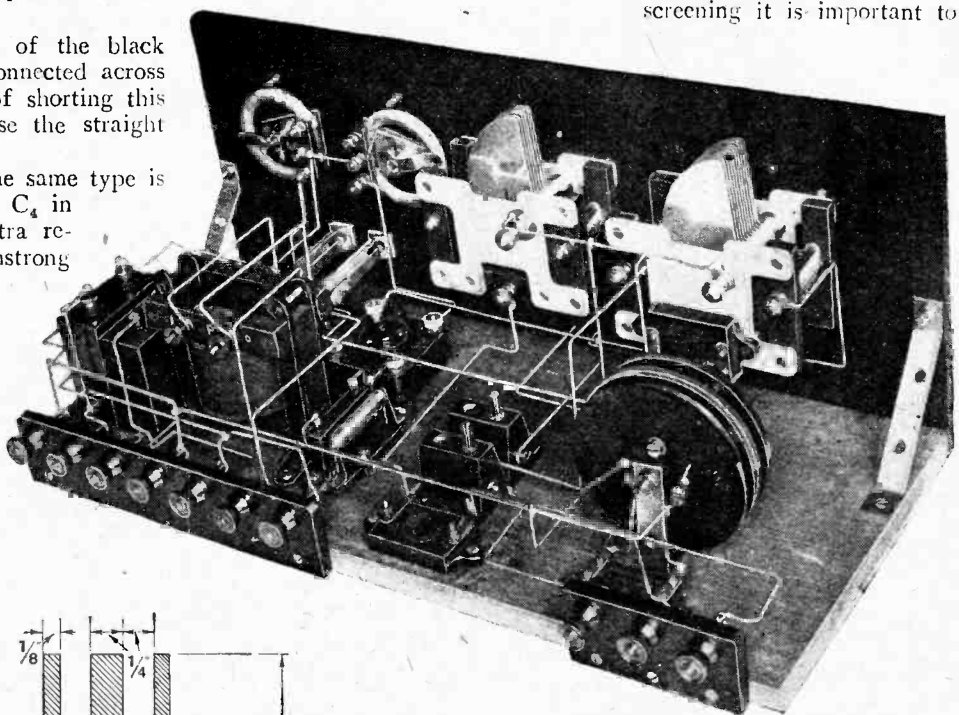
To the left is the variable reaction condenser with the fixed condenser attached to it, and below this is the switch for connecting this condenser in circuit.

Next comes the aerial-grid coil condenser of 0.00025 mfd., and below this the switch for cutting out the Armstrong circuit.

It is convenient to place these two switches with their make and break positions opposite, so that when the Armstrong switch knob is down, the short-circuit is removed; and when the extra reaotion switch knob is down, the fixed condenser is connected in circuit.

The high resistance is placed between the two switches, and on the left are the rheostats with the two jacks beneath.

Burndept geared dials are used on the variable condensers, as tuning is made much easier by this means, and the metal dials ensure freedom from hand-capacity effects. For this screening it is important to connect the moving plates of both condensers to the earth terminal.



Back of panel view, showing method of mounting the fixed condenser C_1 on the end plate of the reaction condenser.

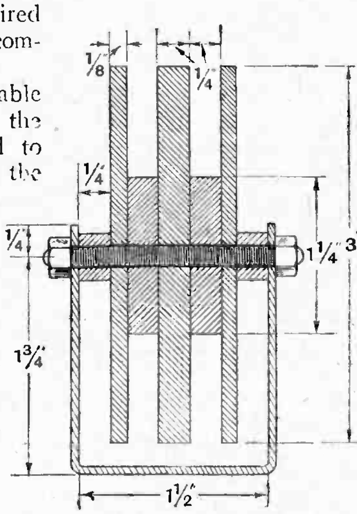


Fig. 5.—Details of the quenching coil former.

Fig. 4 is self-explanatory, showing the layout of components on the baseboard and also the position of the terminal strips, the dimensions of which are given in Fig. 3.

The frame aerial is connected to the centre terminal, and the earth terminal on the smaller strip. These two terminals are shorted when it is desired to use the straight circuit.

The frame aerial consists of eight turns of two-millimetre rubber-covered flex wire wound on a former of the usual pattern, with arms two feet across.

Two-Valve Armstrong Receiver.—

The turns are spaced ¼in. apart, the ends of the winding being brought to two terminals on an ebonite strip fixed to the vertical arm.

Connection from the set to the frame is made by means of flex, such as that used for the winding itself.

The aerial should be capable of being revolved round a vertical axis.

Fig. 5 is a cross-section of the bobbin, on which are wound the "Armstrong" coils.

The discs may be cut out of sheet ebonite by means of a pin cutter and drill, or they may be cut with a fret-saw, and the edges afterwards smoothed with a file, or may be bought ready-made. In any case it is important to see that the smaller discs forming the cores are of correct diameter.

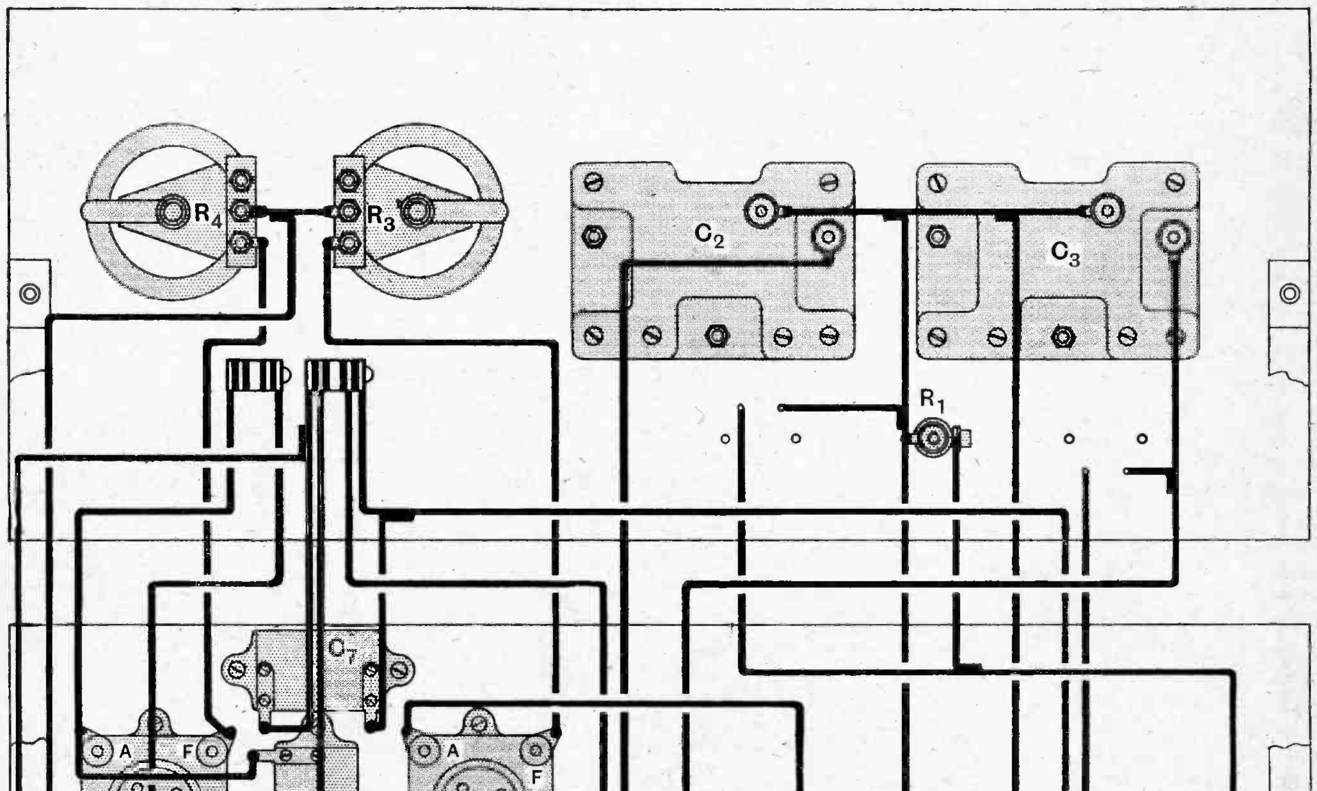


Fig. 6.—Complete wiring diagram. The start and finish of the quenching coil windings are indicated by S and F respectively.

COMPONENTS REQUIRED.

1 Low loss, square law condenser, 0·0005 mfd. (Ormond).
1 Low loss, square law condenser, 0·00025 mfd. (Ormond).
1 Fixed condenser, 0·0001 mfd. (Dubilier).
1 Fixed condenser, 0·0004 mfd. (Dubilier).
1 Fixed condenser, 0·006 mfd. (Dubilier).
1 Fixed condenser, 0·0003 mfd. (Dubilier).
2 Fixed condensers, 0·002 mfd. (Dubilier).
2 Condensers, 2 mfd. (T.C.C.).
1 Grid leak, 2 megohms (Dubilier).
1 Variable anode resistance (Bretwood).
2 Filament rheostats, 30 ohm. (Climax).
1 L.F. transformer (Radio Instruments).
1 Telephone jack, double-circuit closed (Hamley Bros.).
1 Telephone jack, single-circuit open (Hamley Bros.).
1 Telephone plug (Hamley Bros.).
3 Plug-in coils, "A," "B" and "C" (Gambrell).
2 Geared dials (Burndept).
2 Valve holders, suspended type (Benjamin Electric Co.).
2 Small enclosed switches.
No. 36 S.W.G. D.S.C. wire.
2 mm. rubber-covered flex, for frame.
No. 16 S.W.G. bare tinned copper wire.
Ebonite for bobbin and terminal strips.
Ebonite panel, 16in. × 6½in. × ¼in.
Baseboard, 16in. × 7in. × ½in.
Cabinet to suit.

Approximate cost, including cabinet, but excluding valves, batteries, etc. - £9 0s. 0d.

Clearance holes are drilled through the flanges and cores, the centre spacing disc being tapped No. 4 B.A. for the securing screws.

The two ends of each coil are brought out through small holes in the flanges, and are then soldered to double-ended tags, two on each side of the bobbin.

Both coils are wound in the same direction, one consisting of 1,200 turns, and the other of 1,500 turns of No. 36 S.W.G., D.S.C. copper wire.

Before winding, it is advisable to solder the commencement of the windings to their respective tags in order to avoid the possibility of the wires becoming entangled and breaking off short during winding.

The coils may be wound with the aid of a hand-drill held in the vice in a manner described in a previous issue of this journal.[2]

A neat appearance may be imparted to the bobbin when wound by covering the windings with a layer or two of empire cloth secured with a little shellac varnish.

The holder for securing the bobbin to the baseboard is made from $\frac{1}{16}$in. brass ½in. wide, and may be easily bent to the shape shown by first heating the brass.

The wiring is carried out with No. 16 bare tinned copper wire, and as much of the wiring as possible should be done on panel and baseboard before assembling.

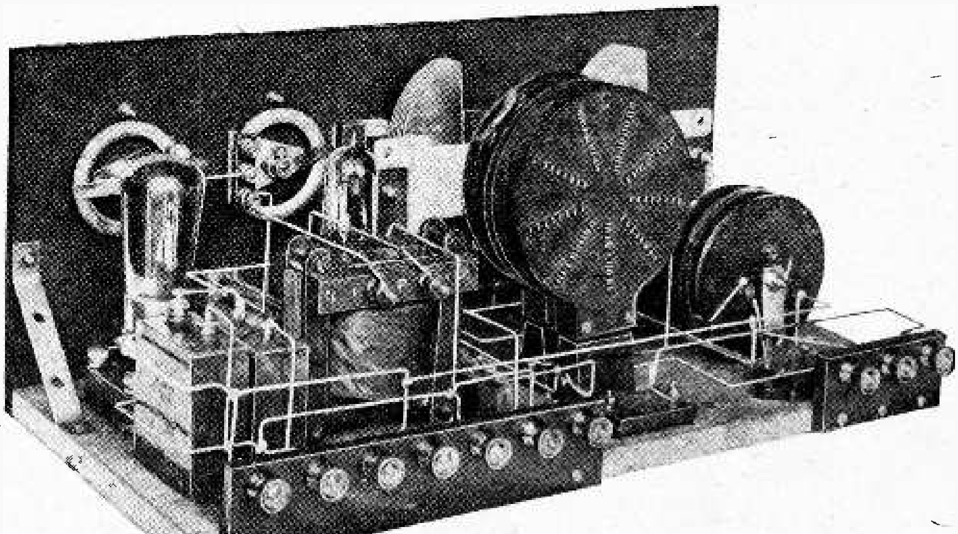
A valve of high impedance should be used as detector and one of lower impedance as L.F., the valves used by the writer being a D.E.R. and a B.T.H. B.3 respectively.

For B.B.C. wavelengths Gambrell coils "B" and "C" are used for the grid circuit, with a "C" coil as reaction.

When using the straight circuit, coils "A" and "B" are suitable for the aerial-grid coil, with "C" coil as reaction.

The set should first be tried with the Armstrong off to ascertain whether the reaction coil is correctly connected.

Having obtained reaction, the high variable resistance should be set at minimum and the Armstrong switched on.



The finished receiver with valves and plug-in coils L_1 and L_2 in position.

The resistance should now be increased until a high-pitched whistle is heard in the phones.

The local station should now be tuned-in, and if it is found that increasing reaction causes the Armstrong whistle to stop, the high resistance should be further increased until the whistle recommences, and after a little experiment along these lines the best value of resistance will be found.

The value of this resistance is different for different valves and values of H.T.

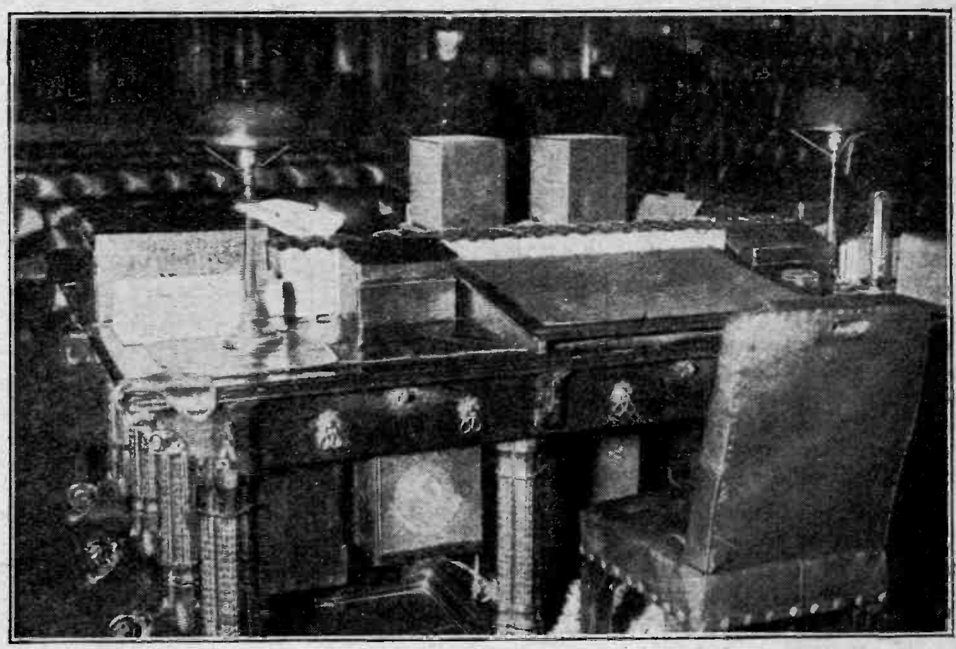
H.T. of about 80 volts for the detector and 100 volts for the L.F. valve gives good results, with, of course, correct grid bias on the L.F. valve.

[2] H. F. Smith, *The Wireless World*, Aug. 26th, 1925.

SPEECH AMPLIFIERS IN PARLIAMENT.

System Adopted in the House of Lords.

Of the many branches connected with the wireless industry, the "Public Address" section is one of the most interesting, and new developments are cropping up day by day. In this particular case, details of a very recent installation have been given which we feel will be of considerable interest to our readers.



The microphones. The two on the table are placed back-to-back and receive from the Government and Opposition benches, while a third, seen below the table on the left-hand side, picks up from the Woolsack.

Headphones in use in the Press Gallery.

IN the House of Lords the acoustic properties of the Chamber are such that they do not in any way lend themselves to public speaking. In fact, in the Press Gallery speech has been inaudible on the majority of occasions.

The installation of loud-speakers had already been considered, but they simply aggravated the trouble by producing an echo of several seconds' duration, rendering the reproduction to the ear as an unintelligible jumble of sounds. Besides, needless to say, such instruments did not in any way blend with the architectural tone of the Chamber.

This necessitated the application of methods quite out of the ordinary to reproduce the speeches, and a telephone system was installed which would enable any member to hear speeches from any part of the House and at the same time enable the Press to hear every word.

Details of the Installation.

After a series of tests conducted by the Office of Works, with various types of apparatus, the Marconiphone system was decided upon, which comprises three Marconi microphones, amplifier, and specially designed telephones. The three microphones are arranged: two back-to-back, facing the Government and Opposition, and one facing the Woolsack.

The wiring system is taken down through the floor of the House to the amplifiers below, from which position the whole is controlled, and the output is taken over distribution lines to the various benches. Twenty-four "Lorgnette" phones are arranged at intervals on the benches for the Peers, and a dozen or so for members of the Press Gallery. Attached to each phone circuit is a separate control

Speech Amplifiers in Parliament.—

which varies the strength of the reproduction to suit individual requirements.

The switchboard has been arranged to enable charging and discharging simultaneously with duplicated sets of batteries, and requires no readjustment during the time in use, necessitating only the switching off and on as required.

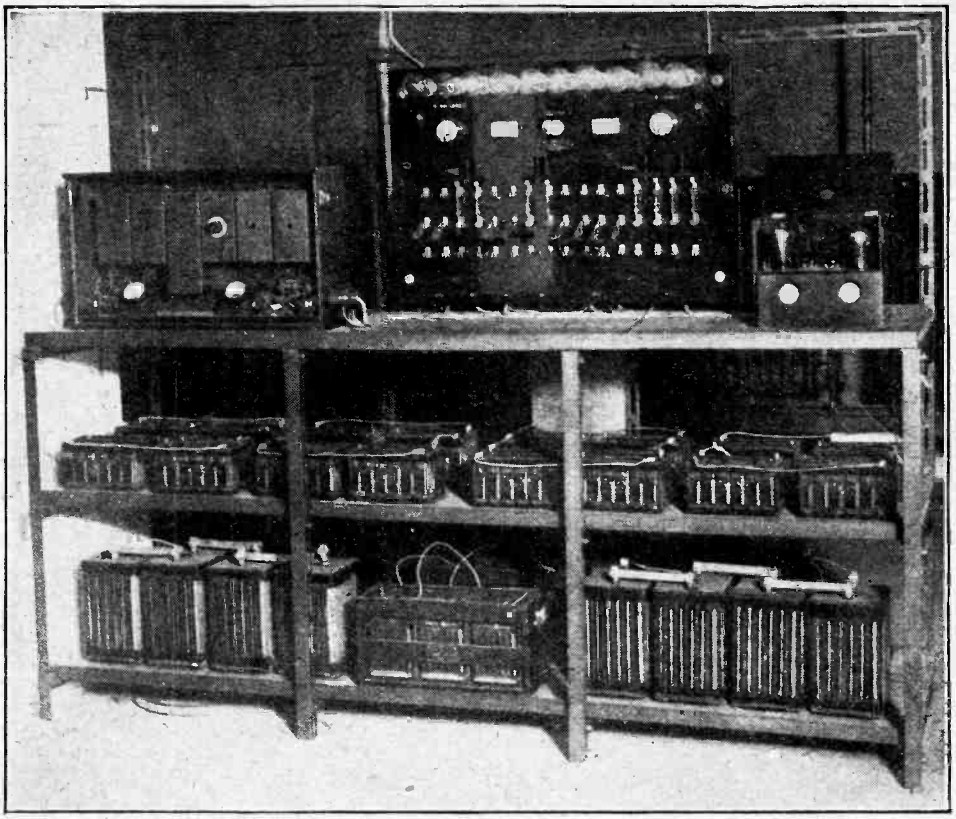
Recently very drastic tests were applied, the results of which fulfilled the most exacting requirements, and created a great deal of astonishment amongst critical members present.

Interference Problems.

As in most cases of this type of installation, considerable interference was experienced from electric motors and the lighting system, especially from two lamps situated close to the two microphones opposite the benches, but by a systematic process of elimination all interference was cleared up, leaving a clear and pure rendering of the microphone "pick-up."

It might be mentioned that the installation was first put into operation recently, during the discussion of the historical Locarno Pact, when Lord Haldane spoke, and, for the first time, the speech was heard perfectly, not only by the back benches but also by every member of the Press.

Further tests have been conducted on the other side of the Thames Embankment at County Hall, Westminster, where the acoustic properties are somewhat more aggravating than in the Upper House.



Amplifiers, H.T. and L.T. accumulators and charging board of the House of Lords speech-amplifying equipment.

TRANSMITTING NOTES AND QUERIES.

General Notes.

Señor Miguel Moya (EAR1), Concordia 4, Madrid, has been elected President of the Spanish section of the Amateur Radio Union.

oooo

Mr. J. A. Partridge (2KF), arranged an interesting round the world" test on Sunday, November 29th, working from 6 a.m. to 6 p.m. Starting with the 6th District in U.S.A., he got into touch with a station in Pasadena, California; he then worked the 4th, 2nd, and 1st Districts, and later was in communication with New Zealand, 4AC (R. E. Robinson, Dunedin), and Australia 3YX (B. Hardie, Melbourne); the latter reported his signals to be R7. Mr. Partridge was also able to work with Brazil and Canada, where he was in communication with 3AA (W. L. Love, Galt, Ontario).

On other occasions 2KF has been heard in South Africa by A4M (S. C. Pleass, Johannesburg) on 23 metres when working with a Mullard 0250 valve and 170 watts input; he has also worked with GFUP, H.M.S. "Durban," when this vessel was in Japanese waters.

oooo

Several Swedish boats are now equipped with short-wave apparatus operated by amateurs, and can be heard working experimental tests. They will welcome reports.

oooo

Mr. J. J. Fassett (1AR), Pleasant Street, Dartmouth, Nova Scotia, and several other Canadian amateurs are now working together on wavelengths of 15 to 17 metres, and will be glad of any reports from British listeners.

German Transmitting Schedule.

Reports on a new series of tests on Wednesdays and Saturdays will be welcomed by K-Y5 (Herr Fritz Sabrowsky, Gutenbergstr. 62, Stuttgart). The transmissions are carried out on 46.5 metres from 2200-0100 G.M.T.

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New Call Signs Allotted.

2IT.—B. Walsh, Clovelly, Victoria Street, Armagh, N. Ireland, transmits on 23, 45, 90, and 150-200 metres.

5WV.—D. Woods, Station House, Braintree, Essex (in place of 2AXZ), transmits on 23 and 45 metres, and will welcome reports.

oooo

Changes of Address.

Mr. C. A. Liles (G6TH) advises us that his address is now "Morningside," Fields Road, Newport, Mon.

Mr. K. H. Thow (G2TK), 2, Victoria Road, Eltham, S.E.9, transmits on wavelengths of 23, 45, 115-130, and 150-200 metres, but will be away in Iceland for the next two or three months.

CHOKE AMPLIFICATION.

Choice of Valves and Design of Chokes for Audio-Frequencies.

A. C. BARTLETT.

OF the various methods of L.F. amplification available, resistance coupling for freedom from distortion can scarce be excelled; choke amplification, however, is very good, and has advantages in that slightly more amplification can be obtained, and that either less H.T. volts are required, or with the same H.T. volts considerably greater voltage swings can be dealt with.

The theory is quite simple; using Vallauri's idea of the three-electrode valve—if an alternating voltage e be applied between grid and filament of a valve having an impedance R_i ohms and amplification factor m, the alternating component of the current flowing through any apparatus connected in the anode circuit would be the same as if a small alternator of voltage $m \times e$ having an internal resistance R_i were connected to the apparatus.

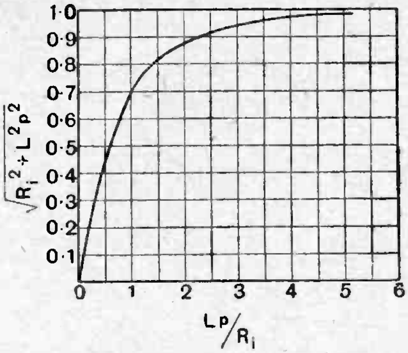


Fig. 1.—Curve showing relation between voltage amplification and the ratio between the external impedance Lp and the internal impedance of the valve R_i.

Consider the case of a valve having in its anode circuit an inductance L, the frequency of the applied E.M.F. being $\frac{p}{2\pi}$. Then the current through L will be $\frac{me}{\sqrt{R_i^2 + L^2p^2}}$, therefore the voltage across L will be $\frac{meLp}{\sqrt{R_i^2 + L^2p^2}}$, and the voltage amplification will be $m\frac{Lp}{\sqrt{R_i^2 + L^2p^2}}$.

Obviously at very high frequencies, when Lp is very large compared with R_i the amplification will become equal to m; it cannot be greater than m, which suggests that "high m" valves should be used for choke coupling.

The behaviour at lower frequencies is shown by means of the curve of Fig. 1, where $\frac{Lp}{\sqrt{R_i^2 + L^2p^2}}$ is shown plotted against the value of $\frac{Lp}{R_i}$, it will be seen that a value of about 3 is sufficient to give very nearly full amplification.

As an example, Fig. 2 gives calculated values of amplification for various values of inductance with assumed valve constants.

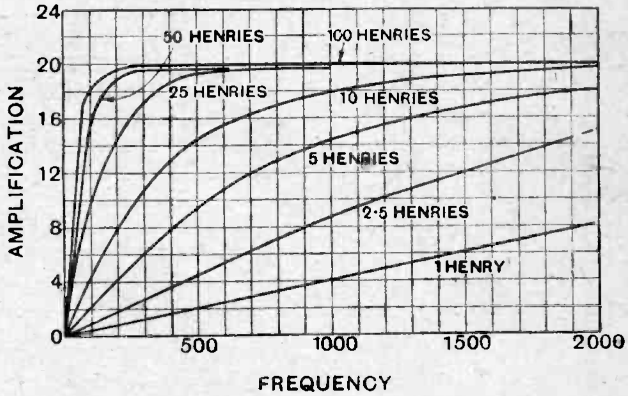


Fig. 2.—Calculated amplification curves for a value with internal impedance R_i of 30,000 ohms and amplification factor m of 20.

The capabilities of any valve for choke amplification can be most easily estimated by taking static characteristics of the valve and plotting constant anode current curves with anode volts as ordinates and grid volts as abscissæ.

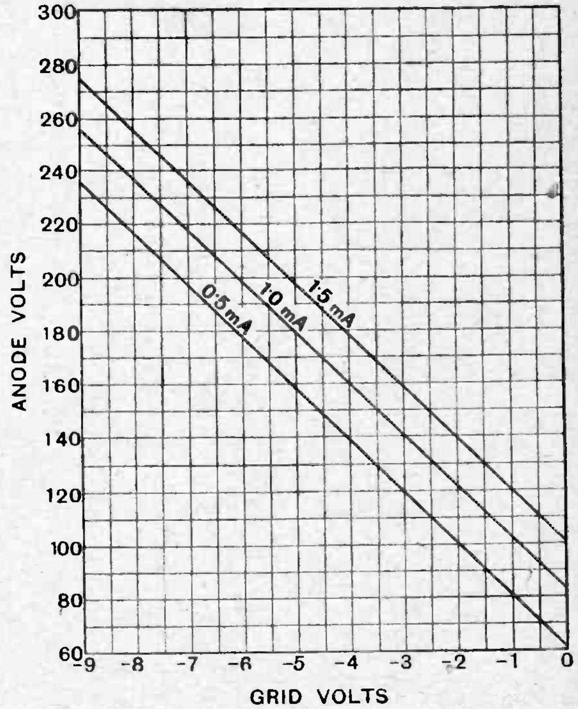


Fig. 3.—Constant anode current curves for the D.E.5B valve.

Fig. 3 gives such a set of curves for an Osram D.E.5B. valve; over the range plotted they are practically straight lines.

Choke Amplification.—

Suppose this valve is connected up as a choke amplifier and that the choke is an ideal choke, that is to say, has an infinite inductance and no D.C. resistance, and that a H.T. voltage of 150 volts and grid bias of – 3.5 volts are used. Then the anode current will be 1.0 mA., and if now we change the grid voltage, there can be no change in the anode current, since the anode inductance is assumed infinite. Thus, if we swing the grid volts

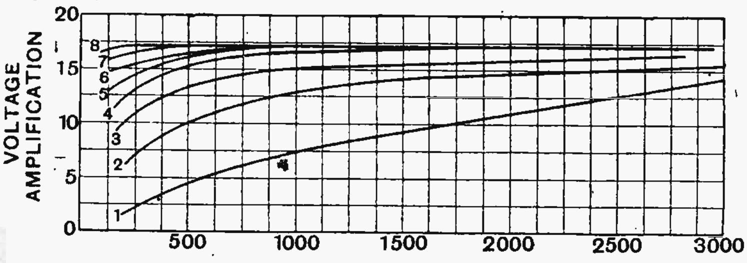


Fig. 4.—Measured voltage amplification curves for a D.E.5B. valve, the external impedance consisting of an 8,000-turn choke wound on an intervalve transformer core and tapped every 1,000 turns.

from 0 to – 7 the anode volts will swing from 83 to 216, the corresponding grid and anode volts always being represented by a point in the 1.0 mA. line.

Thus theoretically the valve with this adjustment will take an input grid swing of 7 volts without running into grid current, and deliver an output voltage swing of 216 – 83 = 133 volts, the voltage amplification being $\frac{133}{7} = 19$.

Again, without 120 volt H.T. and – 3 volts grid bias we see that without running into grid current the input voltage swing can be 0 to – 6, while the output voltage swing is 176 – 62 = 114, the anode current being 0.5 mA.

In practice, of course, an infinite inductance is not available, but since the impedance of the choke is large compared with that of the valve, the above assumption is approximately true; further, there are losses in the grid leak and iron core, so that the full theoretical amplification is never quite attained.

The upper curve in Fig. 4 shows the results of some measurements of the voltage amplification of a D.E.5B. valve taken at varying frequencies with a choke consisting of 8,000 turns of No. 42 S.W.G. wire wound on a closed core of stampings such as are used for intervalve transformers; the amplification curve is remarkably flat.

A useful refinement to introduce when making such a choke is to bring out a number of tappings. The connections are as Fig. 5. the whole of the choke being permanently connected between H.T. + and anode, while the coupling condenser is connected to a tapping. Such tappings allow a comparatively fine adjustment of amplification; for example, suppose the choke has 8,000 turns and at full tap gives an amplification of 18, then if 3,000 turns are between H.T. + and the coupling condenser the amplification will be $\frac{3,000}{8,000} \times 18 = 6.6$, and so on, while the flatness of the amplification curve is fully retained.

So far distortionless amplification has been dealt with, but it is often of value to introduce a certain amount of controllable distortion; the tapped choke can be used for this purpose.

In this case the connections are as in Fig. 6.

Here the effect of reducing the number of turns, and therefore the anode inductance, is to decrease the amplification at the lower frequencies, as would be expected from a consideration of the curves of Fig. 2.

Fig. 4 gives the amplification obtained with tappings from one thousand to eight thousand turns of the same 8,000-turn choke with a D.E.5B. valve.

Thus by reducing the tapping we can amplify the higher tones more than the lower, which is sometimes advantageous when a loud-speaker having a rather low resonant frequency is used.

The experimental curves given all refer to a "high m" valve, the Osram D.E.5B.; other valves, such as

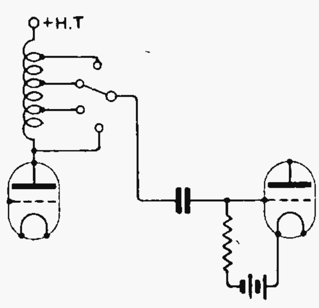


Fig. 5.—Tapped choke arranged to give volume control without introducing distortion.

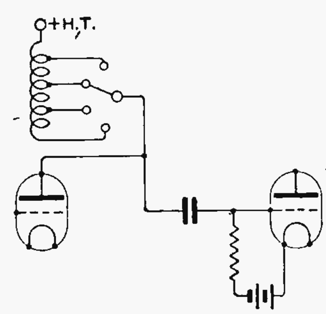


Fig. 6.—Connections of tapped choke for reducing amplification on the lower frequencies.

the D.E.3B., D.E.2H.F., and D.E.8H.F. are also suitable.

"Low m" valves, of course, can be used, but they give a smaller amplification, and, what is of greater importance, take larger currents from the H.T. battery. They can, of course, deal with much larger input voltage swings, but output voltage swing is not much greater.

HIDDEN ADVERTISEMENTS COMPETITION.

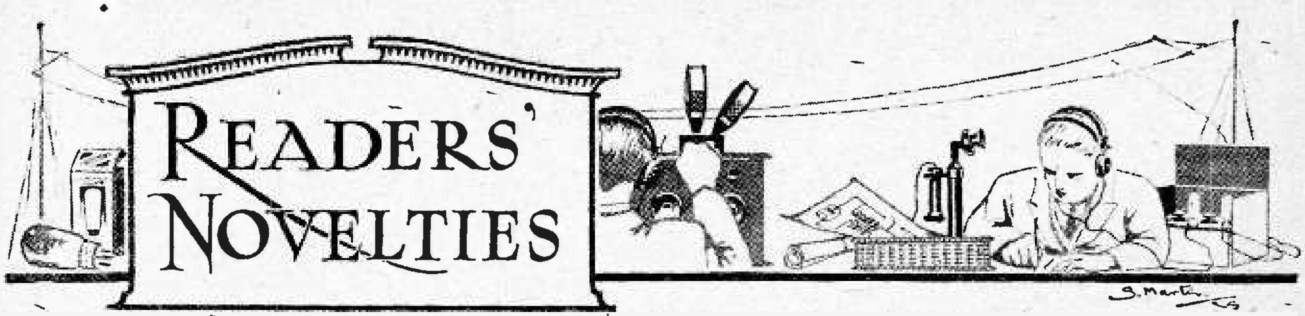
The Hidden Advertisements Competition, recently inaugurated in "The Wireless World," has proved to be extremely popular, and the Competition will be continued from week to week until further notice.

The recipients of prizes in the first week of the Competition are as follow:—

Courtenay H. Davis, Westcliff, £5.
Ian Redvers Brown, New Milton, Hants, £2.
A. E. G. Kennard, Sidcup, Kent, £1.

Ten Shillings each to the following four:—

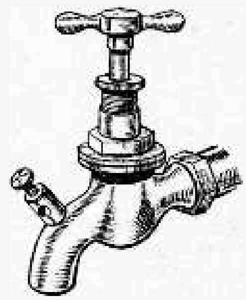
C. A. Chalmers, Crookes, Sheffield.
D. E. Eastham, London, S.W.17.
C. E. St. G. Caulfeild, Wimbledon, S.W.19.
H. R. Webb, Tufnell Park, N.19.



A Section Devoted to New Ideas and Practical Devices.

EARTH CONNECTION.

The usual water pipe earth connection is often unsatisfactory owing to the large surface and inadequate pressure applied by the conventional earthing clip. A far sounder joint from the electrical point of view is



Earth connection to the water tap.

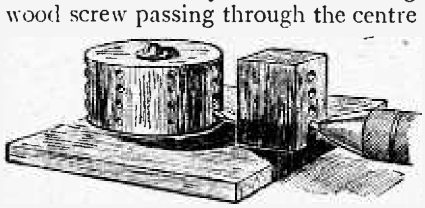
obtained by drilling and tapping a hole for a small terminal, as indicated in the diagram. It is most important that the tap should be drilled only at the point indicated in the diagram, which is on the out-flow side of the valve.—H. H.

oooo

DRILLING COIL FORMERS.

The diagram shows the construction of a simple jig for drilling the holes for winding pegs in the formers of duolateral and other types of coil.

The coil former is screwed to a small baseboard by means of a long wood screw passing through the centre



Drilling jig for duolateral coil formers.

hole. A thin washer inserted under the head of the wood screw will increase the friction and prevent the coil former from turning while the drilling operation is in progress. The drill is inserted through a guide block screwed to the baseboard near the front edge, several holes being provided in order that the spacing of the pegs may be varied according to the type of coil which it is required to produce.—J. T. H.

oooo

LOUD-SPEAKER CONNECTIONS.

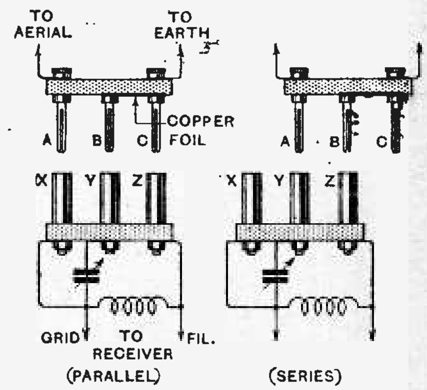
The connections of loud-speakers and telephones should be so arranged that any permanent current flowing through the windings tends to assist the field produced by the permanent magnet. The positive terminal if not marked + can be located in the following manner. Connect the loud-speaker to the receiver and adjust the diaphragm until it just begins to rattle on the pole pieces, then reverse the loud-speaker leads and observe the effect on the tone of the loud-speaker. If the rattle is increased, or if the diaphragm has been attracted to the pole pieces, the leads are now correctly connected, but if the rattle has decreased, showing that the diaphragm is further away from the pole pieces, it will be necessary to revert to the previous method of connection. —R. H.

oooo

SERIES-PARALLEL SWITCH.

A neat series-parallel switch can be constructed with a set of three valve pins and sockets. The diagram shows the method of mounting these, the pins B and C being connected by means of thin copper strip. With the pins A, B, and C in the sockets, X, Y, and Z respectively, the tuning condenser is connected in parallel with the A.T.I.

To connect the tuning condenser in series with the aerial, it is necessary to move the pins into the position shown at the right-hand side of the diagram. A is then inserted in Y



Series-parallel switch.

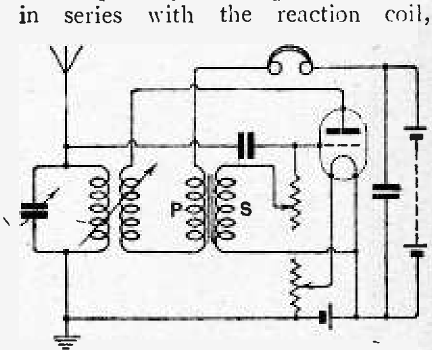
and B in Z. A separate panel carrying two sockets electrically joined together, and having spacing corresponding to the distance between the pins A and C, may be used to earth the aerial when not in use.—L. L. J.

oooo

REFLEX CIRCUIT.

The diagram shows the method of connecting a low-frequency transformer in a simple reacting single valve circuit, which has proved effective in increasing signal strength.

The primary winding is connected in series with the reaction coil,



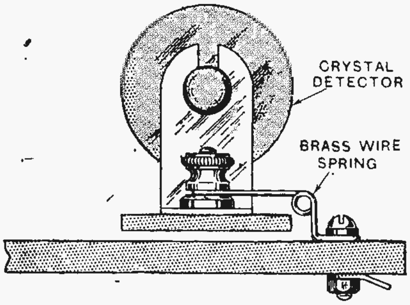
Simple reflex circuit.

while the secondary is connected between one end of the variable grid leak and + L.T. It is essential that a variable grid leak should be employed, as the success of the circuit depends upon the correct adjustment of this resistance. Usually a fairly high value is required to prevent the set from howling. The various connections of the transformer should be tried, as it will be found that amplification will be obtained with only one system of connections.—A. R. B.

oooo

CRYSTAL DETECTOR MOUNTING.

If it is found difficult to keep the crystal detector in correct adjustment through vibration of the receiver panel, it will be found an advantage to mount the detector as a whole



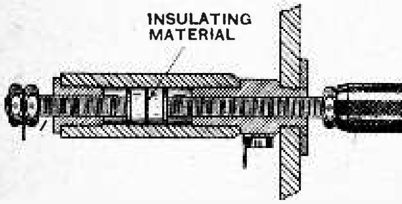
Spring mounting for crystal detectors.

on wire brackets of the shape shown in the sketch. The holes already drilled in the panel for securing the detector terminals and clips may be used to clamp down one end of the wire loop. The other ends of the springs are clamped under the terminals of the detector, which may have to be remounted on a small ebonite strip if of the panel mounting variety. J. C. K

oooo

NEUTRODYNE CONDENSER.

A faulty variable grid leak can be made to give good service as a neutrodyne condenser if converted according to the directions given in the diagram.



Neutrodyne condenser converted from variable grid leak.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A receiving valve will be despatched to every reader whose idea is accepted for publication.

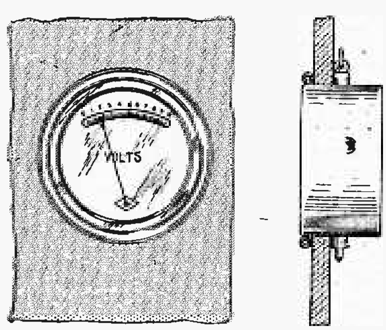
Letters should be addressed to the Editor, "Wireless World and Radio Review," 139, Fleet Street, London, E.C. and marked "Ideas."

If the grid leak is of the compression type containing a series of small discs impregnated with carbon, an adjusting screw is generally fitted with a small disc which serves as the variable electrode of the neutrodyne condenser. A small disc of mica should be inserted to prevent short circuiting.—G H. B.

oooo

MOUNTING FLANGELESS INSTRUMENTS.

Many low-priced instruments which are quite suitable for testing filament voltage cannot be mounted on the front of the receiver panel owing to the fact that they are not provided with flanges through which securing screws may be passed.



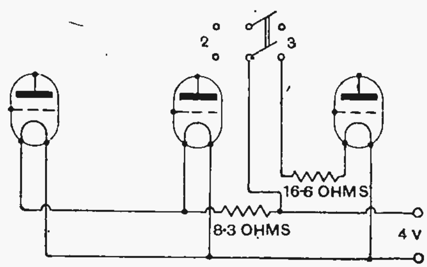
Panel mounting for a pocket voltmeter.

The diagram shows a very convenient method of mounting these instruments, which also enables them to be withdrawn, if desired, for tests and experiments outside the receiver. A circular hole slightly larger in diameter than the instrument itself is cut in the panel with a special "fly cutter" by drilling a series of holes and carefully breaking out the centre piece. The voltmeter is then inserted from the back, and a round rubber ring, having a cross-section of approximately ¼in., is stretched over the projecting front of the instrument, and so adjusted that it tends to pull the meter forward against the projecting point contact and ring holder. If a rubber ring of suitable diameter is not available, one may be improvised with a short length of rubber tube, held in position by a central wire pulled tight and twisted up with the meter in position.—H. A.

oooo

FILAMENT SWITCHING.

When operating 60 milliampere valves from a 4-volt accumulator with a fixed resistance in series, some difficulty is experienced when it is desired to reduce the number of valves in use in the receiver. Thus



Switching fixed filament resistances for 3-volt, 0·06 amp. valves.

a higher value of resistance is required when two valves are connected in parallel than when three valves are being used. When the number of valves is changed the value of the fixed resistance may also be changed to maintain the filament current at the correct volume by fitting an extra set of contacts to the changeover switch between the second and third valves. The diagram shows how the method may be put into operation in practice.—K. L.

oooo

DISTILLED WATER.

During the winter months a supply of distilled water for "topping up" accumulators may be obtained by melting freshly fallen snow.

When water freezes the ice crystals form from pure water only, and all dissolved impurities are rejected. Supplies of water obtained in this way should last for several months, but it is unwise to keep distilled water too long, as it is known that in time impurities are dissolved from the walls of the containing vessel.—R. S. A.

RADIATION IN OSCILLATING RECEIVERS.

Some Measurements with a Vacuo-Junction.

By E. A. ANSON.

EVERY wireless receiver in an oscillating condition is radiating power as a small transmitter; the current in the aerial is there, and can be measured if the measuring instrument is sufficiently sensitive. That power is being radiated by receivers on the broadcast wavebands is distressingly obvious in most districts. Some actual measurements as to what is being radiated may interest users of valve receivers, and perhaps cause persistent oscillators to stop and think.

Nearly all high-frequency measurements make use of some heating effect when measuring currents. The system adopted in these tests makes use of a vacuo-junction,

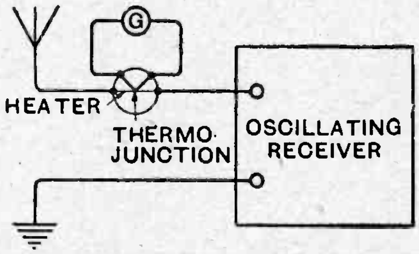


Fig. 1.—Method of connecting the thermo-junction and galvanometer to the receivers under test.

which has an advantage in that calibration can be carried out with direct current. Those who are not clear on the action of a vacuo-junction may find the following description helpful. When either direct or alternating current flows along a wire heat is generated always. The higher the resistance of the wire and the larger the current the greater the heat generated. When two dissimilar metals are joined together, either by twisting or soldering two wires together, and the junction is heated a small voltage is set up across the free ends of the wires. This may be detected by a sensitive direct current galvanometer. Thus, if alternating current is passed through a heater wire in contact with a junction of dissimilar metals, the junction will become heated and the direct current galvanometer will detect the voltage caused by the heating. If the heater and thermo-junction are placed in a

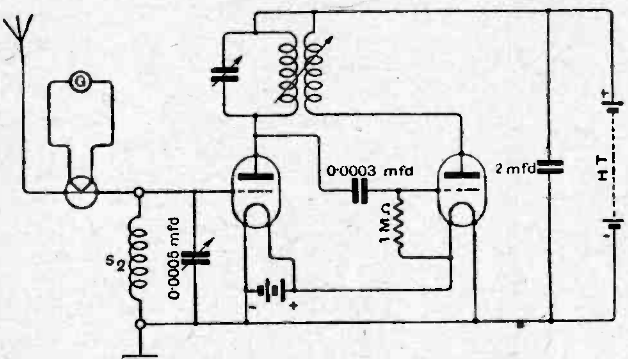


Fig. 2.—Two-valve circuit (H.F. and detector) used in the preliminary tests. Reaction is coupled to the tuned anode circuit.

glass bulb exhausted of air the sensitivity is increased, and it is called a vacuo-junction. The diagram below shows the general layout adopted for the measurements.

The galvanometer was a suspended coil instrument with a resistance of 103 ohms, giving full deflection for 1 millivolt. It was obtained quite cheaply from Messrs. Heayberd and Co. The vacuo-junction was obtained from the Cambridge Instrument Co., Ltd. The heater resistance was 8.76 ohms, and a current of about 10 milliamps A.C. or D.C. across the heater gave full deflection on the galvanometer. The aerial consisted of one single 7/22 wire, 100ft. long and 35ft. high. The "earth" consisted of 4 wires buried under the aerial and soldered to the water main at the far end. The earth resistance was 18 ohms, so that the total resistance, including the vacuo-junction, was about 27 ohms.

The aerial capacity was 0.00027 mfd.

The first tests were carried out on a tuned anode and detector receiver connected as in the diagram below. Reaction was on to the anode from the plate of the detector,

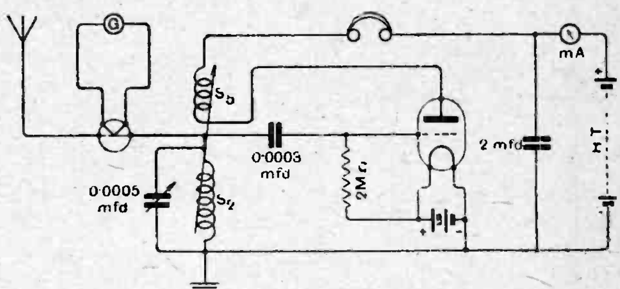


Fig. 3.—Single-valve reacting receiver which gave the results shown in the table.

and the anode coil and aerial coil were connected in such a way as to assist reaction in the aerial circuit.

Burndept coils were used in all the tests. In this case with a H.T. battery of 80 volts, and using bright emitter valves at 300 metres, the aerial current when oscillating was 0.25 milliamp. With a H.T. of 140 volts the aerial current rose to 1.5 milliamps. Tests were then carried

Valve.	H.T. Volts.	Aerial Current, Milliamperes.			
		Maximum.	Just Oscillating.	Just not Oscillating.	Tuned to 2EH–326 Metres Min. Reaction.
	60	—	—	1.8	0.7
Marconi-	80	4.3	3.0	2.0	0.8
Osram	100	6.1	4.1	3.4	0.9
"R."	120	8.0	4.3	3.8	1.5
	40	1.4	1.2	0.5	0.7
D.E.3 ...	60	4.8	2.0	1.0	1.1
	80	9.0	3.0	2.5	1.6

Radiation in Oscillating Receivers.—
out in greater detail on a one-valve set. The circuit was a typical one-valve circuit, as may be seen from the diagram.

The wavelength used was 326 metres. The table shows the results obtained, which are fairly representative of the radiation that can be put out into the ether by a one-valve set when oscillating. With a counterpoise in place of the earth and a bright emitter at 80 volts H.T. the aerial current increased to 5.1 milliamps. The reaction coil used was only large enough to give normal reaction, and was not chosen so as to get as much radiation as possible. An S.4 coil was too small. Full reaction consisted in placing the coils almost touching, and gave a maximum of radiation. Just oscillating needs no explanation, whilst just not oscillating was such that distortion of speech occurred, although the oscillation "plonk" had not been reached.

It is obvious from these tests that a tuned anode receiver will cause very much less disturbance than a detector valve straight on the aerial. A one-valve receiver reacting on the aerial would appear to be quite an efficient transmitter. It is interesting to note that even before oscillation has occurred there may be quite a considerable aerial current; caused presumably by the decreased aerial circuit resistance. This aerial current would not have any but the transmitter frequencies, and should act as a local relay station to the benefit of neighbouring crystal receivers. It is hoped that valve users will realise from these tests that their receivers are emitting quite considerable power when oscillating and will cause annoyance over many square miles of country.

Calls Heard.

Extracts from Readers' Logs.

Thornton Heath.
Germany: KK7, 4LV, KXH, KPL. Czecho-Slovakia: OK1, AA2. Sweden: SMTQ, SMVS, SMUK, SMWF, SMXU, SMXX, SMZS, SMZZ. Finland: 2CO, 2ND, 2NL, 2NN, 3NB, 5NF. Italy: 1AS, 1BD, 1GB, 1RM, 1BB, 1BP, NTT. Russia: RCRL, NRL. Norway: LA4X, LA1A. India: HBK. Tunis: OCTU. Palestine: 6YX. Malta: GHA. Yugo-Slavia: 7XX. Switzerland: 9AD, 9BR, 9XB. Canada: 1AR, 2BG, 2FO. Porto Rico: 4JE, 4SA, 4UR. Brazil: 1AB, 5AA, 5AB. China: GFUP. Denmark: 7ZM. Java: ANE. Miscellaneous: NISR, GB1, EAC9, FL, OCML. French Morocco: N-LAB, FW, GCS, SDK, GHK, GB2, SDK. U.S.A.: 4IO, 4OA, 4RM, 4TP, 4TV, 4XE, 8ALY, 8BPL, 8BTH, 8DPL, 8DON, 8ADG, 8GZ, 8JQ, 8ZU.
(0-v-0.) W. A. J. Warren.

Belfast.
November 3rd to 17th.
Great Britain: 2AK, 2AO, 2EQ, 2JU, 2VS, 2QB, 2GY, 2VO, 2MX, 5HX, 5SK, 5MO, 5IK, 5KO, 5XO, 5PM, 5RB, 5HG, 5ID, 5ZU, 6BQ, 6LB, 6FA, 6AH, 6KB, 6LJ. France: 8DD, 8WOZ, 8QR, 8VX, 8OQ, 8PAX, 8GRA, 8TK, 8MH, 8RIC, 8FW, 8JD, 8HM, 8BE, 8SG, 8JF, 8DSH, 8GM, 8DK, 8AU, 8PKX, 8SOT, 8HFD, 8WZ. Italy: 1AS, 1AF, 1BB, 1BD, 1GB, 1RM. Holland: OWC, OQX, 2PZ, OKV, OKW, OGG, OCZ. Switzerland: H9XB. Germany: 4LV, 4WU. Argentine: BA1. U.S.A.: 1CH, 2CVJ, 2GK, 3JO, 4JE, 4TV, 4SA. Sweden: SMXR, SMYV. Finland: 2CO, 2ND. Belgium: G6, K3. Czecho-Slovakia: AA2. Hungary: 1CF. Java: ANE.
(0-v-1.) Below 60 metres.
J. P. Allen (G6YW).

Thornton Heath.
Java: ANE. India: HBK. Brazil: BZ2SP, BZA1, BZ5AA. Porto Rico: 4SE. U.S.A.: 4TV, 8DON, 8ALY, 8FL, 8EQ, WIZ, WIR, NKF, NVE, 9ZT. Canada: 1AR. Morocco: F8MB, MAROC. Spain: EAR21. Norway: LA1A, LA4X. Yugo-Slavia: YS7XX. Czecho-Slovakia: CSOK1, CSAA2. Luxembourg: LOOR. Mesopotamia: 1DH, GHH. Finland: 2ND, 2NM, 5NF, 2CO. Switzerland: 9AD, 9BR, 9KD. Miscellaneous: GB1, GB2, FB1, POB1, AIS1, SDK, AIN, FW, OCML, NISR, NTT, SGC, NKY. Telephony: F8HU, F8BF, I1RG, KXH, G2OO, G2NM, G2KF, G6TD, G6AH, G2SZ, G2LZ.
(0-v-0.) Below 50 metres.
M. E. Coaffee.

Bath.
November 22nd to 29th.
U.S.A.: 1ACI, 1AH, 1AMF, 1APV, 1AVF, 1AXA, 1BV, 1CCX, 1CH, 1CK, 1CMF, 1II, 1KA, 1KS, 1RD, 1RR, 1SI, 1UCK, 1YB, 1YG, 1ZSJ, 2AET, 2AGQ, 2BKR, 2BQL, 2CV, 2GK, 2KR, 2WR, 2XAF, 3APV, 3BWT, 3CNU, 4LV, 6BUC, 6HM, 8AOK, 8BPL, 8BWW, 8CBI, 8CES, 8DAE, 8DON, 9DNG, 9VO, NKF, WIZ, WQO. Canada: 1AR. Argentine: LPZ. Chile: 9WF. Brazil: 1AB. Porto Rico: 4JE. Cuba: 2JT. Africa: A4X, OCDJ. Palestine. 6ZK. New Zealand: 4AC. Miscellaneous: INCC, RRP, RKX, MWF, U NISP, UNTT (Adriatic).
(0-v-1, no aerial or earth). 10-50 metres.
G. W. Salt.

Haslemere.
Great Britain: 2KZ, 6LG, 5DK, 2KF, 2NM, 2UV, 2GO, 2GY. France: 8QRA, 8PKX, 8IX, 8DK, 8EE, 8RPB, 8EV, 8EW, 8RB, 8TOK. Denmark: 8NN. Holland: OGG. Italy: 1BD, 1 AM. U.S.A.: WIZ. Scorpion. Miscellaneous: PCLL, 1GB. Maroc.
N. Gutteridge.

Birmingham.
November 3rd to 29th.
U.S.A.: 1ATJ, 1ACI, 1ARK, 1AAO, 1BGC, 1BKE, 1CCX, 1CH, 1CKP, 1CMF, 1CNP, 1CMP, 1CAL, 1HN, 1IB, 1RR, 1SI, 1TP, 1ZS, 2AKY, 2CGJ, 2CLG, 2CVJ, 2BNN, 2AGQ, 2GK, 2KU, 2MM, 2ZV, 3AHA, 3BHV, 3CBV, 3JW, 3DH, 3JO, 4IB, 4TV, 5YD, 8ALY, 8AJ, 8AWA, 8AYY, 8ADM, 8BGN, 8BNH, 9AJJ, NISP. Canada: 1AR, 2FO, 2BG. Bermuda: BER. Brazil: 1AB, 1BC, 2CC, 2IG, 5AB. Argentine: AF1. Australia: 3EF. New Zealand: 4AG. Miscellaneous: XGB1, GFP, KPL, RRP, RGC, ZHC, FW.
(0-v-1, Grebe.) 30-70 metres.
B. Smith.

Sheffield.
During November.
Spain: EAR14. Holland: OKV, PCMM, OPX, OBL, PCLL, OKW, OQX, OPM. France: 8DK, 8JC, 8QR, 8FDR, 8HU, 8HSF, 8EE, 8PKX, 8OQ, 8TX, 8GP, 8CA, 8TK, 8IX, 8TOK. U.S.A.: KDKA, 8MC, WIZ, 2ZU, WIR, 8JQ, WQO, 2AMJ, 3AFQ, 1CK, 1MT, 1AIU, 8BGN, 8GZ, 1AEP, 1CNF, 1CDV, 1CMX, 1QM, 8COB, 1YB, WGY. Germany: KK7, POW. Italy: 1BF, 1GW, 1AS, 1MT. Belgium: 4YZ, P2, T2. Sweden: SMVB, SMZZ, SMVS, SMUK. Porto Rico: 4UF. Czecho-Slovakia: AA2. Scandinavia: 2CO. Unknown: OCML, FW, V2BXT, SDK, MIZ, AIN.
(0-v-1.) On 25-70 metres.
A. S. Williamson.

Beckenham.
November 5th to 19th.
Australia: 1AL, 2CM, 2DS, 2RJ, 2YI, 3BD, 3BM, 3BQ, 3EF. New Zealand: Z1IO, 2AC, 2AQ, 2XA, 4AA, 4AC, 4AK, 4AR, NRRL. Brazil: 1AB, 1AC. Philippine Islands.: 1HR, 1CW (heard 1400 G.M.T.). China: GFUP, NEQQ. W. Indies: 4JE, 4RL, 4SA, 4TV. U.S.A.: 5AHP, 5EE, 5QK, 6AWT, 6BJX. India: HWK. South Africa: O-4Z, O-4ZA.
All on 30 to 40 metres.
U.S.A.: 1ASF, 1BGI, 1CCX, 1CMP, 1KA, 1PL, PR, 4SA, 4TV. Italy: 1RG.
On 10 to 20 metres.
G. E. Hitchcok (G-6GH).

Birmingham.
Since October 30th, 1925.
Brazil: 1AB, 1AC, 1AF, 1AO, 1AP, 1AX, 1IT, 1IA, and 5AA. Argentina: DE2, DE3. Porto Rico: 4JE, 4SA, 4VR. New Zealand: 4AA, 4AM, 4AS, 2XA. Australia: 2CW. India: HBK. America: 3WO, 3LJ, 3NI, SHG, 3JW, 3AUV, 3AFQ, 3LW, 3JO, 4TV, 4RM, 4IO, 4AM, 4RR, 5ASP. Canada: 1AR, 2FO. Various: NISM, UNTT, JOU, BST, WIZ, WIR, WQO, CSOK1, CSAA2, Y7XX, AIN.
(0-v-0 receiver.) 30 to 50 metres.
T. S. Calder.

CURRENT TOPICS
News of the Week in Brief Review

News of the Week in Brief Review.

DUBLIN BROADCASTING.

The official opening of 2RN, the new Dublin broadcasting station, is expected to take place before Christmas. 2RN will operate on 390 metres.

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BROADCAST RECEPTION IN COLOGNE

As a sequel to the evacuation of Cologne by the British troops the ban on wireless receivers is removed and a huge sale of receiving apparatus is already in progress.

The Rhineland area will shortly be supplied with broadcast programmes from a high power station to be erected at Cologne or Dusseldorf.

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SHORT-WAVE FACTS AND NOTIONS.

At the annual general meeting of the Radio Society of Great Britain, to be held this evening (Wednesday) at the Institution of Electrical Engineers, Mr. Duncan Sinclair will deliver a lecture entitled "Some Facts and Notions about Short Waves." The meeting will begin at 6 p.m., tea being served at 5.30.

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OXFORD UNIVERSITY WIRELESS.

The claims of wireless research have at last been recognised in Oxford University, the Vice-Chancellor having given his permission for the formation of a society. Accordingly, on December 1st a University Wireless Society was established with a membership of over forty. The Hon. Secretary and Founder is Mr. Eric Cuddon (Merton), from whom particulars of membership may be obtained.

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THE BROADCASTING ENQUIRY.

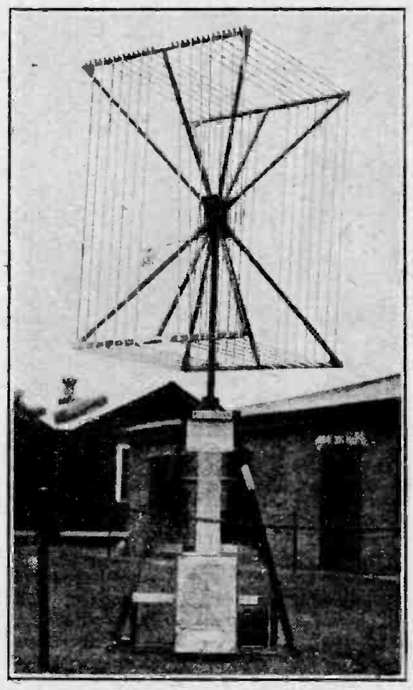
The next meeting of Lord Crawford's Committee appointed to advise as to the future policy of broadcasting will be held to-morrow (Thursday) in Committee Room No. 4 of the House of Lords at 4 p.m., when evidence will be tendered on behalf of the Newspaper Proprietors' Association and the Newspaper Society.

A further meeting will take place on Friday at the same time and place to hear evidence on behalf of

1. The entertainment industry;
2. The Music Publishers' Association, Limited; and
3. Messrs. Chappell and Company as concert-givers and the lessees of the Queen's Hall.

SIMULTANEOUS BROADCASTING IN SWEDEN.

Sweden's official and private broadcasting stations are being interconnected by underground or aerial wires, according to *The Electrical Review*, the main station at Stockholm forming the exchange point. Amplifiers are situated at various spots on the different routes, and to prevent



A NEW WIRELESS COMPASS. This interesting frame aerial is used in conjunction with the radio compass installed at Charleston, Mass., by the U.S. Navy, to assist warships in computing their position when approaching the coast.

the stations nearest Stockholm from absorbing too much of the power, resistances are inserted in the feed to each local amplifier.

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MOROCCO UP TO DATE.

At Ceuta, in Spanish Morocco, a society has been formed to carry out the establishment of a broadcasting station operating with a power of 250 watts.

WIRELESS ON GIANT PASSENGER 'PLANE.

Readers who take an interest in the 900-metre telephony of the Imperial Airways machines should listen for the new Vickers-Rolls-Royce "Vanguard," which has now been handed over to the Company after service trials by the Air Ministry.

This giant machine, which provides saloon accommodation for twenty passengers, has been fitted with a wireless telephone installation of the latest type.

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FIRST WIRELESS BEQUEST.

With the true American *flair* for the unusual, officials in New York have discovered, after an exhaustive search through legal files, that the late Mr. Edward F. Gordon, of New York, whose will has just been proved, was the first man to bequeath a wireless set. The legatee is Mr. Gustave W. Fuerth, of New Jersey.

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A WIRELESS PIONEER.

Captain Charles Crompton, who has just retired from the position of Chief Engineer of the Glasgow Post Office, will be remembered by many as one of the early experimenters with the inductive wireless system invented by the late Sir W. H. Preece. Early in 1895, when the submarine cable between Oban and the Island of Mull was broken, Captain Crompton succeeded in establishing communication without wires between Mevern, on the mainland, and Craignure, in Mull, using Preece's system. The service operated successfully for ten days until cable traffic was resumed.

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OFFICIAL PRAISE FOR U.S. AMATEURS.

In a letter of appreciation to Mr. Hiram Percy Maxim, President of the American Radio Relay League, the U.S. Secretary of Commerce, Mr. Herbert Hoover, praises the accomplishments of the American wireless amateur. Referring to the recent national radio conference, Mr. Hoover stated that he was particularly glad that no steps were taken which would hinder in any way the activities of wireless amateurs in the wavebands allotted to them.

R.S.G.B. APOLOGISES.

Under-estimating the probable response to an invitation given from the 2LO microphone, the Radio Society of Great Britain now feels under an obligation to apologise to several hundred people. Mr. H. A. Rock, the speaker, intimated that free tickets to a demonstration at Selfridges could be obtained on application to the Society's offices. The response, however, was unexpectedly large, and several hundred listeners who applied for tickets were disappointed.

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FREE STATE AND D.F.

In view of the present state of the national finances, the Free State Minister for Industry has declined to recommend the establishment of a wireless direction-finding station for assisting ships in distress. He points out that the stations at Valentia and Malin Head have so far intercepted every S.O.S. from ships near the Irish coast.

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PHYSICAL AND OPTICAL SOCIETIES' EXHIBITION.

The Exhibition of the Physical Society of London and the Optical Society, which annually attracts a considerable number of wireless experimenters, is to be held on January 5th, 6th and 7th, 1926, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington. The exhibition will be open in the afternoon from 3 to 6 o'clock, and in the evening from 7 to 10 o'clock.

Some 70 firms will exhibit scientific apparatus, and among interesting lectures to be delivered will be that of Major W. S. Tucker, D.Sc., who will deal with "Electrical Listening" at 8 p.m. on January 7th. The exhibition will be open to the general public without tickets on the third day; on January 5th and 6th tickets will be required, these being obtainable from Professor A. O. Rankine, Imperial College of Science and Technology, South Kensington, S.W.7.

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SHORT-WAVE BROADCASTING FROM WGY.

As a wireless research centre, the experimental laboratories of the General Electric Company at Schenectady, New York, probably rank among the largest in the world. At the present time no fewer than nine transmitters, some of them broadcasting, are operating from this spot. Each has its own antenna system and individual wavelength for its special task. The stations transmitting programmes from the WGY studio are 2XAG on 379.5 metres, 2XK on 109 metres, and 2XAF on 41.88 metres. C.W. transmissions are conducted from 2XAZ on 214 metres, 2XAC on 80 metres, 2XAD on 21 metres, and 2XAW on 15 metres. 2XAH, which works on 1,560 metres, is undergoing changes in design at the moment, but will resume transmissions in the near future. From 11 p.m. (G.M.T.) onwards on Mondays, Tuesdays, Thursdays, and Fridays, 2XK and 2XAF transmit WGY's programmes on 109 and 41.88 metres respectively.

SPEECH AMPLIFIERS IN LONDON COUNTY HALL.

In connection with the installation of speech amplifiers in the County Hall, Westminster, referred to in our columns last week, we understand that only experiments have been conducted with the apparatus, which has since been dismantled.

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D.F. TO THE RESCUE.

During recent gales the value of wireless as a means of bringing aid to ships in distress has again been proved. The Anglo-Newfoundland Development Company's ship "Geraldine Mary," on a recent voyage, received a wireless message from the s.s. "Stiklestad," stating that she had broken her propeller shaft and needed to be towed to St. John's, Newfoundland.

CAIRO CALLING. The aerial and counterpoise of SRE, an amateur-owned broadcasting station which sends out weekly concerts in Cairo. The station is referred to in the next column.

The "Geraldine Mary" used her Marconi direction finder to locate the "Stiklestad," and went to her assistance. Owing to rough weather, four days elapsed before a towing wire could be taken aboard the "Stiklestad," and during that time the ships twice lost touch with one another, having been blown as much as 50 miles apart during severe hurricanes.

On each occasion the "Geraldine Mary" was able to find the "Stiklestad" by means of wireless bearings taken with the Marconi direction finder. Finally the crews succeeded in passing a towing wire.

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FOUR-ELECTRODE VALVE RECEIVER.

An error occurred in the circuit diagram showing the wiring of the four-electrode valve receiver on page 728 of the issue of November 25th. The connection passing from the earth terminal and the condenser C_1 are joined together on to one of the terminals of the Dubilier variometer. Unfortunately these leads are shown terminating on one of the moulded legs of the variometer.

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AMATEUR BROADCASTING IN CAIRO.

A proposal is afoot to establish a wireless club in Egypt, which would be open to keen amateurs of all nationalities who are resident in the country. Much of the present enthusiasm is due to the efforts of Mr. O. Castellani, who for some time past has operated a private broadcasting station (SRE) in Cairo at his own expense.

The power of the station is of necessity low, the present input being about 40 watts, but the results obtained are reported to be excellent and the transmissions are highly appreciated by a growing body of amateurs in Cairo and the surrounding district. A view of Mr. Castellani's station is shown in the photograph on this page.

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NEW CLEARTRON DIRECTORS.

Messrs. Cleartron Radio, Ltd., manufacturers of the well-known Cleartron range of valves, make the interesting announcement that Sir Edward Marshall Hall, K.C., and Major G. E. Miller Mundy have joined the Board of Directorate.

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AVOIDING INTERFERENCE IN SPAIN.

A novel system of unified control in broadcasting is being tried in Madrid, which possesses three stations all likely to clash when operating simultaneously. The three stations—Radio Castilla, Radio Iberica, and Union Radio—have come to an arrangement whereby the available period for transmission is equally shared between them. Three periods of time have been taken, viz., four to six p.m., six to eight p.m., and ten p.m. to one a.m., and each of the three stations takes its allotted period throughout the month.

Such a scheme undoubtedly solves the interference, but it cannot be said to be a satisfactory solution of the demand for alternative programmes.

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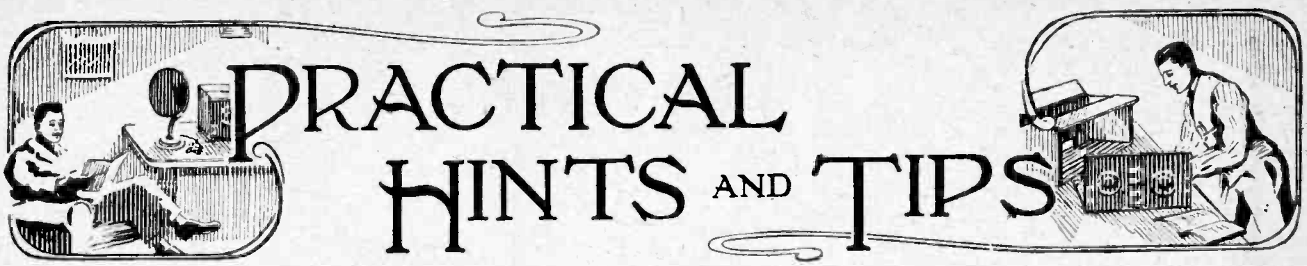
A STOLEN WIRELESS SET.

Thefts of wireless receivers have fortunately been uncommon in the past, but a recent case shows that even these instruments are not immune from the attentions of the light-fingered. A six-valve Zenith Portable Receiver was stolen from the London office of the Colonial Technical Press, Ltd., at 36, Southampton Street, Strand, W.C.2, on Thursday afternoon, December 3rd. The set is enclosed in a black leather suit case and should be easily recognised by a large "Z" let into the leather next to the handle. As the set is probably the only one of its kind in the country, it should be easily traced. Any reader who discovers the whereabouts of the set would do a service by notifying the Colonial Technical Press, Ltd.



PRACTICAL HINTS AND TIPS

A Section Mainly for the New Reader.

H.T. SUPPLY FROM THE MAINS.

The high-tension battery is probably the most expensive item to maintain in a wireless receiver—at any rate, in a set using valves suitable for loud-speaker reproduction. Even the largest capacity batteries seldom have a life exceeding six months when in continuous use at a discharge rate of some 10 milliamperes. High-tension accumulators, of course, offer a good solution to the problem of anode current supply, but, unfortunately, they are easily damaged by incorrect charging or short-circuiting, and also involve a fairly heavy initial expenditure.

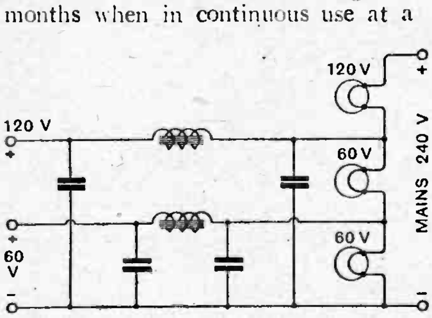


Fig. 1.—Lamp potentiometer with smoothing circuits.

In considering the question of H.T. voltage supply, it should be realised that, generally speaking, the L.F. amplifying valves will be responsible for the consumption of the greater part of the current used. Luckily, these may often be fed by "smoothed" direct current supplied by the house-lighting mains. Sometimes, indeed, when this supply is fairly free of "ripple," it may be used for all the valves, without going to the trouble of installing unduly elaborate filtering devices.

A certain amount of latitude is generally permissible as to the voltages applied to most modern valves, and it will be found that 60 volts for H.F. and detector and 120 volts for L.F. valves will be sufficiently correct in the majority of cases. A suitable arrangement for obtaining these pressures is shown in Fig. 1, where, as will be seen, three lamps are used as a form of potentiometer. It is assumed that the supply voltage is 240 (a very common one). Two 60-volt and one 120-volt lamps are connected in series; thus the sum of the rated voltages of the lamps equals that of the supply. Whatever the supply voltage may be, this point must be observed, and it will generally be possible to obtain a combination of lamps of suitable type. All should have approximately the same *current* rating; in the example shown, the 60-volt lamps must have double the rated wattage of the 120-volt lamp.

The drop of voltage due to the resistance of the chokes has been ignored; this is hardly likely to be appreciable in actual practice. These chokes may be of the type used in low-frequency intervalve couplings, while all the condensers should have a capacity of from one to two microfarads.

Another method of obtaining somewhat similar results is shown in Fig. 2. In this case 120 volts is obtained by tapping across one or two lamps of that rating connected in series. A fixed resistance, shunted by a large condenser, is inserted in the low-voltage lead. This resistance, which should be of the wire-wound type, should have a value of something in the neighbourhood of 50,000 ohms, depending entirely on the number and types of valves used, etc. It should really be adjustable, in order to meet various operating conditions, but, as far as is known, no variable resistance with sufficient current-carrying capacity is at present on the market. It is, however, well within the capabilities of the average amateur constructor to make a suitable resistor by winding an ounce of No. 45 S.S.C. "Eureka" or similar resistance wire on a bobbin former, with some ten equally spaced tapping points connected to the studs of a selector switch.

A double filter or smoothing circuit is included in the second arrangement. This will help to still further reduce "hum," but, of course, the second choke and condenser may be omitted if it is not considered necessary.

If it is found difficult to eliminate extraneous noises one or more of the valves may be supplied by an ordinary H.T. battery. Even if this expedient becomes necessary the arrangement will still be well worth while, provided we are able to feed our low-frequency valves from the mains. It is generally found that the "leaky grid" rectifying valve is the most likely source of trouble in this direction.

A large fixed condenser should be connected in series with the earth lead; sometimes, however, for short-distance reception it is found that better and quieter operation is obtained without any earthing other than that supplied by the mains.

The simplest way of determining the actual voltage on the anode of any valve is to take a reading with a milliammeter connected in this circuit, and then to substitute temporarily an H.T. battery, the voltage of which is adjusted until a similar plate current is obtained, other factors remaining constant. The measured voltage of the battery will, of course, then be equal to that of the main supply.

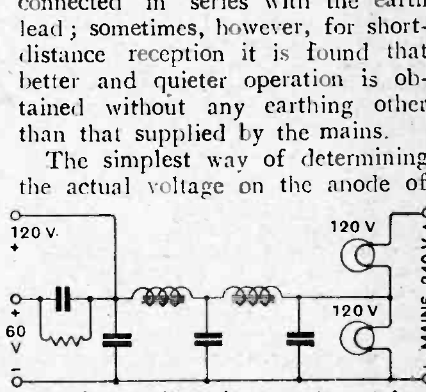


Fig. 2.—An alternative arrangement for H.T. supply from D.C. mains.

However "noisy" the current supply may be, it always seems possible to smooth out variations sufficiently to operate a set consisting of a crystal detector with two or three stages of resistance-coupled low-frequency amplification, and such a receiver is to be recommended to those having direct current, and who are situated sufficiently near a broadcasting station.

The use of a counterpoise in place of an earth will often result in a distinct improvement, and should be tried where circumstances permit of it.

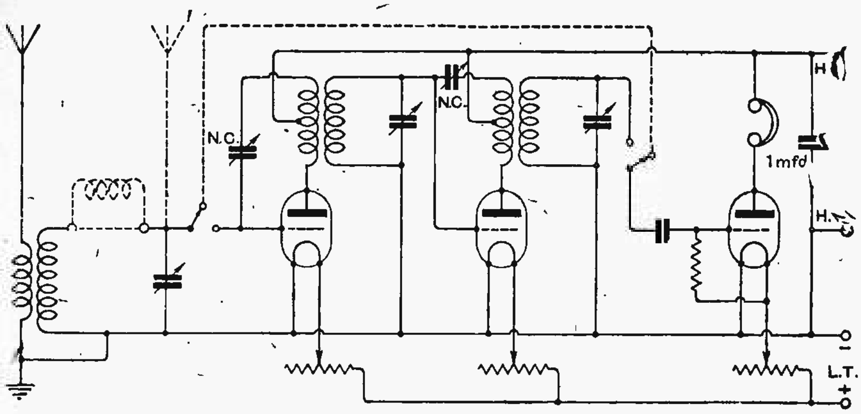


Fig. 3.—Neutrodyne modifications

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LONG WAVES ON A "NEUTRODYNE."

There is no doubt that the 2 H.F. neutrodyne receiver would be even more popular than it is were it easier to adapt for reception of stations operating on the longer wavelengths. There are good reasons for the fact that designers are chary of introducing such complications as interchangeable H.F. transformers or other possible alternative methods of attaining the same end. If, however, one is willing to sacrifice the high-frequency amplifier on the long waves, it is a comparatively simple matter to arrange for the reception of the high-power station in the manner indicated in Fig. 3. The change-over is effected by inserting a loading coil in the grid circuit, moving the aerial connection, and joining the high potential end of the resulting tuned aerial-earth circuit to the grid condenser of the detector valve, as shown in the dotted lines. If the modifications are carefully carried out there should be no appreciable loss of efficiency on the short wavelengths. The switches used in the grid circuits should be small and of low capacity, while the lead joining them might, from practical considerations, be fitted with plugs in such a way that it can be removed when the amplifier is being used for its normal purpose.

TESTING FOR FAULTS.

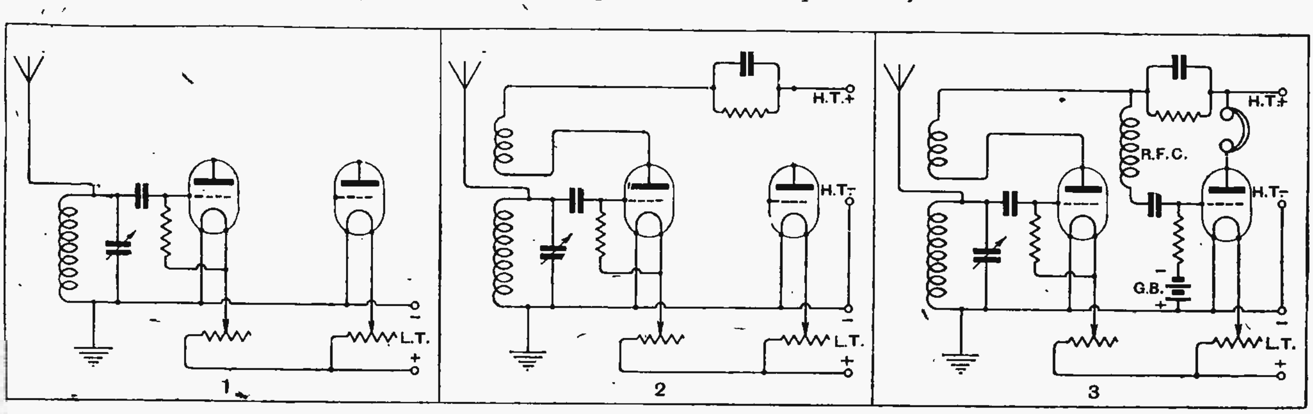
The testing device consisting of a pair of telephones and a battery connected in series with the suspected circuit is most helpful in locating faults when used with care.

In testing for insulation in a circuit having a parallel capacity (either in the form of an actual condenser or of incidental capacities) it may be that a decided click is heard when making contact, which may lead to the erroneous assumption that a leakage is present. This click is merely due to charging current flowing into the condenser; provided that no click is heard when the circuit is broken, everything is probably in order.

DISSECTED DIAGRAMS.

No. 10.—A Valve Detector with One Stage of Resistance Coupled Amplification.

For the benefit of those who have not yet acquired the simple art of reading circuit diagrams, we are giving weekly a series of sketches showing how the complete circuits of typical wireless receivers are built up step by step. Below is illustrated the method of applying resistance-capacity low-frequency amplification to a detector—a point which seems to puzzle many readers.



Two valves, with filament circuits completed in the usual manner. An aerial tuning coil, shunted by a variable condenser, is connected between grid and filament of the first valve, a leaky grid condenser being inserted for rectification.

The plate circuit of the detector valve is completed through the reaction coil (which may be variably coupled to the grid coil), a high resistance, shunted by a very small fixed condenser (to bye-pass H.F. currents), and the H.T. battery

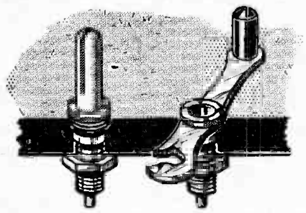
Differences in voltage set up across the resistance are communicated to the grid of the L.F. valve through a fixed condenser, the choke being inserted to keep H.F. impulses off the grid. Negative bias is applied through the leak resistance, and phones are inserted in the anode circuit.

New Apparatus

A Review of the Latest Products of the Manufacturers.

TWO USEFUL BELLING LEE PRODUCTS.

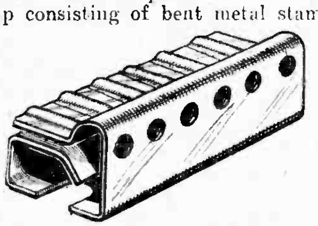
The pin and socket connector manufactured by Belling & Lee, Ltd., Queensway Works, Ponders End, Middlesex, is fitted



Belling Lee short circuiting plug and socket.

with a lever so that the connectors can be short-circuited. This is a very useful device, and its principal application is for introducing a tuning coil for loading a 200-500 metre circuit to receive on a wavelength of 1,600 metres.

Another useful component is a connector strip consisting of bent metal stamp-



The Belling Lee connector.

ing with holes and grooves so that telephone tags or other wires can be easily connected together on a common terminal.

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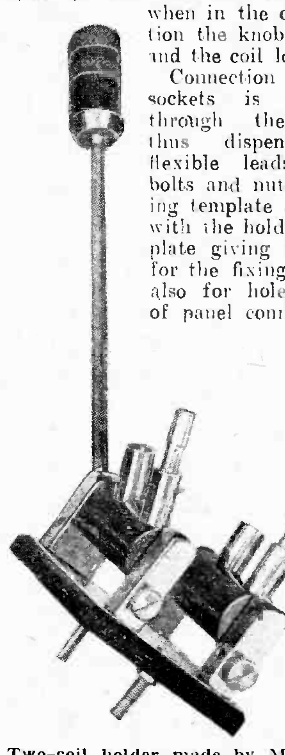
A LOCKING COIL HOLDER.

The Power Wireless Co., Wexham Road, Slough, Bucks, is manufacturing a complete range of adjustable coil holders. As can be seen from the illustration, the design is particularly simple, and the coil holder is consequently low priced, yet, nevertheless, it is quite reliable, and can be depended upon to give satisfactory service in any set where tuning is carried out by means of coils of the plug-in type.

A special feature consists of providing a locking action for the movable holders. The long extension handle is threaded at the end where it enters the spindle of the coil socket, and by rotating the operating knob the extension arm is caused to bind on to one of the brackets, giving a very secure and rigid fixing. Thus the coil can be freely operated by means of the extension handle, and when in the correct position the knob is rotated and the coil locked.

Connection to the sockets is picked up through the bearings, thus dispensing with flexible leads. Fixing bolts and nuts and drilling template are supplied with the holder, the template giving the position for the fixing bolts and also for holes for back of panel connections.



Two-coil holder made by Messrs. The Power Wireless Co. The moving coil can be locked in any position by rotating the operating knob.

The coil holders are obtainable with a nickel-plated or bright brass finish.

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DECKO DIAL INDICATORS.

The well-known pointer supplied by A. F. Bulgin and Co., 9-11, Cursitor Street, Chancery Lane, London, E.C.4, for indicating instrument settings, is now available in a modified form. The pointer is raised about ⅛in. above the surface of the panel for use with dials which do not fit down closely to the panel face.

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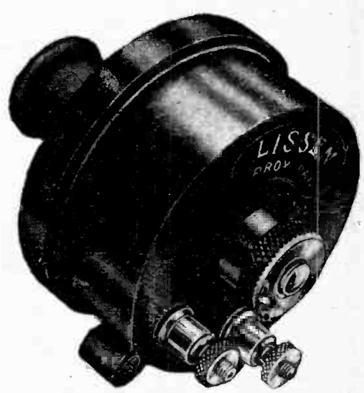
LISSENOLA LOUD-SPEAKER UNIT.

It is in the construction of sets of the cabinet type that the amateur so often needs a loud-speaker movement suitable for connection to the horn which forms part of the cabinet work. A low-priced unit of reliable construction suitable for this purpose is produced by Lissen, Ltd., Lissenium Works, Friars Lane, Richmond.

A moulded ebonite housing is made use of to enclose the adjustable electro-magnet unit and to give support to the diaphragm. Four semi-circular magnets are used to produce the permanent field, and these



Lissen loud-speaker attachment.

are held in position and at the same time clamped to the soft iron pole pieces by means of screws in the same manner as is usually employed in telephone and ear-piece construction, each pole piece carrying a winding with a resistance of 1,000 ohms. The permanent magnets are nickel plated to prevent rusting, while the back mounting plate is galvanised. A spring washer and screw operating through the back of the case provides an adjustment of the air gap between the diaphragm and the ends of the poles. The Stalloy diaphragm is somewhat thicker than the diaphragms usually employed in telephone receivers, and the stiffening thus afforded probably tends to eliminate resonance effects.

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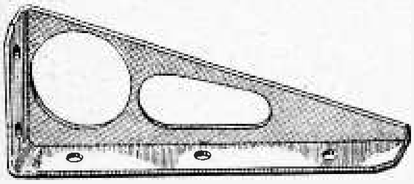
PANEL BRACKETS.

Vertical panels are now invariably adopted in receiver construction secured to a horizontal baseboard carrying the heavier components.

To hold the panel and baseboard correctly at right-angles the use of metal angle brackets is essential, and quite a good type is produced by Peranne & Co., Ltd., Diamond Works, Regent's Park

Road, Church End, Finchley, London, N.3, in the form of an aluminium pressing. The sides of the bracket, which are turned over and provided with holes are quite rigid, the actual corner not being



Aluminium angle bracket, a product of Messrs. Peranne & Co., Ltd.

opened as is often the case, and which would have the effect of weakening the bracket.

The reader is reminded that the longer edge should be attached to the softer material, and therefore when bracketing an ebonite panel to a wooden baseboard the longer edge should be attached to the wood

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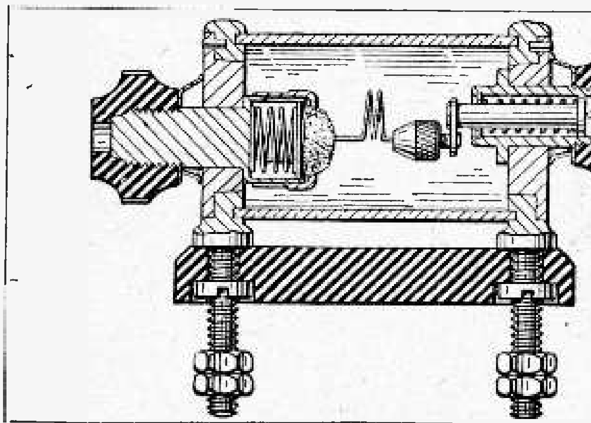
THE M. & M. CRYSTAL DETECTOR.

Crystal detectors are in such universal use that it is to be expected that every endeavour would be made to produce a wide range of types in which the primary object in design is to provide easy adjustment. Several models are, of course, obtainable, but a common defect is that either the construction is too simple or the mechanism to produce fine adjustment too complicated. The M. & M. detector is quite a good practical job, made up from clean and well-machined parts, liberal in dimensions and robust.

The accompanying sectional diagram shows the various adjustments that can be obtained and the control which is provided for giving a critical setting. The crystal, which is mounted in a good form of spring cup, can be rotated whilst the wire contact rotates on an eccentric, and can search out almost any point on the crystal face. A very delicate adjustment is obtained by driving the wire contact forward against a spring. The glass dust-proof cover, which is almost an essential feature in detector design, prevents the crystal surface and the wire contact from becoming oxidised or corroded by the action of the atmosphere.

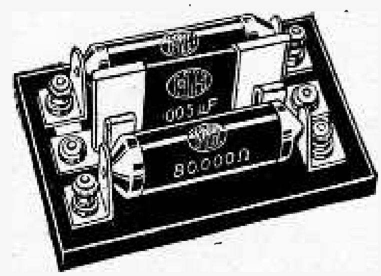


Sectional drawing showing the action of the M. & M. crystal detector. (McLeod & McLeod, 329, High Holborn, London, W.C.)

McMICHAEL RESISTANCE CAPACITY COUPLING UNIT.

A great deal of trouble can be saved by making use of a specially constructed unit for resistance capacity coupling in preference to selecting the various necessary components and separately mounting them. Wiring up, too, is simplified.

The McMichael unit consists of a well-finished ebonite base carrying suitable clips for supporting the anode resistance, the grid leak and the coupling condenser. The method of assembly entirely eliminates wiring between these components, the connections being made by short metal straps, whilst the clips used to interchange the resistances are held down by means of the four terminals, which are con-



McMichael resistance capacity coupling unit.

nected up in the amplifying circuit in the same way as the terminals of a transformer.

The units are supplied both for H.F. and L.F. amplification, and the experimenter can interchange various values of anode resistance and coupling condenser to suit the conditions existing in the amplifying apparatus. Standard type McMichael resistances are employed, in which the resistance material is clamped between two brass end pieces.

The special merit of this McMichael unit is that it can be introduced into almost any receiving set to replace transformer coupling without the need for drastic structural alterations.

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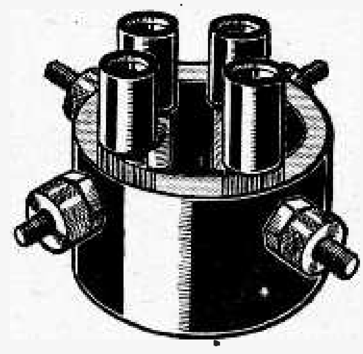
BALTIC VALVE HOLDER.

The Baltic valve holder, obtainable from L. J. Hydleman and Co., 32, Queen Victoria Street, London, E.C.4, is intended for baseboard mounting, and is attached by means of a screw passing through the centre.

The design differs from many of the existing types on the market, inasmuch



Baltic low-capacity valve holder. The sockets are ebonite covered.

as a circular mount is employed, to which the sockets are bolted by the screw terminals. Capacity between the sockets is thus kept to a minimum by avoiding the inclusion of solid insulating material. The sockets are ebonite covered to prevent accidental contact between the filament pins of the valve and the plate socket of the holder, thus eliminating the risk of burning out the filament when inserting a valve.

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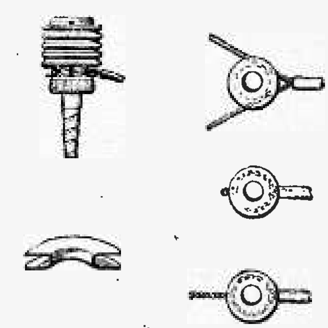
CLIX RING TAGS.

A ring connector has recently been introduced by Autoveyors, Ltd., 84, Victoria Street, Westminster, London, S.W.1, to facilitate the making of a connection between flexible wire and Clix plug and socket connectors.

The "ring tag" is really an eyelet of suitable dimensions, and with a liberal groove for accommodating the strands of the wire. The wire is opened out to a "V" formation and twisted round the ring tag, making reliable contact, and, if desired, the wire can actually be soldered without difficulty, as the surface of the



The Clix ring tag, showing the method of making connection between a flexible conductor and a Clix plug.

tag is tinned. Although essentially designed for use with Clix connectors, the tag can with advantage be adopted in all instances where connection is required between a terminal and a flexible lead.

A NEW RESISTANCE-COUPLED AMPLIFIER.

Coupling Condensers and Resistances Mounted Inside the Valve.

By Dr. H. KRÖNCKE.

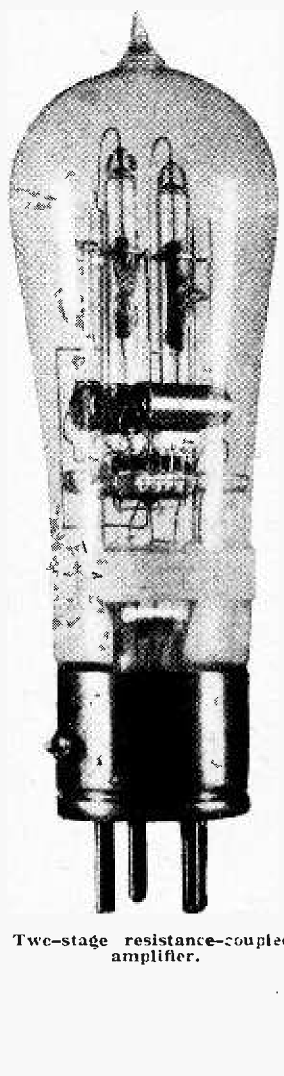
THE ideal amplifier of electrical oscillations would be one which gives even amplification over the greatest possible range, for example, from 100 to 1,000,000 oscillations per second. Amplifiers with transformers and choke-coil coupling—those chiefly employed hitherto—cannot possibly satisfy the demand for a completely faithful reproduction, because transformers and choke coils have, in all circumstances, certain natural oscillation frequencies which lead to distortion of the current curve.

It has been known for years past that a faithful amplification could only be obtained by the resistance amplifier, and a description was recently given in this journal how, by the method of von Ardenne and Heinert, a high degree of amplification can also be obtained with the resistance amplifier, so that this apparatus is not inferior in efficiency to the transformer amplifier, but is considerably superior to it as regards the quality of reproduction. A special advantage of the resistance amplifier is that it can be used equally for high-frequency and low-frequency amplification. Formerly the view was held that with a wavelength of about 1,000 metres a limit was set to the use of the resistance amplifier which could not be passed. It has, however, been found that considerably better results can be obtained if one uses suitably devised resistance material and avoids as far as possible all distributed capacities.

It has been found, in fact, that many resistances of high ohmic value give rise, notwithstanding their small dimensions, to a certain electrical fatigue, which acts as if a condenser of, say, 30 cm. capacity were connected in parallel with the resistance. This equivalent capacity, which is increased still further by the parasitic capacities of the circuit and the valve, is the reason for the loss of efficiency on short waves.

Resistance Construction.

Much has been accomplished by the new resistances of very small dimensions, which are manufactured by the Loewe-Audion firm of Berlin, and which consist of an extremely thin metal film on a support of good insulating material. These are free from electrical fatigue, and are, moreover, independent of the potential applied to the resistance. By the use of such resistances, therefore, the sphere of utility of the resistance-coupled amplifier is extended considerably. Now, advancing still further, Dr. S. Loewe has recently taken a radical step in order to eliminate also the parasitic capacities of the wiring to such an extent as, generally speaking, had only been possible in theory. The diminution of these capacities is, in fact, only possible by keeping the leads as short as possible, and by running them at a sufficient distance apart. But Dr. Loewe has obtained the shortest connecting leads possible by enclosing the whole resistance amplifier, consisting of coupling resistance, grid condenser, and grid leak, together with the amplifying valve, in a glass bulb. He did not stop there, however, but at once enclosed two, and even three, stages of a resistance amplifier in a glass bulb, together with the electrodes of the valves. A valve is thus obtained which, as regards size, is similar to a small transmitting valve, but which is in effect an amplifier unit for electrical oscillations of any desired frequency between about 1,000,000 and 100 per second.



Two-stage resistance-coupled amplifier.

Advantages of Unit Construction.

The manufacture of such amplifiers was dependent upon both the high ohmic resistances and the grid condensers being able to bear without injury the high temperature to which they must be heated for a considerable time during the pumping out of the valve. When, however, such an amplifier is completed, its construction in a vacuum has, of course, the advantage that the individual parts of the circuit are not subject to variations of atmospheric conditions. Such resistance amplifiers are suitable, for instance, for long-distance reception without reaction, in that two or three stages of high-frequency amplification can be connected to a crystal detector, and this can be followed by two stages of low-frequency amplification. The purity of the reception and the quality of the transmission exceeds anything hitherto known in the matter of long-distance reception, and, by reason of its clarity, is reminiscent of crystal reception with telephones in the vicinity of the broadcasting transmitter. There is the additional advantage that the consumption of current of the new multi-stage amplifier is very small, as has already been described in a previous issue.[1] The operation of the amplifier for the reception of rather short wavelengths is, of course, still somewhat difficult at times, but there is no doubt that these last difficulties of high-frequency amplification will soon be overcome, and that, by means of low-frequency amplifiers, one will obtain an ideal receiver giving good signal strength and pure reproduction, and one in which it is only necessary to turn a single condenser for the purpose of adjustment.

[1] *The Wireless World*, September 23rd, 1925.

NEWS FROM THE CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Woolwich Radio Society.

In the November number of the society's lively little magazine, "The Oscillograph," some trenchant remarks are made upon a recent "junk sale" in which the bids for good apparatus in many cases did not reach a quarter of the wholesale price of the article. Whether "junk sales" are carried out with greater success by other societies is a questionable point, but the Woolwich Society has decided that this form of enterprise must cease unless a more acquisitive spirit prevails amongst the members.

The number of transmitting amateurs on the society's membership roll is slowly but steadily increasing. 2LT, 2QQ, 5QN, 5FL and 2BAY are already owned by members, and three other members have entered applications.

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City of Belfast Y.M.C.A. Radio Club.

Some interesting historical material was provided in a lecture on "Aerials," given by Mr. J. Forsythe on November 27th.

The lecturer first dealt with the experiments of Kelvin, Faraday, Hertz, and Marconi, enumerating the discoveries of each. Capacity and inductance were next considered together with the various theories regarding the transmission of radio signals round the earth, the lecturer's opinion being that the Heaviside layer theory, in the light of present-day knowledge, appeared the most rational.

In the lively discussion which followed a number of members sketched the shape and height of their aerials on the blackboard.

Hon. secretary: Mr. John J. Cowley, 4, St. Paul's Street, Belfast.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 16th.

Radio Society of Great Britain.—Annual General Meeting.—At 6 p.m. (tea at 5.30 p.m.) At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Some Facts and Notions about Short Waves," by Mr. Duncan Sinclair.

Barnsley and District Wireless Association.—Valve Reception and Circuits.

Halifax Wireless Club.—Discussion evening opened by Mr. J. R. Clay (2YF).

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, Golders Green, N.W.11. Lecture: "Infra Red Rays as Applied to Radio." by Mr. G. G. Blake, M.I.E.E.

THURSDAY, DECEMBER 17th.

Chelmsford Engineering Society.—At the East Anglian Institute of Agriculture. Lecture: "The Operation of Transformers," by Mr. S. Austin Stigent, M.I.E.E., M.I.Amer.E.E.

Walthamstow Amateur Radio Society.—Lecture: "How to Start Transmitting," by Mr. Stanley Ward, M.I.E.E.

FRIDAY, DECEMBER 18th.

Sheffield and District Wireless Society. Elementary Lecture (3): "Wavelength, Capacity, and Inductance."

MONDAY, DECEMBER 21st.

Hackney and District Radio Society.—At 8 p.m. At the Holy Trinity Institute, Mayfield Road, Dalston Junction, E.8. "What Can be Done with a Three-valve Set," by Mr. A. Bell.

TUESDAY, DECEMBER 22nd.

Bolton and District Radio Society.—Open night.

Lewisham and Bellingham Radio Society.

A keenly interested gathering witnessed an unusual demonstration given on December 1st by Mr. Riddle, who showed what could be done with "a valve, three batteries and a junk box." With this material Mr. Riddle constructed a practical milliammeter with which he illustrated his lecture on the plotting of curves and the determination of valve characteristics.

Hon. secretaries: Mr. C. E. Tynan, 62, Ringstead Road, Catford, S.E.6; Mr. J. A. Clark, 35, Boones Road, Lee, S.E.13.

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Dulwich Radio Club.

November was a very successful month for the club.

An interesting *résumé* of the history of broadcasting was given on the 9th by Mr. Whitehouse, deputising for Captain West, who was unable to attend. For two hours the lecturer's audience was entertained with accounts of the apparatus used for ordinary transmission and for outside broadcasts, many amusing anecdotes being related in connection with difficulties encountered. On the 16th of November Mr. Gay, of the Streatham Radio Society, lectured very ably on the subject of A.C. rectifiers for H.T. supply, discussing in detail various methods of chemical and valve rectification.

A debate on the question: "Is H.F. amplification of any real value in reception?" was held on November 23rd. As an outcome of the discussion it was generally agreed that on the broadcast wavelengths some form of H.F. amplification was both advantageous and desirable. With regard to the short wavelengths the problem was admitted to be a difficult one, due to the enormously high frequencies dealt with, and some valuable suggestions were made with a view to further experiments in this direction.

Hon. secretary: Mr. W. T. Milsom, 15, Forest Hill Road, E. Dulwich, S.E.22.

ROUND THE WORLD IN A WEEK-END.

MR. J. A. PARTRIDGE (G 2KF), of Collier's Wood, S.W.19, again conducted a series of "round the world" tests on Sunday, December 6th, and we give below an extract from his log:—

G.M.T.	Reported strength.
5th December, 1925.	
5.45 p.m.—Exchanged signals with 6ZK Army Signals, Palestine.	
6th December, 1925.	
3.40 a.m.—Worked with O A4Z, Streeter, of Cape Town, S. Africa.	R.6.
4.30 a.m.—Worked U 3AHA, U.S.A.	R.4.
5.0 a.m.—Worked U 2GX, U.S.A.	R.5.
8.0 a.m.—Worked Z 4AS, Dunedin, N.Z.	R.4.
12 noon.—Worked N 2NM, Finland.	R.6.
1 p.m.—Worked D 7EC, Copenhagen, Denmark.	R.7.
1.30 till 2.30. Listened to two-way communication on 35.40 metres between Philippine stations 1HR, NAJD, and U.S.A. 6's. U 6CTO being a steady R.4, whilst the Philippines were R.5.	
3 p.m.—Worked for an hour with A 6AG at Inglewood, nr. Perth, W. Australia, who was steady R.6, consistent and little fading.	R.7.
6 p.m.—Worked CRP, a station located at Delhi, India.	R.7.
7 p.m.—Worked A 3YX at Melbourne.	R.5.
8 p.m.—Closed down.	

In every case the signals from G 2KF were reported as being pure D.C. and steady with very little fading. The best signals received were those of A 6AG, who was exceptionally strong and clear.

A 6AG stated that he was the manager of the Perth Broadcasting station 6WF, which works on 1,250 metres, and that his times were from 1 to 6 a.m., Western Australian time.

POLARISATION OF WIRELESS WAVES.

Experiments in the Transmission of Vertically and Horizontally Polarised Waves.

By R. L. SMITH ROSE, Ph.D., M.Sc., A.M.I.E.E.

IN a recent article published in this journal[1], Dr. E. F. W. Alexanderson has drawn attention to the importance of a study of the polarisation of wireless waves, particularly in connection with the transmission of short waves over long distances. It will be interesting, therefore, to describe some experiments carried out by the writer, which illustrate very clearly the planes of polarisation of waves as normally propagated along the earth's surface. The term "polarised" originated in the study of optics and its extension to wireless, although perfectly correct, is in some ways unfortunate, since most electrical engineers associate the term with a magnet or an instrument employing a magnet, such as a polarised relay.

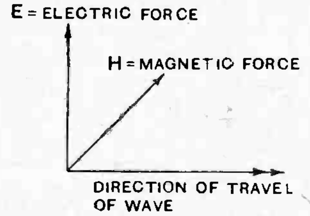

Fig. 1.—Directions of the electric and magnetic fields in relation to the direction of propagation in a vertically polarised wave.

Planes of Polarisation in Electromagnetic Waves.

An electromagnetic wave, whether its wavelength be in the optical or the wireless region, is said to be polarised when the directions of the oscillatory forces in the wave are confined to definite planes. If, for example, the electric force is confined to a vertical plane, the wave is said to be vertically polarised. Since it is known that in a wave the magnetic force is always perpendicular to the electric force, the magnetic force will always be horizontal in this case. Further, it is known that the direction of travel of a wave is perpendicular to both the electric and magnetic force, and this direction will, therefore, be horizontal in the above instance (see Fig. 1). If, now, while keeping the direction of travel of the wave the same, we arrange that the electric and magnetic forces shall change places, as shown in Fig. 2, we shall have obtained a wave which is horizontally polarised. A little consideration of the case of a wave in which the electric force is neither vertical nor horizontal will show that this can be resolved into two component waves polarised in a vertical and horizontal plane respectively.

Polarisation of Light.

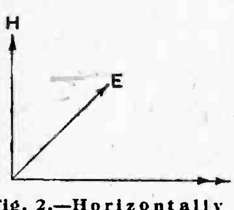

Fig. 2.—Horizontally polarised wave, in which the direction of the electric field of force is parallel to the earth's surface

Now in the case of optics it can be demonstrated that ordinary white light consists of a collection of waves polarised in all directions in a plane perpendicular to the direction of travel, and the beam of such light waves is said to be "unpolarised." There are certain arrangements, however, which can be set up by which the effects obtained vary with the plane of polarisation of the light. Two such cases are the reflection of light waves from a plain sheet of glass, and the transmission of waves through certain crystals, such as tourmaline. If a beam of white light is passed through a crystal of tourmaline, the resulting transmitted light will be polarised in a plane parallel to what is termed the optic axis of the crystal. If the crystal is rotated in its own plane about the direction of the beam as an axis, no change in the intensity of the transmitted light will be observed. This is due to the fact that, whatever may be the direction of the optic axis of the crystal, the sum of the components of the vibrations of the white light in that direction is uniform. Supposing, however, after having obtained plane polarised light from the first crystal we transmit this through a second crystal. If the second crystal has its axis parallel to that of the first, a maximum proportion of the plane polarised light will pass through it. As the second crystal is rotated about the direction of the beam of light as an axis, the light passing through it will gradually diminish until when the axes of the two crystals are at right angles none of the light will pass through the second crystal. Such an experiment demonstrates the fact that no light can pass through a crystal, with optical qualities similar to that of tourmaline, except that which has a component of vibration parallel to the optic axis of the crystal.

[1] *The Wireless World*, September 16th, 1925, p. 373.

Polarisation of Waves from a Hertzian Oscillator.

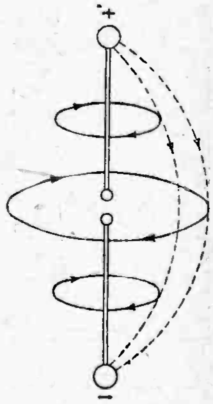

Fig. 3.—Directions of the electric and magnetic fields generated by a simple Hertzian oscillator.

Let us now proceed to consider the nature of the polarisation in wireless waves such as we are ordinarily accustomed to deal with. Taking first the simplest case of the generation of waves by an elementary Hertzian oscillator, the directions of the electric and magnetic forces will be as depicted in Fig. 3. The lines of electric force (shown dotted) are seen to be in vertical planes parallel to, and intersecting in, the oscillator itself, while the lines of magnetic force are horizontal circles with the centres at the oscillator. It is a fundamental condition that at every point in the space surrounding the oscillator the directions of the electric and magnetic forces shall be perpendicular to each other, while the direction of travel of the wave is at right angles to both of them.

If we consider the state of affairs at some distance from the oscillator, it will be found that in the horizontal plane through the centre of the oscillator the wave is travelling in a horizontal direction with the electric force

Polarisation of Wireless Waves.—

vertical and the magnetic force horizontal. This case is illustrated as wave No. 1 in Fig. 4. In the same diagram wave No. 2 is shown as travelling in upward direction at an angle θ to the horizontal, and while the magnetic force is still horizontal, the electric force is tilted backwards at angle θ to the vertical. As the angle θ is increased, the intensity of the radiation decreases steadily, becoming zero in the vertical direction. We thus see that the maximum radiation from this simple type of Hertzian oscillator, which is assumed to be oscillatory at or above its fundamental wavelength, is in the horizontal direction, and that in this direction the electric force is vertical and the magnetic force horizontal. In the path of such a wave, therefore, the maximum e.m.f. will be

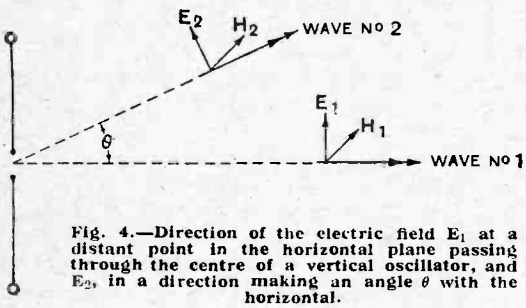

Fig. 4.—Direction of the electric field E_1 at a distant point in the horizontal plane passing through the centre of a vertical oscillator, and E_2, in a direction making an angle θ with the horizontal.

induced in a vertical aerial or in a loop with its plane vertical and parallel to the direction of travel of the wave. No e.m.f. will be induced in an aerial which is entirely horizontal or in a horizontal loop. The simple oscillator is thus seen to radiate waves which are polarised with the electric force always in the vertical plane containing the direction of travel of the wave; in other words, the waves are vertically polarised.

Let us suppose now that the oscillator is turned so that it lies horizontally as depicted in Fig. 5. The directions of the forces will have the same relation to that of the oscillator as shown in Fig 3. In the horizontal direction through the centre of the oscillator the wave will contain a vertical magnetic force and a horizontal electric force (Fig. 6). This means that no e.m.f. will be induced in a vertical aerial or loop, and for maximum reception the aerial and loop must be arranged in the horizontal plane, the direction of the aerial being such as to be parallel to the electric force. The radiation from the oscillator in this position is now said to be horizontally polarised.

Polarisation of Wireless Waves from a Transmitting Aerial.

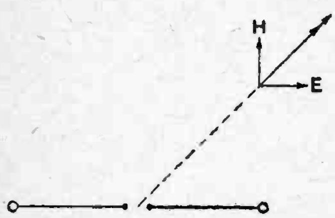

Fig. 5.—Hertzian oscillator in a horizontal position. The magnetic force is now vertical, and the electric force horizontal. The waves are, therefore, horizontally polarised.

In converting the ideal case of the Hertzian oscillator to the more practical case of an aerial connected to earth, we may first suppose that the aerial is a straight, vertical wire, and that the earth below has an infinitely high conductivity. It is, then, quite accurate to consider the aerial as half of an oscillator, the other half of which is formed as an image below the surface of the earth. The process of radiation from such an aerial is of the form depicted in Fig. 7, in which the half loops of electric force accompanied by the concentric circles of magnetic force are shown being thrown off from the aerial at each period of oscillation. It will be seen that at a distance of a few wavelengths from the aerial (as at point P) the electric force at the earth's boundary surface is vertical, and the magnetic force at this point will be horizontal and perpendicular to the direction of travel of the wave.

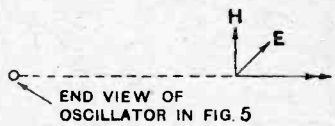

Fig. 6.—Another aspect of the conditions depicted in Fig. 5.

If the aerial possesses horizontal as well as vertical components, as in the inverted L type, it is evident that the former will contribute to the radiation in such a manner as to give a horizontal electric force and a vertical magnetic force at the earth's surface. Illustrating the case diagrammatically in Fig. 8, the electric and magnetic fields marked E_2 and H_2 respectively, due to the horizontal portion of the aerial, will be superimposed on those marked E_1 and H_1, due to the vertical portion of the aerial. But we must remember that a complete image of the transmitting aerial is formed below the earth, and that therefore the image of the horizontal portion will also contribute to the radiation. A consideration of the case as shown in Fig. 8 will show that at any instant the current in the horizontal member (2) of the aerial is exactly equal to the current in its image (3), and that

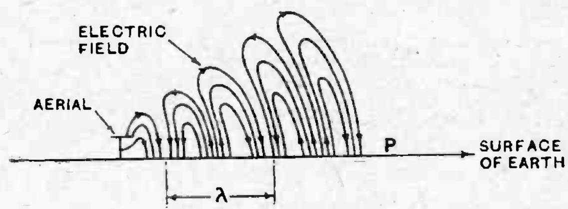

Fig. 7.—Form of the radiation from a vertical aerial.

therefore at the point P on the earth's surface the forces E_3 H_3 due to the image will be exactly equal and opposite to those (E_2H_2), due to the horizontal portion of the aerial. In brief, there will be no horizontally polarised waves radiated along the earth's surface, and the forces in the waves set out will be those shown as E_1H_1, *i.e.*, vertically polarised. Another way of viewing the position is that the horizontal portions of the electric force and the vertical components of magnetic force create eddy currents in the earth, the secondary fields due to which are exactly equal and opposite to the primary fields in the wave, and thus eliminate these components at the earth's surface.

If, however, we are considering the radiation in an upward direction from the earth's surface—for example, towards the point Q—the distance of this point from the member 2 and its image 3 will not be quite equal, and there will therefore be a resultant of horizontal polarised waves in the radiation in this direction. In the case of short wave working when the aerial may be operated at wavelengths below its fundamental, or the distance

Polarisation of Wireless Waves.—
between the flat top of the aerial and its image may be comparable with the wavelength, the consideration of the nature of the polarisation in the waves emitted becomes much more complicated than in the case considered above, and would need to be calculated for each specific example.

Effect of Finite Conductivity of the Earth.

It will be noted that in the above discussion it was assumed that the earth possessed an infinite conductivity at wireless frequencies, a state of perfection which evidently cannot prevail in actual fact. The effect of an imperfectly conducting earth is to decrease the equivalent currents in the image, so that in the case shown in Fig. 8 the forces E_3H_3 will be less than those E_2H_2 due to the aerial, and there will therefore be a small residuum of horizontally polarised waves sent out along the earth's surface. From a recent experimental determination of the conductivity of the earth, however, it can be shown that the currents in the image are only a few per cent. less than those in the aerial at ordinary commercial wavelengths. We should expect to find that in the radiation

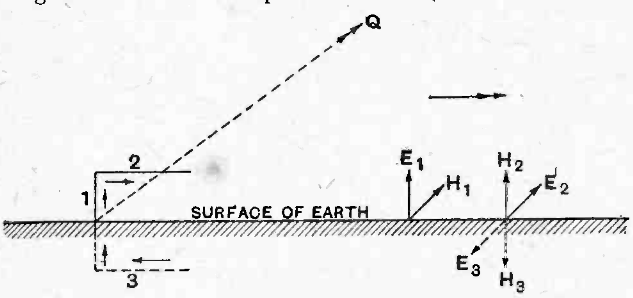

Fig. 8.—Diagram explaining the absence at the earth's surface of horizontally polarised waves in the radiation from an inverted L aerial.

received on the earth's surface from ordinary transmitting stations, the great majority of the waves are vertically polarised. This deduction from theoretical principles has been verified experimentally in two ways: first, by ascertaining directly the plane of polarisation of the waves received from typical transmitting stations, and secondly by making two deliberate attempts to radiate horizontally polarised waves along the earth's surface.

Experimental Verification of the Theory.

In conjunction with Mr. R. H. Barfield, the writer has developed methods for the absolute determination of the directions of both the electric and magnetic forces in wireless waves. These methods were fully described in a recent issue of *Experimental Wireless*,[1] with details and photographs of the apparatus employed. A long series of systematic observations carried out during the past two years with this apparatus has shown that the radiations received from various transmitting stations operating on wavelengths of from 350 to 12,000 metres has shown that the arriving waves are very accurately polarised in a vertical plane so long as the transmission is in the day-time and free from the usual night phenomena. One effect of the finite conductivity of the earth was observed in that the electric force of the arriving waves was not quite vertical, but was tilted forward slightly in the direction of travel of the wave. But as the angle of departure from the vertical is only a fraction of a degree on long waves, and never more than 3° on the shorter waves, it is evident that the resulting diminution of e.m.f. induced in a vertical aerial is practically negligible, and that the e.m.f. received on a horizontal aerial is nearly, if not quite, zero. In all cases it has been found that the magnetic force was accurately horizontal or parallel to the earth's surface, so that no signals could be received on a horizontal loop.

[1] *Experimental Wireless*, September, 1925, p. 737.

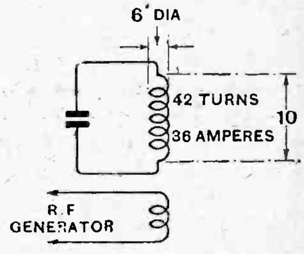

Fig. 9.—Coil aerial used for experiments in the transmission of horizontally polarised waves.

Coil Aerial for Radiation of Horizontally Polarised Waves.

In the first of the attempts made to radiate horizontally polarised waves the transmission was made from a large coil aerial arranged with its axis vertical as shown in Fig. 9. The coil was actually a large aerial tuning inductance, whose dimensions were about 10ft. high by 6ft. diameter, and which contained forty-two turns. The aerial and earth connections were removed from the inductance, which was then tuned with a dummy aerial circuit to the required wavelength. In this condition a current of 36 amperes was obtained in the coil. Now such a transmitting arrangement radiates in two ways. First, owing to the vertical height of the coil, it will act as an ordinary vertical aerial, which, although only 10ft. high, is carrying a current of 36 amperes. This part of the radiation will evidently be vertically polarised in the normal manner. Secondly, it will act as a coil transmitting aerial with its axis vertical instead of horizontal as is usually the case. Although the radiation from a coil is known to be considerably less than that from an aerial, it must be remembered that this coil gave 1,512 ampere turns in a circular area 6ft. in diameter, and that therefore the magnetic field inside and outside the coil was quite considerable. The direction of this magnetic field is shown in Fig. 10, from which it will be seen that the waves emitted were horizontally polarised.

It will be understood, therefore, that the radiation from this coil transmitter was a mixture of vertically and horizontally polarised waves, and that if these were transmitted equally well over the earth's surface, the polarisation of the waves arriving at a distant receiver should have some direction intermediate between the vertical and horizontal. At a distance of nine miles from the transmitter, however, adequate signals could be received on either a vertical aerial or a frame coil, but the arriving

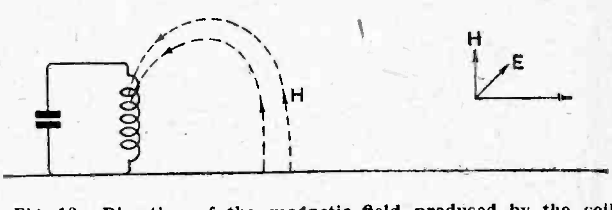

Fig. 10.—Direction of the magnetic field produced by the coil aerial in Fig. 9.

Polarisation of Wireless Waves.—

waves were found to be vertically polarised. The horizontal component of the magnetic field was exactly at right angles to the direction of transmission, and no trace of a vertical component of the magnetic field could be found.

Horizontal Hertzian Oscillator.

In the second attempt to transmit horizontally polarised waves, a very large Hertzian oscillator was set up in a horizontal plane. The oscillator was actually the earth screen of a large transmitting aerial, which was removed for the purpose of this experiment. This screen was cut in two halves, which were then connected to the secondary circuit of a spark transmitter. By this means a horizontal oscillator was formed, whose dimensions were 600ft. long by 150ft. in width, the height above the ground being about 9ft. A diagram of the arrangement is shown in Fig. 11. The natural wavelength of the system was found to be about 800 metres, and by inserting series condensers this was reduced to 450 metres, at which adjustment a current of about 4 amperes was

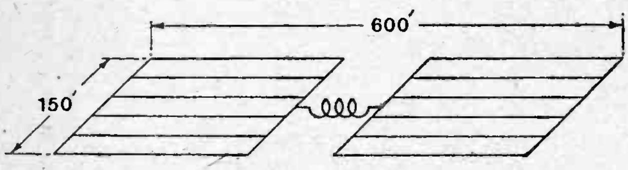

Fig. 11.—Modified counterpoise excited from a spark transmitter for the purpose of radiating horizontally polarised waves.

obtained at the centre of the screen. Great care was taken to prevent the possibility of any vertically polarised waves being emitted. The coupling between the primary and secondary coils of the transmitter was made very loose, to reduce any capacity connection to earth, and the vertical portions of the "aerial" circuits were only 1ft. or 2ft. long, and even over this length the leads with current in opposite directions were run side by side with a spacing of a few inches, these distances being negligibly small compared with the dimensions of the screen. The polarisation of the waves emitted by this arrangement was measured at two receiving stations distant 11.5 and 93 miles respectively. At both stations the waves received were found to be exactly similar to those from any other station, *i.e.*, vertically polarised. While this result is perfectly consistent with those obtained in showing that horizontally polarised waves cannot be transmitted along the earth's surface, it may be wondered how it was that the waves became converted into those of the vertically polarised type. One possibility is that the precautions taken to prevent vertical electric fields in the transmitter itself were not so efficient as they were considered to be. But another and more probable explanation is that the field in the neighbourhood of the transmitter was modified by the presence of various objects such as trees or metalwork in the locality. A long wire, for instance, which is neither entirely vertical nor horizontal throughout its length would have a current induced in it by a horizontal electric force. Any re-radiation then taking place would introduce a vertical component into the original electric field, which would evidently form part of the total radiation of the whole system.

Conclusions.

It may be fairly concluded that the above experiments provide adequate proof of the theoretical deduction that horizontally polarised wireless waves can be transmitted over the earth's surface, only with difficulty, if at all, and that the effect of such waves is entirely negligible compared with the effect of any vertically polarised waves emanating from the same transmitter. It must be remembered, however, that this does not preclude the practicability of projecting horizontally polarised waves upwards at an appreciable angle of elevation to the earth's surface. If subsequently these waves are deflected downwards from the upper portions of the earth's atmosphere, and their plane of polarisation is rotated in transit, it is evident that they will be detectable with a receiver employing a vertical aerial at some considerable distance. We have here the nucleus of the idea of the possibility of one system of secret wireless communication, in which signals sent from a transmitter to a distant receiver cannot be detected by receivers situated at intermediate points. The study of the propagation of such polarised waves is being pursued by small groups of workers in both this and other countries, and the results obtained are bound to have a great influence on the future of short-wave wireless communication.

WHAT IS BEING SAID.

A WORD FOR THE BROADCASTER.

"The further we look into this broadcasting business the more we realise the tremendous responsibility that devolves upon those entrusted with organising the programmes. An ordinary concert often takes weeks to organise properly, yet day after day this inexorable organising for broadcasting goes on. Each and every day a complete programme calling for the best artistic talent available must be prepared.

"When summing up the programmes, therefore, it is but fair to consider them generally. Broadcasting is the most inexpensive form of entertainment the public can get."—*Wireless Weekly*, Sydney, Australia.

"SUPER-HET." WISDOM.

"To many the super-heterodyne is an alluring proposition largely because it is new. . . . But those who settle down soberly to the construction of a six- or seven-valve 'super-het.' are, at any rate, progressive, and in all probability will encounter some instructive surprises before they are through with the task. Later, if the Geneva conferences bear fruit, they may derive diminished satisfaction from their costly arrays of valves, but their labours will certainly not have been in vain, for anyone who can build and operate successfully a 'super-het.' has learnt a great deal which only practical experience can teach."—*Manchester Guardian*.

Broadcast Brevities

SAVOY HILL TOPICALITIES

By Our Special Correspondent.

Newcastle's Birthday.

Newcastle Station's third birthday occurs on December 24th, and a special birthday programme is in preparation by 5NO.

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A Stable Yard Studio.

The station was started three years ago in rather a hurry, in order to satisfy the local demand for listening facilities. From a studio point of view, therefore, the arrangements were rough and ready. The first concert was transmitted from a stable yard, where the microphone was placed in an old cart and the artists had as stable companion an old watch dog, who added to the liveliness of the broadcast by barking vociferously at every item.

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The New Premises.

In celebration of the anniversary, Newcastle's new studios and offices will probably be ready for use on December 23rd. They are situated in New Bridge Street, in a building which was formerly used as a hospital. The chief studio will be much more roomy than the old one in Eldon Square, its dimensions being 37ft. 6in. by 42ft. 6in. In addition, there will be a talk studio, 16ft. by 13ft. 4in.

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When is a Frenchman a Cockney?

A French listener living at Chatou sends me an amusing comment on the broadcasting of Bow Bells from 2LO. While the bells were ringing his little daughter was born; but although the happy event occurred within sound of Bow Bells, his patriotism shrinks from admitting that the baby girl is a Cockney. "Notwithstanding this international incident, and the confusion it may provoke," he says, "we in Chatou want still to go on hearing London calling."

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Ringing in the New Year.

The Albert Hall Ball on New Year's Eve in aid of the Middlesex Hospital and British Empire Service League will be put on the ether, and dance music will be broadcast from midnight until 2 a.m. on New Year's Day. The B.B.C. expects to "go over" just as Big Ben is sounding the knell of the dying year, and the music will form a background to Westminster's chimes.

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Education in Holland.

I learn from Savoy Hill that the Rotterdam educational authorities have established a committee which has the task of looking after the education of the children whose homes are on the thousands of river and canal boats in Holland, and, incidentally, of the parents of such children. The committee has now decided that as far as possible all boats on inland waters shall be provided with receiving sets, in order that those on board may take advantage of educational items. The sets will not be supplied free, but on the hire purchase system at a cost within the reach of the skippers.

BERLIN'S NEW BROADCASTING STATION. A photograph taken at the opening of the new station at Koenigswusterhausen, near Berlin. On the left is Dr. Bredow, Secretary of State, who performed the opening ceremony. Herr Graf von Arco, the celebrated German wireless engineer, is seen on the right.

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Shorthand Speed Tests.

Lord Riddell, who is this year's President of the Pitman Fellowship, is to broadcast speed tests for shorthand writers from the London studio on January 7th. He will dictate at speeds of 100, 150, and 200 words a minute, and will choose passages from celebrated authors.

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Food for Critics.

It is usual at shorthand classes to take bits from newspaper leading articles for the purpose of speed tests; but if Lord Riddell and the B.B.C. were to take a similar risk the critics would no doubt come down on them like a ton of bricks and accuse them of spreading political propaganda in a subtle form. One has to be so careful nowadays.

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Sir George Henschel to Broadcast.

That veteran singer, pianist, teacher, conductor and composer, Sir George Henschel, has promised to broadcast some of his own songs from 2LO on January 6th. He connects the present with the period of Jenny Lind, the "Swedish Nightingale," whom he succeeded as a professor of singing at the R.C.M. It seems centuries ago; and now, at the age of 75 years, Sir George is going to sing to the British Isles.

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Christmas Programmes.

The week preceding Christmas will be celebrated by the B.B.C. in much the same way as its third anniversary week, *i.e.*, by special broadcasts, starting on December 20th, when a ballad concert will be given in the afternoon by radio stars. The artists will include the Squire Octet, which has been one of the successes of broadcasting during the past two years; Miss Peggy Cochrane, the violinist; and Miss Edith Penville, flautist. The band of the Grenadier Guards will give, during the evening, a Christmas programme. Mr. Harold Williams, baritone, and Mr. Maurice Cole, pianist, will also appear before the microphone.

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A Public School Broadcast.

On December 21st a Christmas play in French will be broadcast. The main portion of the musical programme will be provided by the London Chamber Orchestra under the conductorship of Mr. Anthony Bernard. The programme will include the appropriate "Concerto" for Christmas night (Corelli); a short poem by Tailleferre (the lady composer included in the famous French "six"); Elgar's Introduction and Allegro for strings; and the second Brandenburg Concerto (Bach). The closing part of the end-of-the-term concert will be relayed from Marlborough College—the first, it is hoped, of a series of relays from the great English public schools.

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Hansel and Gretel.

Mr. Percy Pitt will on the following day (December 22nd) conduct a shortened version of the popular Christmas fairy opera, "Hansel and Gretel." On December 23rd there will be a special Continental relay.

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Christmas Eve.

Christmas Eve will be devoted to a really old-fashioned Christmas party which listeners will overhear as from a typical English fireside. Impressions of familiar games and old-time songs will be heard. In this connection, listeners must regard this transmission, not as a professional "put up" job, but rather as a genuine slice of old-fashioned English life. The inevitable Sir Roger de Coverley will find its place. Mr. Percy Merriman, whose work in connection with the Roosters concert party is common knowledge, will be the host of the evening. Later the same evening carols will be relayed from "somewhere in London."

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Christmas Day.

On Christmas morning Bow Bells, followed by organ music from the same church of St. Mary-le-Bow, will be broadcast. In the afternoon a service, including many carols, will be relayed from Canterbury Cathedral; and in the evening the programme will include jolly military band music, songs by Miss Wynne Ajello and Mr. Dale Smith and a ghost story by Mr. A. J. Alan. A Christmas "gather round," with John Henry as the Master of Ceremonies, will be a feature of the Boxing Night programme.

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A Black List?

Should a black list be compiled of foreign broadcasting stations which are habitual offenders against British stations in causing interference and disturbing the comfort of listeners?

oooo

Heterodyne Interference.

From week to week a list is carefully compiled by the B.B.C. and sent to Geneva, containing chapter and verse of heterodyne interference. It has become a fairly common experience for nine or ten stations to be definitely heterodyned on one day and for others to be unreadable at Keston owing to mush. Here are some examples :—

2LO.—Bad interference by Cadiz and another Spanish station daily, one above and the other below 2LO's wavelength. Several successive days' interference by Petit Parisien, which, on representations being made, went to 368 and then 358 metres; complaints have since ceased.

5XX.—Blotted out in Warsaw by Komintern (Moscow) when that station transmits opera on 1456 metres. After the opera Daventry is heard all right.

EDINBURGH.—Heterodyned by Barcelona (Altrincham report).

MANCHESTER.—Union Radio, Madrid, whose normal wavelength should be 373 metres, interferes at Darlington and other towns.

SHEFFIELD.—Has been heterodyned for a week by the new station at Berne. The most grievous point is that Sheffield is on the lowest of all B.B.C. wavelengths, since it is one of the most distant stations from the coast line.

BIRMINGHAM.—Heterodyned very badly by Radio Lyons, also jammed by harmonic of a commercial station at intervals.

BOURNEMOUTH.—Heterodyned by Oslo, Hamburg, and probably Graz, as well as Union Radio, Madrid; 6BM listeners are treated to the French, German, and Austrian National Anthems, and "Deutschland über Alles."

CARDIFF.—Listeners have bombarded the station with complaints of interference by San Sebastian and Seville. The latter station should be on 350 metres.

oooo

Seniores Priores.

The view has been expressed in some quarters that the B.B.C. stations offend in this matter of interference just as much as foreign stations; but the majority of British stations have been working a good deal longer than those in many other parts of Europe, and *a priori* in the interests of British listeners have insisted on preferential treatment whenever the question of the allocation of wavelengths is discussed.

oooo

A Jig-saw Puzzle.

In some cases the trouble is complicated by the fact that when one foreign station which is interfering with a British station changes its wavelength it immediately falls foul of some other European station. Geneva has its work cut out in trying to fit the jig-saw puzzle of wavelengths together and in proper order.

oooo

5GB.

"5GB testing," followed by the numerals one to ten and the months of the year, disturbed some listeners in the neighbourhood of Fleet Street, London, one evening last week, during broadcasting hours.

oooo

Sets Need Readjusting.

This should not have been the case, as the wavelength used was far removed from that of 2LO. The B.B.C. engineers were, in fact, carrying out tests on 450 metres in connection with their investigations of the possibilities of alternative programmes for London. The use of the call-sign 5GB seems to have been taken as an indication that Chelmsford was again experimenting; but the work there ended early in November, and the decision of the Post Office is now awaited as to the effect of the experiments on other wireless services. For the later tests the transmissions took place from another locality nearer the Metropolis, and apart from valuable information obtained at the transmitting end it seems clear that many receiving sets on which 5GB was heard would require readjusting if at any time 2LO were to transmit regularly on 450 as well as 365 metres.

FUTURE FEATURES.

Sunday, December 20th.

LONDON.—9.15 p.m., The Band of H.M. Grenadier Guards.

BIRMINGHAM.—3.30 p.m., Carol Service. 5.30 p.m., Children's Christmas Corner.

BOURNEMOUTH.—4 p.m., Christmastide Concert.

CARDIFF.—9.15 p.m., Symphony Concert—Solo Pianoforte, Leff Pouishnoff.

Monday, December 21st.

LONDON.—7.45 p.m., London Chamber Orchestra, conducted by Anthony Bernard.

BIRMINGHAM.—7.45 p.m., Choral Concert relayed from the Town Hall.

MANCHESTER.—8 p.m., The Roosters Concert Party.

GLASGOW.—7.50 p.m., The Pianoforte Sonatas of Beethoven.

Tuesday, December 22nd.

LONDON.—8 p.m., "Hansel and Gretel" (Humperdinck).

MANCHESTER.—1.15 p.m., Carols by the Manchester Cathedral Choir.

BELFAST.—8.25 p.m., Methodist College Prize Day Concert relayed from Ulster Hall.

Wednesday, December 23rd.

NEWCASTLE.—8 p.m., 5NO's Birthday.

GLASGOW.—8 p.m., A Mixed Night.

Thursday, December 24th.

LONDON.—8 p.m., An Old-fashioned Christmas Party.

BIRMINGHAM.—8 p.m., Radio Pantomime Revue.

BOURNEMOUTH.—8 p.m., John Citizen.

MANCHESTER.—8 p.m., A Christmas Pantomime.

ABERDEEN.—8 p.m., Scottish Programme.

Friday, December 25th.

LONDON.—10.15 a.m., Bow Bells. 3 p.m., Service relayed from Canterbury Cathedral.

CARDIFF.—7.30 p.m., Christmas Concert relayed from Theatre Royal, Barry.

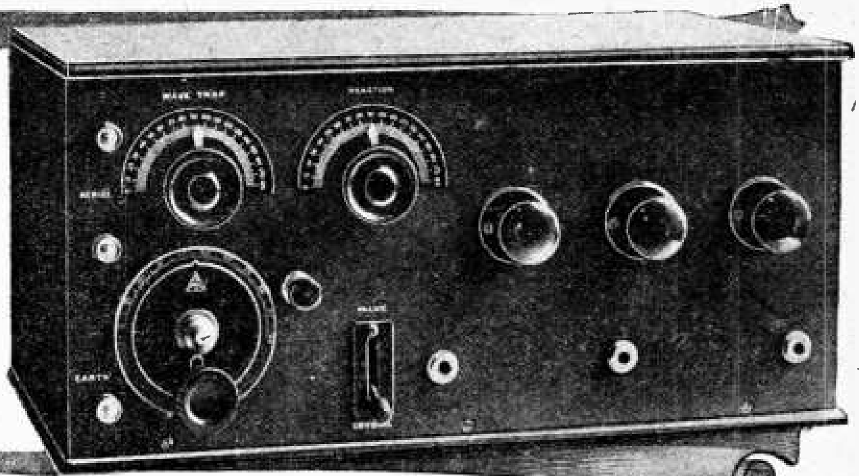
MANCHESTER.—7.30 p.m., Ye Spirit of Christmas.

Saturday, December 26th.

LONDON.—8 p.m., Christmas Gatheround with John Henry.

SELECTIVE TWO-CIRCUIT RECEIVER.

By J. ENGLISH.



Reinartz Circuit for Distant Stations; Crystal and Two-Valve Amplifier for Local Transmissions.

IN designing this receiver, an attempt has been made to fulfil two broad requirements of amateurs situated within a radius of five to ten miles of a B.B.C. station; firstly, the distortionless loud-speaker reception of programmes broadcast by the latter, and, secondly, the reception of long-distance signals with the minimum of interference from the local station.

The majority of amateurs will no doubt agree that, for short range reception, a crystal detector followed by a well-designed two-valve amplifier, constitutes an ideal receiver for loud-speaker reproduction, while one of the simplest and most sensitive receivers for long-distance work is a detector valve employing some such circuit as the Reinartz followed by one or two L.F. valves.

The satisfactory fulfilment of both these requirements resolved itself, therefore, into a choice of detectors with suitable associated tuning circuits, a crystal detector for short range and a valve detector for long-range reception followed in each case by a reasonably distortionless amplifier. The necessity of having two separate receivers is obviated if we employ some means of using either detector at will followed by a common L.F. amplifier. In the receiver described herein this selection of detector and its associated circuits is effected by one movement of a switch. Thus it will be seen that this receiver consists in reality of two separate receivers, both of which have been designed for maximum efficiency under the conditions in which they are to be used. It will be appreciated that a set which can be adapted for either short or long range reception by the movement of one switch possesses many advantages.

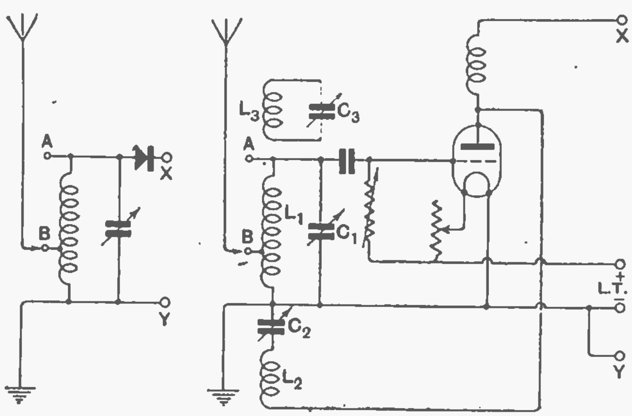


Fig. 1 —Alternative detector circuits provided by the changeover switch in the circuit in Fig. 2.

The Alternative Circuits.

A simple form of interference eliminator has been incorporated, namely, an absorption wave-trap. This greatly assists in cutting out the local station when receiving distant signals.

Fig. 1 shows theoretical connections of both detectors. Two tappings A and B are provided on the tuning coil L_1 for the aerial lead, A for the crystal detector and B for the valve detector. In the modified Reinartz circuit associated with the valve detector, the inductances L_1 and L_2 are wound on the same former, to which is loosely coupled the absorption wave-trap coil L_3 tuned by the condenser C_3. The output terminals X and Y of each detector are connected at will by movement of the selecting switch to the input terminals of the L.F. amplifier, the input coupling being a transformer. Choke-capacity coupling is used between the two amplifying valves. The full circuit is shown in Fig. 2, and it will be seen that provision is made for separate H.T. taps and grid bias for each valve. This allows for the individual control of each valve, which is essential for distortionless reception.

Three jacks are incorporated in the receiver, and these, in conjunction with the detector selecting switch, give one the choice of the following combinations: crystal receiver, or single-valve receiver, followed by one or two L.F. stages.

When tested on an average-sized aerial system, the crystal 2 L.F. combination gave very strong loud-speaker reproduction of the local station, 2LO, six miles away, very little, if any, distortion being discernible. As a

Selective Two-Circuit Receiver.—permanent detector is used, this combination constitutes a powerful local receiver which is simplicity itself as far as operation goes, there being but one tuning control.

On changing over to the valve detector 2 L.F. combination, and eliminating 2LO by means of the wave-trap, the usual round of B.B.C. and foreign stations came in very well, some being quite strong on the loud-speaker. Interference from 2LO, thanks to the trap, was almost negligible, and the search for distant stations thereby made easy, tuning being sharp and selective.

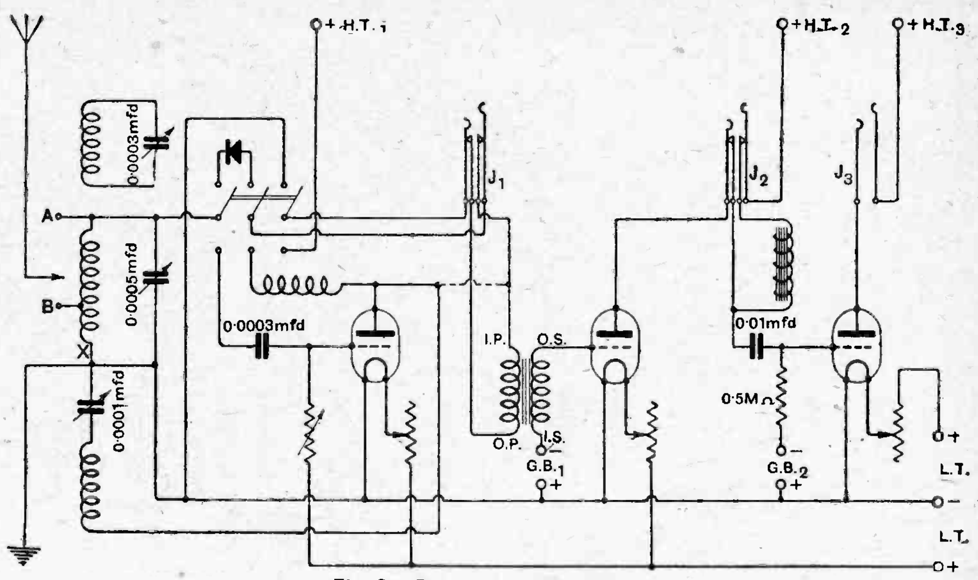


Fig. 2.—Complete circuit diagram.

Hand-capacity effects are practically non-existent, and, with only two controls (grid circuit and reaction condensers), tuning is quite a simple operation.

The wavelength range of the receiver when coupled to an average aerial system is approximately 200 to 600 metres.

Components.

Turning now to the design of the receiver, examination of the rear view photographs will show that it is constructed on the American system. On the extreme right is the tuning coil former, inside which slides the wave-trap coil, of low-loss design, thus varying the coupling of the trap. Behind the tuning coil is the trap condenser (0.0003 mfd.), and beneath it the main tuning condenser, which is fitted with a slow-motion dial.

Next to the wave-trap condenser is the reaction control condenser (0.0001 mfd.), and beneath it the permanent detector suspended by its connecting wires to the switch beneath. This is the detector selecting switch. The valve holders are fixed beneath a valve platform, behind which are two transformers, the second, with its windings connected in series, being used as the L.F. choke coil in preference to an ordinary iron-cored choke, as this transformer happened to be on hand and it is considerably more efficient than some of the commercial

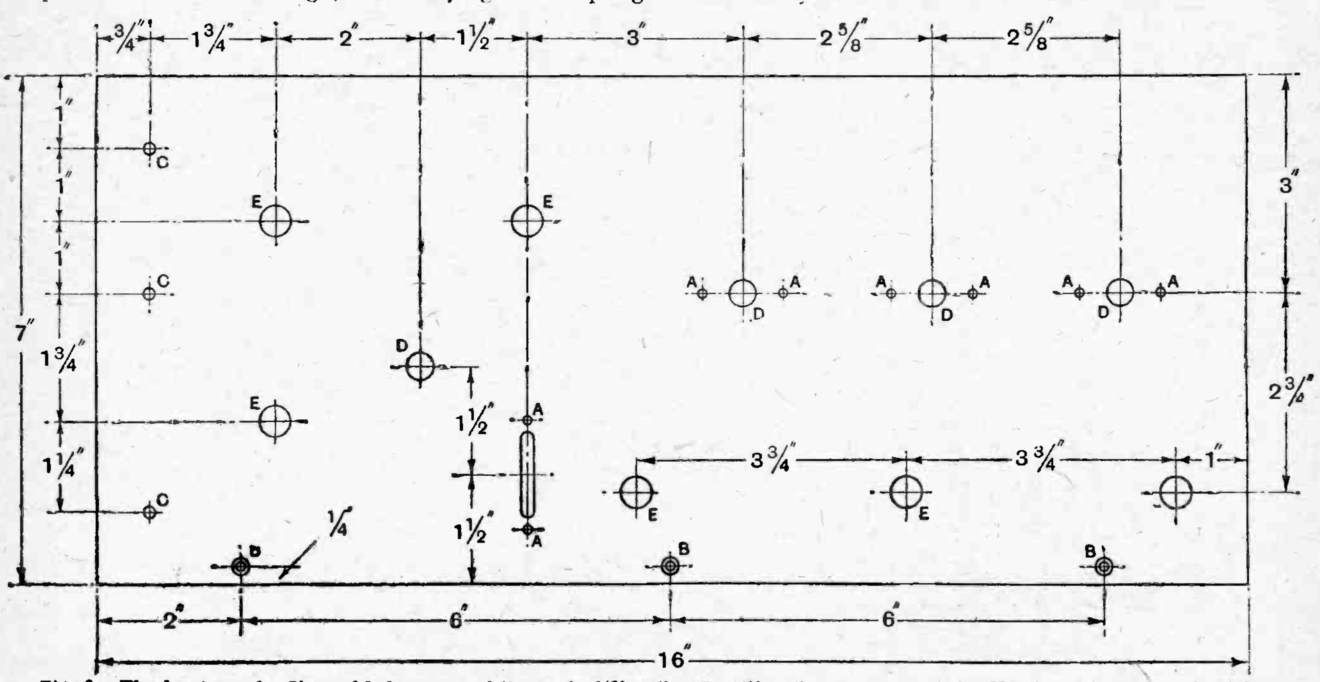
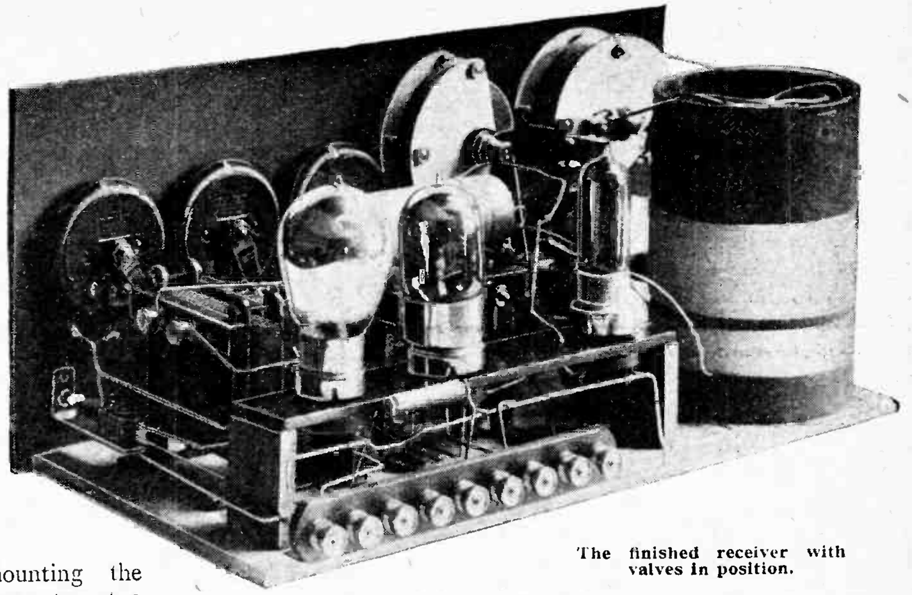


Fig. 3.—The front panel. Sizes of holes are as follow: A, 1/8in. dia.; B, 1/8in. dia., countersunk for No. 4 wood screws; C, 5/32in dia.; D, 3/8in. dia.; E, 7/16in. dia.

elective Two-Circuit Receiver.—
:ypes of L.F. chokes, the impedances of which are too low. The terminal strip, mounted on the left-hand back edge of the baseboard, projects through a slot in the rear of the cabinet when the panel and baseboard are placed therein.

No fixed condensers have been incorporated in the set either across the H.T. battery or across the phones, as it is possible to connect such condensers externally.

When commencing construction the panel and valve platform should first be marked out and drilled in accordance with Figs. 3 and 4 with occasional reference to the components to be mounted and with the assistance of the templates supplied with them. When mounting the detector-selecting switch it is necessary to cut a 1¼in. slot in the panel, and the easiest way to do this is to mark out the position and area of the slot, drill a line of ¼in. holes nearly touching along the slot and



The finished receiver with valves in position.

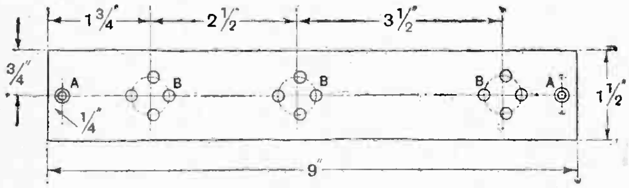


Fig. 4.—Valve panel. A, 1/8in. dia., countersunk for No. 4 wood screws; B, 3/16in. dia.

then cut away the ebonite between the holes with a chisel, filing out the remainder with a flat file.

A list is appended of components required, those to be constructed being the aerial and wave trap coils and the H.F. choke. The aerial coil is wound on a 6in. length of well waxed cardboard tube 4in. in diameter, putting on 35 turns of No. 20 D.C.C. with a tapping at the 10th turn counting from the bottom. The series reaction winding consists of 30 turns of No. 26 D.C.C.

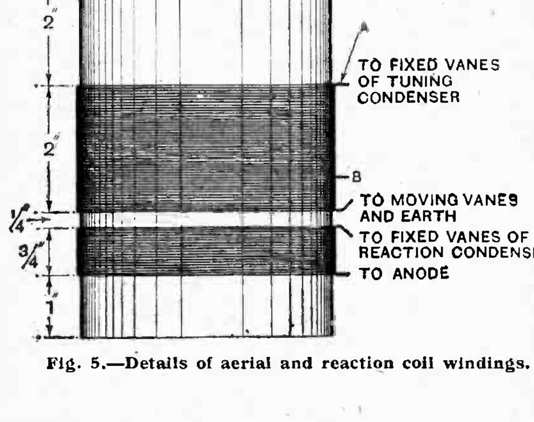


Fig. 5.—Details of aerial and reaction coil windings.

wound on beneath the aerial coil. The spacing and connections of windings are shown in Fig. 5.

Construction of the Wave-trap.

The wave-trap coil, which must have very low H.F. losses, is constructed from two pieces of wood 1¼in. wide, ¼in. thick, fitted together edgeways to form a cross which fits inside the coil former sufficiently tightly to remain in place when adjusted at any height therein. The length of each piece of wood will depend upon the internal diameter of the former, which will be approximately 3½in., saw cuts being made in each piece at an

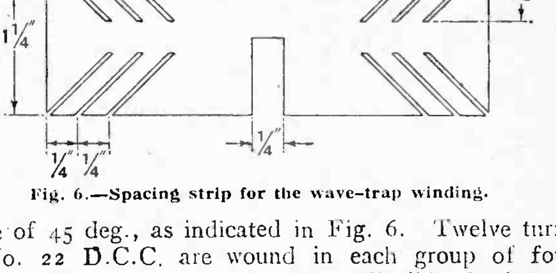


Fig. 6.—Spacing strip for the wave-trap winding.

angle of 45 deg., as indicated in Fig. 6. Twelve turns of No. 22 D.C.C. are wound in each group of four slots, making 72 turns in all. Flexible leads are soldered to the ends of the coil for connection to the tuning condenser.

The H.F. choke coil consists of 200 turns of No. 36 D.S.C. wound in a single layer on a 3in. length of cardboard tube 1¼in. in diameter, which, when wound, is bound over with tape. This choke is shown in the photographs mounted over the first transformer.

If desired, the panel may be suitably marked by means of panel transfers, and it will be noticed from the photograph of the panel face that the wave-trap and reaction condensers are furnished with engraved scales and pointers instead of the usual dials. Besides giving a neater appearance, the use of a scale and pointer permits

Selective Two-Circuit Receiver.—of more accurate reading, while there is insufficient room on the panel for the usual condenser dials.

Wiring the receiver is facilitated by mounting all components but the large coil former, intervalve transformer, and L.F. choke. Wiring up is then commenced, beginning with the connections of the detector selecting switch, then the detector valve, and through to the last valve, placing the transformer and L.F. choke in position as required. The coil former is mounted and wired up last of all.

With the help of Fig. 7 and the photographs, wiring up should not give rise to any difficulty, but particular attention should be paid to the connections of the terminal strip, each wire being well clear of its neighbours. Although some idea of the wiring may be gathered from the photographs, it is not possible, unfortunately, to show the exact spacial relationship of every wire, but all connections should follow the shortest paths possible. A point to notice is that clips to hold the grid leak for the last valve may be fashioned from the leak connecting wires themselves as in the original instrument.

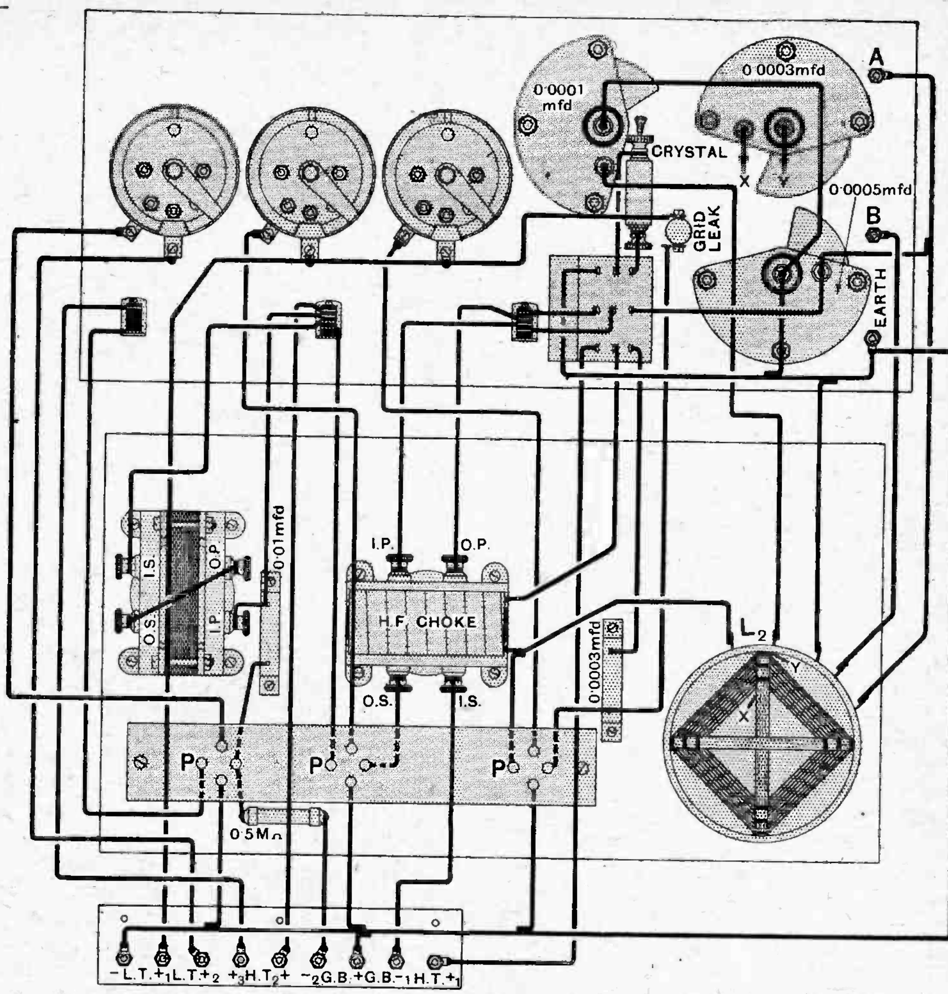


Fig. 7.—Wiring diagram. The leads to the wave-trap inductance are marked X and Y.

In the circuit diagram of Fig. 2 a connection is shown from the anode end of the H.F. coil to I.P. of the first transformer, but this connection is optional. The detector valve, when used alone, may be somewhat unstable, but the circuit is completely stabilised by making this connection, and although the choke is shorted when the telephone plug is withdrawn from the first jack, the impedance of the transformer primary is sufficiently high to compensate for the absence of the choke.

If it is desired to receive transmissions from the Daventry station on the crystal combination, provision can be made for the insertion of a loading coil at the point marked X in Fig. 2.

It will be observed from the diagrams in Figs. 2 and 7 that a separate L.T. positive terminal is provided for the last valve, as it is advisable to use a power valve here; the usual types of which require up to six volts L.T. Three valves of the 0.06 type may be used, working off dry batteries, the first two being D.E.3, B.5, or similar types, and the third a B.7, one of the few power valves yet marketed which operate on such a low filament current as 0.06 amperes.

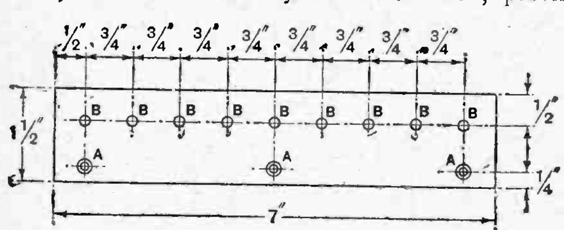


Fig. 8.—Terminal panel. A, 1/8in. dia., countersunk for No. 4 wood screws; B, 5/32in. dia.

Testing the Crystal Circuit.

In order to test out the crystal—2 L.F. combination, the aerial and earth leads are connected, the aerial lead going to the top aerial terminal (A). Then the trap condenser is set at zero, the detector selecting switch pressed down, and the phone plug placed in the first jack. This gives a simple crystal receiver with which the local station should be received without difficulty. It will be readily appreciated that the ability to revert to a crystal receiver without difficulty is a decided advantage for several reasons. One or two L.F. stages may be added by placing the plug in the second or third jacks.

COMPONENTS REQUIRED.

1 Ebonite panel, 16in. × 7in. × ¼in.
1 Baseboard, 15in. × 8in. × ½in.
1 Variable condenser, 0·0005 mfd.
1 Variable condenser, 0·0003 mfd.
1 Variable condenser, 0·0001 mfd.
1 Coil former, 4in. dia.
1 Intervalve transformer (R.I.).
1 L.F. iron-cored choke (or transformer).
1 3-P.D.T. anti-capacity switch (Burndept).
1 Fixed condenser, 0·01 mfd. (T.C.C.).
1 Fixed condenser, 0·0003 mfd. (Dubilier).
1 Grid leak, 0·5 megohm (Dubilier).
1 Variable grid leak (E.M.C.).
3 Dual rheostats (Burndept).
1 Permanent detector (R.I.).
2 Double jacks, four pole (Sterling).
1 Single jack, two pole (Sterling).
1 Telephone plug (Sterling).
1 Vernier dial (Apex).
1 doz. terminals.
Knobs, scales and pointers for two condensers.
Sundry wires and materials for valve platform, terminal strip and coils.
Cabinet to hold panel and baseboard.

Approximate cost, excluding valves, batteries, etc. - £9 0s. 0d.

In conjunction with a good loud-speaker the full combination gives extremely good results, provided proper attention is paid to the values of anode and grid bias voltages, the correct value of the latter for any particular anode voltage being ascertained by reference to the curves and data issued by the valve manufacturers.

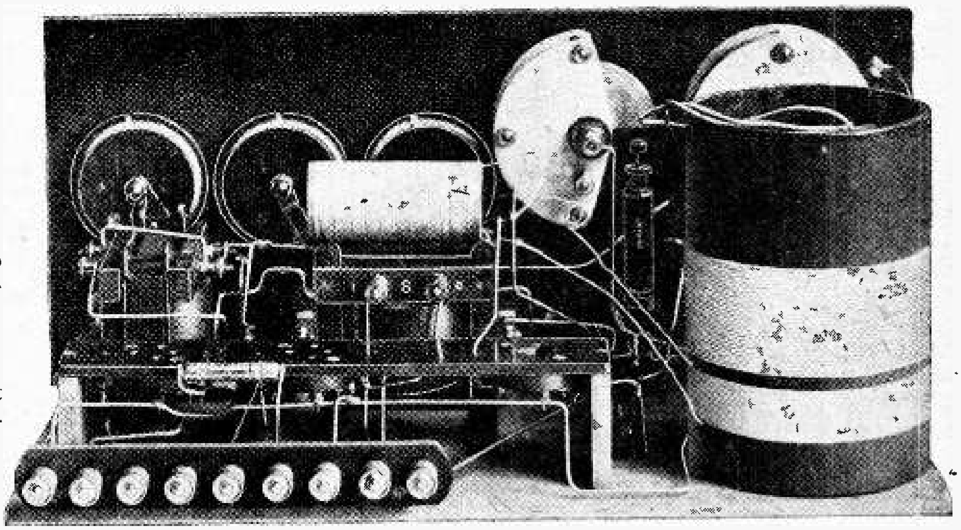
Turning now to the other combination, valve detector and 2 L.F. valves, as selectivity is of paramount importance, the aerial lead should be connected to the lower of the two aerial terminals (B), thus reducing the damping of the grid circuit. Placing the phone plug in the first jack and lifting the selector switch into the other position gives the single-valve Reinartz circuit.

Reinartz Circuit Tuning.

Anode voltage, filament current, and grid leak resistance are then adjusted for smooth reaction; that is, as the reaction condenser is rotated from zero to maximum the circuit should pass gradually into oscillation without any "plop" or backlash. To obtain a satisfactory state of affairs, it is best to use a low anode voltage on the first valve, say twenty or thirty volts, rather high filament current, and not to screw the grid leak resistance too far down.

When the first valve is working correctly, the local station should be tuned in at maximum strength without the assistance of reaction. The wave-trap coil is then fixed at the top end of the coil former, as shown in the photograph, and the trap condenser varied until signals disappear. The correct setting of this condenser is rather sharply defined, so that it should be rotated slowly in order not to pass over the critical point of adjustment.

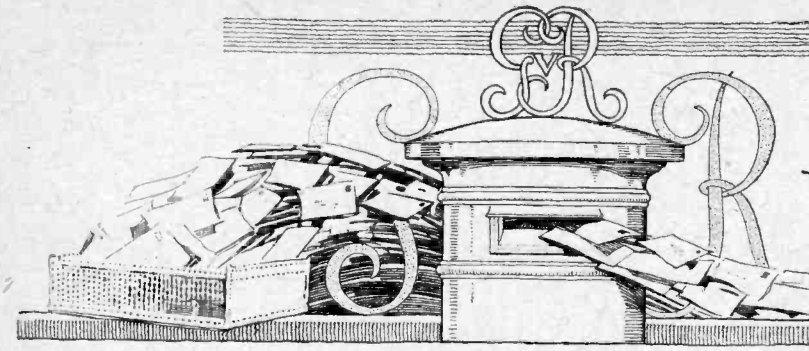
Having eliminated interference from the local station, all is ready for long-distance reception, searching being an easier operation if the phones are plugged into the anode circuit of the second valve, *i.e.*, into the second jack. Too much reaction should be avoided, only sufficient being used to maintain the receiver in a sensitive condition. If the main tuning condenser is varied and followed round with the reaction condenser, one can soon acquire the knack of tuning in weak signals without oscillating. The control of reaction being so smooth, searching is a delightfully easy operation.



Rear view, showing H.F. choke mounted on the first intervalve transformer.

The absorption wave-trap certainly eliminates the local station, however strong, but it has the disadvantage of reducing somewhat the strength of signals from stations on closely adjacent wavelengths. Thus, when 2LO is tuned out, Cardiff and Mancheaster are rather difficult to receive in any volume, but Bournemouth, higher up the wavelength scale, comes in quite well and, with the full combination, comfortably strong on the loud-speaker.

Where interference is not very strong, the coupling of the wave-trap coil may be made quite loose, such as standing it nearly upright inside the former, thus reducing at the same time the absorption on adjacent wavelengths. Where interference is very great, however, the trap coil must be more closely coupled.



LETTERS TO THE EDITOR

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

AMPLIFYING FROM GRAMOPHONE RECORDS.

Sir,—I noticed in your issue of last week an article upon a modified "Round" device for gramophone reproduction.

I am enclosing two photographs of a similar device which I have had in use regularly for some months now, and wish to draw your readers' attention to two points not mentioned by your contributor.

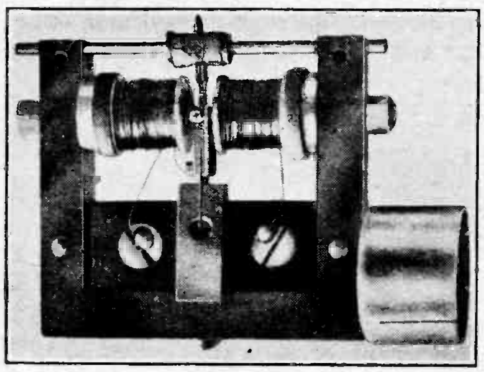


Fig. 1.—Reproducer with adjustable pole-pieces designed by Mr. Douglas.

In the first instance, although he provides a threaded adjustment to the tensioning arms carrying the needle and its damping pad, there is no provision for adjustment of the magnet poles relatively to the armature. It will be appreciated that if the armature is mounted on an elastic suspension such as a clock-spring, there will be a natural tendency for the spring to assume a central position and to take the armature and needle with it. To attempt to correct the air gap by screwing the tensioning arms in or out is not satisfactory, because the differential action of the screw is unequal, as the spring has to be stressed one way against its natural centre of action, and will tend to rebound on the opposite side, probably introducing a secondary rebound which in the course of my investigations I have found to produce distortion. The method adopted in the photographic figures can be clearly seen, more particularly from Fig. 2, which shows the device dissembled. The signal coil is held on a light Duralumin bobbin between the pin F and the rubber pad G, on the pole-piece K. A spacing piece H is slotted so as to prevent turning on the magnet bar. The pole-piece may obviously be drawn up against the rubber pad G by adjustment of the nut I, which will be more evident from the photograph of the complete instrument, Fig. 1. There is no doubt that this adjustment is essential, and owing to the binding action of the rubber the adjustment is very stable. The screwed end of the pole piece K may be slotted if desired to assist in this direction.

A further point which appears to me to be undesirable is the arrangement for mounting the needle in a solid holder in the middle of the damping pad D (Fig. 2). There is unquestionably a tendency for the lower part, consisting of the needle and the pad D, to vibrate from a pair of centres regarded as the needle point to the centre of the armature, and then a further movement from the centre of the armature to the clamping edge, which produces a harmonic motion not at all consistent with the fundamental vibrations at the needle point. It is very necessary that the needle should be as light and rigid as possible, and it should therefore pass right into the clamping screw C in the armature. A further point which I have found to be useful for experimental purposes is to have the spring suspension A slotted, so that it may be adjusted for elasticity and frequency between the clamping screw in the block B and the corresponding screw in the armature.

I have used a damping pad of cotton wool at D with great success, and that in the illustrations is constructed from rolled cotton wool soaked in collodion cement.

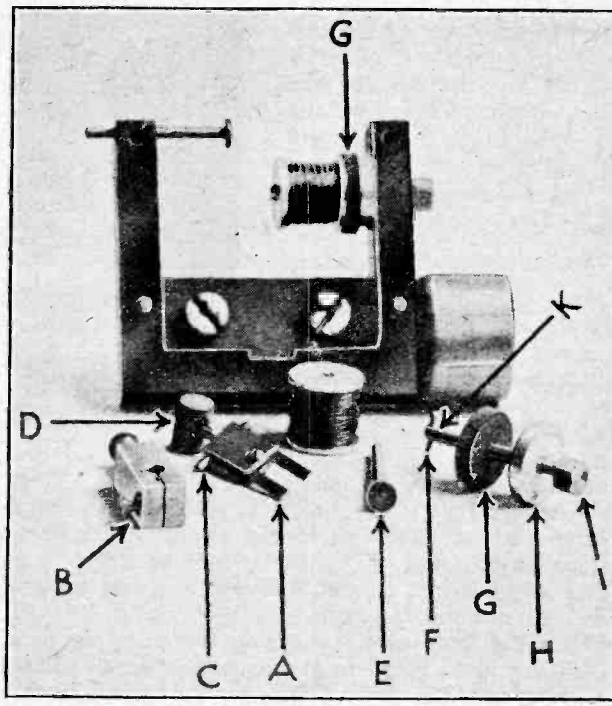


Fig. 2.—Armature and one pole-piece dismantled to show component parts.

In conclusion, the device may be very well used to control a small (or, indeed, a large) telephony transmitter.

It should be noted that the output is somewhat greater than that from a magnetophone, and therefore considerably less amplification is required; which, of course, renders the device more adaptable to the requirements of the experimenter.

Incidentally a permanent needle should be used, otherwise the constant changing means continual readjustment of the whole device.

A. L. M. DOUGLAS, M.I.R.E.

DICTIONARY OF TECHNICAL TERMS

Definitions of Terms and Expressions commonly used in Wireless Telegraphy and Telephony.

This section is being continued week by week and will form an authoritative work of reference.

Magnetic Inductive Capacity. An expression sometimes used for PERMEABILITY.

Magnetic Linkage. See LINKAGE, or LINE LINKAGES.

Magnetic Remanence. See REMANENT MAGNETISM.

Magnetic Screen or Shield. An iron box or shield with fairly thick walls placed round a piece of apparatus in order to screen it from the effects of stray magnetic fields. The intervalve transformers of multivalve low-frequency amplifiers are often screened in this manner to prevent *regeneration* being set up by magnetic interaction between the transformers.

Magnetic Shunt. A piece of iron placed near the poles of a permanent or electro-magnet in order to divert part of the magnetic flux from the airgap. The field strength in the airgap of a moving coil instrument is usually adjusted in this manner.

Magnetisation Curve. See B-H CURVE.

Magnetising Force (H). The magnetic field strength in lines per square centimetre at a point where no iron or other magnetic material is present. If a piece of iron of *permeability* μ is brought to a place where the magnetising force is H, the *flux density* produced in the iron will be $B=\mu H$ lines per square centimetre. The magnetising force of a coil carrying a current I amperes is $0.4\pi NI/l$, where N is the number of turns, and l is the length of the *magnetic circuit*.

Magnetomotive Force (M.M.F.). A quantity which may be applied to a *magnetic circuit* in the same manner in which "electromotive force" is applied to an electric circuit. It is that which drives the flux through the magnetic circuit, the value of the magnetic flux being given by the M.M.F. divided by the *reluctance*, just as the current in an electric circuit is given by the E.M.F. divided by the resistance. The M.M.F. of a coil of N turns carrying a current I amperes is equal to $0.4\pi NI$, the unit being the "gilbert." See RELUCTANCE.

Magnetron. A special type of *thermionic valve* so designed that the stream of *electrons* flowing between the plate and the filament can be controlled by means of a magnetic field.

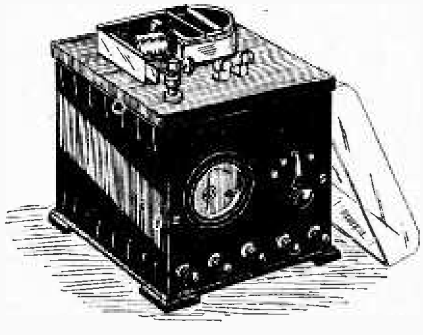
Manganin. An alloy of copper, manganese and nickel used for making resistances on account of its very low *temperature coefficient*. Shunts for ammeters and other instruments are usually made of this alloy. Its *specific resistance* is about 44 microhms per cm. cube.

Mansbridge Condenser. Condenser made by a special process. Layers of paper are coated on one side with tin foil and pressed together, the whole being impregnated with paraffin wax. The dielectric losses in this type of condenser are considerable, and they should not be employed in places where dielectric losses are detrimental to efficiency.

Marking and Spacing Waves. In the transmission of Morse signals by wireless telegraphy, it is sometimes arranged that, instead of starting and stopping the oscillations in the transmitting aerial to correspond with the dots and dashes and intervening spaces of the Morse code, the oscillations are not stopped at all, but merely changed slightly in wavelength when the transmitting key is operated. The receiving station is tuned to the wavelength which represents the dots and dashes of the Morse code, being *detuned* from the wavelength which is emitted from the transmitter during the intervals between the dots and dashes. The wavelength emitted during the sending of the dots and dashes themselves is called the "marking wave," and that representing the spaces between them is called the "spacing wave." Such a system is used in order that the transmitter shall have a steady load upon it.

Maximum Value (of an alternating quantity). The peak value reached by each half-wave, or the *amplitude*.

Maxwell. A name commonly used for the unit of *magnetic flux*, *i.e.*, one *line of force*.



Vibratory mechanical rectifier.

Mechanical Rectifier. A *rectifier* which functions by the rotation of a commutator, or by the making and breaking of a contact by a tongue or reed vibrating synchronously with the frequency of the current to be rectified. Cf. NODON VALVE.

Megger. An instrument for the measurement of high resistances, a pointer giving a direct indication of the resistance on a scale.

Megohm. The unit of resistance commonly employed for evaluating high resistances such as insulation resistance, the resistances of grid leaks, etc. It is equal to the resistance of one million ohms, and is usually denoted by MΩ.

Mercury Vapour Rectifier. A *rectifier* in which an arc is formed between carbon electrodes and mercury in an exhausted vessel. The arc in the mercury vapour will only conduct current in one direction (unidirectional conductivity), and this property is made use of for purposes of *rectification*. A mercury vapour rectifier is very efficient, especially at high powers and voltages.

Metre Bridge. A *Wheatstone bridge* of the slide wire type, the wire being one metre long.

Mf. or mfd. Abbreviation for *microfarad*.

Mho. The unit of *conductance*, being the conductance of a wire whose resistance is one *ohm*. It is the reciprocal of the ohm.

Micro-. A prefix meaning the millionth part of. Thus microampère, a millionth of an ampère, etc.

Microfarad. The millionth part of a *farad* and widely used as the practical unit of *capacity*, the *farad* being too large a unit for practical evaluation of the capacity of a condenser. See CAPACITY.

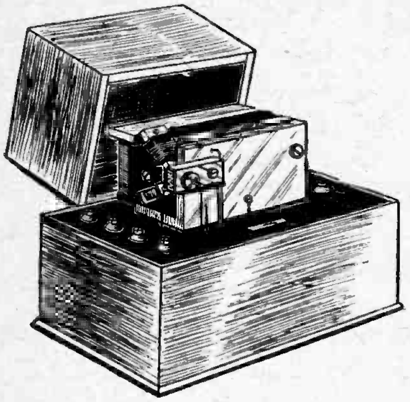
Microhenry. The millionth part of a *henry*, used as a practical unit of *inductance* for wireless purposes; for instance, for evaluating the inductance of tuning coils, etc.

Microhm. The millionth part of an *ohm*, used almost exclusively for denoting the *specific resistance* of metals and other conducting materials.

Microphone. The name now commonly used for any instrument which is used for converting sound vibrations into electrical vibrations or pulsations of similar wave form, *i.e.*, a telephone transmitter.

Dictionary of Technical Terms.—

Microphone Amplifier or Microphone Relay. A device for magnifying electrical oscillations, etc., and often used for amplification of speech when received on an ordinary crystal detector set. The signals to be amplified are applied to the coil of an *electromagnet*



Microphone amplifier.

the armature of which varies the pressure on, and therefore the resistance of, a loose carbon contact, or operates in a similar manner on a *Skinderviken button*, and so controls the current in a local circuit.

Milli-. A prefix meaning the one-thousandth part of. Thus milliampere, the thousandth part of an ampere.

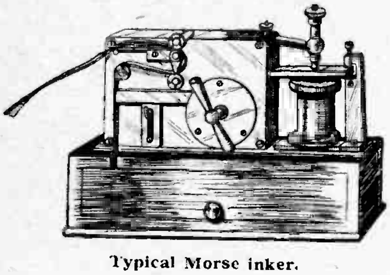
Milliammeter. A low reading *ammeter* graduated to read current in *milli-ampères.*

Millivoltmeter. A low reading *voltmeter*, graduated to read directly in millivolts, *i.e.*, in thousandths of a volt.

M.M.F. Abbreviation for *magnetomotive force.*

Modulation. The variation at an *audio frequency* of the amplitude of the high-frequency oscillations in a wireless telephone transmitter, in accordance with the waveshape representing the low-frequency or speech vibrations. The high-frequency wave which is thus modulated is called the *carrier wave*, and its frequency is called the "carrier frequency." See Side Bands.

Modulator Valve. In the *choke control* method of wireless telephony transmission, the "modulator valve" is the one whose function it is to amplify the low-frequency oscillations and superimpose them on the high-frequency oscillations, *i.e.*, the valve which modulates the H.F. oscillations. See Modulations.



Typical Morse inker.

Morse Inker. A recording instrument which marks down on a moving tape the dots and dashes of the Morse code representing the message being received.

Morse Key. A tapping key which is specially constructed and balanced for signalling by hand in the Morse code.

Motor Generator. A generator or dynamo direct-coupled to an electric motor, usually on same bedplate, used for converting A.C. into D.C. or *vice versa*, or for converting D.C. at one voltage into D.C. at another and more convenient voltage. For instance, for charging small accumulators a low voltage dynamo is driven from an A.C. or D.C. motor, according to the nature of the electric supply. Cf. Anode Converter and Rotary Converter.

Moullin Voltmeter. See Thermionic Voltmeter.

Moving Coil Instruments. Ammeters, voltmeters, etc., in which the moving part consists of a pivoted coil, the sides of which are situated in a strong magnetic field between the poles of a permanent magnet. The current to be measured (or a definite fraction of it) flows through the coil and so sets up a torque or turning moment which rotates the coil on its pivots. The motion of the coil is controlled by the action of spiral hair springs, which also serve the purpose of leading the current into and out of the coil. The pointer is carried on the central moving part of the pivot at one end of the coil and the whole moving part must be balanced so that the centre of gravity lies on the central axis. Such instruments indicate the average value of the current passing through them, and are therefore only suitable for direct current measurements. A moving coil instrument is usually identified by its perfectly uniform scale. See Magnetic Damping.

Moving Iron Instruments. Ammeters, voltmeters, etc., in which the moving part consists of a suitably shaped piece of soft iron pivoted so as to be rotatable about some axis. The current to be measured is passed through a coil, the magnetic effects of which cause the iron to rotate on its axis and so move the pointer over the scale. The motion must be controlled in some way, and this is done either by spiral hair springs or by having the centre of gravity of the moving part situated outside the axis of rotation (gravity control). With spring control the centre of gravity is on the axis, and thus the instrument need not be levelled before taking readings, but in the latter case it is essential to see that the instrument is levelled so that it reads zero when no current is flowing. Such instruments usually indicate the *root mean square* value of the current or voltage, and are therefore suitable both for alternating and direct currents in general, but *hysteresis* effects make them rather unreliable for direct current measurements. The scale is not usually a uniform one. Cf. Moving Coil Instruments.

Multilayer Coil. See Banked Winding.

Multiple Tuner. A highly selective tuning arrangement consisting usually of three tuned circuits: the *aerial circuit*, an *intermediate circuit*, and the *detector circuit*, each of these being separately tuned and the coupling between them variable.

Multistage or Multivalve Amplifier. An *amplifier* in which a number of *thermionic valves* are used in *cascade.*

Multi-Vibrator. A special piece of laboratory apparatus for producing high-frequency oscillations of various frequencies and used for the accurate determination of wavelengths.

Mush. An expression used to denote the type of interference experienced from high-power arc stations.

Musical Spark. A spark transmission in which the number of sparks passing per second is sufficient to produce a more or less high pitched note in the receiving telephones.

Mutual Inductance. When two circuits are so placed relatively to one another that a current flowing in one of them causes a magnetic flux to be linked with the other, "mutual inductance" is said to exist between them, for if the current in the one circuit changes, an E.M.F. will be induced in the other. See Coefficient of Mutual Induction, Electromagnetic Induction and Inductance. Cf. Self-Inductance.

Natural Frequency, or Natural Period. The *frequency* or *period* of free electrical oscillations in a circuit containing inductance and capacity. The natural frequency is given very approximately by $f = \frac{1}{2\pi\sqrt{LC}}$ cycles per second, where L is the inductance in henries and C is the capacity in farads. Sometimes called the frequency of *resonance.*

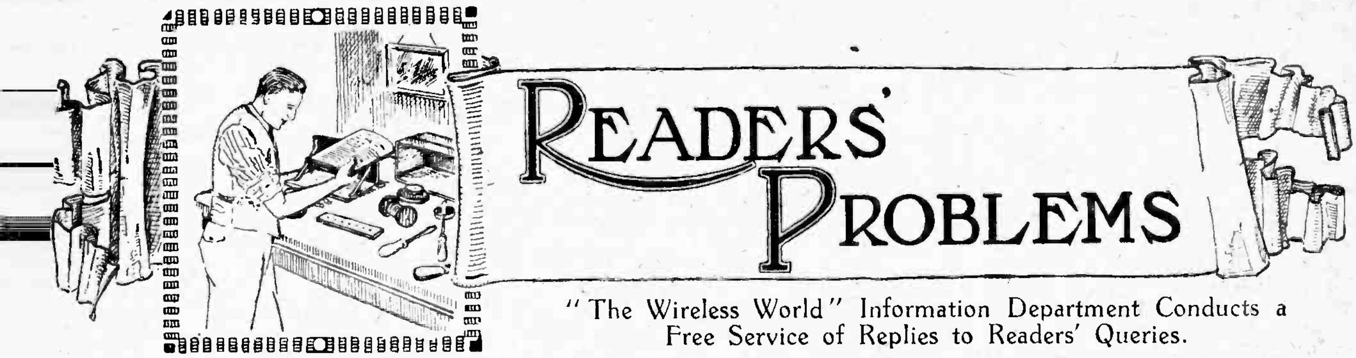
Natural Rectifier. A substance or mineral which naturally possesses the property of *unidirectional conductivity*, such as the various natural crystals used for detecting.

Natural Wavelength. The wavelength to which an aerial or tuning coil will respond due to its own inductance and capacity; for instance, in the case of a coil, the wavelength of the coil alone without any added capacity, the self-tuning effect being due to the *self-capacity* or distributed capacity of the coil. The natural wavelength of an ordinary inverted "L" aerial is just over four times the length of the aerial.

Negative Charge. The *quantity of electricity* carried by a body when it is negatively electrified. See *negative electrification.*

Negative Electrification. According to modern theory a body is said to be negatively electrified if it contains an excess of *electrons* or particles of negative electricity. Cf. Positive Electrification.

Negative Ion. See Ions.



"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed 'Information Department.' Each separate question must be accompanied by a stamped addressed envelope for postal reply.

A Common Fault in Reflex Receivers.

In the single-valve crystal reflex receiver which I have in my possession I notice that when I lift the catwhisker little or no fall in volume is experienced; in fact, the crystal seems to be a passenger. Can you assist me in tracing the trouble? H.N.P.

This trouble is by no means uncommon in a reflex receiver, and in almost every case which has been brought to our notice has been traceable to a faulty connection, usually in the wiring immediately associated with the crystal. Theoretically, all signals should cease on lifting the catwhisker if the receiver is in perfect order. Actually, however, it is impossible to quite approach this ideal in the case of a reflex receiver, and, in the best regulated of these, signals will not quite disappear when the catwhisker is disengaged, although signal strength should fall by at least 90 per cent. It is imperative that the amplifying valve be kept from rectifying, and in all cases it will be found to be beneficial to raise the H.T. voltage to a higher value than usual, and to apply a negative bias of about $1\frac{1}{2}$ volts to the grid of the valve.

oooo

Separating Two Stations Operating on the Same Wavelength.

I understand that it is possible, by using two carborundum crystals in a balanced crystal circuit, to separate two stations even though they be working on exactly the same wavelength. Will you therefore give me a crystal circuit embodying a series-parallel switch, a direct or loose-coupling switch, and also switching for changing over to galena, perikon, or balanced carborundum detector? H.R.T.

It is possible, as you state, to obtain high selectivity in a crystal receiver by means of the balanced crystal method, using two carborundum crystals. Actually, when using this method, it is possible to receive weak incoming signals and completely eliminate strong incoming signals *on the same wavelength*, which, as is well known, is not possible with any type of tuned circuit.

In order to make use of this method of reception it is necessary to employ two carborundum crystals, each having separate potentiometer control. The use of carborundum crystals has been greatly neglected by the average crystal user, possibly owing to the fact that their sensitivity is slightly less than that of the galena-catwhisker combination, but they have the advantage that, once set, they are extremely stable and not likely to be thrown out of adjustment by vibration or the accidental jarring of the table on which the receiver stands. In most cases they are, from all points of view, greatly to be preferred to the many so-called permanent detectors which are upon the market, these latter usually forming a perikon detector by means of a zincite-bornite combination. The stability of the carborundum crystal is due to the fact that it is used with a flat steel plate bearing firmly upon it, whilst if greater sensitivity is desired the plate may be substituted by a steel gramophone needle adjusted with a firm pressure, and not lightly, as in the case of a catwhisker. The circuit which we illustrate in Fig. 1 should be suitable for your purpose. Switch S_1 places the aerial tuning condenser in series or parallel, S_2 changing from direct to loose coupling as desired. By throwing S_3 to the left it is possible to use either an ordinary galena crystal or a perikon combination, according to the setting of S_4. By placing S_3 to the right the carborundum rectifier is brought into use. As will be seen, it is possible to use either carborundum crystal separately as an ordinary rectifier by closing either S_6 or S_7. The battery switch S_5 must also be closed. The battery providing the positive or negative potential to the crystal may consist of two small $1\frac{1}{2}$-volt dry cells, which will last a considerable time, as the drain on them is small. It is important, however, that the battery switch be opened when the receiver is not in use, in order to prevent the small dry cells from unnecessarily wasting their substance through the potentiometer windings. In order to use either carborundum crystal the procedure is quite simple. Having closed the battery switch and the switch associated with the particular crystal it is desired to use, the receiver should be tuned in to the local or Daventry transmissions, after which the slider of the potentiometer associated with the crystal should be moved slowly until the crystal is adjusted to the correct portion of its curve, which will be indicated by quite a considerable increase in signal strength denoting maximum sensitivity. It should be mentioned that when the slider is in the central position no potential will be applied to the crystal, and moving it in either direction will apply either a positive or negative potential up to a maximum of $1\frac{1}{2}$ volts. In order to make use of the balanced system it is necessary to adjust one crystal to its maximum sensitivity, as already indicated, after which the switch associated with it should be opened and the second crystal similarly adjusted. Having done this, both switches should be closed and no signals should be heard, as each crystal will balance the effect of the other. When separately adjusting each crystal a slight difference of sensitivity between the two crystals will almost certainly have been noticed. Having closed both switches, the slider associated with the *least* sensi-

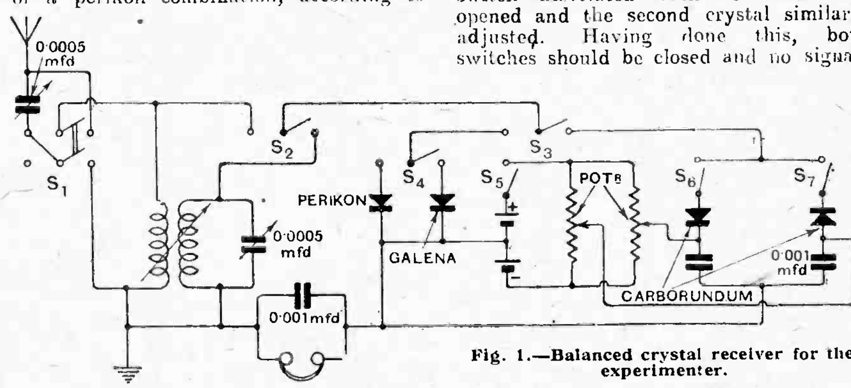


Fig. 1.—Balanced crystal receiver for the experimenter.

tive crystal should now be moved slightly in either direction, and it should be possible to tune in weak incoming signals *without any interference from stronger incoming signals, even though on the same wavelength.* Thus the balanced crystal method enables us to achieve a form of selectivity not obtainable by loose coupling, or any other form of tuning, namely, the elimination of interference on the same wavelength. This method will be found most beneficial for coastal dwellers, since it enables strong flatly-tuned morse signals to be tuned out, or at any rate greatly mitigated, when ordinary tuning methods fail. By the use of plug-in coils this circuit is adaptable to any wavelength.

oooo

A Four-Electrode Single-Valve Reflex.

Noticing in a recent issue of THE WIRELESS WORLD *a circuit for a four-electrode valve set, it occurs to me that a reflex circuit might be devised using a valve of this description for the three purposes of high-and-low frequency amplification and rectification, together with full reaction control. I shall be glad if you could indicate a suitable circuit, if this is possible.* R.J.B.

It is certainly quite possible to use one of these valves in this manner, and such a receiver is actually in commercial use. We illustrate the circuit in Fig. 2. The inner grid of this valve performs the same function as the grid of a conventional three-electrode valve. The outer grid, however, acts not as a grid, but in the same manner as the anode of the ordinary type of valve, all amplification at both high and low frequency being carried out

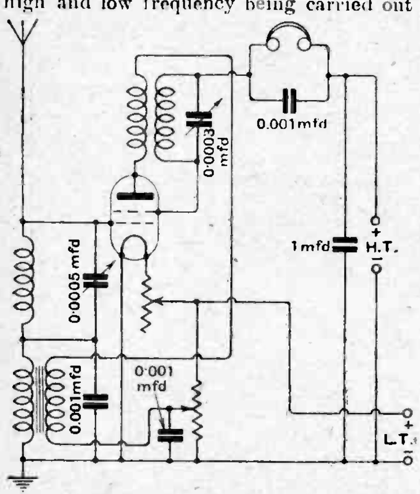


Fig. 2.—Four-electrode valve circuit, combining the functions of H.F. amplification, rectification and L.F. amplification.

between filament and outer grid, the electron emission being controlled by the potential of the inner grid in the usual manner. The plate of this valve takes control of rectification and serves no other purpose. The functioning of the valve is as follows: Incoming signals set up a potential across the tuned aerial coil in the usual manner, these H.F. impulses passing to the inner grid and being amplified in the usual manner. The amplified H.F. impulses are transferred by means of the H.F. transformer to the filament-plate circuit, and are therein rectified. The impulses, having been thus rectified, arrive once more at the inner grid of the valve through the intermediary of the L.F. transformer, and they are then again amplified by the valve at low frequency, the output passing, of course, to the telephones. Reaction is controlled by suitably adjusting the potentiometer, and by careful adjustment of the latter this circuit can be brought to a high degree of sensitivity. The H.F. transformer can, of course, be of the conventional plug-in type tuned by a variable condenser across its primary.

oooo

An Avoidable Mishap.

I recently had three accumulators on charge at a 3-amp. rate. Desiring to remove one for test purposes, I removed the connecting wire from the wing nut without first switching off the mains. I was at once startled by a violent explosion, and found the accumulator casing badly bulged, whilst acid was splashed in all directions. Whilst realising the lack of wisdom displayed in attempting to remove the accumulator without first switching off the mains, I am quite at a loss to account for the explosion. Can you suggest a possible cause? P.P.R.

Quite apart from the liability to receive a violent electric shock, it is a most dangerous thing to attempt to remove an accumulator from the mains without first switching off. As is well known, an accumulator is constantly giving off hydrogen and oxygen during the process of charging, and when at the end of a charge the accumulator commences to "gas," these vapours are given off in considerable quantities, collecting in the top portion of the accumulator casing unoccupied by plates or electrolyte, and being present in the atmosphere surrounding the accumulator. If a naked ligh is brought into the vicinity of thes gases an explosion of considerabl violence is inevitable, water being forme in the process. The naked light woul be provided by the slight arc caused a the moment the wire was removed fron the accumulator terminals, and woul easily account for the accident. The explosion of the gases actually inside the accumulator casing accounts for the bulging of the casing. During the process of charging accumulators it is most important to remove the filling stopper, since the small vent hole usually provided is insufficient to cope with the gases generated, and if it is wedged tightly in, the gases will cause bulging of the case to take place until sufficient pressure has accumulated to blow out the stopper. Naked lights of all description should be kept well away from accumulators when on charge.

oooo

The Armstrong Super-regenerative Receiver.

Can you give the original Armstrong single-valve super-regenerative receiver, giving values of coils, condensers, etc., for the B.B.C. wavelengths—suitable for use on a short indoor aerial, not on a frame? J.S.T.

We reproduce this circuit, as requested, in Fig. 3. The aerial and reaction coils are, of course, exactly the same as would be used in a conventional single-valve regenerative receiver. In fact, a receiver of this type can be instantly converted to a single-valve set of the ordinary type by merely removing the two large "quenching" coils and inserting short-circuiting plugs in their places. These

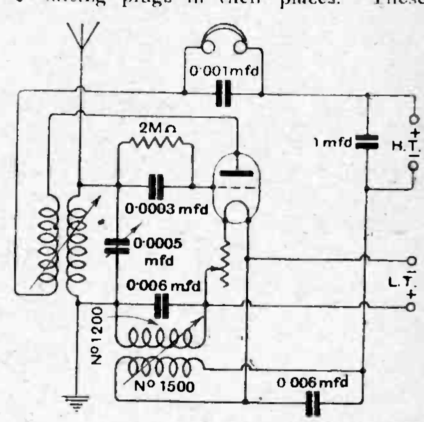


Fig. 3.—Single-valve Armstrong Super-regenerative receiver.

latter coils may consist of a No. 1,200 and a No. 1,500 plug-in coil for the grid and plate circuits respectively. Contrary to general opinion, the receiver does not necessarily entail the use of a frame. It is, however, a most difficult circuit to operate. It is well worth while constructing, however, since, in the event of not proving suitable, it is so easily converted to the conventional circuit. It should never be used on an outdoor aerial, as it re-radiates very violently.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

SHORT WAVES.

LOOKING back over a period of two or three years it is remarkable how rapidly the importance of short waves for wireless communication has come to be recognised. At different stages of wireless development radio engineers have been inclined to consider that little in the way of startling developments would be forthcoming. At the time that the first long-distance reception successes using comparatively short waves were achieved, the attitude of the majority of professional wireless engineers was that the short wavelengths were of comparatively little value for dependable communication, and wherever very long-distance transmissions had to be conducted, it was generally accepted that long wavelengths should be used.

To-day the position has altered to a very great extent, for although the abandonment of the use of long wavelengths is not yet openly recommended, yet the tendency is always towards the adoption of short wavelengths for any future long-distance communication.

In this issue we devote considerable attention to the subject of short waves, as it is often convenient, from the point of view of the reader, to appropriate a particular issue to some special subject rather than dividing articles over a number of issues where they cannot be so readily referred to.

Professor E. V. Appleton, who has done so much work in the investigation of the theory of short-wave propagation, contributes an article on this subject which should be of great interest to everyone who has had practical experience of short-wave reception or transmission. Another article of outstanding interest is an account of the long-distance communication tests effected by the short-wave station at Mosul, Iraq, which were conducted by Flight-Lieut. R. E. Durrant. The history of the development and application of short-waves in the early days will always be incomplete without a reference to the outstanding results which were obtained by this station at Mosul in communication with this country and many other parts of the world.

There is also included in this issue, in addition to special constructional articles on short-wave receivers, a list of commercial and experimental stations throughout the world which are now working on short wavelengths. This list has been compiled so as to be as accurate as possible up to the time of going to press, but it is recognised that the information is neither complete nor entirely accurate in every respect, for, in view of the fact that most of the stations are experimental, the wavelengths, and even the call-signs in some instances, are being changed frequently. We shall welcome any additional information which can be supplied by our readers, and we hope also that they will point out to us any changes in wavelength or other information which may come to their notice.

The future possibilities which the discovery of short-wave efficiency opens up probably cannot be fully appreciated at the present time, but next to the discovery of wireless itself, the short-wave is the greatest advance which has yet been made in wireless communication.

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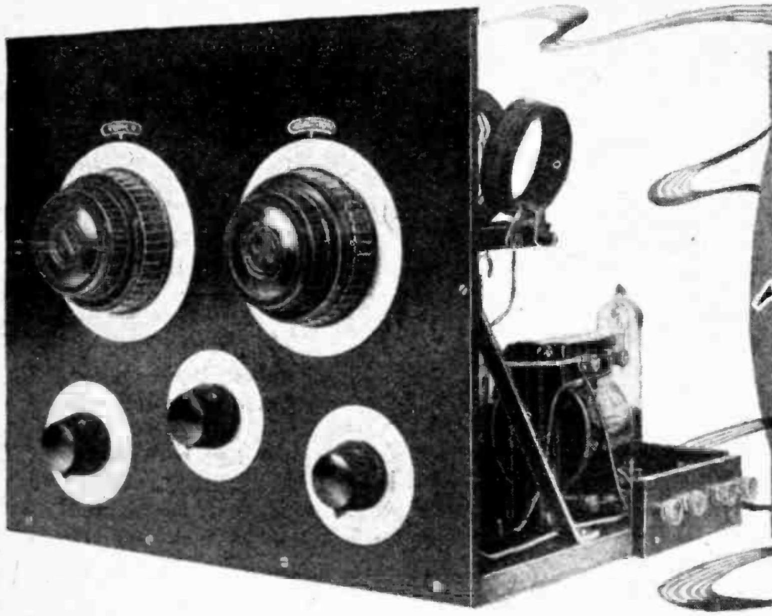

20~1800 METRES A THREE VALVE RECEIVER.

by W. JAMES.

Its Design and Construction, with Operating Notes.

THIS receiver has three valves, one of them being used as a reacting detector and the others as audio-frequency magnifiers. The use of two magnifiers instead of the customary single stage adds to the sensitivity of the receiver under favourable conditions as to the signal noise ratio.

An examination of the list of stations sending on short wavelengths shows that there are very few telephony transmissions, and that even the stations sending Morse often do so at irregular intervals. At certain times during the day foreign amateurs transmit on the short wavelengths, and many of them can be heard very easily in the evening and the early hours of the morning, but when it is remembered that the wave band of 30-100 metres corresponds to a frequency range of 10,000,000 to 3,000,000 cycles, that is, a band of 7,000,000 cycles, and, allowing 10,000 cycles per station, that 700 broadcast stations could be accommodated in this band, it will be realised that these frequencies are practically unused. There are two stations of interest, KDKA sending on 64 metres and WGY on 80, 41.88, and 21 metres. Even so, from the point of view of the use made of short wavelengths and also of the design of the receiver, the writer feels that there is nothing to justify building a set to receive short wavelength signals *only*. In other words, a carefully made set for short waves only is not likely to receive a single station more than an equally carefully made set which will tune over a wide band of waves.

The receiver illustrated here will tune over the short-wave band, the lower broadcast band, and to the longer broadcast wavelengths, including the station 5XX.

The problem of how best to design a receiver capable of working effectively over so wide a wavelength range was tackled by making first of all a thoroughly good short-wave receiver; then steps were taken to make the set equally effective on the longer wavelengths.

The wavelength range of a tuner depends upon the inductance of the circuit and its capacity. Now the inductance of the circuit is mainly that of the tuning coil, while the total capacity is determined by the stray circuit capacities and the capacity range of the tuning condenser. Hence, if a decision as to the tuning condenser to be included in the receiver is made, a set of coils can be designed to cover the various wavebands with a fair degree of accuracy. There is no need to calculate exactly, because the electrical constants of the tuned grid circuit are modified by the reaction coil and by the aerial.

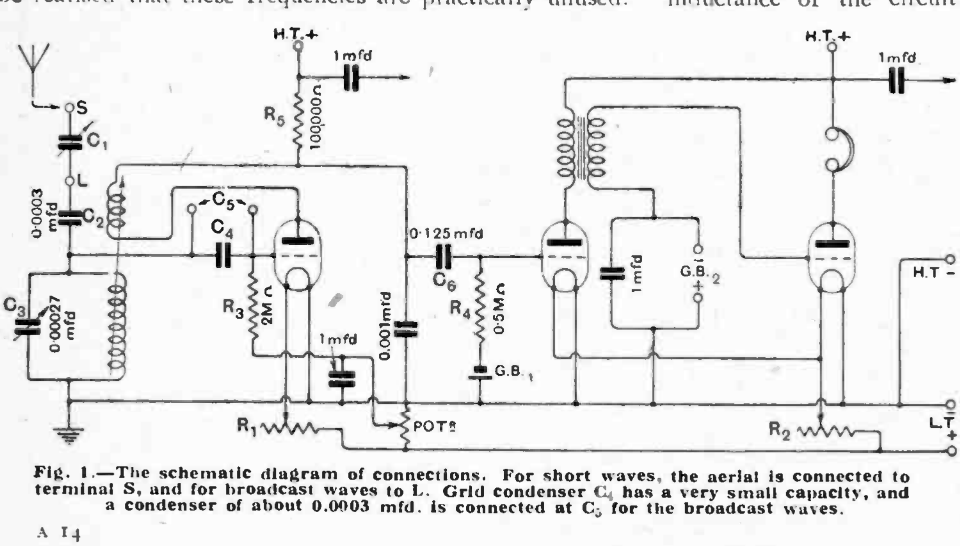

Fig. 1.—The schematic diagram of connections. For short waves, the aerial is connected to terminal S, and for broadcast waves to L. Grid condenser C_4 has a very small capacity, and a condenser of about 0.0003 mfd. is connected at C_5 for the broadcast waves.

20-1,800 Metres.—A tuned grid circuit laid out for the reception of short wavelengths and connected to an ordinary receiving valve has a capacity of about 25 micro-microfarads when the tuning condenser is set at its minimum value. When a tuning condenser of 270 micro-micro-

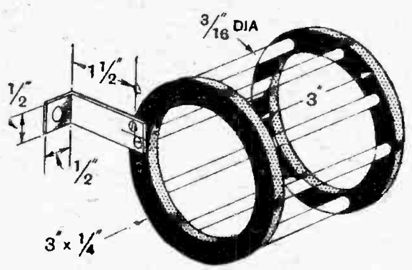

Fig. 2.—Arrangement of the short wave and broadcast coil formers. The ebonite ends are drilled to take glass rods or wood dowelling, which are stuck in position.

farads maximum capacity is used (as in the set illustrated), the capacity range is roughly 25-295 micro-microfarads, giving with a coil of 9 microhenries a wavelength range of 28-95 metres. The wavelength range when another size of tuning condenser or coil is used may easily be found from Table I., which gives the value of the product of capacity and inductance, in microfarads and microhenries respectively, for a number of wavelengths. Thus, if the tuning condenser has a maximum value of 200 micro-microfarads, the variation of capacity may be taken as from 25 micro-microfarads to 225 micro-microfarads, and for the maximum wavelength of 90 metres, the L.C. value is seen to be 0.00228; hence a tuning coil with an inductance of 0.00228/0.000225, or roughly 10 microhenries, is required. The minimum wavelength of the circuit will then be that corresponding to an L.C. value of 10 × 0.000025, or about 30 metres.

Having found the inductance of a tuning coil for a given wavelength band, the size of the coil may be calculated, or the information can be obtained from Table II.

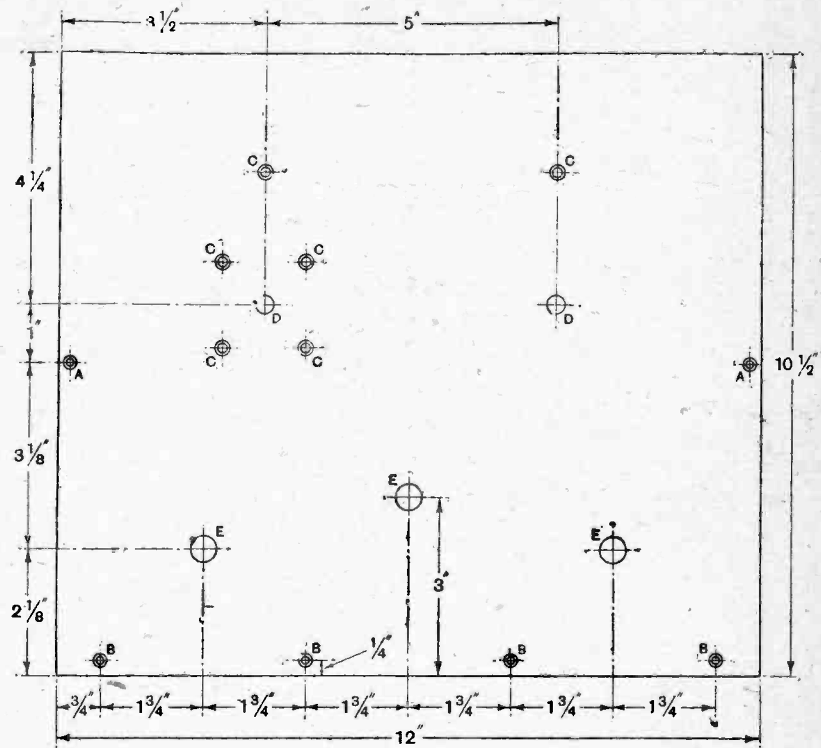

Fig. 4.—Details of the front ebonite panel. A, ⅛in. and countersunk for No. 6 B.A. screws; B, ⅛in. and countersunk for No. 4 wood screws; C, 5-32in. and countersunk for No. 4 B.A. screws; D, [illegible] in.; E, 7/16 in.

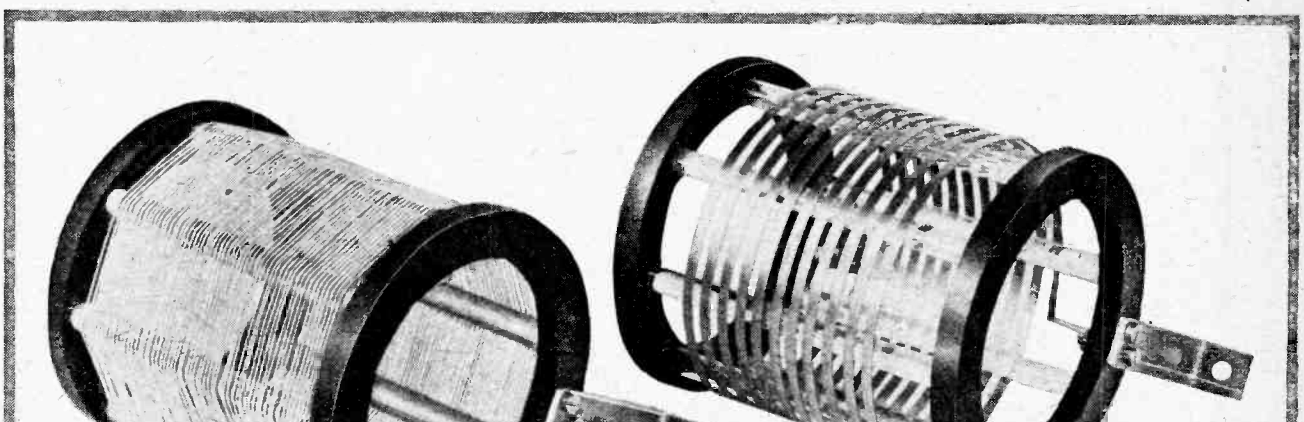

Fig. 3.—View of the broadcast coil for 300–500 metres, and of a short wave coil wound with ¼in. strip copper. The brass feet which act as supports and as connections are clearly shown.

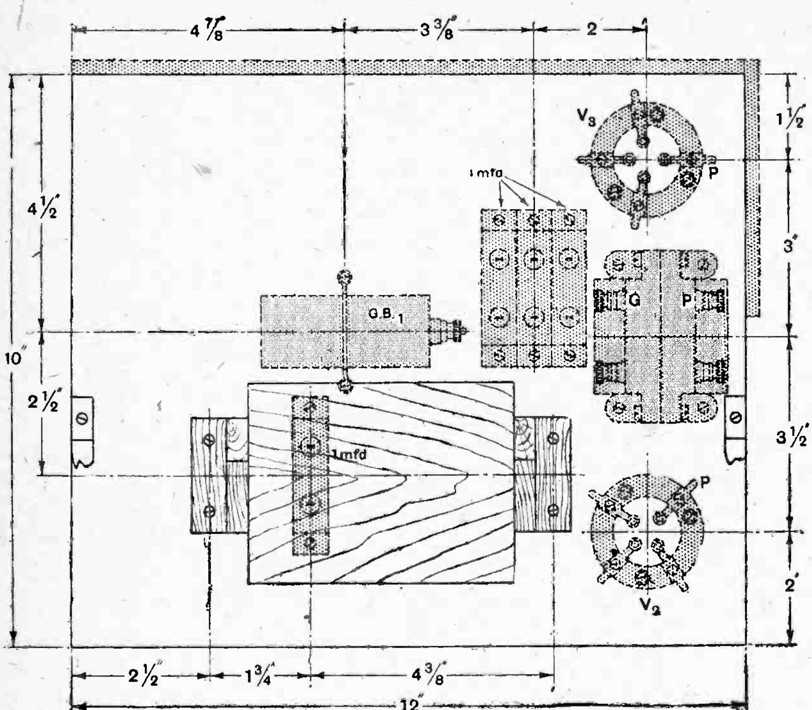

Fig. 5.—Layout of parts on the baseboard, which is of ½in. wood.

filament end of the secondary was to reduce capacity coupling.

A reaction coil connected between the anode of the detector valve and the primary of the transformer in the usual manner was also coupled to the secondary coil. This coil was adjustable in position, and although the tuning was varied when the reaction coil was moved, excellent results could be obtained. It was thought, however, that superior results would be obtained by mounting the reaction coil at the filament end of the secondary, and when this was done it was found that the best method of connecting the aerial was through a condenser of exceedingly small capacity.

In the set illustrated, therefore, the aerial is connected to the grid coil through a very small condenser, and the reaction coil is mounted at the filament end of this coil, the direction of the windings of the two coils being such that the two inner ends are connected to points of fixed potential.

By taking these precautions and using a reaction coil having just sufficient turns to cause the set to oscillate at its longest wavelength, the tuning varies only very slightly indeed as the reaction coil is moved from the "just oscillating" to the "not oscillating" point. As a matter of fact, a slight change in the tuning is produced by a movement of the reaction controlling device, whatever method of obtaining adjustable reaction is employed.

As with the receiver using an aerial coil of a few turns, it is found that there is one setting for the aerial coupling condenser which gives the best results on a given aerial, and having found the correct setting for this condenser by trial there is no need (for the short wavelength band) to readjust it. The capacity of the coupling condenser is in the neighbourhood of 3 micro-microfarads, and it may consist of two metal discs 1in. in diameter, their distance apart being found experimentally. The coupling condenser used by the writer is a Gambrell adjustable neutralising condenser, and this is usually set at its minimum capacity, care being taken to reduce the capacity between the aerial wire itself and the grid coil to as little as possible.

Further details of the circuit are given in Fig. 1. It will be seen, for instance, that two aerial terminals and two aerial coupling condensers are used. The aerial is connected to the upper terminal (S in this diagram, actually it is the lower terminal of the two in the set) when receiving the short waves and to the lower terminal

which gives details of a number of coils having diameters of 3in. and 2in., these being usual sizes for coils used in short-wave sets. No. 18 gauge wire will wind 20 turns to the inch and No. 16, 15 turns to the inch, hence a winding pitch of 8 per inch is a reasonable one. If the pitch is increased so that less turns are wound to the inch, the inductance for a given number of turns is less and more wire is required for a coil of given inductance, while there is no compensating advantage, unless it is a constructional one.

Which is the Best Tuner ?

There are a number of methods of coupling the aerial to the tuned grid circuit and of applying reaction. The tuner favoured by the writer for a long while had an aerial coil of a few turns mounted in such a manner that its coupling with the tuned grid coil could be varied. This aerial coil was mounted at the filament end of the grid coil, and the object of providing for a variation of coupling was because it was found experimentally that for a given aerial there was one position for the aerial coil with respect to the grid coil which gave the loudest signals. A tighter coupling than this critical value did not increase the signal strength, but reduced the selectivity somewhat and more reaction was required. The object of mounting the aerial coil at the

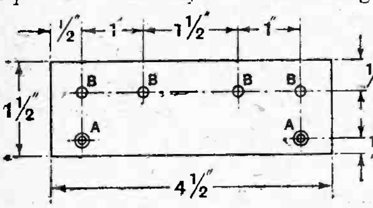

Fig. 6.—The small terminal strip for the grid bias and telephone connections. (See Fig. 7.)

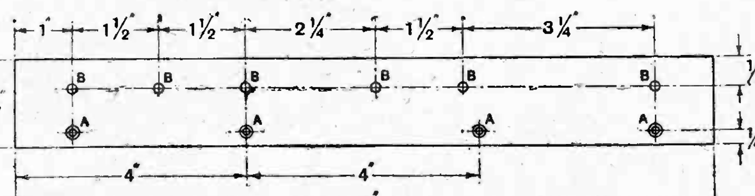

Fig. 7.—The large terminal strip for the earth and the batteries. A, ⅛in. countersunk for No. 4 wood screws ; B, 5–32in.

20-1,800 Metres.—

(L) when receiving the ordinary broadcast transmissions. When the aerial is connected to the lower terminal the small coupling condenser C_1 is not in circuit, and the aerial is connected through a 0.0003 mfd. condenser.

Design of Tuning and Reaction Coils.

The grid circuit and reaction coils employed in this set are interchangeable, brass feet being fitted to the coils to act as connections as well as the means for fixing them. Three aerial and three reaction coils are required, one set being for the 30-95 metre band, the second set for 300-500 metres, and the third set for 1,600 metres. Intermediate wavelengths can be tuned in, of course, by using coils having the appropriate number of turns, and the set will work effectively down to below 20 metres.

All grid coils are wound on a former with a winding length of 3in. The diameter of the coils can be varied, if desired, from 2in. for the short wave coils to 4in. for the long wave coil. For the short waves a reaction coil 2in. in diameter can be used and for the longer wavelengths, coils 2in. or 2½in. and 3in. respectively are suitable, the lengths varying between ½in. and 1in. Details of the coils are given in Table III.

Are Low-loss Coils Necessary ?

It is fashionable to specify for short-wave sets coils of thick wire with considerable spacing between the turns, the turns being supported on a skeleton framework, and the question as to whether this is justified naturally arises in view of the fact that the effect of the detector valve is to throw an appreciable load upon the circuit. A few tests soon show that a carefully made grid coil will give louder signals and better selectivity than a coil having large losses, care being taken, of course, to use the best value of coupling with the aerial and to connect the return end of the grid leak to the most suitable potential by means of a potentiometer, or, alternatively, to use a variable grid leak.

With regard to the general shape of the coil, a single-layer winding on a circular or nearly circular former is undoubtedly the best, a ratio of coil length to diameter of unity, with the turns spaced by about their diameter being satisfactory for short waves. Spacing reduces the H.F. resistance, while a skeleton former of good material makes the losses due to the self-capacity of the coil less than they would be if a bad former or a solid one were used. There is no doubt that a very heavy wire will have more losses than a wire of No. 16, 18 or 20 gauge, and it would appear that tinned copper wire is just as effective as plain copper wire or wire with an enamel coating, although one would not, of course, stretch a tinned copper wire as is done when straightening lengths for connecting-up purposes.

Grid Condenser and Leak Values.

As for the reaction coil, there can be—so far as the writer can see—no object in using thick wire, for the reaction coil usually has only about one third or one half as many turns as the grid coil, and is connected to the anode circuit of a valve. Further, the capacity between the reaction and grid coils is reduced by using a fine wire reaction coil; hence for the short waves the writer uses a reaction coil wound with No. 28 or 30 D.S.C. wire. For the broadcast and longer waves No. 30 to No. 36 D.S.C. wire is suitable.

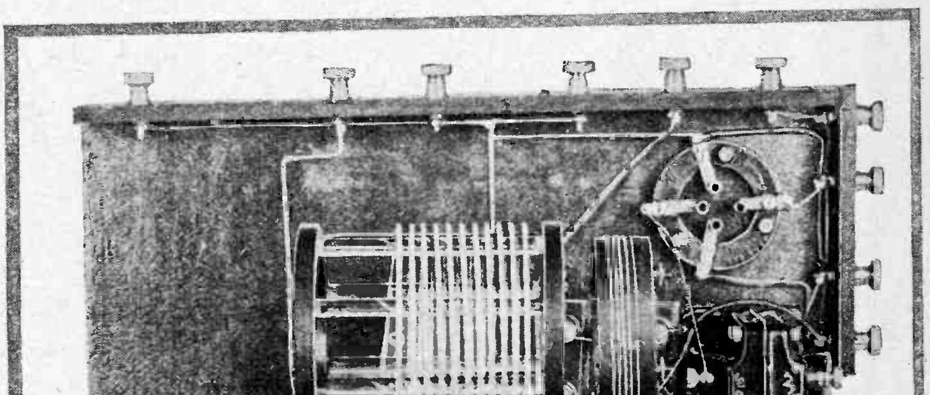

Fig. 8.—The appearance of the set from above. On the right-hand side is the reaction coil at the earth end of the grid coil, while on the left can be seen the aerial coupling condenser.

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When receiving short-wave signals a grid condenser of much less capacity than is usually employed for the broadcast wavelengths can be used to advantage, and the writer employs a tubular condenser of the wire type, the advantage of this type being that the capacity can be varied by altering the amount of wire wrapped round the tube. Commencing with a condenser of 0.0002 mfd. capacity, it was found that best operation and loudest signals were obtained with a capacity of about 50 mmfd. or less, and a condenser of this capacity was wired permanently in the set. Provision is made, however, to connect a larger condenser in parallel with it for the broadcast wavelengths, a McMichael clip-in condenser being used. The clips are mounted on a piece of ebonite and connected to the ends of the small grid condenser (Fig. 1); the value of the plug-in condenser used for the longer waves is 0.0003 mfd.

The gain in changing over from a 0.0002 mfd. or 0.0003 mfd. condenser to one of 40 to 50 mmfd. for the short waves is a very real one, and the advantage of using the wire wound tubular type suggested is that the best value can easily be found by adjusting the number of turns of wire used as one electrode of the condenser. As a matter of fact, the best capacity is not a critical one, and the adjustment should, of course, be made on a weak signal. As a potentiometer is used in conjunction with the grid

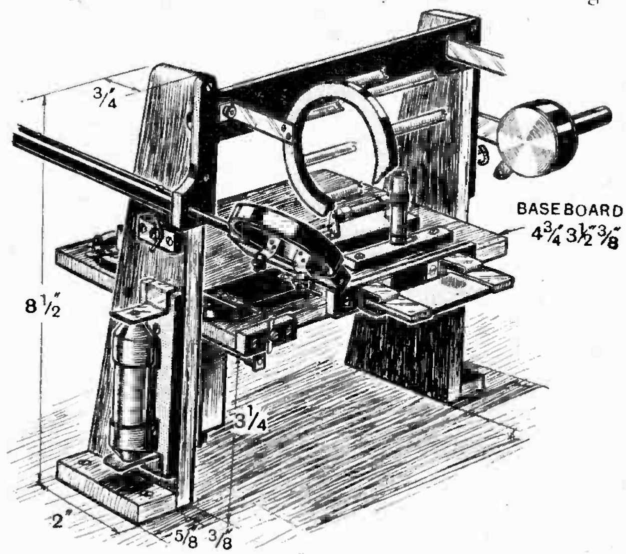

Fig. 10.—Arrangement of the two wooden supports and the platform. Notice in particular the grid condenser of the tubular type and the plug-in type grid condenser; also the shape of the ebonite piece carrying the grid coil and acting as one support for the reaction coil.

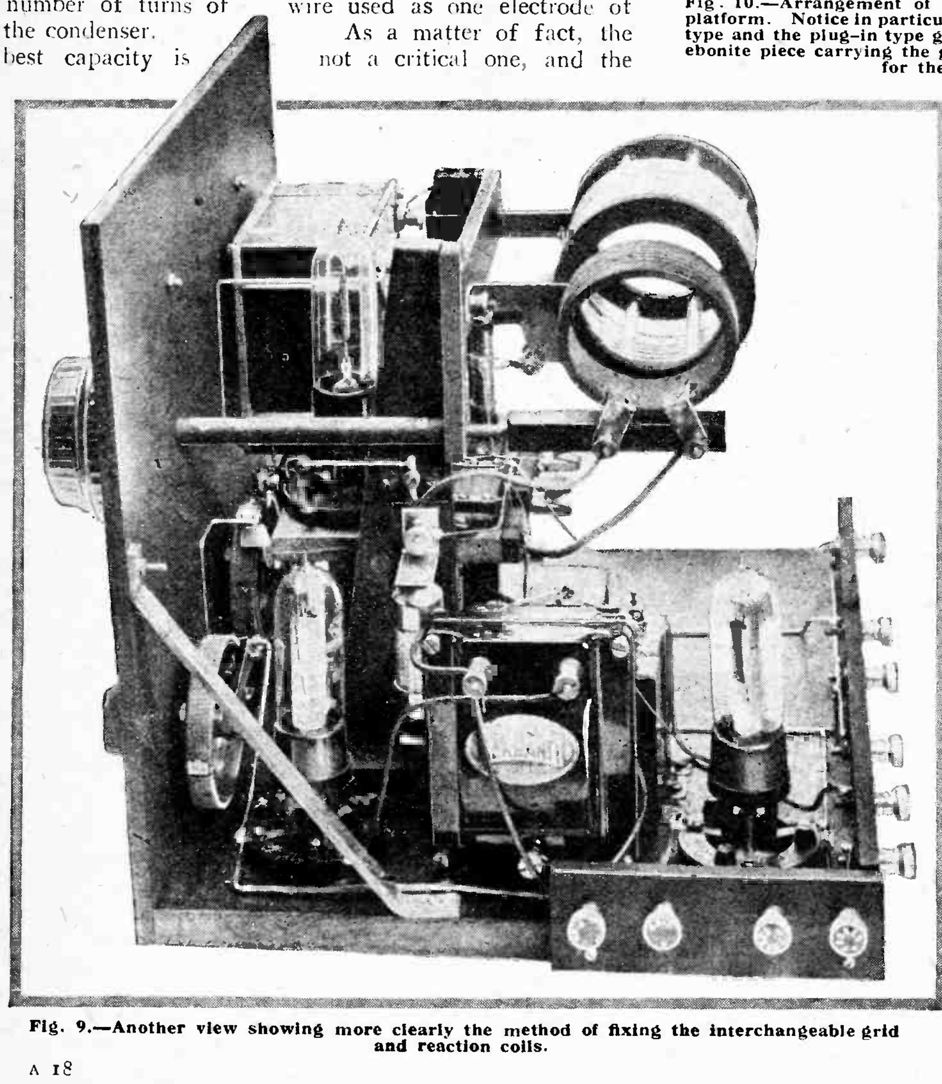

Fig. 9.—Another view showing more clearly the method of fixing the interchangeable grid and reaction coils.

leak, a grid leak of about 2 megohms is usually found to be quite satisfactory, the potentiometer control enabling one to fix the grid bias to giving best rectification and smooth reaction. The potentiometer, in a receiver of this type, where so much depends on critical adjustments, while not perhaps an absolute necessity is certainly of very great help, and the writer would not think of building a set of this type without one.

The Anode Resistance Coupling.

As there are times when short-wave signals are very weak, it was decided to couple the detector to the first audio-frequency valve by a resistance-capacity coupling, as it would appear that transformers and chokes amplify *very* weak signals rather poorly; in other words, there appears to be a certain "threshold" effect, signals below a certain strength not being amplified to such an extent as stronger signals of the same frequency.

The anode resistance em-

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ployed should be quiet in operation, and a good coupling condenser and grid leak ought to be used.

The resistance-capacity-coupling was not put in with any object of quality, so far as the short wavelengths are concerned, because reaction is generally used to such an extent that the signals are distorted before they reach the audio-frequency amplifier. When an anode resistance is used in the way described (Fig. 1), it is easily possible to get a delightfully smooth reaction control.

The second stage of magnification is used to enable

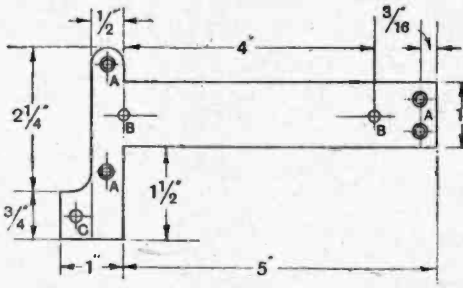

Fig. 11.—Details of the ebonite coil support referred to in Fig. 10. The ebonite is ¼in. thick; A, ⅛in. and countersunk for No. 4 wood screws; B, 5-32in.; C, 3/16in.

comfortable loud-speaker reception of the broadcast transmissions to be made as well as to add to the sensitivity of the set, as already mentioned. The transformer is a Ferranti, ratio 3–1, and a DE5B valve is used, with a grid bias of 1½ volts, the last valve being a DE5 or DE5A, depending on the signal strength required, with a grid bias of 12-18 volts and appropriate values of anode voltage.

Choice of Detector Valve.

The valve generally used for rectification in a short-wave receiver is of the low capacity type, such as the DEV or DEQ. These valves, however, are not good leaky-grid rectifiers, and they are inefficient, having

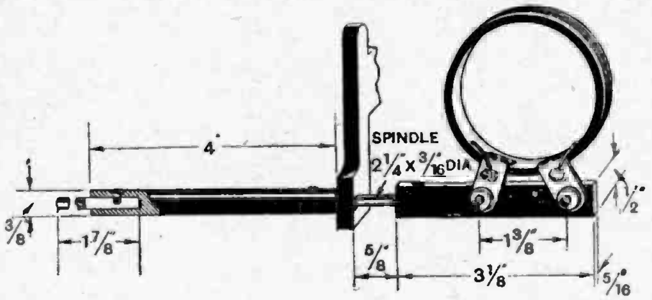

Fig. 12.—Constructional details of the reaction coil support.

a high anode impedance for their amplification factor. They are also inclined to be noisy.

Experiments were, therefore, made with other types, and it was found that far superior results were obtained when ordinary valves were used as the detector, the valve recommended being the Cosmos SP18 "Green Spot." This valve takes 0.3 amp. at 1.8 volts, has an amplification factor of 15 and an impedance of about 17,000 ohms. Its self-capacity is remarkably low, and it is a cheap valve. Other valves which give good results are the DE3B and DER. A DE5B valve works extremely well so far as the reception of KDKA is concerned, but its working capacity is rather high, which limits the wavelength range of the short-wave coil. As a resistance coupling is used, one of the high "m" value valves should preferably be employed as the detector.

Morse Reception.

For the reception of Morse signals a transformer having a peak at 1,000 to 2,000 cycles can be used, and will be productive of better results than a transformer designed for speech amplification. A receiver to be used exclusively for continuous wave signals could very well have a carefully tuned note magnifier, thus adding to the over-all selectivity of the set, but for a receiver which is to be used mainly for telephony, intelligibility is the main requirement (on short waves), and for all-round work a transformer-valve combination having a flat frequency-magnification characteristic is the thing to use.

Arrangement of the Set.

Examination of the illustrations will show that the tuning and reaction coils are well clear of all other components and they are easily got at, so that it is a matter of but a few seconds to change them.

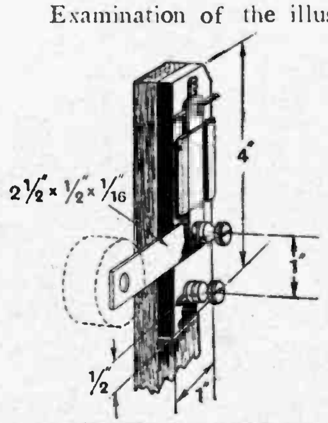

Fig. 13.—The two aerial condensers, mounted on a piece of ebonite and fixed to the side of one of the wooden upright pieces.

On the ebonite front panel is mounted a tuning condenser, two filament rheostats, potentiometer, and the reaction control. Two supports of wood are fastened to the baseboard, and these carry a platform of wood and an ebonite strip. The ebonite strip is shaped, as indicated in Figs. 10 and 11, and two screws are fitted to it for the grid coil support and connections, while one end is drilled and acts as a bearing for the reaction coil spindle. Thus one end of the reaction coil spindle is carried by the panel and the other by the strip of ebonite.

Details of the reaction coil spindle are given in Fig. 12, from which it is seen that two short lengths of brass rod are used, also a length of ebonite rod. This spindle is a fairly loose fit, the particular geared dial used being of the type which presses against the panel and is prevented from slipping by a friction device.

On the top side of the platform is mounted the tubular grid condenser, the grid leak, valve-holder, and by-pass condenser of 0.001 mfd. A piece of ebonite carrying a pair of clips to take the McMichael plug-in fixed condenser is screwed to its back edge, while on the under side is mounted the 0.125 mfd. coupling condenser and 0.5 megohm grid leak. These components are shown in Fig. 10.

Screwed to one of the supports is the "Cosmos" (wire wound) anode resistance of 100,000 ohms, while on the other support is fitted on a small piece of ebonite a 0.0003 mfd. fixed condenser (Igranic), two aerial terminals, and the Gambrell neutralising condenser. These parts

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are all shown in the illustrations, and do not need a detailed description.

The grid condensers, and the large aerial condenser, are all mounted on suitable pieces of ebonite, and the small capacity aerial condenser is fixed by means of a brass strip screwed to the lower end of the piece of ebonite carrying the aerial terminals.

At the back of the set is a terminal strip for the earth and battery connections, a second strip with terminals for the load-speaker, and the grid bias battery for the third valve being mounted on the right-hand edge of the baseboard.

Wiring is not a very difficult matter if proceeded with in an orderly fashion. First, the two upright pieces carrying the platform should be removed. Most of the wires connecting components on the front panel and on the base can then be put in. The parts on the platform can also be partly wired before assembly. It is suggested that a relatively fine connecting-up wire, such as tinned No. 22 gauge, be used for the short connections, the filament circuits being wired with No. 16.

The tuning coils are easily made, the type shown in the illustrations consisting of a pair of ebonite rings drilled to hold glass rods or lengths of round wood. Details are given in Fig. 2. As the tuning coil for the short waves has 11 turns of 2⅞in. diameter, only part of the former is covered by the wire. A 2in. coil will need 16 turns, the winding length being about 2in.

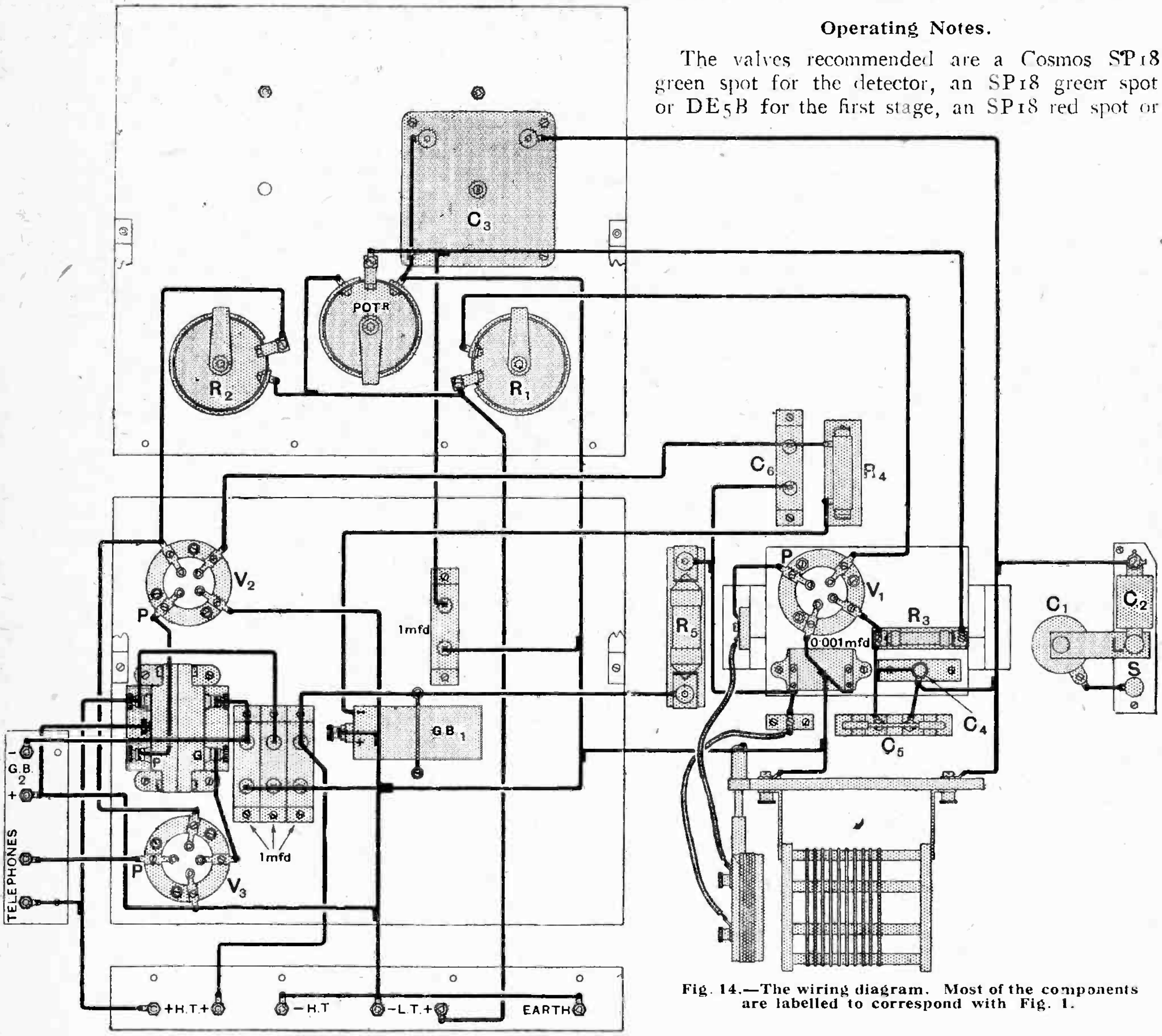

Fig. 14.—The wiring diagram. Most of the components are labelled to correspond with Fig. 1.

Operating Notes.

The valves recommended are a Cosmos SP18 green spot for the detector, an SP18 green spot or DE5B for the first stage, an SP18 red spot or DE5 for the last stage when receiving short wave or other weak signals, and a DE5A when receiving the broadcast transmissions. Suitable anode voltages are 60 for the detector and 120 for the last two valves. With 120 volts on the anode of the last valve the grid bias should be −6 for a DE5 and 12 or 18 for a DE5A.

If other valves are to be used it is worth while to remember that a valve having a fairly high amplification

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factor should be used as the detector, while the valve in the first stage may have an impedance of the order of 30,000 ohms with the particular type of transformer employed. For the last stage a valve suitable for working into a loud-speaker should be used; that is, a valve having an impedance of not over 10,000 ohms for the average 2,000 ohms loud-speaker.

It should be noted that the SP18 green spot valve requires a filament voltage of only 1.8, and its filament rheostat should be handled carefully. The value of this rheostat should be adjusted for the particular type of valve that is to be used as a detector. A DER works quite well, and so does a valve of the .06 H.F. class.

Whenever possible, valves should be tried with a view to selecting those which are the *most quiet*, for, after all, the usefulness of a signal is its strength and clearness as compared with the background of noise which unfortunately is usually present in greater or lesser degree. An anode battery of ample capacity should also be used, and it should be as nearly noiseless as possible. In this connection it may be said that it is productive of better results if a separate H.T. battery be used for the detector, especially so far as reception on the short waves is concerned.

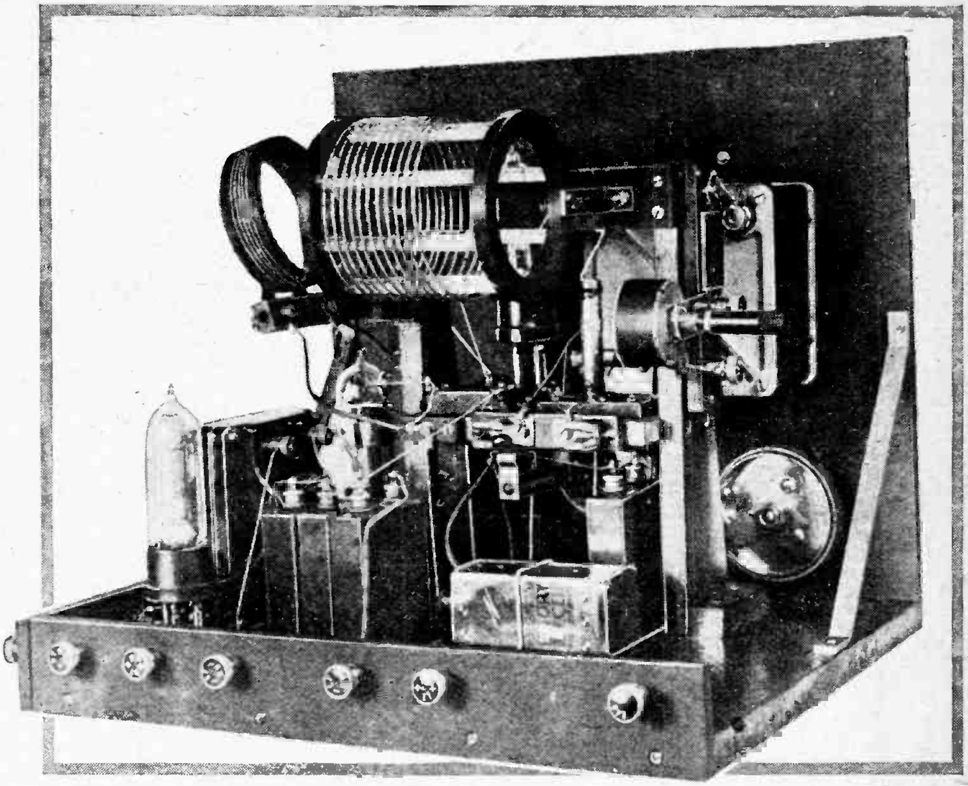

Fig. 15.—Another view of the set, in which practically the whole of the parts can be seen.

There is also a tendency for the H.F. currents to pass through the set to the telephones, and to be applied to the input circuit through the hands of the operator. This is more noticeable on a two- than a three-valve set, the effect being absent on the set illustrated here. Those dispensing with the third valve may find the effects a nuisance, and a partial remedy is to connect high-frequency chokes about an inch in diameter and wound with No. 30 D.S.C. or finer wire in the grid lead—between the grid coupling condenser and the grid of the second valve. A certain cure is to cover the telephone cord with a layer of No. 26 copper wire and to connect this wire to the metal part of the earpieces and to negative L.T. or earth. It would be better if the telephone cord were covered with a flexible metal covering.

Much can be done to eliminate the trouble by using short aerial and earth lead-in wires, and by connecting the filament and H.T. battery with short wires. Arrange for the leads to be at the back of the set, the aerial wire being at the side. This wire should not hang near the grid coil, or the coupling between the aerial and grid circuit may be above that required for the best results. The coupling required is an exceedingly small one.

In certain instances the operation on the short waves is improved by connecting the earth wire through a small condenser, or by not connecting the earth at all, leaving only the capacity of the batteries to earth in circuit.

MATERIALS USED.

- *1 Ebonite panel, 12in. × 10½in. × ¼in.*
- *1 Baseboard, 12in. × 10in. × ½in.*
- *4 1 mfd. Mansbridge condensers (T.C.C.).*
- *1 0·125 mfd. Mansbridge condenser (T.C.C.).*
- *1 0·001 mfd. fixed condenser (Dubilier).*
- *1 0·0003 mfd. plug-in condenser with clips (McMichael).*
- *1 0.0003 mfd. fixed condenser (Igranic).*
- *1 Neutralising condenser (Gambrell).*
- *1 0·00027 mfd. tuning condenser, Corrected Square Law (Burndept Wireless).*
- *1 0.0001 mfd. tubular wire-wound condenser (Marconiphone).*
- *1 Potentiometer (Burndept Wireless).*
- *2 Filament rheostats, values depending on valves to be used (Burndept Wireless).*
- *1 2 megohms grid leak with mounting (Dubilier).*
- *1 0·5 megohm grid leak with mounting (Marconiphone).*
- *1 Cosmos 100,000 ohms anode resistance with mounting (Metro-Vick Supplies).*
- *1 Intervalve transformer (Ferranti).*
- *3 Antipong valve-holders (Bowyer-Lowe).*
- *2 Accuratune slow-motion dials.*
- *12 Terminals.*
- *Materials for reaction and grid coils.*

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This scheme is not altogether to be recommended, however.

For short wave reception an aerial which is not too large should be used, with a good earth or counterpoise. It is certainly worth while to experiment with the length of the top of the aerial, a 100 ft. aerial being cut down to 60-70 ft. An aerial of this size will be quite effective on the broadcast wavelengths, and will usually markedly increase the selectivity of the receiver as compared with a 100ft. aerial.

It should be noticed that the tuning condenser and reaction coils are controlled by slow motion dials. These dials should be the best that can be afforded, as it is quite essential that delicate adjustments can be made with ease.

If the reader has a condenser of known value it is possible for him to calibrate his receiver—in a rough sort of way, it is true. In the case of the short waves, a coil should be made up from the details given in Tables 1 and 2, so that with the tuning condenser the wavelength is a known value within the limits of the accuracy of the condenser and coil. If the receiver is now caused to oscillate freely and the "wavelength unit" is held somewhere near the receiver, a noise will be heard in the telephones when the grid circuit is brought into tune. The setting of the condenser for a given wavelength is then recorded. Other coils and condensers of known value may be made up and their wavelengths found from the tables, and thus the receiver can be roughly calibrated. This will be a great help when first the receiver is used for the reception of really distant transmissions. If a reader who is not accustomed to short waves is keen on the idea, he might get a friend who has received the foreign stations to give him their positions on a wavelength unit.

After having made and tested the receiver the writer hopes that the amateur will agree with him that there is nothing difficult in making an effective receiver for short and long wavelengths—provided a little care is taken in its construction. The receiver has been thoroughly tested, and, in spite of (or is it because of?) its simplicity, is a truly remarkable one.

TABLE I.

FOR DETERMINING THE WAVELENGTH, FREQUENCY AND L.C. VALUE OF RADIO FREQUENCY CIRCUITS.
(L. is in microhenries and C. in microfarads.)

Wave-length. Metres.	Frequency Kilocycles.	L.C.	Wave-length. Metres.	Frequency Kilocycles.	L.C.
10	30,000.00	.0000282	150	2,000.00	.006335
11	27,273.00	.0000340	155	1,935.00	.006760
12	25,000.00	.0000405	160	1,875.00	.007204
13	23,076.00	.0000476	165	1,818.00	.007662
14	21,426.00	.0000552	170	1,765.00	.008134
15	20,000.00	.0000634	175	1,714.00	.008620
16	18,748.00	.0000720	180	1,667.00	.009120
17	17,646.00	.0000813	185	1,622.00	.009634
18	16,667.00	.0000912	190	1,579.00	.01016
19	15,788.00	.0001016	195	1,538.00	.01071
20	15,000.00	.0001126	200	1,500.00	.01126
21	14,284.00	.0001241	205	1,463.00	.01183
22	13,635.00	.0001362	210	1,429.00	.01241
23	13,042.00	.0001489	215	1,395.00	.01301
24	12,500.00	.0001622	220	1,364.00	.01362
25	12,000.00	.0001755	225	1,333.00	.01425
26	11,538.00	.0001903	230	1,304.00	.01489
27	11,110.00	.0002052	235	1,277.00	.01555
28	10,713.00	.0002207	240	1,250.00	.01622
29	10,343.00	.0002366	245	1,255.00	.01690
30	10,000.00	.0002533	250	1,200.00	.01760
32	9,374.00	.0002883	255	1,177.00	.01831
34	8,823.00	.0003255	260	1,154.00	.01903
36	8,333.00	.0003648	265	1,132.00	.01977
38	7,894.00	.0004065	270	1,111.00	.02052
40	7,500.00	.0004503	275	1,091.00	.02129
42	7,143.00	.0004966	280	1,071.00	.02207
44	6,818.00	.0005446	290	1,034.50	.02366
46	6,522.00	.0005960	295	1,017.00	.02450
48	6,250.00	.0006485	300	1,000.00	.02533
50	6,000.00	.000704	310	967.70	.02705
55	5,454.00	.000852	320	937.50	.02883
60	5,000.00	.001014	330	909.10	.03066
65	4,615.00	.001188	340	882.40	.03255
70	4,286.00	.001378	350	857.10	.03448
75	4,000.00	.001583	360	833.30	.03648
80	3,750.00	.001801	370	810.80	.03854
85	3,529.00	.002034	380	789.50	.04065
90	3,333.00	.002280	390	769.20	.04277
95	3,158.00	.002541	400	750.00	.04503
100	3,000.00	.002816	410	731.70	.04733
105	2,857.00	.003105	420	714.30	.04966
110	2,727.00	.003404	430	697.70	.05204
115	2,609.00	.003721	440	681.80	.05446
120	2.500.00	.004052	450	666.70	.05700
125	2,400.00	.004397	460	652.20	.05960
130	2,308.00	.004757	470	638.30	.06219
135	2,222.00	.005130	480	625.00	.06485
140	2,144.00	.005518	490	612.20	.06759
145	2,069.00	.005919	500	600.00	.07039

TABLE II.

SIZES OF SHORT WAVE COILS WOUND WITH NO. 16 WIRE.

Turns, Spaced 8 per in.	Dia. of Coil. in.	Inductance Micro-henries.	Turns, Spaced 8 per in.	Dia. of Coil. in.	Inductance Micro-henries.
6	3	3.5	6	2	2.25
7	3	5.0	8	2	3.0
8	3	6.0	10	2	4.5
9	3	7.25	12	2	5.75
10	3	8.25	14	2	7.5
12	3	11.25	16	2	9.0
14	3	13.75	18	2	10.5
16	3	17.0			
18	3	20.0			

TABLE III.

DETAILS OF TUNING AND REACTION COILS.

Wave-length Range. Metres.	Reaction Coil.			Grid Coil.		
	Turns.	Dia.	Length of Winding.	Turns.	Dia.	Length of Winding.
30—95	5 of No. 30 D.S.C.	2″	About $\frac{3}{8}$″	11 of No. 16	2$\frac{7}{8}$″	About 2″
300—500	35 of No. 34 D.S.C.	3″	About $\frac{1}{2}$″	55 of No. 26 D.S.C.	2$\frac{7}{8}$″	About 3″
1000—2000	80 of No. 34 D.S.C.	3″	About 1″	230 of No. 34 D.S.C.	4″	About 3″

SHORT-WAVE TRANSMISSION THEORY.

Refraction and Absorption in the Upper Atmosphere.

By PROF. E. V. APPLETON, M.A., D.Sc.

IN the earliest days of wireless we might say that theory preceded practice, for Maxwell's electromagnetic theory preceded Hertz's experimental detection of electric waves. But since those early days the reverse state of affairs has usually obtained. Practice has usually out-distanced theory, and the wireless engineer has almost always been able to achieve more than he could understand. Particularly has this been the case in long-distance wireless transmission. When Marconi first signalled to America, Lord Rayleigh promptly asked how it was that the electric waves could manage to bend round the protuberance of the earth. The mathematicians calculated how strong the signal intensity should be in cases of long-distance transmission, and, when the measurements of Austin were available, Dr. van der Pol was able to compare the results of the mathematicians with the experimental results. In this way he was able to show that the experimentally observed signal intensities were many thousand times the calculated values. Obviously there was some influence, other than that of diffraction, tending to assist the waves in bending round the curvature of the earth.

The Heaviside Layer.

The suggestion was made almost simultaneously by Kennelly and Heaviside that an ionised atmospheric layer would assist propagation in that it would deviate electric waves back to the ground where they might be detected. There has, however, been a good deal of opposition to the ionised layer theory in recent years, particularly in Germany and America. It has been stated that the bending of the waves round the earth is quite natural, since the waves start from the transmitter with their feet on the earth, so to speak, and that there seems no reason why they should leave it. Such objections, of course, completely ignore the results of the diffraction calculations and so can hardly be entertained seriously. Much more sympathy can be extended to other objectors who have asked for a more direct proof of the existence of the layer. Such a proof was sought recently by Smith-Rose and Barfield, who, in some very accurate experiments with tilted Hertzian oscillators and coils, attempted to detect the presence of down-coming waves at a receiving station. Smith-Rose and Barfield found that due, no doubt, to the presence of the reflected wave from the ground they were unable to get any evidence of down-coming waves such as must exist if the Heaviside layer theory is correct. At the end of their paper (*Experimental Wireless*, September, 1925) they say that "adequate experimental evidence on the existence of the Heaviside layer is still lacking."

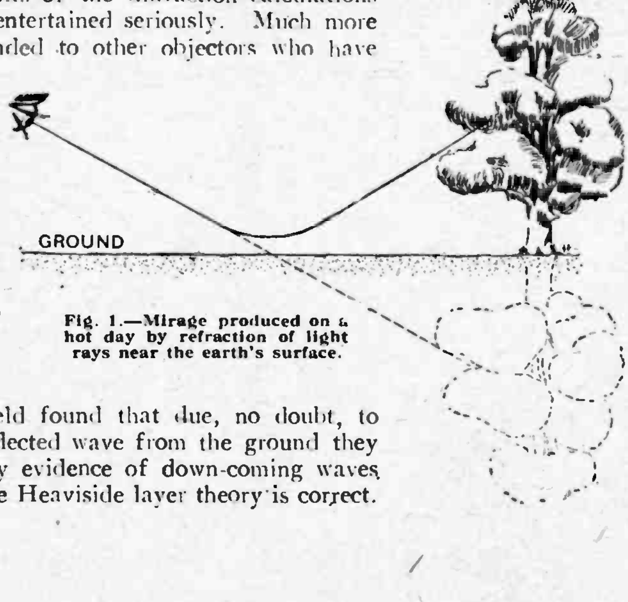

Fig. 1.—Mirage produced on a hot day by refraction of light rays near the earth's surface.

Interference Effects.

In a recent paper[1] Mr. Barnett and the writer have given a direct experimental proof of the existence of the ionised layer. With the assistance of the technical staff of the British Broadcasting Company (and of Capt. West in particular), it was shown that changing the wavelength of a transmitter continuously by a small amount caused interference phenomena to be observed at a receiving station 80 miles away. This proved the existence of two rays. A further experiment showed that during night variations the signal variations at the same place were relatively greater on a loop aerial than on a vertical antenna. This was shown only to be possible theoretically for a down-coming wave, so that the fact that loop fading is greater than aerial fading is in itself a proof of the existence of the ionised layer. From the relative value of the signal variations in the two cases it was possible to calculate the angle at which the waves arrive at the ground. In the case of 2LO signals measured at Cambridge this angle was found to be 65°-70°. It is obvious that such figures give us information about the height of the layer at night.

Action of the Layer on Short Waves.

I have devoted a good deal of my space to the evidence relating to the existence of the ionised layer because, in short-wave transmissions over even moderate distances, we can only explain the results if an ionised layer is assumed at the outset. It is easy to show that, for any type of waves, bending round obstacles is made less appreciable the shorter the wavelength, so that with wavelengths of 20-50 metres the bending of the waves round the earth must be practically inappreciable. Also it is well known experimentally, and the results are in agreement with theory, that the shorter the wavelength of a transmission the more rapidly is it attenuated when the waves pass over ground. Thus we conclude that, for the short wavelengths which have been used by amateurs in their very successful long-distance experiments, the transmissions have been brought about solely by the action of the ionised

[1] Appleton and Barnett, Proc. Roy. Soc. A., Vol. 109, p. 621, 1925.

Short Wave Transmission Theory.—

layer. It is therefore obvious that if we wish to understand why short waves have been so successful, we must enquire more closely into the action of ionised gas on the electric waves passing through it.

The "Inverted Mirage.

It was shown some years ago by Dr. Eccles that we can explain the action of the upper ionised layer if we take into account the variation of refractive index of the layer. We can most easily understand Dr. Eccles's argument if we consider first a phenomenon which is somewhat similar and which is well known. It is known to most people that on very hot days an inverted image of distant objects can sometimes be seen in the ground.

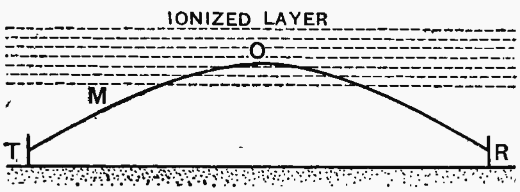

Fig. 2.—Refraction of wireless waves by the ionised layers of the upper atmosphere.

The phenomenon, which is known as a "mirage," is most often seen in the desert, but can easily be reproduced in the laboratory. The explanation of the effect is that near the surface of the sand or ground the air is very hot, and thus its refractive index is smaller than that of the layers of air above it. Now it is a well-known law of optics that a ray of light, which reaches a medium of lower refractive index than that of the medium in which it is travelling, is bent away from the normal. Thus in the case of the mirage the path of the light is as shown in Fig. 1, being bent away from the vertical when it reaches the layers of low refractive index near the ground. The eye, not being cognisant of the turning of the ray near the ground, sees the image of the tree apparently under the ground.

Now let us consider the analogous wireless problem. It was shown by Dr. Eccles that if the ionisation increased as the height increased in the atmosphere, we should have a very similar state of affairs for the much longer wireless waves. As the ionisation increases, the refractive index of the medium for electric waves decreases. Thus, as the wireless ray TM from a transmitting station, T (see Fig. 2), reaches the layers of lower refractive index, it is bent away from the vertical and ultimately bent back to the ground, where it reaches the receiver R. We thus look upon the process as one of refraction rather than reflection, and it is by this process that we think short wave reception is carried out.

Absorption of Different Wavelengths.

In cases of ionic refraction as described above absorption of the waves always accompanied the process of bending. We can easily understand this must be so if we consider the impacts between the electrons and the gas molecules. Under the action of the electric forces in the waves the electrons are caused to vibrate, and when they make a collision with a molecule they give energy to it, which process simply means that energy is communicated from the waves to the molecules of the gas, and is thus turned into heat. It is clear that the absorption of the waves will thus be smaller the lower the pressure of the gas through which the waves travel, since in a very attenuated gas the number of collisions would be small. Also we can see in a general way that with short waves, and thus very high frequencies, the electron can make many vibrations between the times of two collisions, so that the absorption is very much reduced. For the very short waves of light the absorption is clearly reduced to a very small amount.

Fortunately we are able to state exactly the amount of absorption per unit length of path in the case of short waves. The absorption factor a is given by the equation

$$a = K\frac{f}{p^2 + f^2},$$

where f is the frequency of the electron collisions with the air molecules and $p/2\pi$ is the frequency of the waves. K is constant for a given electron density. The reduction in amplitude in travelling a distance x is given by e^{-ax} and is specially marked when a is large. We must thus consider how a varies with different conditions. The most important point to be examined is the variation of a with frequency, or, in other words, with wavelength. A simple calculation shows that there is a marked decrease in absorption when the angular frequency p is increased beyond the collisional frequency of the electrons f. This means that for waves travelling in the atmosphere at a given height there will be a marked reduction in absorption when the wavelength is reduced through a certain critical value. To illustrate this we may consider a purely imaginary case in which f, the collision frequency, is taken at 6×10^7. The variation in the absorption with different wavelengths in such a case is illustrated in Fig. 3, where it is seen that the reduction of absorption is specially marked below 50 metres.

It must be pointed out that the use of shorter waves tends to increase signal strength apart from the reduction

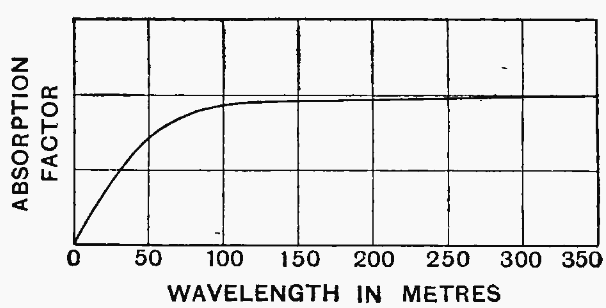

Fig. 3.—Variation of atmospheric abserbtion with wavelength.

of atmospheric absorption. As soon as the function of an aerial was properly understood it was realised that, for a series of transmitters with the same metre-amperes but of different frequencies, the radiation fields would be proportional to the frequencies. But I do not think that this factor alone explains the extraordinary low attenuations experienced in short-wave transmissions. The reduction in atmospheric absorption is almost certainly the deciding factor.

Short Wave Transmission Theory.—

To work out a complete theory of atmospheric influence on short-wave transmission is, however, impossible at present. So many factors (*e.g.*, exact height of and variation of ionisation in the layer) are unknown. Our information on the practical side is very meagre. We know that enormous distances are covered by short waves, but very few exact measurements of short-wave signal intensities have been made. I hope that the amateurs, who first discovered the extraordinary properties of these short waves, will not remain content until they have included signal measurements in their successes. Such measurements will be difficult, but difficulties are often welcomed by the enthusiastic.

TRANSMITTING NOTES AND QUERIES.

General Notes.

The German station K4LV has now been working for two months, and during that time has been in communication with 82 stations, including several in the U.S.A., when using an input of only 9 watts. Since November 8th the power has been increased to 14 watts. Communications may be sent *via* "Journal des 8," Rugles, Eure.

oooo

Mr. E. J. Simmonds (G2OD), Gerrards Cross, has established two-way telephonic communication with a station in Hong Kong, the strength of his signals being about R8 on a wavelength of 45 metres, and those of the China station about R7 on 35 metres. The input at 2OD was 100 watts.

oooo

Mr. F. R. Neill (G5NJ), Whitehead, Co. Antrim, established communication on Saturday, December 5th, with 8QQ, Saigon, French Indo-China, using 100 watts input. He has also worked with many stations in Australia, New Zealand and America.

oooo

Mr. W. A. S. Butement (G6TM), 127, West End Lane, N.W.6, reports two-way working with OA6N, Cape Town, on 45 metres and with an input of less than 60 watts, the strength of signals being reported as R4. He has also received Japanese 1PP on about 36 metres on December 9th, 10th, and 11th. On the latter occasion good speech and music were received.

oooo

Mr. S. K. Lewer (G6LJ), West Hampstead, also reports having heard both sides of a communication between J1PP and HU6DCF, Honolulu, at 8.30 a.m. on December 10th and the speech and music on December 11th. He also states that several New Zealand stations can be heard until 11.0 a.m. and become audible again at 3.0 p.m., G.M.T.

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An American station in the Philippine Islands, whose call sign is 1HR, works daily at 2 p.m. (G.M.T.) on 30 metres with the 6th District in U.S.A., and usually calls CQ after completion of traffic.

oooo

Sergt. M. H. Figg, Sialkot, India, is now using the call sign FGG in place of A50, and will be transmitting after December 17th on 34 and 105 metres. He has already worked with A2CM and M1DH on the latter wavelength.

oooo

Mr. F. A. Mayer (G2LZ), Wickford, Essex, has been experimenting in the reradiation of B.B.C. programmes on short wavelengths, and has been heard by Mr. N. W. Gillham, of the Hobart Radio Club, Tasmania. This is understood to be the first occasion on which a B.B.C. programme has been received in Tasmania.

oooo

An Unusual Coincidence

Mr. T. A. Studley, Harrow, writes that on November 25th, when listening for anything that might be on the ether, the first signal he heard was a weak D.C. note calling "Studley thanks for your QSL," and found it was an Argentine amateur, FC6, whom he had heard only once before, and to whom he had sent the report which was being acknowledged at that moment.

oooo

QRA's Wanted.

G2ALT, G2BL, G2BN, G2SI, G2ZA, G5HUG, G5NB, G5QL, G5UN, G6DA, G6GU, G6MA, G6NB, G6YU, GFB (calling GHA), F8TZ, ZIWS, Z2QB, Z4AV, 4-7A, 6-8R, OCML, FW, V2BXT, INCC, ICC, HBXB, XGBI, G2VS, G2WS, G5HT, G5RY, G6KX, E1BH, FG6, LS1, NPV4, NPB2, O2CTF, TM2, T12, AP.

Calls Heard.

Extracts from Readers' Logs.

Bedford.

(During October.)

English: 2NM (Tel.), 2OM (Teleph.), 2JB, 2VX, 2XV, 2XY, 2DX, 2UO, 2UV, 2LH, 2OD, 2WZ, 2GO, 2OF, 2KU, 5OL, 5XA (Tel.), 5LS, 5SI 5ID, 5LF, 5SU, 5BK, 5PM, 5LB, 6CN, 6YU, 6QB, 6NR, 6BJ, 6DO, 6AR, 6RW, 6NF, 6TM, 6PM, 6DO, 6KB. American: WHA, WIR, SGC, NADM, 1CKP, 1ACI, 1ACK, 1WL, 1BVL, 1SI, 1PM, 1RD, 2XS, 2CXL, 2ACY, 2GN, 3BNU, 3AUV, 4RR, 4AM, 5LF, 5CM, 8AC, 8DAA, 8BWR, 8ER, 9DNG, 9EJI. Canadian: 1UW, 2AX, 2BL, 3KP, 8AL. French: 8PM, 8TO, 8LB, 8RBP, 8DK, 8RIC, 8GR, 8KGS, 8CO, 8KI, 8GS, 8PKX, 8SOT, 8Bé, 8IL, 8GI, 8TOK, 8DK, 8AG, 8CAX, 8PKX, 8JR, 8JA, 8GM, 8TV, 8NA, 8CT, 8WW, 8PA, 8BPD. Italian: IRNA, IRT, 1BD, AS, 1TT, 2NT, 1AF, 1MT. Dutch: PCMM, PCTT, PDRG, 10PM, 10GG, 10MS, 10WB. Africa: OCML, OCQI. Argentine: RRP, PAZ, RA6, AAA. Belgium: U3, D2. Scandinavia: SMMZ, 2NM. German: G6. Australian: 3BQ. New Zealand: 1AB, 7Z. Unknown: FW, NPV4, NPB2, OTK, AGA, FEAEU, NC, FG6, OIE, KZ, REET4, G6K, 7AR, 7VX, 7VZ, NA1, JG6, G6, TM2, 6Q, BST, NOUS, Q2, TI2, NUE, U3, 7A, 4NJ, 4AH, 4RM.

All between 20 and 150 metres.

S. Williamson (G2ACI).

Cachar, India.

Great Britain: 2AD, 2BZ, 2CC, 2DX, 2KF, 21Z, 2MM, 2NM (Telephony), 2OD, 2QB, 2RB, 2SZ, 2WO, 2XY, 5DH, 5MA, 5MO, 5TA, 6AH, 61J, 6RM. U.S.A.: 1CH, 2WC, 2AGQ, 2AHM, 2CLG, 5BG, 5QN, 5UK, 6AWT, 6BJX, 6BQ, 6CA, 6CAE, 6DAG, 6HM, 6TS, 8PL, 9CVN, 9UA, 9ZT. Holland: PB1, PB3, PCJJ. Belgium: D4. Scandinavia: 2CO, 2ND, 7EC, SMZS. Switzerland: 9AD. France: 8DK, 8JA, 8TK. Philippines: 1AR, 1CW, 1HR, NEQG, NIRX, NUQN. South Africa: A3E, A4Z, A4V. New Zealand: 1AO, 2AC, 4AV. Australia: 1AK, 2RJ, 2UI, 2WJ, 2YH, 2YI, 3AD, 3AK, 3BD, 3BK, 3QN, 3TM, 5KW. Argentine: AF1, AF3, DM9. Brazil: 1AB, 1AF, 1BD, 1IA, 2AE. Indo-China: 1BT. Hawaii: FX1. Italy: 1RM. Mexico: 1AA. Miscellaneous: WIZ, POZ, FM, FW, NPO, NPP, ANE, RDW, WPP, WQO, NRL, NEQQ, NSX, NPN, NISM.

On 32 metres.

G. W. G. Benzie (2BG).

Weybridge.

France: 8GI, 8CT, 8DP, 8VU, 8LZ, 8TH, 8TOK, 8JU, 8ML, 8JC, 8TK, 8EU, 8DK. Italy: 1BS, 1AS, 1CO, IMT. Holland: OPM, PB3, OAX. Belgium: 4RS, 4GB, 4YZ. Switzerland. 9AD. Finland: 2CO. Northern Ireland: 5NJ. New Zealand: 1AX. U.S.A.: 1YB, 1ZA, 2KR. Unknown: 1RG, 1RR, 4UC, 8CAX.

(Short-wave 2-valve set.)

All on 24 to 60 metres.

R. C. Nisbet.

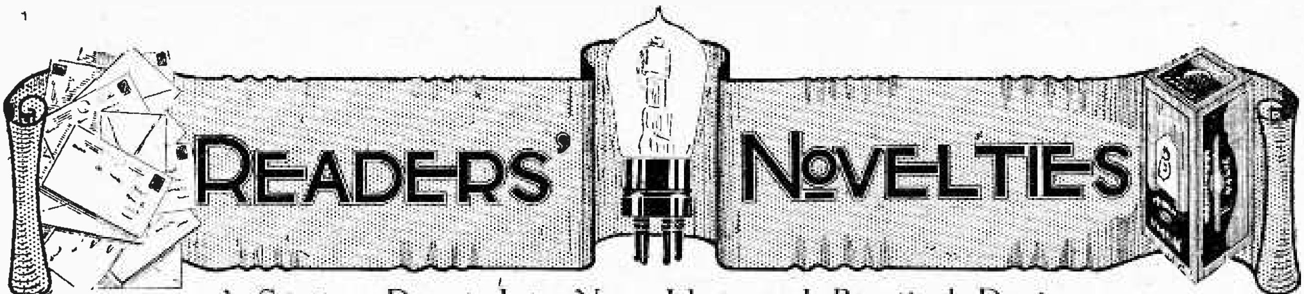
Thornton Heath.

(November 22nd to 30th.)

Spain: EAR6, EAR10, EAR22. Russia: RRP. Java: ANF. Egypt: 1BH. Mespot: GHB. Philippines: 1HR. India: HBK. New Zealand: 2AC, 4AC, 2XA. U.S.A.: 4FM, 5KW, 6EW, 6CTO, 8G2, 8CES, 8CYI, 9BHT, 9EGU, 9EJI, 8BY, 8KC. Etc.: 6LF, QO (MAO?), OCDJ, NRDM, SGC, NISP, 6YX, KY5, D7MT, S2NX, S5NF.

(0-v-0) on 30 to 50 metres.

Walter A. J. Warren.



A Section Devoted to New Ideas and Practical Devices.

NEUTRODYNE UNITS.

In neutrodyne receivers employing plug-in units of the type illustrated on page 650 of the issue of November 11th, 1925, a single neutrodyne condenser is connected in the circuit for each H.F. valve and adjustments have to be made every time the unit is changed. Considerable time is saved if a separate neutralising condenser is mounted in each H.F. transformer unit, when a setting is obtained for the particular band of wavelengths covered by each individual unit, and no time is lost in readjustment of the neutrodyne condenser when changing the wavelength range.—A. L. O.

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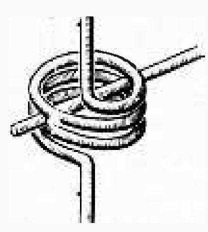
SPIRAL JOINT.

In experimental work it is very convenient to have some method of making temporary joints which do not involve the use of a soldering iron. The diagram shows a spiral joint which is very satisfactory in practice, giving a firm electrical contact of low resistance. The principal wiring,

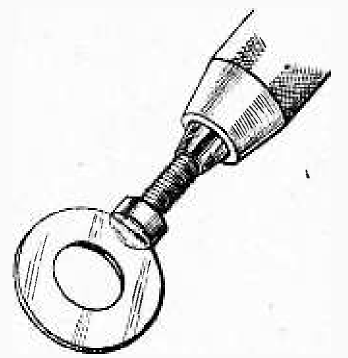


Spiral joint for temporary connections.

such as — L.T. and earth leads in the receiver, should be twisted up at regular intervals to form a close spiral consisting of two or three turns. Then, if it should be desired to join, say, a fixed condenser between two different points in the circuit the leads from the condenser may be forced between the turns of the spiral which will hold them firmly in position.—R. E.

DRILLING EBONITE.

The amateur with limited workshop facilities often finds difficulty in drilling the $\frac{3}{8}$in. holes necessary for standard condenser and filament resistance bushes. The cutter shown in the diagram is quite easy to construct, and cuts cleanly and rapidly when



Cutter for drilling 3/8in. holes in ebonite.

held in a hand drill in the ordinary way. It is necessary to drill first a small pilot hole with, say, a No. 6 B.A. clearance drill before using the cutter, and in general it will be found best to drill through from one side only. A high speed and light pressure are desirable, but the pressure must not be too light, otherwise chattering may take place. Everything depends upon the soundness of the soldered joint between the head of the cheese-head screw and the washer. The parts should be carefully tinned before soldering together in a Bunsen or blowlamp flame. Cutters of various diameters can be produced by clamping the washers on a length of screwed rod and filing them down while being rotated in the hand drill.—G. F.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A receiving valve will be despatched to every reader whose idea is accepted for publication.

Letters should be addressed to the Editor, "Wireless World and Radio Review," 139, Fleet Street, London, E.C.4, and marked "Ideas."

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LOUD-SPEAKER HINT.

The quality of reproduction from loud-speaker movements of the plain stalloy diaphragm type can often be improved by fixing a puncture repair patch to the centre of the diaphragm. Prepared patches are obtainable which can be at once applied to the diaphragm after removing the protective disc of paper. The rubber patch has the effect of introducing damping and altering the distribution of anodes in the vibrating diaphragm.—F. B.

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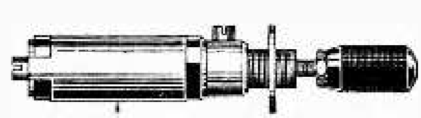
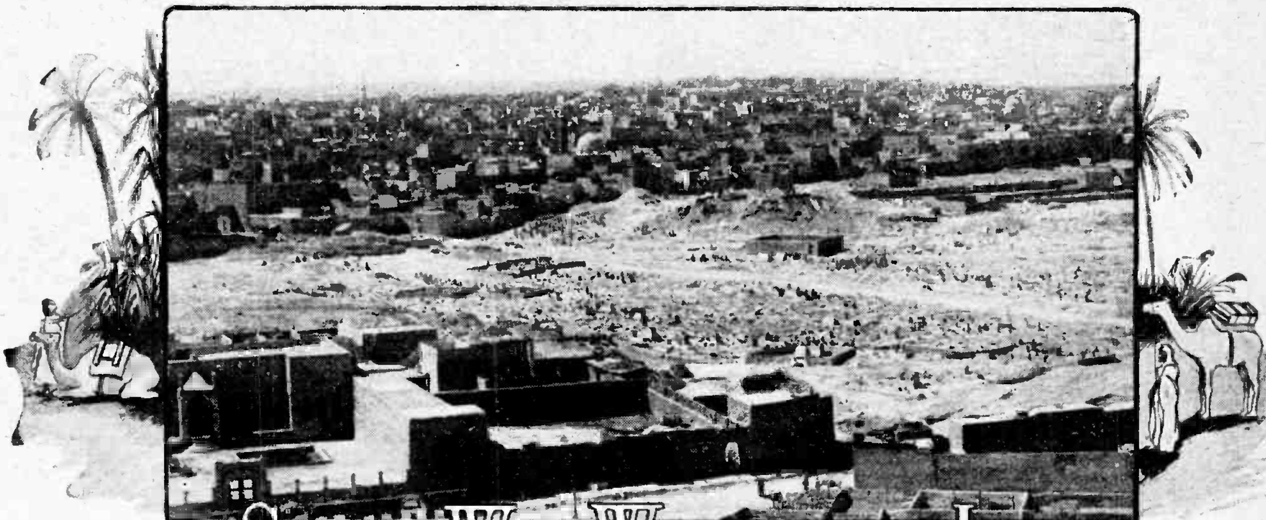
COMBINED GRID CONDENSER AND LEAK.

Variable grid leaks of the type employing a short ebonite tube to contain the resistance element may be converted to a compact unit including the grid condenser by the method shown in the diagram. A rectangular piece of copper foil, approximately $1\frac{1}{4}$in. × $1\frac{3}{4}$in., is cut with a projecting tag at one side for connection to the end terminal screw of the grid



Combined grid condenser and variable grid leak.

leak. The sheet of foil is then wrapped round the ebonite tube and secured with shellac varnish, thus providing a capacity approximating to 0.0003 mfd. between the end terminal plate and the screwed rod passing down the inside of the tube.—F. C. R.



SHORT WAVE WORKING with IRAQ

The Interesting Story of how Communication was First Established on Short Waves between England and Mesopotamia.

By FLIGHT-LIEUTENANT R. F. DURRANT, A.F.C., R.A.F. (GHH).

BOTH the amateur and professional experimental radio world have been so busily engaged in collecting data on the waveband 15 to 100 metres, that I offer no apology for intruding on this subject and setting down my experiences, obtained in the atmospheric-laden ether of Iraq (Mesopotamia). My work extended, geographically, from Basrah, in the Persian Gulf, up country to Baghdad, and more particularly in the Mosul Vilayet. At Basrah, in Southern Iraq, one has a large sector of swamp country to work over for radio communication; it is here that static and atmospherics of the "grinder" type, originating in the Indian Ocean, appear with venomous regularity, rendering urgent communication on the higher wavelengths at times slow and inaccurate.

When I left England in 1923, experimental long range, short wave work was entirely confined to a few British and French experimenters carrying out nightly tests with the United States of America on 100 metres and above, and, as far as I am aware, communication had not been established with any experimenter East of Suez. It was with the object of investigating the strength, fading effect, etc., of signals on short waves from Europe, and also to ascertain the strength of static on a waveband of 70 to 100 metres, that the first receiver was constructed.

The Receiving Equipment.

As an aerial, I had two 30ft. field masts, 45ft. apart, and a four-wire equally spaced counterpoise on spreaders directly underneath the aerial, the antenna consisting of a four-wire sausage on 8in. spreaders, and the lead-in, which was 20ft. in length, ran direct to an ebonite tube. On one side, practically against the aerial, was a bamboo matting fence, and scattered around were buildings, mostly with tin roofs.

The receiver used was the ordinary aperiodic aerial arrangement with tuned secondary and reactance. Owing to the absence of suitable coils or proper formers, and in order not to waste time obtaining supplies from England, circular cardboard boxes were used, wound with 28 D.C.C. wire. Condensers, also, were a problem, as the only available were of an obsolete pattern of 0.01 to 1 jar (0.001 mfd.) capacity. Crude wooden handles were fitted to avoid body capacity effects. It was with great curiosity that I spent a memorable night and dawn in sweeping around trying to intercept a definite call sign. One valve was used, an ordinary dull emitter, which took normally 20-40 volts H.T., but the set could not be persuaded to oscillate unless H.T. of the value of 80-90 volts was applied.

First English Station Heard.

After several hours a steady R7 note was heard, which turned out to be SMYY (Vaxholm, Sweden), using, it was afterwards verified, an input of 30 watts on 90 metres. Hardly had I copied his call-sign ere G5NN came through, and I had the great satisfaction of intercepting in Iraq the first British station. Nightly watches were kept, and G2NM and G2LZ came on the scene, followed by others whose call-signs follow.

The Transmitter.

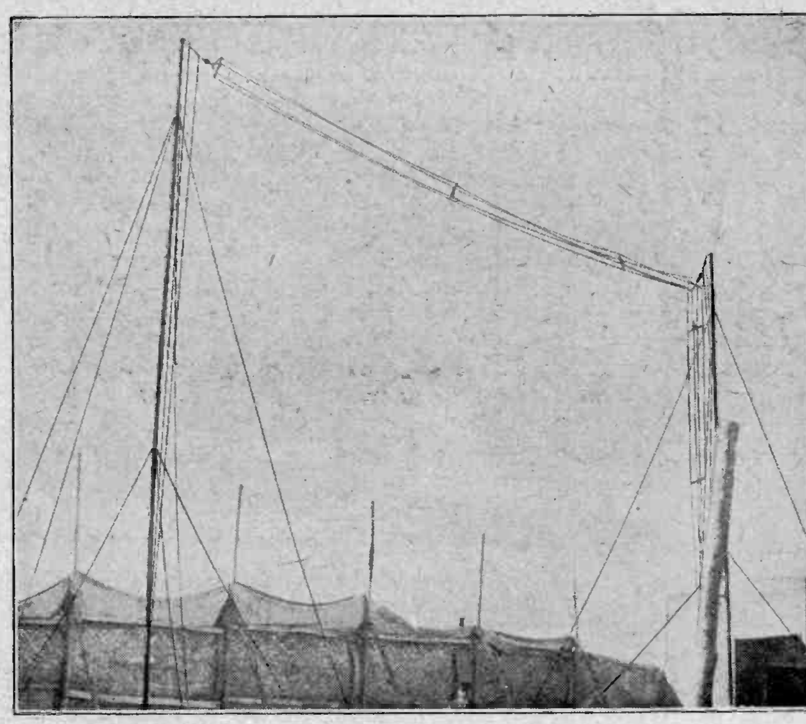
Steps were then taken to rig up a transmitter, and the following very roughly improvised gear was wired up, using a direct-coupled aerial circuit, with aerial coil and reactance both on cardboard formers wound with seven stranded 22 bare copper wire. High tension supply was obtained from a D.C. motor generator giving 1,000-1,500 volts run from the lighting mains. The

Short Wave Working with Iraq.—
transmitting valve was rated at 250 watts, and a 14-volt accumulator supplied the filament heating current.

No great hopes were entertained of reaching farther than 1,000 miles with this extraordinarily primitive apparatus. One week's tests were arranged with G5NN, and in the early dawn (0200 G.M.T.) I had the great satisfaction of hearing him telling me I was quite readable, the signals at the British end growing steadily in strength while the sun was rising in Iraq. During this first test, which was the first time direct two-way wireless communication between England and Iraq had been obtained, the atmospherics were too fierce to read signals on the higher waves, and although reception was difficult on the one valve, each word was only sent twice, and at the finish, as the atmospherics dwindled with the sun rising, each message was sent once only. These tests were satisfactorily carried out without interruption for one week.

After this, regular nightly watch was maintained, and communication established with G2NM and G2LZ, both gentlemen giving me the greatest assistance with various improvements and in the conducting of tests to determine the most suitable wavelengths.

As soon as regular communication was a nightly occurrence, investigations were made to find the periods for reliable work during the twenty-four hours.

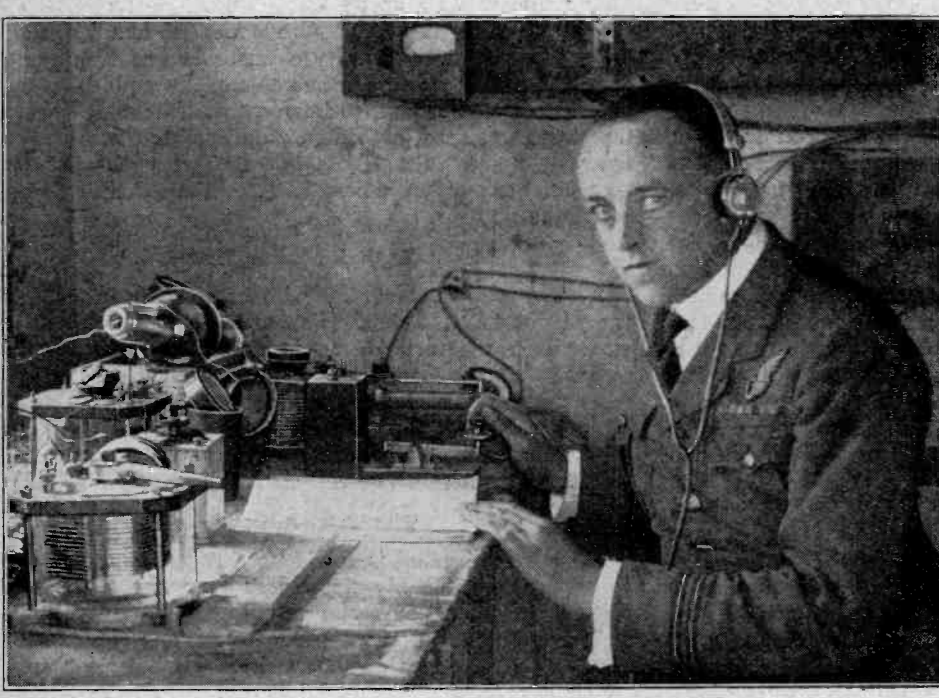


The aerial is supported by two 30ft. masts 45ft. apart. A four-wire cage is used, carried on 8in. spreaders.

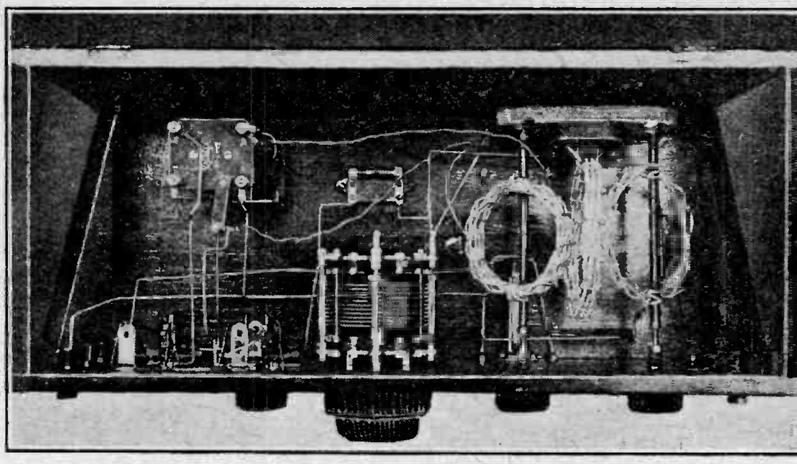
Times of Working and Atmospherics.

Owing to the fact that the British stations were unable to transmit during broadcasting periods, some very valuable data were not able to be obtained. There was not another short-wave set within a thousand miles, and I was entirely reliant on the British experimenters for all information. From December to March, communication was usually opened up at 1815 G.M.T. (9.15 p.m. in Iraq), on 90 metres, though this could only be carried out until 1900 G.M.T., owing to the British stations having to close down for the B.B.C. transmissions, the next available period being usually 2300 G.M.T., or 2 a.m. from me. Signals from Great Britain were always R6 to R7 at 1815 G.M.T. At 2300 G.M.T. this strength would increase to R9 *plus*, and they would reach their maximum at 0130 G.M.T., after which period they would go to R7 and finally fade out at 0530 G.M.T., when it had been sunlight for three hours in Mosul.

It was at first thought that atmospherics in Iraq would be sufficiently moderate on low



Flight-Lieutenant Durrant at the key at GHH. The improvised nature of the equipment is readily apparent.



The short wave receiver, presented to the author by G2LZ and G2NM

waves to ensure continuous communication with the United Kingdom every night. I had great hopes that this would be the case, and everything during December, January, February, and March pointed to that end, but with the advent of the summer it was found that there were certain nights when atmospherics were too strong to read U.K. on any wave from 20 to 100 metres. The percentage of "bad air" nights was, however, comparatively very few.

Only those who have listened-in around the Equator and South America will realise what I mean by X's. It is no exaggeration to say that, with a three-valve receiver and with the telephones on the table, X's can be heard one hundred feet away. They are at their maximum at night, but herald the approach of a sandstorm during the day, and often continue throughout the twenty-four hours. Their minima, as measured by D.F., were N.E. or S.W.

World-wide Working.

The first tests with Great Britain were always carried out on waves varying from 82 to 95 metres. Watch was also kept directly the sun was slipping below the horizon, and to my astonishment Australian and New Zealand stations could be heard "tuning up" and giving preliminary calls. They would then fade out for two hours and reappear two hours after sunset, when communication was opened up with A3BD and A2BQ, and New Zealand 2AC, 4AA, and 4AK. These stations would fade out about 1930 G.M.T., and, strange to relate, could never be heard at sunrise in Iraq, but only at sunrise in Australia.

The best low-power results were always obtained with Finland, all stations being workable each way on 12 to 20 watts. The operators were mostly students in military colleges.

The average power of GHH was 100 watts. Let me remark that, of the many English stations read, it was only with stations possessing a steady, clear note, like 2OD, 2NM, and 2LZ, which could be read through the static. An amazing frame aerial test was carried out with G6KK, who, with 12 watts input using an 8ft. square frame, was situated on the first floor of a three-storied house in Blackpool. He was worked for several hours, being received R5 on two valves. On switching over to his ordinary outdoor aerial, the received strength was only two points higher.

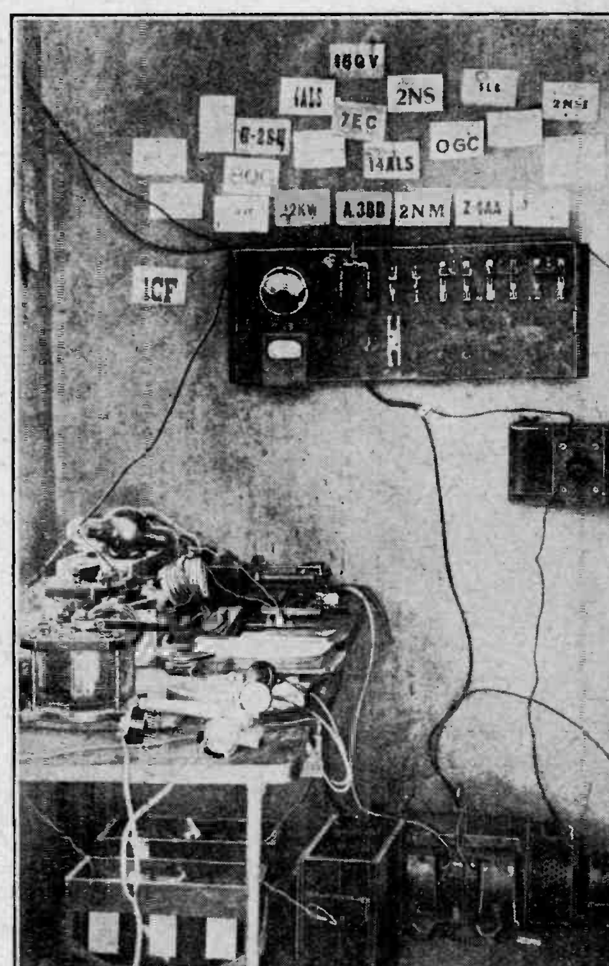
A look-out was then kept for U.S.A., and signals were first exchanged with that continent through 1ABS and 1PL and 4OU. U.S.A. is audible from 2100 G.M.T., maximum signals being received at 0330 G.M.T.

Nova Scotia rapidly followed, and Major Borrett, C1DD, and C1AR came in very well, usually at dawn. The Hamilton Rice Expedition, 3,000 miles up the Amazon, was intercepted many times (SA WJS).

The only Russian on the air was 1FL, who is at Novgorod.

Reducing Power Tests.

Aerial radiation on 100 watts was 0.9 amp. Reducing power tests were then tried with G5MO,



Another view of the transmitter. Cards from several well-known stations adorn the wall.

Short Wave Working with Iraq.—

G2LZ, and G2NM, all of whom could read me R3 when I was using an input of 20 watts. It is interesting to note that while I was working on 100 watts to England, using a directly coupled aerial circuit, the main station only a quarter of a mile away (short- and long-wave aerials running parallel) experienced no interference while using a three-valve direct coupled receiver and listening to the majority of the B.B.C. stations on an auxiliary aerial. Bournemouth and Newcastle were exceptionally good, but 5XX, despite its power, was not received so strongly or consistently. KDKA on 66 metres was very useful for calibrating our short-wave receiver.

The Humorous Side.

The situation was not without humour, particularly in view of the fact that in giving my QRA it never seemed to strike the average experimenter that Mosul was in the East, especially as its commercial call-sign began with a "G." The first gentleman to point out to me my obscurity was a well-known Swede (whose call-sign shall not be disclosed). The log read as follows:—

SWEDE: QRA.

I: QRA, Mosul, Iraq.

SWEDE: Where is Iraq?

I: Mesopotamia. O.M.

SWEDE: Where is Mesopotamia?

I: (With motor humming and wondering what on earth to say on the spur of the moment.) Near Baghdad. (Thinking he must know of the Thousand and One Nights.)

SWEDE (after a pause): Where is that?

I (in despair): Up the Persian Gulf.

SWEDE: R, TKS, FB (Fine Business) OK, etc., etc.

Here is another incident; it was 3 a.m. with me when a steady call came through on 90 metres. I replied, and the fingers on the key in England said GE OM UR VY OK, etc., and then the startling announcement: "I am in bed, O.M." Thinking my co-optimist was in bed sick, I replied: "Not very ill, I hope." "Oh, no," came the cheerful reply, "I've merely got a relay and the transmitter is downstairs." Such are the ways of the enthusiast.

Is 40 Metres the Best Wavelength?

The great problem that awaits solution is on what wave can continuous day and night communication on low powers be carried on over distances of 3,000 miles and over. As I have previously stated, 70, 80, 90, and 100 metres were all equally efficient with darkness at either end or the other—but with daylight completely in between, signals fade right out on this waveband. Quite recently daylight communication has been established between Mosul and G2LZ in the United Kingdom on 23 metres, but insufficient time has elapsed to enable me to prove that this is completely successful for the whole of the 24 hours.

That it will be on a waveband slightly below 40 metres is my firm conviction, and perhaps before these words are in print the efforts of the British experimenters will have proved it. When one comes to retrospect—what would we have thought five years ago of securing direct nightly communication between England and Mesopotamia with stations whose aerials are scarcely visible and whose power and equipment could be installed in a telephone call-box.

I attach a list of stations worked. My heartiest thanks go out to them all, as by their co-operation and help, a great deal of useful data has been obtained.

I have proved by experiments that wavelengths of the order of 70 to 100 metres follow the "Heaviside" layer, and are dependent upon the density of that medium as regards range. Below 70 metres, the waves appear to shoot off at a tangent, and stations coming in the effective "reflected" zone are in good communication. Experiments showed that A and B could communicate over 3,000 miles by day on 23 metres, but C and D, who were situated in a direct line between A and B, at 500 and 1,500 miles respectively, could not hear A or B stations.

Telephony from G2NM came through consistently on 40 metres from June onwards. Mr. Gerald Marcuse's cheery voice greatly helped to banish loneliness at this outpost of Empire.

Short Wave Calls Heard and Worked.

England: 2JF*, 2KF*, 2LS*, 2LZ*, 2NC, 2NN*, 2NO, 2OD*, 2OM, 2SH*, 2SZ, 2WJ*, 2XA, 2DB*, 2NJ*, 2FM*, 2RB, 2DX, 2CC, 2FU, 2WD, 2VS, 2FN, 2KZ, 2RB, 2IN*, 2KW*, 2GK, 2MQ*, 2YQ*, 5BV, 5MA*, 5MO*, 5NN*, 5QV*, 5RZ*, 5SZ, 5LF*, 5UQ, 5TZ, 5XL, 6NF*, 6LW, 1GH*, 6TD, 6VP, 6TM*, 6UV*, 6RM*, 6KK* (frame aerial 12 wts.), 6NH*.

America: 1AAL, 1ABS*, 1BHM, 1CMP, 1KC, 1LW, 1AW, 1AO, 1PM*, 1BVS, 1ARY, 1YD, 1BY, 1QV, 1CRU, 1AUC, 1CRI, 1BZP, 1XU, 1AXN, 2CEE, 2KKP, 2CXW, 2AX, 2YT, 2WY, 2AG, 2GK, 2CJB, 2BRC, 2AAN, 2AAA, 2CVJ, 2BGI, 2WIK, 2ANM, 3BCO, 3BUY, 3OQ, 3HH, 3CS, 3BNU, 3CJN, 3DHK, 3OY, 4IR, 4KE, 4XE, 4EQ, 4JE, 4OU*, 4JX, 4JY, 6CD, 6CSS, 6AK, 7OC, 9KR, WPY, WPX, WPG, KDKA, test ship LN*.

France: F8B, F8S, 8QG*, 8SM, 8TG, 8DU, 8AQ, 8RO, 8FC, 8GM, 8FO, 8UU, 8DA, 8BO, 8AB, 8GP, 8XR, 8AZ, 8DE*, 8DI, 8GO, 8CN, 8GK, 8TK, 8GH, 8EM, 8PL*, 8SSU*, 8FJ*, 8HSG*, 8HRG*, 8MAR*, 8CN, 8NQ, 8CF, 8CT, 8CK, 8AG, 8MJM*, 8EE*, 8RF, 8YX, 8RIC, 8NK*, 8JBL, 8VX*, 8HGW, 8UK*, 9BR, 2DE*, MOREL.

Holland: PC1*, OLL*, GCCH*, OCTU, NSF, OBA, OAB, OFL, ONL, OZN, ONCT, OXF, OZA, OGC*, NSFN, PC7*.

Sweden: SMYY*, SMZS*, SMYV*, SMBL, SMXV, SMVV, SHER*, SMWF.

Norway: ORE, ERK1.

Australia: 3BD*, 3BQ*, 3BM, 2DS, 2TC, 2YG.

New Zealand: 1AA, 2AC*, 4AA*, 4AC, 4AK*.

Canada: 1DD*, 1AR*.

North Africa: 8ALG*.

Denmark: 7EC*, 7QK*, 7XX*, 7ZM.

Finland: 1IM, 1CP, 2CA, 2NN*, 2NM*, 2NS*, 2NCB*, 5NQ*, 2NCA, 2NAB, 3NB.

Italy: 1MT*, 1KX*, 1WB, 1FP, 1AM, 1NO*, 1CO, 3AM, 3AF*, 3RM.

Belgium: 4AU*, 4RS, 4AS, 4AL, 4SR.

Russia: OCDEJ, 1FL.

Germany: 1CF*, 1RB*, XOX, POX.

South America: SAWJS (Amazon Expedition).

Switzerland: H9AD*, 9BR*.

French Indo-China: HVA.

* Two-way communication.

CURRENT TOPICS

News of the Week—in Brief Review

BROADCASTING ON CHRISTMAS DAY.

In spite of rumours to the contrary, the B.B.C. staff will remain on duty on Christmas Day, and a full-time programme will be given.

oooo

LICENCES ON INSTALMENT PLAN.

To stimulate interest in broadcasting among the less wealthy classes, the Italian Government has arranged a scheme of easy payments in respect of receiving licences. Listeners may now pay for their licences at the rate of 8 lire (about 1s. 4d.) per month.

oooo

POLICE AND WIRELESS ECONOMY.

The headquarters of the East Suffolk Police are to be equipped with wireless for the reception of the B.B.C. time signals. A special time signal has hitherto been received daily from Greenwich, involving an expense of £7 per annum.

oooo

ITALY'S NEW BROADCASTING STATION.

Listeners who study Continental transmissions should be on the alert for "Milano 2MI," this being the regular announcement made from the new broadcasting station at Milan, operating on 320 metres. Although opened only a fortnight ago, Milan has already been achieved remarkable success, excellent reception being reported in Scotland.

oooo

WIRELESS LICENCES IN FRANCE.

The new wireless licensing regulations in France draw a distinction between valve and crystal sets. For valve receivers the Post Office tax amounts to 60 francs (about 9s. 6d.) for the first year and 50 francs for succeeding years. Crystal receivers are taxed at 20 francs for the first year and thereafter 15 francs per annum.

A drastic provision is laid down (says a *Daily Mail* correspondent) that listeners who are discovered to be pirates will be fined to the extent of ten times the licence fee.

oooo

RUGBY TESTS WITH AUSTRALIA.

Preliminary trials with the giant Post Office wireless station at Hillmorton, Rugby, have fully justified the hopes of the engineers. According to a Sydney report the experimental transmissions made early on December 12th were received in Australia with "amazing clarity."

It is understood that Rugby will be formally opened as a commercial station early in the New Year.

oooo

MR. FORD'S WIRELESS LICENCE.

The final episode in the protracted dispute between H.M. Postmaster-General and Mr. Robert Moffatt Ford on the question of the latter's unlicensed wireless apparatus was enacted on December 12th, when Mr. Ford was arrested and taken to Marlborough Street Police Court. On his refusal to pay the £10 fine and costs for the same amount as ordered by the Marlborough Street magistrate on November 26th, Mr. Ford was locked in a cell. Half-an-hour later he paid the fine and was released.

PARIS PRESS AND THE MICROPHONE

The *Radio Paris* broadcasting station is showing unmistakable signs of becoming what may be described as a "speaking journal." Three of the more important Paris newspapers have decided to make use of the station for broadcasting news and other items.

oooo

BERNE RECEIVED IN ARGENTINA.

Within a month of the opening of the Berne broadcasting station on November 19th, enthusiastic reports of reception have been sent in from all over Switzerland, Italy, Portugal, Germany, France, Czecho-Slovakia and Belgium. Even from as far away as Argentina a telegraphic message has been received saying that the transmission was very good.

The Berne station which operates on 302 metres is equipped with a Marconi 6 kW transmitter similar to the apparatus used in the majority of British stations.

RADIO REVELRY. A flashlight photo of some of the happy throng at Olympia on December 15th, on the occasion of the Radio Revels organised by the B.B.C. and the Faculty of Arts.

CLUB MEETINGS AT CHRISTMAS.

The near approach of Christmas is generally the signal for a momentary lull in club activity. An exception is shown in the case of the North Middlesex Wireless Club, whose Hon. Secretary advises us that an ordinary meeting will be held this evening (Wednesday) at 8.30.

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FARMERS AND WIRELESS WEATHER FORECASTS.

A plea for a B.B.C. weather forecast at an earlier hour than 10.30 a.m., the present time, has been strongly supported by farmers in all parts of the country. A symposium of opinions solicited by "The Farmer and Stockbreeder" indicates that the farmers are in favour of a weather transmission at 8 a.m., which would give more time for preparing the day's plans.

The extreme value of the wireless weather bulletins is warmly emphasised by all contributors, who state that the information given is wonderfully accurate.

oooo

SWEDISH D.F. STATION FOR SHIPS.

A new marine D.F. station, giving reliable bearings up to a distance of 100 nautical miles, has been established at Landsort, on the east coast of Sweden. The call sign is SAO.

oooo

THE KOOTWIJK HIGH POWER STATION

In the caption accompanying the photograph of one of the masts of the Kootwijk station in *The Wireless World* of December 9th, the height of the mast was erroneously given as 210 ft., whereas the actual height is 210 metres, or nearly 700 feet.

oooo

CHRISTMAS GREETINGS BY WIRELESS.

A special schedule of reduced rates has been arranged by the Marconi Company for the transmission of greetings by wireless to Canada, Australia, New Zealand, Pacific Islands, Bermuda, British West Indies, and British Guiana.

To-day (Wednesday) there is still time to send a Christmas greeting "*via* Marconi" to Canada under the reduced rate. New Year greetings for any of the above destinations may be handed in at all Post Offices and Marconi offices up till midnight on December 28th. Messages for Canada may be handed in (at Marconi offices only) up till midnight, December 30th.

The rates to Canada vary from 2s. 6d. to 4s. 2d. for a message of ten words or less; to Australia and New Zealand, 5s., with a minimum of ten words.

oooo

WIRELESS AND THE YOUNG.

INATTENTIVE PUPIL: Yes, sir, I was listening, but I heard nothing.

TEACHER: How was that?

PUPIL: I was in a silent zone.

—*Radio Electricité, Paris.*

oooo

WIRELESS DEVELOPMENTS IN RUSSIA

By way of the Russian Information Bureau in Washington, U.S.A., comes the news that the Soviet Government has formed a State syndicate for the manufacture of wireless apparatus, including receiving sets and parts.

In the province of Moscow some 200 village reading-rooms have been equipped with receivers and loud-speakers for the benefit of peasants who cannot afford receivers of their own. It is hoped that this measure will help to overcome the scarcity of trained teachers, wireless filling the *rôle* of village schoolmaster.

oooo

EUROPEAN BROADCASTING STATIONS.

In the list of European Broadcasting Stations which appeared in our issue of December 9th the wavelength of the Milan station should have been given as 320 metres and the call sign 2MI. Also, the power of Brussels (Radio Belgique) should have been given as 1.5 kW., and that of Karlsborg as 0.25 kW.

A SPANISH STATION.—A view of the new broadcasting station at Bilbao, with its lofty and well-proportioned masts.

oooo

CHOOSING THE RIGHT VALVE.

A trade publication of exceptional interest has been issued by the General Electric Company, Ltd., under the title of "Osram Valves for Broadcasting." This handsome forty-eight page brochure deals with nearly twenty-five types of valve, setting forth particulars of each, with operating data and characteristic curves. A useful introductory article is incorporated which treats of the importance of choosing the right valve. We understand that copies are obtainable from The General Electric Co., Ltd., at Magnet House, Kingsway, London, W.C.2.

WIRELESS BOMBING RAIDS.

Some interesting experiments have been carried out in the neighbourhood of Portsmouth with bombing aeroplanes guided and controlled from the ground by wireless. Although a comparatively low power has been used at the transmitter, the tests have shown that the aeroplanes remained under control at a distance of fifty miles.

oooo

EXPERIMENTS AT DUBLIN.

The first experimental transmission from 2RN, the new Dublin broadcasting station, was carried out with success on December 12th, and since then listeners in the Irish Free State have been able to enjoy a series of test transmissions which included the relaying of programmes from Belfast and London.

Mr. Seumas Clandillon, director of the Dublin station, hopes to perfect his plans so that the official opening may take place on January 1st.

oooo

WIRELESS OPERATORS' STRIKE.

A step in the direction of peace in connection with the strike of wireless operators was taken on December 15th, when representatives of the Association of Wireless and Cable Telegraphists attended a meeting of about forty M.P.'s at the House of Commons.

In a statement issued afterwards by the Association it was said that after a keen discussion a committee of three Members of Parliament was appointed to seek an interview with the President of the Board of Trade in order to place the views of the meeting before him. Representatives of the Association stated that they welcomed the fullest enquiries into the facts of the dispute.

oooo

INTERNATIONAL WAVELENGTHS CONFERENCE.

A congress to consider the equitable distribution of broadcasting wavelengths in Europe opened at Brussels on December 14th under the chairmanship of Rear-Admiral C. D. Carpendale. The countries represented were Great Britain, France, Belgium, Germany, Austria, Italy, Sweden, Norway, Spain, and Czecho-Slovakia.

The congress was arranged through the initiative of the International Broadcasting Bureau at Geneva.

oooo

NEW PARIS BROADCASTING STATION.

Sunday transmissions on a wavelength of 340 metres are being conducted by a new broadcasting station in Paris under the direction of *Etablissements Tex.* The programmes, which are generally given between 4 and 6.30 p.m., consist mostly of retransmissions from Daventry.

oooo

RECEIVING LICENCES IN CANADA.

In public appreciation of broadcasting, Ontario is an easy first among Canadian provinces. During the first nine months of this year Ontario issued half the total number of receiving licences in the Dominion with a total of 32,833. The total number of licences issued throughout Canada during the period mentioned amounted to 64,682, showing an increase of 7,823 over the previous year.

SHORT-WAVE TRANSMISSIONS.

Few of the stations included in this list undertake transmissions at regular stated hours, and times of working have therefore been omitted. Many of the transmissions are, of course, only of a temporary nature for test and research purposes, and in consequence it is probable that in some instances the transmissions are now discontinued.

The Editor would welcome information concerning additions and amendments for inclusion in future lists.

Wave-length.	Call-sign.	Station.
13.0 metres.	POF	Nauen.
17.0 „	NKF	Naval Lab., Bellevue, Anacostia.
18.0 „	POF	Nauen.
20–30 „	NAL	Navy Yard, Washington, D.C.
20.0 „	NAL	Washington, D.C.
20.0 „	NEPQ	U.S. s/s. "Relief."
20.0 „	POX	Nauen.
20.8 „	NKF	Bellevue, Anacostia.
22.0 „	WIK	New Brunswick, N.J.
25.0 „	2YT	Poldhu.
25.0 „	POY	Nauen.
25.6 „	NKF	Bellevue, Anacostia.
26.0 „	POX	Bellevue, Anacostia.
26.0 „	AGA	Nauen (working with Argentine).
28.0 „	POW	Nauen.
30.0 „	2XI	Schenectady, N.Y.
30.6 „	NAL	Washington, D.C.
32.0 „	2YT	Poldhu.
33.0 „	OCDJ	Issy-les-Moulins. (Météo Europe 1008–1028 G.M.T.)
35.0 „	2XI	Schenectady.
35.0 „	WQO	Rocky Point, N.Y.
36.0 „	LPZ	Buenos Aires.
37–40 „	NPU	Tutuila, Samoa.
38.0 „	2XI	Schenectady, N.Y.
40.0 „	1XAO	Belfast, Me.
40.0 „	NPG	San Francisco, Cal.
40.0 „	NRRL	U.S. s/s. "Seattle."
40.0 „	NQW	U.S. s/s. "Mexico."
40.0 „	NAJ	Great Lakes, Ill.
40.0 „	NAS	Pensacola, Fla.
41.0 „	NKF	Nav. Res. Lab, Bellevue, Anacostia.
41.6 „	NKF	Nav. Res. Lab, Bellevue, Anacostia.
42.0 „	PCUU	The Hague (Colonial Min.).
43.0 „	WIZ	New Brunswick, N.J.
43.0 „	NPG	San Francisco, Calif.
45.0 „	NPG	San Francisco, Calif.
45.0 „	OCTU	Tunis la Casbah. (Météo Tunis 2130–2250 G.M.T.)
45.0 „	PCMM	The Hague (P. & T.)
47.0 „	POZ	Nauen.
49.0 „	NPM	Honolulu, Hawaii.
49.0 „	WHD	Sharon, Pa.
50.0 „	NKF	Anacostia, D.C.
50.0 „	AIN	Casablanca, Ain Bordja. (Météo Maroc, 0830–0840 and 1930–1940 G.M.T.)
51.5 „	WQN	Rocky Point, N.Y.
53.0 metres.	NPU	Tutuila, Samoa.
54.0 „	NBA	Balboa, Canal Zone.
54.4 „	NKF	Bellevue, D.C.
54.5 „	WQN	Rocky Point, N.Y.
56.0 „	KFKX	Hastings, Nebraska.
57.0 „	WQN	Rocky Point, N.Y.
58.79 „	KDKA	East Pittsburg, Pen.
60.0 „	1XAO	Belfast, Maine.
60.0 „	2YT	Poldhu.
62.0 „	KDKA	East Pittsburg, Pen.
67.0 „	8XS	East Pittsburg, Pen.
68.0 „	NPO	Cavite, Philippine Islands.
68.4 „	WRB	Miami, Florida.
68.4 „	WRP	Pinecrest, Florida.
70.0 „	POX	Nauen.
70.0 „	NPO	Cavite, P.I.
70–84.5 „	NERM	U.S. s/s. "Los Angeles."
70.5 „	NQG	San Diego, Calif.
71.0 „	NKF	Bellevue, Anacostia, D.C.
71.5 „	NPL	U.S. Training Ship, San Diego, Calif.
71.25 „	NKF	Bellevue, Anacostia, D.C. (Météo Angot 0330–0345 G.M.T.)
71.5 „	NKF	Bellevue, Anacostia, D.C.
71.7 „	NPL	San Diego, Calif.
74.0 „	WIR	New Brunswick, N.J.
75.0 „	SFR	Paris.
75.0 „	WGN	Rocky Point, Long Island, N.Y.
75.0 „	NUQB	U.S. s/s. "Pope."
75.0 „	NIRX	U.S. s/s. "Canopus."
76.0 „	POX	Nauen.
76.0 „	NAJ	Great Lakes, Ill.
77.4 „	NFV	Quantico, Va.
77.5 „	NFV	U.S. Marine Corps, Quantico, Va.
80.0 „	NEL	Lakehurst, N.J.
81.0 „	NPG	San Francisco, Calif.
81.5 „	NKF	Bellevue, D.C.
83.0 „	RDW	Moscow.
84.0 „	NKF	Anacostia, D.C.
85.0 „	SFR	Paris.
85.0 „	8CB	Paris.
86.0 „	NQC	San Diego, Calif.
86.0 „	WIR	New Brunswick, N.J.
90.0 „	6XO	Kahuku, Hawaii.
90.0 „	KIO	Kahuku, Hawaii.
90.0 „	1XAO	Belfast, Maine.
92.0 „	2YT	Poldhu.
94.0 „	2YT	Poldhu.
95.0 „	KEL	Bolinas, Calif.
95.0 „	SFR	Paris.
96.0 „	8XS	East Pittsburg, Pa.
99.0 „	6XI	Bolinas, Calif.
100.0 „	—	New Orleans, La.
100.0 „	POX	Nauen.
100.0 „	2XI	Schenectady, N.Y.
100.0 metres.	NAM	Norfolk, Va.
103.0 „	WGH	Tuckerton, N.J.
105.0 „	WHU	U.S. s/s. "Big Bill."
107.0 „	2XI	Schenectady, N.Y.
112.0 „	1XAO	Belfast, Maine.
115.0 „	FL	Eiffel Tower, Paris.
119–149 „	NDF	U.S. s/s. "West Virginia."
119–149 „	NEDJ	U.S. s/s. "California."
120.0 „	1XAO	Belfast, Maine.
133.0 „	WDYC	Detroit, Mich.
135.0 „	WJF	Rochester, N.Y.
137.0 „	WHC	Allentown, Pa.
137.0 „	WBI	Frackville, Pa.
137.0 „	WCJ	Hazleton, Pa.
137.0 „	WPH	Williamsport, Pa.
137.0 „	WLF	Wilsonville, Pa.
137.0 „	WDS	Pottsville, Pa.
140.0 „	KDC	Casper, Wyoming.
140.0 „	KFWR	S. Benito, Tex.
140.0 „	KFWS	Brownsville, Tex.
140.0 „	WGF	Flint, Mich.
140.0 „	WAV	Dearbon, Mich.
140.0 „	WDY	Iron Mountain, Mich.
142.0 „	WJBF	Charleroi, Pa.
143.0 „	KGA	Oakland, Calif.
143.0 „	KTA	San Francisco, Calif.
143.0 „	WEQ	Baltimore, Maryland.
143.0 „	WAV	Dearbon, Mich.
143.0 „	WWEE	Marquette Light Station, Mich.
143.0 „	WWED	Stannard Rock Light Station.
143.0 „	WJH	Washington WJH, D.C.
143.0 „	WJX	Washington WJX, D.C.
145.0 „	WWEB	Duluth Range Rear Light Stn. Minn.
145.0 „	WJF	Rochester, N.Y.
145.0 „	WWEC	Superior Entry Light Stn., Wis
146.0 „	KFV	Los Angeles, Calif
146.0 „	KFZ	Los Angeles, Calif.
146.0 „	KGV	Los Angeles, Calif
146.0 „	KYI	Culver City, Calif.
146.0 „	KYJ	Culver City, Calif.
146.0 „	KYX	Los Angeles, Calif.
146.0 „	KYY	Los Angeles, Calif.
146.0 „	KYZ	Culver City, Calif.
146.0 „	WEY	Boston, WEY Mass.
146.0 „	KZI	Hollywood, Calif.
146.0 „	KJU	Culver City, Calif.
146.0 „	KVP	Dallas. KVP, Texas.
146.0 „	6XO	Kahuku, Hawaii.
150.0 „	NITZ	U.S. s/s. "Sturgeon Bay."
200.0 „	KPN	Isabela di Basila, Philippine Islands.
202.3 „	WBAK	Harrisburg, Pa.
202.6 „	WDX	Wyoming, Pa.
202.6 „	WBR	Butler, Pa.

Piezo-Electric VIBRATIONS IN QUARTZ CRYSTALS.

A Visual Method of Observing Nodes and Anti-nodes.

By Dr. H. KRÖNCKE.

AT a recent meeting of the "Deutschen physikalischen Gesellschaft" ("The German Physical Society"), Dr. Giebe and Dr. Scheibe gave a striking demonstration of a simple method whereby the oscillations of piezo-electric crystals can be rendered visible. Readers are already aware that mechanical vibrations can be set up in a quartz crystal, under the

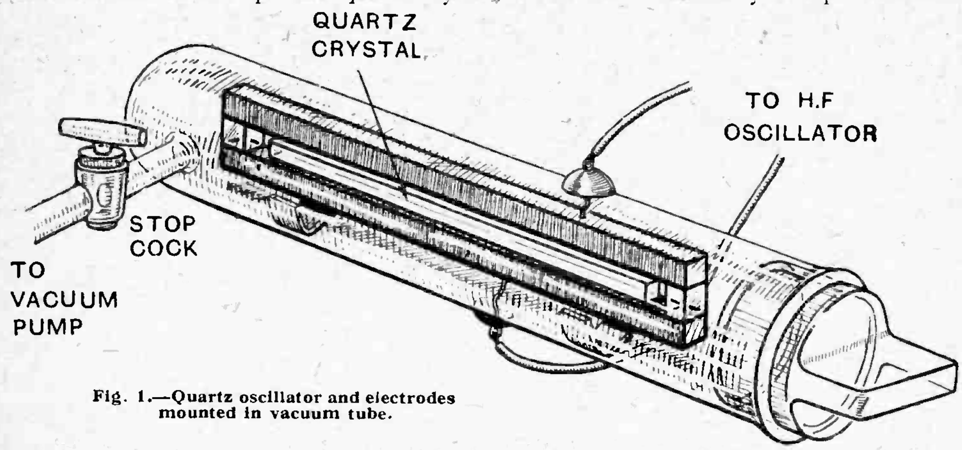

Fig. 1.—Quartz oscillator and electrodes mounted in vacuum tube.

influence of sufficiently high tension electrical oscillations. These oscillations, in turn, set up electrical oscillations in the quartz crystal, which may assume very high values if the vibrations of the crystal are of large amplitude.

Unfortunately, the occurrence of these vibrations cannot be observed with the naked eye. Giebe and Scheibe, however, have obtained evidence of their existence in a simple manner by placing the whole arrangement, consisting of quartz crystal and electrodes, in a glass tube, in

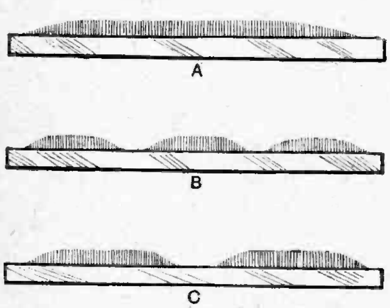

Fig. 2.—Appearance of the luminous discharge on the surface of the quartz crystal: A, at the fundamental frequency; B, at the third harmonic; C, at the second harmonic with the system of electrodes shown in Fig. 3.

which the pressure was reduced by means of an air pump to a few millimeters of mercury. In rarefied air, clearly visible discharge phenomena are obtained on the upper surface of the crystal, under the influence of relatively small electric stresses.

The dimensions of the crystal used by Giebe and Scheibe were 10cm. × 3cm. × 1.5cm. The fundamental frequency of the crystal was of the order of 20,000 per second. The crystal was placed on a narrow metal surface, which was a little longer than the crystal and of the same width, and mounted directly above the upper side of the crystal was a second electrode of similar dimensions. High-frequency alternating current for a valve transmitter was applied to both electrodes, the transmitter being fitted with a 25-watt valve supplied with high tension current at 600 volts. In consequence of the extraordinarily sharp resonance of the piezo-electric oscillations, special devices are necessary, in order to facilitate the tuning of the valve transmitter to the natural frequency of the crystal. This requires a vernier condenser of small capacity, so that really sharp tuning may be obtained. When the frequency of the valve transmitter corresponds with the fundamental frequency of the quartz crystal a phenomenon of light takes place, somewhat as illustrated in Fig. 2, A. If the frequency of the valve transmitter is trebled, the quartz crystal vibrates at the third upper harmonic, and the discharge has the appearance shown in Fig. 2, B. Similarly, one can also render visible the 5th, 7th, and higher upper harmonics. Giebe and Scheibe have succeeded in observing even the 15th upper harmonic of a quartz crystal 10cm. long.

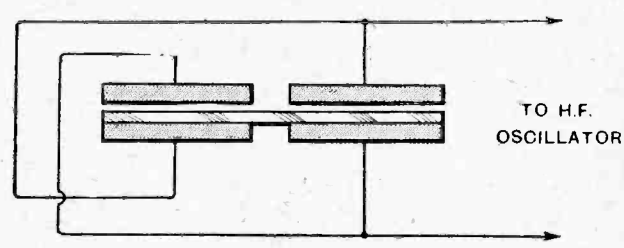

Fig. 3.—Arrangement and connections of electrodes to produce even-numbered harmonics.

With the arrangement of electrodes described, the quartz crystal can only oscillate at the fundamental oscillation or an odd-numbered upper harmonic. It is possible, however, by a slight alteration of the electrode arrangement, to produce and make visible also the 2nd, 4th, and other even-numbered upper harmonics. For this purpose the electrodes are divided, as shown diagrammatically in Fig. 3, and are connected diagonally. The phenomenon of light with the second upper harmonic is shown in Fig. 2, C.

Since the phenomena can be so easily observed, they will no doubt contribute considerably to the use of piezo-crystals as frequency standards.

HINTS and TIPS for NEW READERS

A Section Devoted to the Practical Assistance of the Beginner.

A SIMPLE REFLEX CIRCUIT.

In Fig. 1 is shown what is probably the simplest "dual amplification" or reflex circuit. There is only one tuning control, and, considering the ease of both assembling and operation, the arrangement is capable of giving extremely good results. Due to the effect of the reaction coil, the damping of the grid circuit is reduced, and amplified H.F. voltages are applied to the crystal for rectification. The

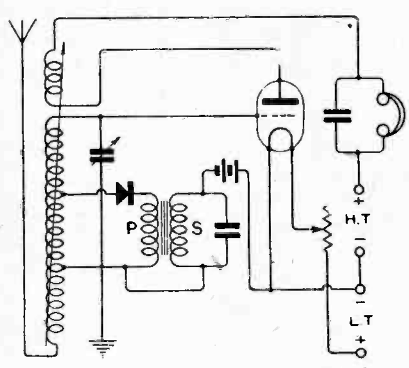

Fig. 1.—A "single tuning control" reflex.

rectified pulses are passed through the primary winding (P) of the L.F. transformer, are stepped up, applied across the grid-filament circuit of the valve, and again amplified.

The main inductance coil may have about eighty turns, 3in. diameter, of fairly heavy wire, the top end of which is connected to the grid. A tapping for the crystal is made at the forty-fifth turn down, and another for connection to earth at the sixty-fifth turn. The aerial is joined to the end of the lower section of the winding, which has about twelve to fifteen turns. The reaction coil may have some thirty or forty turns of finer wire, and is variably coupled to the grid end of the main inductance. The prospective constructor will find that some of the parts of a disused variometer (tubular type) may be adapted for use here.

The grid return circuit is completed through a biasing battery, while the secondary of the L.F. transformer is shunted by a small fixed condenser to bye-pass high-frequency currents. The value of this condenser will depend to a great extent on the type of transformer used, and should generally not be larger than 0.0003 mfd.

Success with this circuit, as with all other reflex receivers of similar type, depends largely on the use of suitable values of components and on the application of a sufficient high-tension voltage.

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RESISTANCE-COUPLED VOLTAGE AMPLIFICATION.

Considerable interest has been shown in the method of voltage amplification described in *The Wireless World* for September 23rd, 1925. Briefly, the novelty of the arrangement may be said to lie in the fact that the anode resistances employed have a very much higher value than those used in ordinary amplifiers, with the result that the grid volts-anode current characteristic curve of the valve is flattened out. Not the least of the advantages claimed for the scheme is that the consumption of anode current is almost negligible, and that, on account of the small emission necessary, the filament may be run at a very low temperature, giving the valve a long life with economy in operation.

Many readers seem to be under the impression that special valves are necessary, but it may be pointed out that most high-amplification British valves are capable of giving good results.

It is hoped that the following hints will be of assistance to the amateur who may wish to construct an amplifier on this principle.

The circuit shown in Fig. 2 was used for tests, and was arrived at after trying out various standard British valves and components; the values given are rather different from those specified in the original

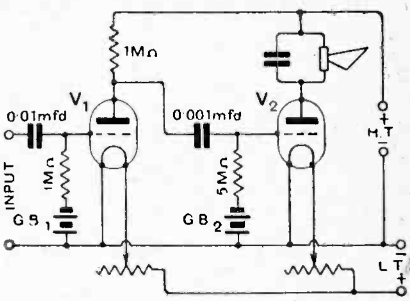


Fig. 2.—L.F. amplifier circuit with high anode resistance.

article, but were chosen as being readily obtainable. The anode voltage was kept constant at 120 volts, and a small power valve was used in the second position (V.2) with a grid bias of 6 volts. The question of grid bias on the first amplifying valve, V.1, is of some importance; it was found that if a general-purpose valve, such as the D.E.R., was used a pressure of seven or eight volts was necessary, while with a high-impedance valve in this position some one or two volts were sufficient. Generally speaking, the lower the filament temperature the more critical and important becomes the adjustment of bias from the point of view both of quality and volume.

The anode resistor should be of the best quality obtainable, and must be capable of carrying the small current flowing through it without serious change of resistance or the production of noise. Good insulation throughout is of greater importance in the case of this amplifier than in that of more conventional instruments, and special attention should be paid to this point.

It would seem certain that the degree of amplification obtainable, using such valves as the D.E.Q., D.E.5B., or S.P.18 (Green Spot) valves, is at least as great as that to be expected from the usual resistance- or choke-coupled amplifier, with extremely good quality and economy both in first cost and operation.

As was to be expected, the loudest signals were obtained when a four-electrode valve (D.E.7) was used, with the input connected across its inner grid and filament, and with 24 volts H.T. on the outer grid. The values of condensers and resistances were as given in Fig. 2, with 120 volts high tension. This valve was found to require nearly its full rated filament current, and a grid bias of some six volts. All adjustments were fairly critical.

AN INEXPENSIVE WAVEMETER.

Every user of a valve receiver will often have felt the need of a wavemeter to help him to tune in to a given wavelength. This is particularly desirable where the set has more than two tuning adjustments. Plain heterodyne wavemeters radiating pure C.W. are of little use in this case, as, unless the receiver is itself oscillating, the radiation will not be heard.

The continuous waves emitted by a valve oscillator may be "broken up" by a buzzer, or the same effect may be obtained by inserting a condenser in the grid circuit, with a shunting resistance of such a value that this condenser discharges at audible frequency when the valve is oscillating.

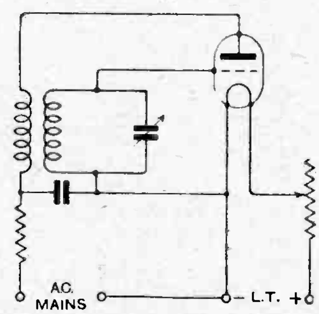


Fig. 3.—Wavemeter with A.C. anode supply.

A good arrangement is provided by the connection of a vibrating buzzer in such a manner as to vary the grid potential of the valve when the armature makes contact.

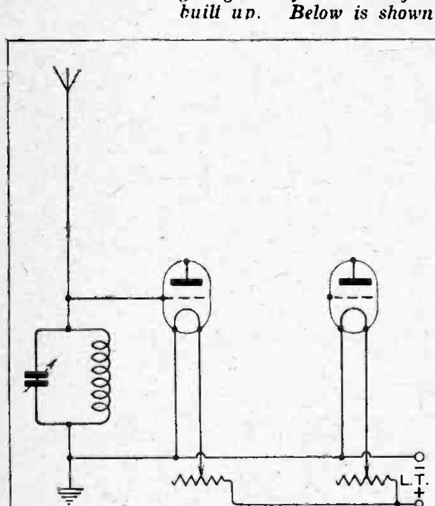
Another practical arrangement is shown in Fig. 3. In this case the anode current is supplied from A.C. lighting mains. As the valve will only oscillate when the plate is made positive, a note corresponding to the periodicity of the supply will be heard in the telephones. It is not suggested that this instrument is suitable for laboratory work, as the emitted wave will be rather "broad," but for many purposes such a wavemeter will be found very convenient.

If a suitable dull emitter valve is used, the meter may be made up in quite a small case, which could also contain a dry battery for heating the filament. A length of flexible wire fitted with an adaptor should be provided to enable easy connection to be made with a lamp socket. To prevent the application of too high an anode voltage to the valve, a resistance is included in this circuit; this should have a value of about 50,000 ohms. It will be noticed that a condenser (1 mfd.) is connected across both the resistance and the supply mains.

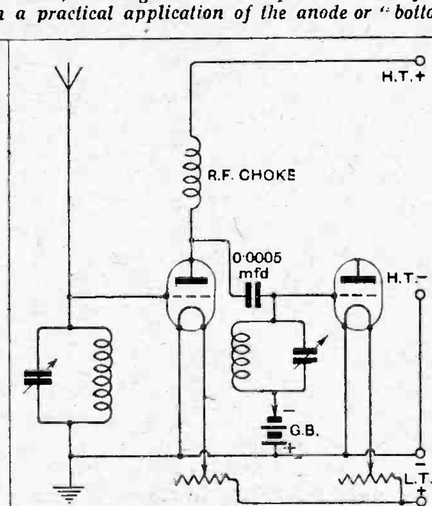
DISSECTED DIAGRAMS.

No. 11.—A "Tuned Grid" H.F. Amplifier with Anode Rectification.

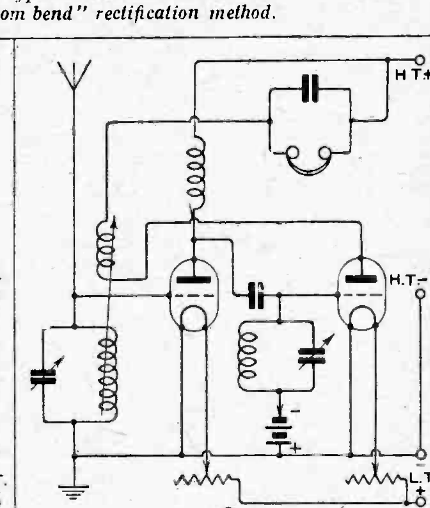
For the benefit of those who have not yet acquired the simple art of reading circuit diagrams, we are giving weekly a series of sketches, showing how the complete circuits of typical wireless receivers are built up. Below is shown a practical application of the anode or "bottom bend" rectification method.



H.F. and detector valves, with filaments in parallel across an L.T. battery, with controlling rheostats. An oscillatory circuit, with aerial and earth, is connected between grid and filament.



An H.F. choke is connected between plate and H.T. battery, amplified currents being thus deflected into the tuned grid circuit. The fixed condenser merely insulates the grid from the H.T. battery.



The grid battery is adjusted to a suitable value for operating on the "bottom bend." The anode circuit is completed through a variable reaction coil, phones, and H.T. battery.

BROADCAST BREVITIES

By OUR SPECIAL CORRESPONDENT.

Daventry Frozen Out.

Daventry has had a spell of misfortune recently. First of all, during the recent frosts the aerial developed a coating of ice which in places was seven-sixteenths of an inch thick. The great weight, combined with the contraction of the wires through the intense cold, caused the aerial to break. The down lead ripped up in falling and the wires lashed back on the mast.

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A Temporary Aerial.

A single-wire aerial was put up in haste to the top of one mast and fastened at the other end to the roof of the power-house. This served temporarily until the wire could be run half-way up the second mast. When daylight came the wire was run to the top of the mast and transmissions were conducted with somewhat reduced signal strength.

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Out of Action Again.

The single-wire aerial served for a week; but before the new aerial was completed and ready to be brought into service the single wire one evening became red-hot and the station was closed down while another wire was run in parallel. Some encroachment occurred on the time schedule of that delightful Gather-round entertainment over which Mr. Morris Harvey presided; but the break was justified by the noticeable increase in signal strength when 5XX was once more in action.

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A Retrospective Evening.

On the last day of 1925 the programme will take the form of a review of the outstanding events in the wireless programmes throughout the year. This should serve the double purpose of providing an entertaining evening's programme and of enabling listeners to gather up the threads of all the achievements in the realms of music, comedy and drama broadcast during the year, and to realise something of the complexity of the endeavour to appeal to so many widely differing individual tastes.

Broadcasting the New Year in.

At 11.30 p.m. the Wireless Chorus will broadcast seasonable carols, which will be followed at 11.45 p.m. by a New Year's message by Dr. Archibald Fleming. Actually the old year will be rung out and the new year welcomed at the Royal Albert Hall, where a Happy New Year Ball is being held in aid of the Middlesex Hospital and the British Empire Service League.

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Stars of the Ether.

To return to the review of the year. This will show that such variety stars as Sir Harry Lauder, George Robey, Billy Merson, George Graves, Wilkie Bard, Milton Hayes, Bransby Williams, Ella Shields and Marie Dainton have appeared before the microphone. The stage stars have included Dame Ellen Terry, Henry Ainley, Gladys Cooper, Robert Loraine, Gertrude Elliott, Mrs. Kendal, Lady Tree, Sir Johnston Forbes-Robertson and many others.

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Concert Artists who have Broadcast.

The concert stars are still more numerous. They include Paderewski, Tetrazzini, Chaliapine, Dame Clara Butt, Ysaye, Kirkby Lunn, Albert Sammons and Moiseiwitsch. The music-hall stars in the 1925 broadcasts number, among others, José Collins, Leslie Henson, Dorothy Dickson, Jack Hulbert, Nelson Keys and Jack Buchanan.

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Changes in Time Signal Broadcasts.

The time signal system has been revised and put on a more definite basis than heretofore. In future the schedule which will be rigidly adhered to, will be as follows: 10.30 a.m., from 5XX every day; 1.0 p.m., from 5XX and 2LO all days except Sundays; 4.0 p.m. from 5XX and 2LO every day; and 10.0 p.m. from all stations every day.

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Big Ben.

In addition, Big Ben will be broadcast if convenient, as follows:—3.30 p.m. on Sundays only, and at end of Sunday afternoon and evening programmes; 5.15 p.m. and 6.0 p.m. from 5XX and 2LO on week-days; 7.0 p.m. from all stations on week-days; and 8.0 p.m. from 2LO and any other station which is taking a simultaneous broadcast on week-days. It should be noted that the 5.15, 6.0 and 8.0 o'clock broadcasts of Big Ben will not be put out if the programme arrangements are inconvenient.

IN SUNNY SPAIN. A corner of the studio of the Bilbao broadcasting station. Note the indicators behind the microphone and over the piano, by means of which the engineers communicate instructions to the artistes and announcer.

Broadcasting in Ireland.

It is understood that the Free State Government intend to base their broadcasting system on that in force in Norway and that small relay stations of 50 to 100 watts will generally be employed. The decision is based on the assumption that the number of licences to be expected is so small that bigger stations are not at present justified.

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The Copyright Question.

In his memorandum of information submitted as evidence to the Committee on Broadcasting, the Managing Director of the B.B.C. remarked on the question of copyright, that it would be necessary to secure protection in some measure against exorbitant demands, as at present no scale is fixed, and copyright owners, or commercial organisations acting on their behalf, can increase their demands yearly to an extent impossible to meet. It is of interest to note in this connection that the copyright fees paid by the B.B.C. are estimated to work out at four shillings per station for each dance item that is broadcast and five shillings per station for every other musical item. Relay stations are omitted. If, therefore, 100 copyright dance items are transmitted in the course of a week, the expenditure under this head alone is approximately £20 a week.

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Open to Question.

There seems to be a good deal of circumstantial evidence against the genuineness of some of the letters complaining about items in the broadcast programmes. One "correspondent" said that on account of the objectionable nature of the programmes he wanted to sell his five-valve set and buy a gramophone. A reader of the paper which published the statement immediately tried, through the paper in question, to get in touch with him, but the offer to negotiate with a view to purchase was ignored.

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On the Track.

And the same paper rendered a disservice to the correspondent whose letter it published, in which he averred that as a protest against a programme he oscillated. The Post Office is now on his trail.

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A Boxing Broadcast.

January 20th, and not the 13th, as announced elsewhere, will be the date of a broadcast of a boxing tournament to be transmitted from the studio at 2LO. Mr. Donald Calthorp is making the necessary arrangements for this replica of a night at the National Sporting Club in co-operation with Mr. Harry Preston and Mr. Eugene Corri, probably the two best known of ringside celebrities in the British Isles. The support of those great patrons of ringcraft, Lord Lonsdale and Sir Claude Champion de Crespigny is also being sought. The boxing events, as overheard by listeners, will be as realistic as they can be made by radio telephony, and the sounds associated with such sporting events will be faithfully conveyed.

FUTURE FEATURES.

Sunday, December 27th.

LONDON.—3.30 p.m., Christmas Oratorio (Bach).

BIRMINGHAM.—9.20 p.m., Orchestral Concert.

MANCHESTER.—9.15 p.m., Special Concert relayed from Hotel Majestic, St. Anne's-on-the-Sea.

NEWCASTLE.—9.15 p.m., Pianoforte Recital by Leff Pouishnoff.

GLASGOW.—9.15 p.m., Recital of Christmas Music.

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Monday, December 28th.

BIRMINGHAM.—7.30 p.m., Mendelssohn's Oratorio "St. Paul."

ABERDEEN.—9 p.m., Choral Excerpts.

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Tuesday, December 29th.

LONDON.—8 p.m., The Offenbach Follies.

MANCHESTER.—8 p.m., A Welsh Night.

BELFAST.—8 p.m., Old Memories.

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Wednesday, December 30th.

CARDIFF.—8 p.m., "In the Gloaming."

NEWCASTLE.—8 p.m., Mirth and Melody, including the "Vicar of Mirth."

GLASGOW.—8 p.m., Scottish Composers.

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Thursday, December 31st.

LONDON.—8 p.m., A Review of 1925. 11.45 p.m., A New Year's Message by Dr. Archibald Fleming.

BIRMINGHAM AND 5XX.—8 p.m., Radio Fantasy No. 11. 9 p.m., A Cameo of the Court of St. James's.

BOURNEMOUTH.—8 p.m., The Wireless Christy Minstrels.

ABERDEEN.—8 p.m., A Scottish Programme.

BELFAST.—8 p.m., Hogmanay.

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Friday, January 1st.

LONDON.—8 p.m., "The New Year"—A Fantastic Forecast.

CARDIFF.—8 p.m., A Phantom Pantomime.

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Saturday, January 2nd.

LONDON.—8 p.m., A Gather-round.

BOURNEMOUTH.—8 p.m., More Tit-Bits.

MANCHESTER.—8 p.m., "The Son and Heir" Play in four Acts by Gladys Unger.

How it is Done.

By the way, I have had a number of inquiries as to the method by which the realistic sounds of a lift ascending and descending and the clanging of the gates was obtained in the broadcasting of "The Mayfair Mystery." The implements used were a whistle (the official responsible for noises at Savoy Hill obtaining a whirring noise by placing the whistle to his lips and exhaling deep breaths), a brass rod, some chains and one cymbal. Listeners with an experimental turn of mind should try this stunt for themselves.

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Talks from the Microphone.

The suggestion has been made that a system should be adopted under which the B.B.C. would guarantee to divide their programmes into a certain proportion with the idea of preventing any tendency to include too many talks, lectures, and other educational subjects.

With this object in view an interesting analysis has been made of an average day's programme, from which it was shown that talks are by no means preponderant. It was found that music occupied 71½ per cent. of the time, Children's Corner 8 per cent., News 4 per cent., and Talks 16½ per cent.

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The Radio Revel.

All over the country on the night of December 15th and well into the morning of the 16th, thousands gathered to celebrate the first Radio Revel. London's carnival was held at Olympia, where dancing continued from 9.30 p.m. until the singing of "Auld Lang Syne" at 4.30 a.m. Continental stations were relayed at intervals to vary the lavish programmes provided by the different bands in the hall.

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European Programmes Relayed.

The first of the relayed programmes came through soon after 11 o'clock, when a tango was picked up from San Sebastian. This was followed by a triumph in relay broadcasting, the strains of "The Merry Widow" being heard from the Berlin station with a clarity and precision that set the whole gathering dancing. Other relayed transmissions, also astonishingly clear, came from Berne, in Switzerland, and Hilversum, in Holland.

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In the Provinces.

The popularity of Radio Revels Night was signalised by remarkable scenes in the provinces. At Manchester the fête in the Bell Vue Gardens was attended by at least 2,000 persons. More than 500 were present in the King's Hall, Stoke-on-Trent, where a special prize was given for the best representation of the Potteries district.

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Proceeds to the Hospitals.

The financial proceeds of the Radio Revels in every town were shared between the "Daily News" Wireless Fund for Hospitals and similar charitable objects.

DICTIONARY OF TECHNICAL TERMS

Definitions of Terms and Expressions commonly used in Wireless Telegraphy and Telephony.

This section is being continued week by week and will form an authoritative work of reference.

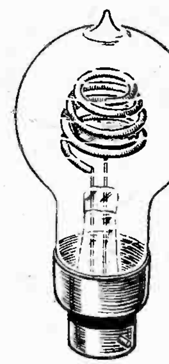
Negative Pole. In any piece of apparatus, the pole which is at a negative potential relatively to the other pole, and therefore in a generator or cell, the negative pole is the one through which the current enters the cell or generator, whereas in the case of a piece of apparatus which absorbs electrical energy the negative pole is the one by means of which the current leaves.

Negative Resistance. A piece of electrical apparatus is said to have a "negative resistance" if the voltage falls as the current increases. This property is possessed by an arc and by various other apparatus. Any device possessing negative resistance is capable of producing electrical oscillations.

Negatron. A special kind of *thermionic tube* having four *electrodes*, there being two plates. So named because a *negative resistance* effect is produced. Cf. FOUR-ELECTRODE VALVE.

Neon Lamp or Neon Tube. A glass bulb or tube enclosing two metal electrodes and filled with the rare gas neon at reduced pressure. When a suitable P.D. is applied to the electrodes a discharge takes place through the gas and the whole of the negative electrode or cathode becomes coated with a luminous glow.

The neon tube has several properties which make its application to wireless and kindred subjects quite important. No current will flow through a neon tube until the P.D. between the electrodes reaches a certain definite value, and therefore if such a tube is connected in series with a high resistance and is *shunted* by a condenser, and a fairly high potential difference is applied to the ends of the circuit, the condenser will gradually be charged up through the resistance until the critical starting voltage of the tube is reached and the cathode suddenly begins to glow. Immediately this occurs the condenser becomes shunted by a comparatively low resistance—that of the tube when glowing, and therefore begins to discharge itself through the tube. Now the glow does not cease until the voltage has fallen to a value considerably below the critical starting voltage, but immediately the discharge does cease, the condenser begins to charge up again, and the same process is



Neon lamp.

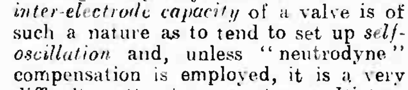
repeated over and over again. Thus an intermittent current is produced by the arrangement, and can be put to a number of uses in connection with wireless measurements, etc.

Neon tubes can also be employed for recording purposes in connection with three-electrode valves, for modulating the high-frequency oscillations in wireless telephony transmission, etc., etc.

Neutrodyne Receiver. A special form of high-frequency valve amplifier and detector in which the stray capacity coupling between the electrodes of the valves is neutralised by low-capacity couplings connected between the grids and suitable points on the windings of the high-frequency transformers. The *inter-electrode capacity* of a valve is of such a nature as to tend to set up *self-oscillation* and, unless "neutrodyne" compensation is employed, it is a very difficult matter to prevent a *multistage* high-frequency amplifier from breaking into self-oscillation. The system is due to Professor Hazeltine, of America.

Nichrome Wire. Wire made of nickel-chromium-steel alloy and capable of withstanding a bright red heat in the atmosphere without oxidising.

Nodes and Loops. Where stationary electric waves are produced along a wire, the points on the wire where



Voltage nodes N_1, N_2, etc., and antinodes or loops L_1, L_2, etc., of stationary electric waves on a straight wire.

the voltage is always zero are called "voltage nodes," and the intermediate points where the voltage is greatest are called "antinodes" or "loops."

Nodon Valve. The name given to an electrolytic rectifier, *i.e.*, an electrolytic cell which will only allow current to pass one way through it. The cathode consists of an aluminium rod immersed in a solution of ammonium phosphate. The anode is usually of lead and sometimes forms the containing vessel for the liquid. When any current commences to flow from the aluminium to the lead a thin coating of oxide is formed over the surface of the aluminium, and as this is an insulator the current is immediately stopped. When the applied potential is reversed so as to drive the current the other way through the cell the coating of oxide is immediately decomposed and the current is allowed to flow freely. Thus if an alternating voltage is applied to such a cell current will flow in one direction only through it, and therefore such an arrangement can be used for charging accumulators from the alternating current mains. Cf. MECHANICAL RECTIFIER.

Non-conductor. Another term for *insulator*.

Non-inductive Circuit. A circuit in which the *inductance* is so small compared with the resistance that it can be neglected. No circuit is quite free from inductance.

Non-inductive Resistance. A *resistance* which is designed to have as low a value of inductance as possible. No resistance is quite free from inductance.

Note Amplifier or Note Magnifier. See LOW-FREQUENCY AMPLIFIER.

Null Method. An electrical test or measurement in which an adjustment is made so that zero deflection is obtained in a galvanometer, such as when using a *Wheatstone bridge* or *potentiometer*. Sometimes called a "zero method."

O.

Ohm. The practical unit of *resistance*. For definition see RESISTANCE.

Ohmic Resistance. The true *resistance* of a circuit, *i.e.*, the resistance offered to an unvarying current, as opposed to

Dictionary of Technical Terms.—
the *apparent resistance* offered to an alternating current.

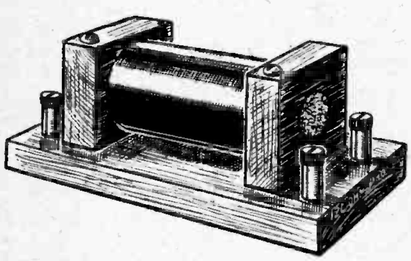
Ohm's Law. For an unvarying current flowing through a *resistance* the value of the current is directly proportional to the applied electromotive force and inversely proportional to the resistance. In the practical system of units the current in *amperes* is equal to the E.M.F. in *volts* divided by the resistance in *ohms*; or I=E/R, where I is the current, E is the voltage, and R is the resistance.

Ondameter. Another name for *wavemeter*.

Open Circuit. A circuit in which a temporary break is made so that no current can flow. A battery of cells or a dynamo is said to be on open circuit when the external circuit is disconnected.

Open Circuit Characteristic. The curve showing the relation between the voltage and field current of a dynamo when not supplying any current.

Open Core Transformer. A *transformer* in which part only of the *magnetic circuit* consists of iron, usually the central part which traverses the centre of the coils.



Open core telephone transformer.

Oscillating Circuit or Oscillatory Circuit. A circuit containing *inductance* and *capacity* and whose *resistance* is sufficiently low to allow the current to have a *natural period* of oscillation. The necessary condition is that R^2C must be less than 4L, where R is the resistance in ohms, C is the capacity in farads and L is the inductance in henries.

Oscillating Component. In some circuits, such, for instance, as the plate circuit of a valve when signals are being received, both a *direct current* and an *alternating current* are flowing at the same time, the resultant current being a unidirectional pulsating one whose value is at every instant equal to the sum of the individual currents. The alternating part of this current considered alone is called the "oscillating component."

Oscillating Current or Oscillatory Current. A *high-frequency* current in an *oscillating circuit*, its frequency being equal to the *natural frequency* of the circuit.

Oscillation Constant. The *natural frequency* of a circuit containing inductance and capacity is given by $f = \frac{1}{2\pi\sqrt{LC}}$, where L is the inductance in henries, and C is the capacity in farads. The quantity $\sqrt{LC}$ is called the "oscillation constant" of the circuit as the frequency depends on this alone (apart from the negligible effect of resistance).

Oscillation Transformer. An *air-core transformer* for transferring high-frequency oscillations from one circuit to another, one or both of the windings being *tuned* to the frequency of the oscillations; *e.g.*, the transformer used for coupling the oscillator of a transmitting set to the aerial.

Oscillations (electrical). The high-frequency alternating current which surges backwards and forwards round a closed *oscillatory circuit*. These oscillations may be continuous if the losses are compensated for from some suitable source of energy, such, for instance, as a *three-electrode valve* connected in the proper manner to the oscillating circuit, in which case the oscillations are said to be "undamped." If the losses are not compensated for the oscillations rapidly die out and are said to be "damped." See DAMPED OSCILLATIONS and UNDAMPED OSCILLATIONS.

Oscillation Valve. The name applied to any piece of apparatus which allows current to flow through it in one direction only, *i.e.*, anything which acts as an electrical valve. The two-electrode *thermionic valve* of Fleming is an example. When an alternating potential difference is applied between the electrodes a unidirectional current flows through the valve, which therefore acts as a *rectifier*.

Oscillator. An apparatus for producing electrical *oscillations* such as a *three-electrode valve* when operated in conjunction with a suitable circuit to produce *oscillations*. See SEPARATE HETERODYNE.

Oscillator Valve. That *thermionic valve* in a transmitting set which actually produces the oscillations being put into the aerial. Cf. MODULATOR VALVE.

Oscillograph. A laboratory instrument for taking a photographic record of the wave shape of an alternating current or the manner in which any other rapidly varying current or voltage changes. See CATHODE RAY OSCILLOGRAPH.

Osglim Lamp. The registered trade name of a form of *neon tube* made for purposes of advertisement, decoration, etc., the cathode being in the form of letters of the alphabet, numerals, etc.

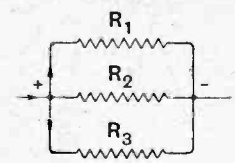
Out of Phase. Two *alternating quantities* of equal frequency are said to be "out of phase" when they are not in step, *i.e.*, when they do not pass through their respective positive maximum values at the same instants. Cf. IN PHASE and see PHASE DIFFERENCE.

Overlap. In a valve circuit where *reaction* is used it is sometimes found that as the reaction control knob is turned gradually to increase the reaction, powerful *self-oscillation* will suddenly commence and the control knob has to be turned a considerable distance back before the oscillation will cease, *i.e.*, there is what may be termed a certain amount of "back-lash." This unsatisfactory state of affairs is known as "overlap" and is usually due to the use of unsuitable voltages on the grid and plate, or to the use of a *grid leak* of the wrong value, or due to all three causes simultaneously.

P.

Pancake Coil. A flat coil such as a *basket coil* or a *slab coil*.

Parallel Connection. The arrangement of resistances, cells, lamps, or any other electrical apparatus in a circuit in a manner that the current divides between them and they all have the same potential difference across their terminals, *i.e.*, when all the positive terminals are joined together and all the negative terminals are joined together. In the particular case where two resistances are connected in parallel the one is said to be "in shunt" with the other. For resistances in parallel the reciprocal of the resultant resistance is equal to the sum of the reciprocals of the individual resistances. Cf. CONDUCTANCE.



Resistances in parallel.

P.D. Abbreviation for *potential difference*.

Peanut Valve. A three-electrode *thermionic valve* of very small dimensions and requiring very low filament current and plate voltage. The advantage of such valves is for use on portable receivers so that heavy batteries need not be carried.

Peanut valve.

Peak Value. Another term for the *amplitude* or maximum value of an *alternating quantity*. The term "peak voltage" is very commonly used.

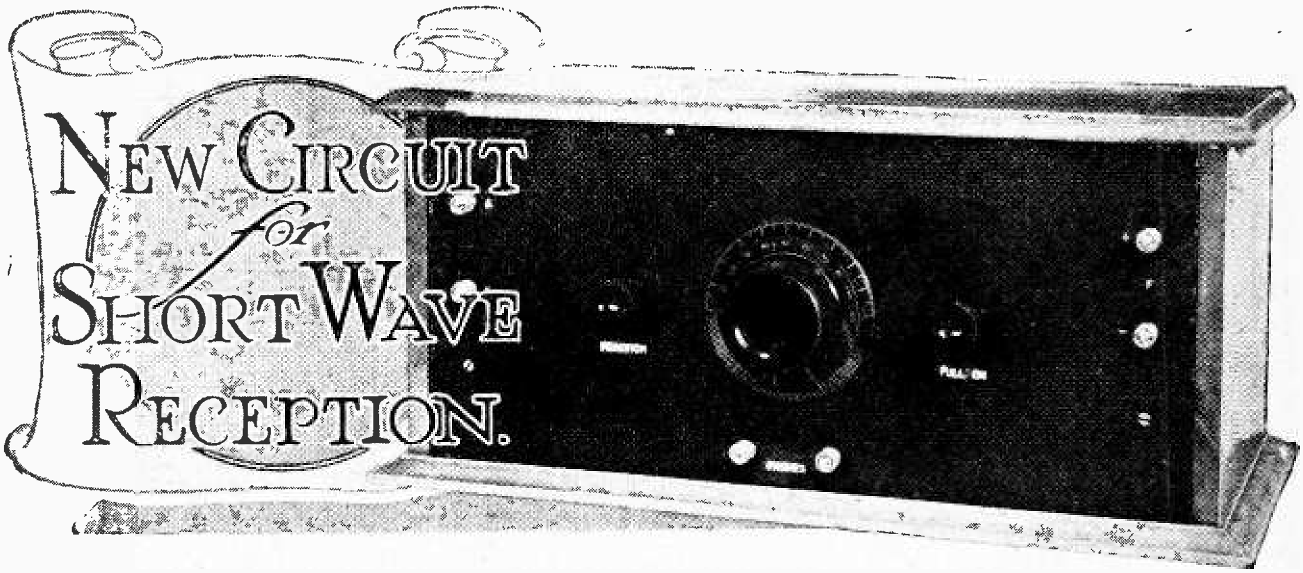
Percentage Coupling. The *coefficient of coupling* expressed as a percentage.

Perfect Rectifier. A *rectifier* in which no current whatever can flow in the reverse direction such as a two-electrode thermionic valve with a very high vacuum.

Perikon Detector. A crystal detector in which contact is made between two crystals, usually *zincite* and *bornite*.

Period. The time in seconds of one complete *cycle* of an alternating quantity. See ALTERNATING CURRENT.

Periodicity. A term sometimes used to denote the *frequency* of an alternating current, voltage, etc., *i.e.*, the number of *periods* that make up one second.



New Circuit for Short Wave Reception.

Reaction Controlled by Variable Resistance.

By A. P. CASTELLAIN, B.Sc., D.I.C., and C. M. BENHAM, B.Sc., A.C.G.I.

MANY readers no doubt know, to their cost, the difference between receiving Morse signals and telephony on short waves, and the reason is not far to seek.

For Morse signals the heterodyne method is employed —*i.e.*, the detector valve is oscillating and producing beats with the incoming signal at audible frequencies, the beats being heard in the telephones.

The signals can be read if these beats vary in frequency between about 50 and 3,000 cycles per second, so that it does not matter very much if the beat note varies between these limits during the signal.

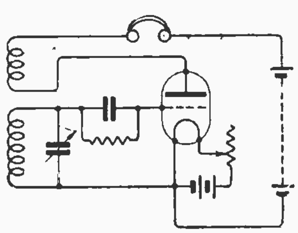


Fig. 1.—Simple detector valve with reaction.

Small changes of the capacity in parallel with the tuning coil, such as are caused by a swaying aerial or often by movement of the hands on the controls, will naturally alter the frequency at which the detector valve is oscillating, and thus alter the frequency of the beat note.

For telephony, on the other hand, it is highly desirable that the detector valve be just not oscillating and also that the receiver tuning does not vary with the position of the operator or swaying of the aerial—it is none too easy to understand weak telephony with a loud and variable howl attached, which is the case with most sets if the detector valve is oscillating.

Suppose we take the usual short-wave set employing a normal coil reaction circuit (o-v-1) and see how it behaves on Morse and telephony. First of all, the detector valve usually starts oscillating violently when it does start, and this makes it very difficult to get the valve in a just-not-oscillating state where it is most sensitive for telephony.

Secondly, moving the reaction coil alters the tuning of the set. This does not matter much for Morse for the reasons given above, but for telephony it is a great source of trouble, as the signal, if weak, is first picked up with the detector oscillating; then the reaction coil is moved away a little from the grid coil, which necessitates retuning, to find the station again, or at any rate to bring its beat note to a reasonably low note so that on next moving the reaction coil the station is not lost altogether.

This process is repeated until the valve is just not oscillating and the set is tuned to the desired speech. In many cases, however, the telephony station will have shut down before this happens.

Thus, it should be fairly obvious that a set which works well for short-wave Morse signals will not necessarily be suitable for telephony, although the contrary is by no means so.

A superheterodyne receiver will do all that is desired, both for Morse and telephony, but it involves a lot of valves and other components which make it rather costly, while the receiver to be described is extremely simple and inexpensive to make.

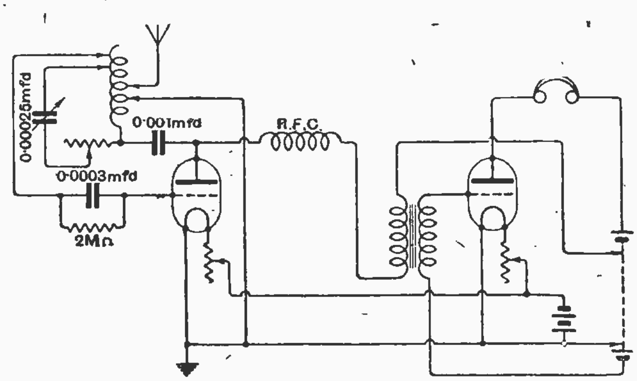


Fig. 2.—The circuit diagram.

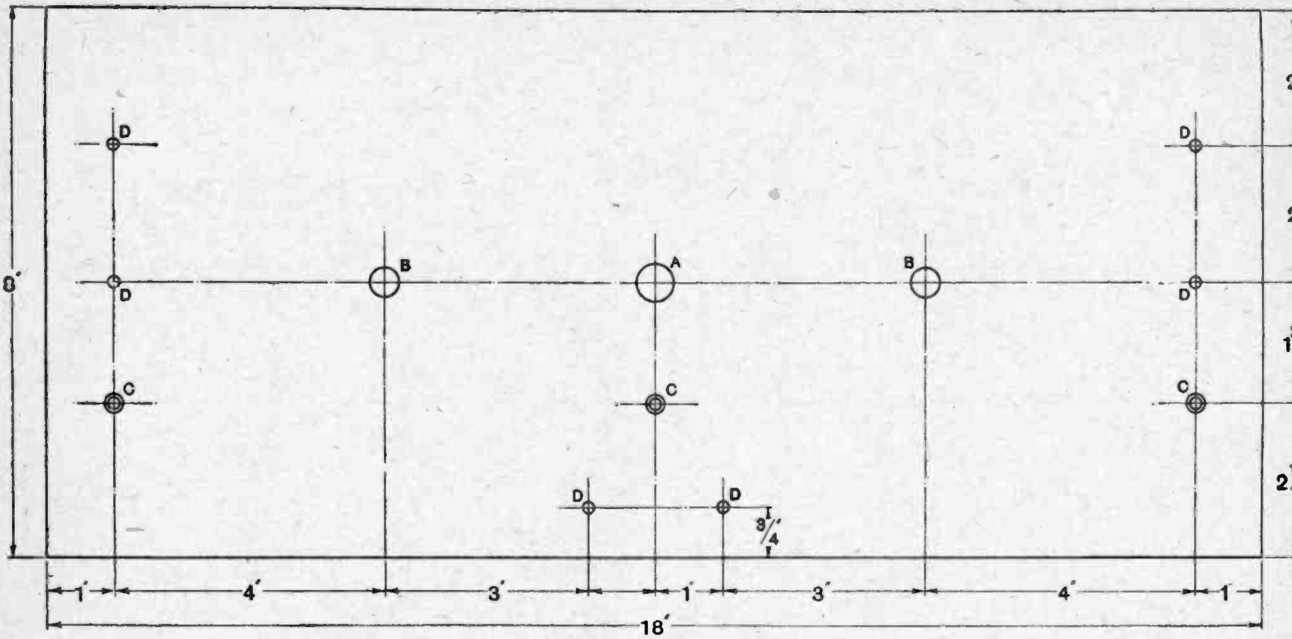


Fig. 3.—Drilling details of the front panel. A, 9/16in. in dia.; B, 7/16in. in dia.; C, 5/32in. in dia., and countersunk for No. 6 wood screws.

Before describing the actual receiver it would be as well to understand just how it works.

It is perhaps generally known that the effect of using reaction on a circuit is to reduce the apparent resistance of that circuit—in other words, it is equivalent to adding a negative resistance to the circuit.

In the case of the simple valve detector circuit shown in Fig. 1, it is the grid circuit which has a negative resistance added when the reaction coil is coupled to it.

In order that the valve may oscillate, it must add at least as much negative resistance to its grid circuit as the ordinary positive resistance of the circuit.

Now any given valve, working under given conditions of high- and low-tension supply, can only add a limited amount of negative resistance to a given circuit—its grid circuit, for example—so that if the positive resistance of that circuit is less than the maximum available negative resistance, then the valve will oscillate; if more, then it will not oscillate.

This addition of negative resistance involves work on the part of the valve, and the output of the valve naturally depends on the power supply available—*i.e.*, on the high-tension battery, and to some extent on the filament temperature.

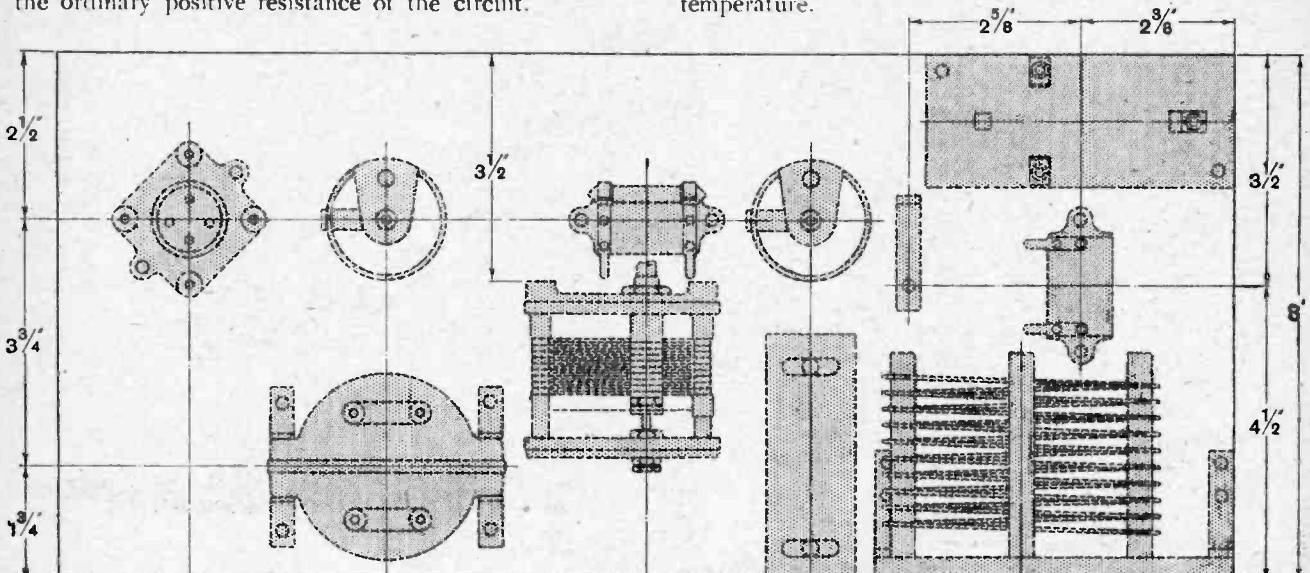


Fig. 4.—Layout of components on the baseboard.

New Circuit for Short-Wave Reception.—

It should be obvious that whether or no the valve in Fig. 1 will oscillate depends on the relation between H.T. supply, filament emission, and resistance of the grid circuit; thus by varying any or all of these it should be possible to control the oscillation of the valve.

Variation of H.T. supply is not practicable in most cases, as continuous variation is required; this can be obtained with a potentiometer, but in this case the H.T. supply should be mains or accumulators; but in any case other methods of oscillation control are simpler.

Variation of filament temperature—for this varies the emission—is a well-tried and well-known method of oscillation control, but variation of circuit resistance gives much the best control of the three, although it does not seem to be generally known.

There is just one snag in its use—the alteration of resistance must not alter the circuit tuning—*i.e.*, the variable resistance inserted must be of constant inductance and capacity (both these being small compared with the rest of the circuit, so as to economise in H.T. supply).

It is a very fortunate fact that the ordinary carbon filament resistance fulfils this condition sufficiently accurately while being of suitable value to add to most receiving sets.

Circuit of the Receiver.

Since the oscillation control can be obtained on such a resistance only, it follows that it is not necessary to have variable reaction or filament controls—which in itself simplifies the operation of the set—in fact, one can go a step further and use a transmitter circuit with one coil only, such as the well-known Hartley circuit.

Hence the only controls on the set to be described are this resistance, the tuning condenser, and, for convenience, a master switch to turn the filaments on or off.

A general view of the receiver is given in the photographs, while dimensioned drawings are also given.

As shown in the photographs, the coil is of the spaced

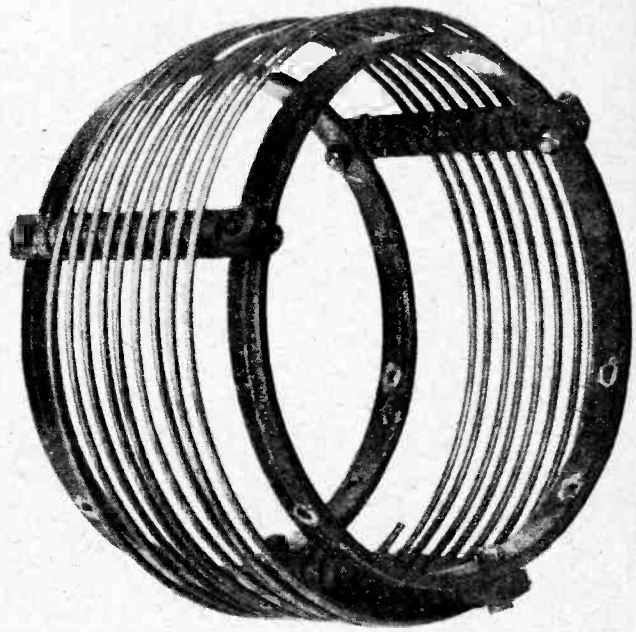
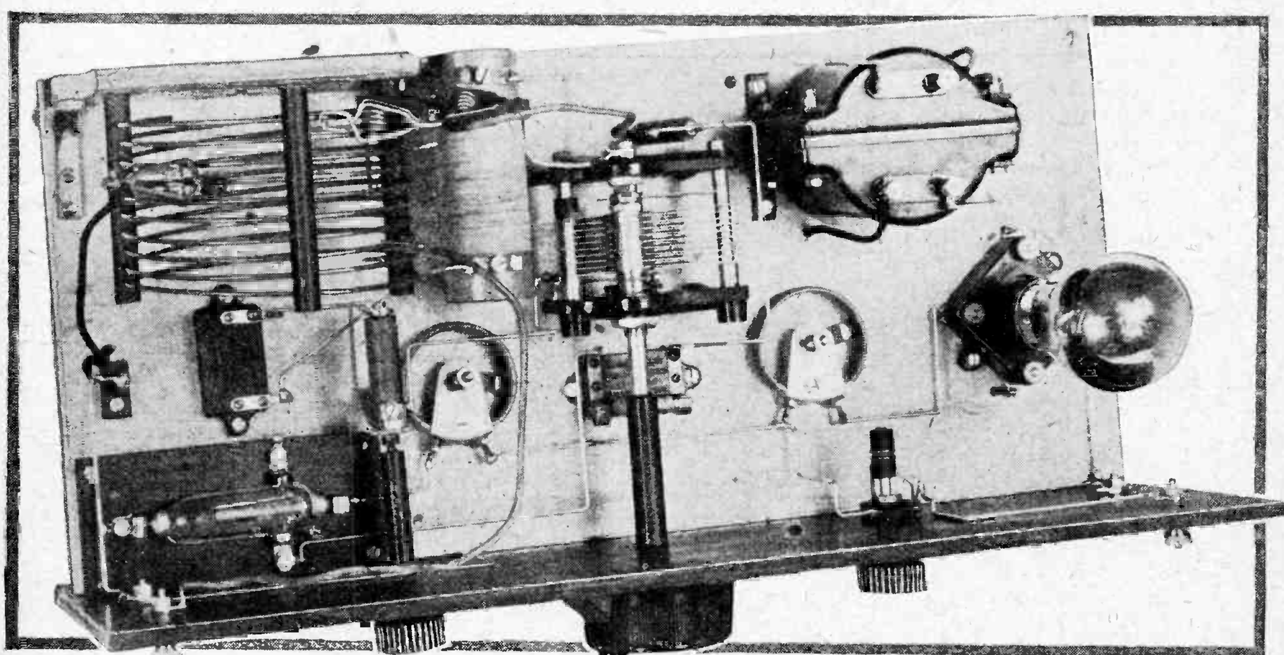


Fig. 5.—An alternative method of constructing the tuning coil.

type and is kept rigid by three ebonite rods with suitable holes drilled through them: coils of more or less similar construction have been described by F. H. Haynes in *The Wireless World*.



The complete receiver seen in plan. The position of each component has been carefully chosen to shorten wiring in the H.F. circuits.

New Circuit for Short Wave Reception.—

The coil of No. 12 S.W.G. phosphor bronze was tightly wound in a lathe on a wood mandrel three inches diameter and allowed to spring out as far as it would.

More wire than was needed on the finished coil was used, and the best coil of eleven turns was cut out of the final sprung out coil.

The ebonite rods should be threaded on and spaced out equally round the coil, and an important point to notice is that the holes should not be made too large, or the coil will be floppy, but should be a tight fit on the wire.

An alternative construction is shown in Fig. 5, in which the coil is sprung on to a former. This type is better and more rigid than the other, and is just as easy to make.

The choke coil is fairly critical in value, and consists of 150 turns of No. 36 D.S.C. wire on a $1\frac{5}{8}$in. diameter paxolin former.

This choke must not be of too small an inductance value else its impedance will be small, and it will not stop the H.F. currents circulating round the H.T. circuit. On the other hand, if the choke is too large then it is liable to form a circuit tuned (by reason of its self-capacity) to a frequency in the range of the set, and thus will usually absorb sufficient energy at this particular frequency to stop the detector valve from oscillating; thus if a choke is too large it is liable to cause

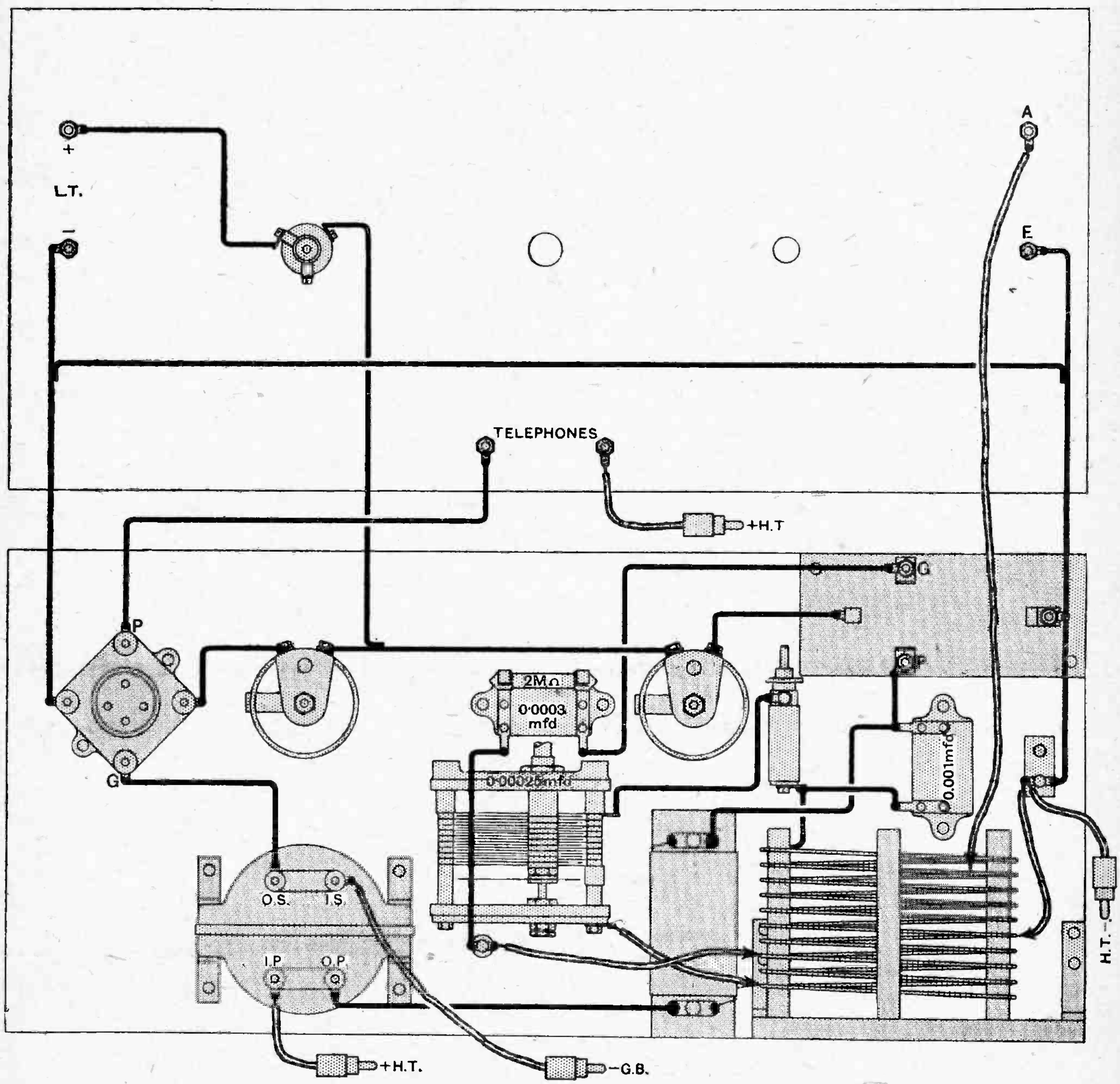


Fig. 6.—Wiring diagram. Connections to the H.T and grid batteries below the baseboard are made by means of flexible leads and plugs.

New Circuit for Short Wave Reception.—

COMPONENTS REQUIRED.

1 Cabinet, 18in. × 8in. × 8in., with 18in. × 8in. × ¼in. panel and false bottom to fit (Messrs. Will Day & Co.).
1 0·00025 mfd. square law condenser (Sterling).
2 0·001 mfd. mica condensers (Dubilier).
1 0·0003 mfd. mica condensers and grid leak (Dubilier).
1 Geared dial (Pico).
1 Intervalve transformer, ratio 4:1 (Marconiphone).
2 Fixed resistors and sockets or 2 variable filament resistances (Burndept).
1 D.E.V. valve.
1 B.T.H. B4 valve and holder.
Ebonite rod.
Ebonite or paxolin tube.
3 Clipo connectors (Burndept).
1 Filament resistance, bright emitter type (Lissenstat Minor).
1 Push-pull switch (Lissen).

what are usually called "dead spots" in the tuning, *i.e.*, spots where the valve refuses to oscillate.

A D.E.V. valve is used for the detector valve on account of its low internal capacities, and it has been found by the authors that these valves vary slightly among themselves, so that the actual number of turns on the choke may have to be varied slightly for different valves.

The actual layout of the components should be followed, as these have been arranged with a view to keeping the H.F. leads short and away from the panel.

To this end ebonite extension pieces are fitted to the reaction-control resistance and to the tuning condenser, and also the flexible leads to the coil are kept as short as possible by using fixed leads terminating on ebonite pillars in the manner shown in the photographs.

The amplifier valve is a B.T.H. B4, and is mounted in an anti-microphonic holder for obvious reasons. The filament resistances are of the *variable* type, adjusted to give the correct voltage across each valve filament, and then firmly screwed down to the baseboard.

Battery voltages are as follow: Filament, 4 v.; detector H.T., 80 v.; amplifier, 100-120 v., with 6-9 v. grid bias. Provision is made for incorporating four 30-v. Hellesen batteries under the baseboard; the grid bias for the amplifier may be tapped off from the negative end of the H.T. battery if desired.

Three small angle pieces of wire are soldered on to the last three turns of the big coil for the tuning condenser clip. With the condenser across the whole coil, 90 metres may be covered comfortably at condenser maximum, while with the condenser near minimum and on the third turn, the set tunes to 15 metres (about).

The following stations have been heard on this set, and were all received in a listening-in period of a very few nights:—

Great Britain: 2DA, 5KF, 2NM, 2AR, 6QB, 5MO, 2XY, 6DO, 2OD, 6MO, 2NB, 2FL, 6TD, 2LZ, 2HF, 5HG, 2UN, 5LF, 2WS, 2AKG, 6AH, 6VP, 5PM, 5WQ, 6ER, 2TM, 6NF.

France: 8NS, 8TOK, 8MUL, 8GW, 8HU, 8NA, 8CQ, 8FW, 8QR, 8PKX, 8CA, 8TH, 8EE, 8TO, 8EE, 8DO, 8SSC, 8RBP, 8CS, 8RG, 8BE 8GI, 8IX, 8SST.

U.S.A.: 1CRE, 8CES, 1ER, NTT, NRL, WAP, 1EF, 8AFQ, 1YB, 2ZB, 2FO, 8TK, 1PL, 1BS, 1CMP, 8CJP, 1PZ, 8BOY, WIZ, 1CH, 8RL, 1QB, 8CES, WQO, 2BGI, 8AJ, 2BXJ, 2ZV, 2AKY, 2LD, 2CXL, 2COL, 2CGJ, 3CDV, 1ACI.

Belgium: U5, W3, YI, 4RS, G6, H6, S5, Z22.

Holland: OPM, OWN, OWC, OKW, ONAA, ORM, OHB, OF3.

Scandinavia: 2NM, 2NL, 2NO, SMZZ, SMXU, 2CO, 2AR. SMTN, SMXR, SMWF.

Spain: EAR6, EAC9.

Switzerland: 9AD, 9ID.

Canada: 2KO, 3AD.

Brazil: 1AB, 5AB, 1AN, 1AF.

Mexico: 2CC.

C.S.: OKI.

Various: XKH, F4SR, 3BC, 3BCO, 3VL, FW, 5HA, AIN, MAROC, J5HX, SDK, RGC.

The above list speaks for itself in showing what can be done with this circuit and set, though it is perhaps as well to add that there are no hand effects whatever anywhere on the panel; all terminals on the panel may be touched without losing a station, and, finally, that the reaction control is so nice that, if desired, the detector valve may be kept in the hissing state (just before oscillation commences) over the whole range of the set —*i.e.*, from 15-90 metres.

HIDDEN ADVERTISEMENTS COMPETITION.

"The Wireless World" Hidden Advertisements Competition, which is proving extremely popular, will be continued from week to week until further notice.

The correct solution of the Second Competition is as follows:—

Clue No.	Name of Advertiser.	Page
1.	British Sangamo Co., Ltd.	8
2.	Ormond Engineering Co.	ii.
3.	Sydney S. Bird	14
4.	British Thomson-Houston Co., Ltd.	iii.
5.	Marconiphone Co., Ltd.	5
6.	Igranic Electric Co., Ltd.	iv.

The prize-winners were:—

A. Hutcheon, Thornton Heath, Surrey	£5
G. H. Henshall, Eltham, London, S.E.9	£2
Alex. Robertson, Stewarton, Ayrshire	£1

Ten shillings each to the following four:—

R. W. Body, Wandsworth Common, S.W.11.
A. Mortimer Codd, Herne Hill, S.E.
P. Bontor, West Bognor, Sussex.
Mrs. E. Johnston, Sheffield.

NEWS *from the* CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

East Grinstead and District Radio Society.

The society has now changed its address to 25a, London Road. All communications should be addressed to the hon. secretary, Miss M. P. Joyce, Barclay's Bank House, East Grinstead.

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Tottenham Wireless Society.

Mr. Philip R. Coursey, B.Sc., of the Dubilier Condenser Co., Ltd., gave a valuable lecture on December 9th, in which he supplemented the information given in his previous lecture on "Condensers." Dealing with his subject from a more theoretical point of view, Mr. Coursey directed attention to the losses liable to occur in condensers and the steps taken to obviate them. Dielectrics—their properties and action under varying conditions—were also considered, after which attention was paid to the thorny problem of the advantages of the so-called square law condensers. Curves were shown on the screen depicting the values of a number of variable condensers at different frequencies and under various conditions.

The question of insulation aroused particular interest, the lantern slides dealing with this phase of the topic being of especial value.

Hon. Secretary: Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

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Muswell Hill and District Radio Society.

There was a good attendance at headquarters on December 9th when Mr. H. F. Klotz gave the third of a series of lectures on "Wireless Reception." The lecturer dealt especially with reflex receivers, illustrating his remarks with blackboard diagrams.

Prospective members should send in their applications to the Hon. Secretary at once, in order that they may derive full benefit from the series of lectures being given during this season.

Hon. Sec.: Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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Lewisham and Bellingham Radio Society.

"The Construction of Fixed Condensers" was the subject dealt with in a lecture given by Mr. Haywood, of the Dubilier Condenser Co., on December 8th. After explaining the methods of selection and grading of suitable mica in the initial stages, the lecturer acquainted his hearers with the entire process of manufacturing fixed condensers, from the smallest type as used for broadcast reception to the largest specimen used for high power transmission.

Hon. Secretaries: Mr. C. E. Tynan, 62, Ringstead Road, Catford, S.E.6; Mr. J. A. Clark, 35, Boones Road, Lee, S.E.13.

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Selfridge Radio Society.

A number of interesting items have featured on the Society's programme during the past few weeks. "Peeps into our Stations and Studios" was the title of a lecture given by Mr. Lynch Odhams, of the B.B.C. (late director of the Newcastle station), before a large and appreciative audience. Another successful lecture was that given by Mr. A. E. Bowyer-Lowe on the subject of "Super Heterodynes," this being followed by a vigorous debate on the question of "American versus British Components."

On November 26th the Society co-operated with the Radio Society of Great Britain, the Palm Court of Messrs. Selfridges being utilised for a debate before an audience of 1,200 persons. (The debate was reported in *The Wireless World* of December 9th.) All present were able to follow the debate with the aid of the Amplion Public Address system which was installed by the society's members with the help of Messrs. Alfred Graham.

An ambitious programme has been prepared for the New Year, and it is hoped that the membership will considerably increase.

Hon. Secretary: Mr. J. A. Edley-Edwards, 400, Oxford Street, W.1.

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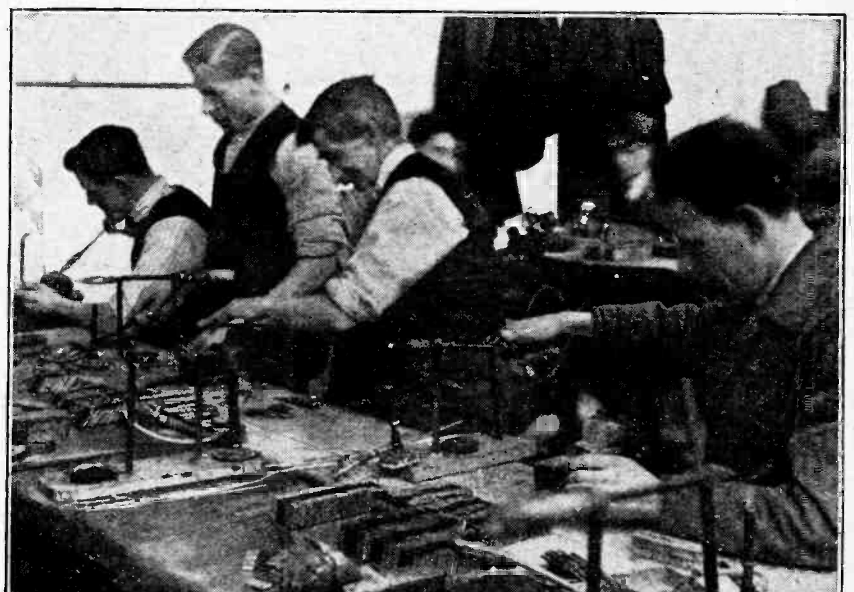
Essex Group of Radio Societies.

The spirit of co-operation which obtains among the Essex Societies was clearly shown at a recent meeting at the headquarters of the Ilford and District Society attended by representatives from the districts of Ilford, Walthamstow, Leyton, Wanstead, and South Woodford. The object of the meeting was to study the requirements of all members in the direction of wireless lectures and demonstrations.

The future of the B.B.C. was also discussed, but it was decided that before any collective opinion could be pronounced the matter should be referred back for careful consideration by each society in the group.



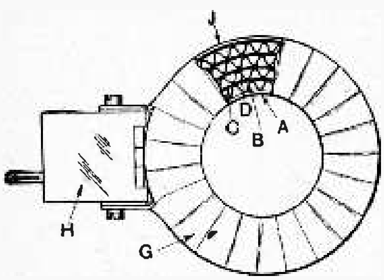
MAKING FIXED CONDENSERS. An interesting glimpse into one of the workshops of Messrs. L. McMichael, Ltd., showing the process of assembling small fixed condensers.

Brain Waves of the Wireless Engineer.

Multi-layer Plug-in Coils.
(No. 240,559.)

A multi-layer inductance coil is described in Patent Specification No. 240,559, granted to E. W. Kirk, in which the layers are wound across the ridges of a corrugated perforated former or separator.

In the accompanying illustration, A is



Corrugated cardboard spacing for multi-layer coils. (No. 240,559.)

a cardboard tube around which is a layer of corrugated and perforated cardboard B.

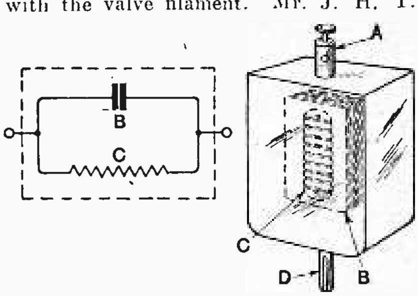
The wire C is then wound on the former so that it lies across the corrugations. When one layer has been wound on the former a layer of corrugated and perforated cardboard D is placed over it, and the wire C is wound in another layer, in a similar manner to the first layer.

The finished coil may be bound with tape G, and mounted on a plug connector H, a strip of insulating supporting material J being preferably arranged around the periphery of the coil.

oooo

Safety Device for Valve Circuits.
(No. 240,510.)

The object of the above invention is to protect valve filaments from burning out, due to the accidental connection of the positive pole of the high-tension battery with the valve filament. Mr. J. H. T. Roberts, in Patent No. 240,510, describes a device consisting of a non-inductive resistance of 2,000 ohms for 0.06 valves, or 500 ohms for 0.2 valves, shunted by a fixed condenser of 0.1 microfarad, when a 100-volt H.T. battery is used.



Resistance and condenser unit for valve protection. (No. 240,510.)

For higher voltages the resistances are correspondingly increased.

The device may take the form of a wander-plug, as shown, or of a unit consisting of a non-inductive resistance of suitable value and a condenser connected as shown in the diagram.

In the drawings A represents one terminal of the wander-plug and D the other; between these terminals is connected the resistance C and the condenser B.

The condenser B is provided in order to by-pass the high-frequency and low-frequency currents which normally flow through the high-tension battery.

oooo

A.C. Mains for Valve Filament and Anode Circuits.
(No. 239,663.)

The object of this invention, by R. S. Elven, is to reduce the A.C. hum in the telephones or loud-speaker caused by audible low-frequency oscillations of the same periodicity as the alternating supply, or of the same frequency as one of the harmonics of the supply.

Two methods of connecting the circuits are shown in diagram, by means of either of which methods the A.C. hum is rendered almost inaudible.

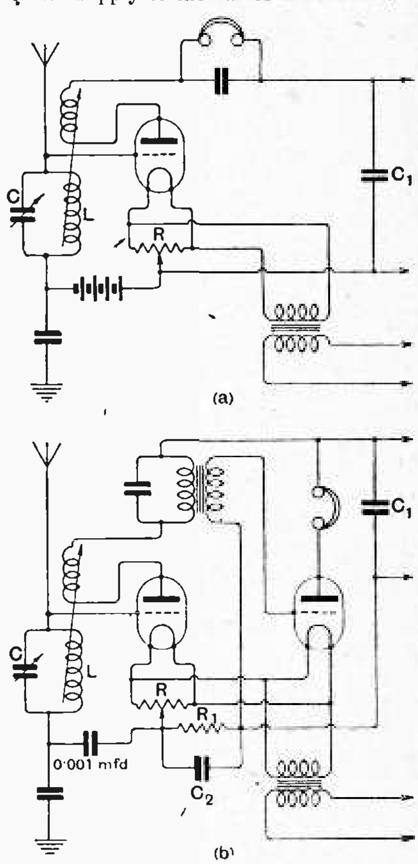
In circuit (a) the filament of the valve is supplied with alternating current from the secondary winding of a transformer having its primary winding connected across the A.C. mains. The anode current required by the valve is supplied from a condenser C_1 of large capacity.

A resistance R is connected across the filament leads, and a battery giving a voltage of from 3 to 8 volts has its positive pole connected to the mid-point of the resistance and its negative pole to the low potential end of the inductance L in the grid circuit.

In circuit (b) the battery is eliminated, the low potential end of the inductance L is connected to one side of a 0.01 mfd. condenser, and the other side of the condenser to the mid-point of the resistance R.

Sufficient leakage path must be provided for the grid to discharge, either through the insulation of the condenser, or a leak of about 10 megohms. The resistance R is connected across the filament of the detector valve.

The grid lead of the audio-frequency amplifying valve is connected to one end of the secondary winding of an audio-frequency intervalve transformer. The other end of this secondary winding is connected to the negative terminal of the condenser C_1, from which the high-tension supply to the valves is obtained.



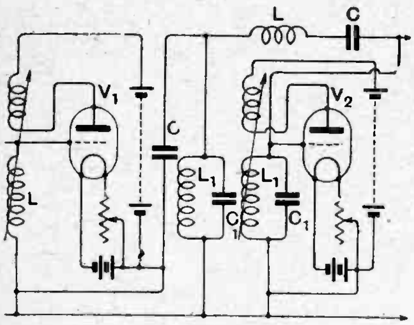
Connections for eliminating hum in receivers supplied from the A.C. mains. (No. 239,663.)

A resistance R_1 connects the negative terminal of the condenser C_1 to the mid point of the resistance R. A condenser C_2 by-passes the audio-frequency currents flowing in the high-tension circuits.

The potential of the grid of this audio-frequency amplifying valve is thus maintained steadily negative with respect to the mean potential of the filament due to the voltage drop in the resistance R_1, because of the passage through the said resistance of the anode current.

Electrical Frequency Traps or Wave Filters.
(No. 238,211.)

The Westinghouse Electric and Manufacturing Company, of East Pittsburgh, describe in the above specification filter circuits comprising one or more reactance elements in series and one or more reactance elements in shunt, of one or more regeneratively arranged thermionic valve systems coupled to one or more of the



An improved filter circuit (No. 238,211.)

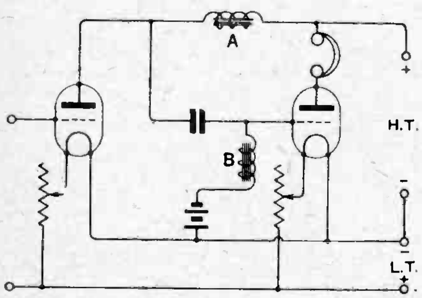
reactance elements so as to tend to neutralise the effective resistance of the wave filter.

In the illustration the filter comprises two sections, each consisting of a series element comprising inductance L and condenser C in series, and a shunt element comprising inductance L_1 and condenser C_1 in parallel. The inductance L of the first section and the inductance L_1 of the second section are included respectively in the grid circuits of valves V_1 and V_2, the plate circuits of which are reactively coupled to their grid circuits, the couplings being adjusted below the oscillating point.

oooo

Choke Coupled Low-frequency Amplifier
(No. 241,257.)

Mr. H. Green, in the above patent, describes a choke amplifier in which an iron-cored choke coil is connected between the grid of a valve and its filament.



Choke coupling. (No. 241,257.)

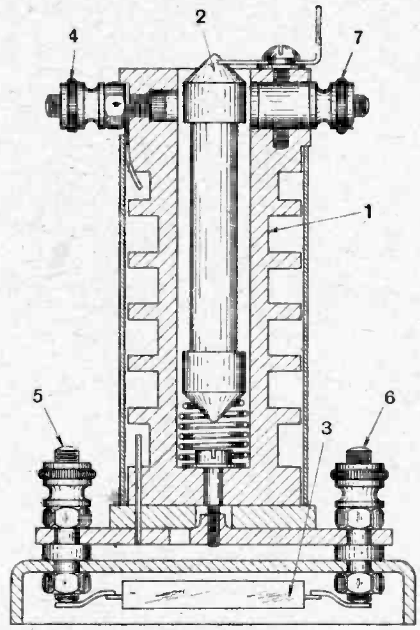
The illustration shows a two-valved choke amplifier in which the iron-cored choke coils A and B are substantially balanced and of low resistance and yet having high inductive value.

The provisional specification states that satisfactory results have been obtained by using Marconi L.S.5 valves and equal choke coils having an impedance of 1 henry.

oooo

Resistance Capacity Coupling Unit.
(No. 240,899.)

Messrs. Norman Lee and Radio-Communication Co., Ltd., described in Patent No. 240,899 a valve coupling unit for resistance-capacity, low-frequency amplification comprising a special wire-wound anode resistance of small self-capacity and small self-induction, a cartridge type grid resistance and a fixed condenser. The anode resistance is wound clockwise and anti-clockwise in alternate grooves on a tubular bobbin. The grid resistance 2 is housed inside the tubular bobbin, and the coupling condenser 3 is incorporated in a case forming the base of the unit. One end of the anode resistance is connected to terminal 4 and the other end to terminal 5. To this terminal is also connected one side of the fixed condenser 3,



Resistance capacity coupling unit. (No. 240,899.)

the other side of the condenser being connected to terminal 6 and to one end of the grid resistance while the other end of the grid resistance is connected to terminal 7.

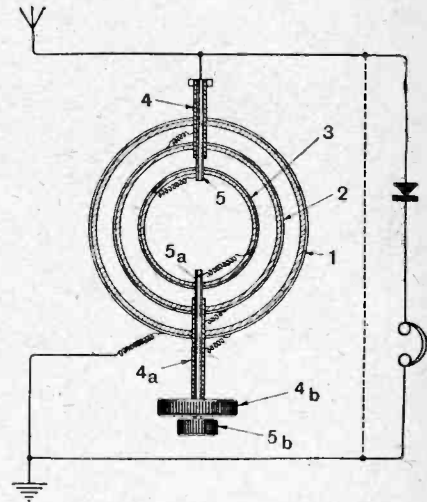
oooo

Variometers.
(No. 241,371.)

A variometer is described in Patent No. 241,371, granted to R. E. Barbour, in which a supplementary winding is connected in parallel with the usual rotary winding, and arranged to be movable independently of or collectively with its associated parallel winding.

The illustration shows an elevation of the variometer connected in circuit with a crystal detector.

The variometer comprises a stator 1 and two rotors 2 and 3, the parts being of cylindrical form mounted one within the other, as is usual. The rotors 2 and 3 are mounted upon spindles 4, 4a, and 5, 5 respectively, the spindles 4a and 5 being provided with knobs 4b and 5b.



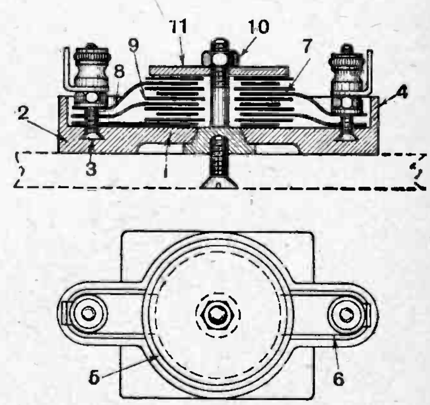
Variometer with three windings. (No. 241,371.)

Variable Condensers.
(No. 240,591.)

The above patent specification granted to G. F. A. Stone relates to variable condensers of the kind comprising a number of interleaved plates and dielectrics secured together by means of bolts or rods.

According to the invention the condenser plates and dielectrics are accommodated in recesses in a body of insulating material in such manner that the number of condenser plates can be readily varied. The illustrations show a plan view and sectional side elevation of the condenser.

A vulcanite body 1 has arms 2 and a projecting flange 4 forming recesses 5, 6, to receive the circular condenser



Variable capacity mica condenser.

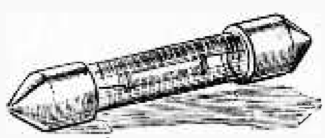
plates 7 having lugs 8 conforming to the shape of the recess 6 and secured to terminals 3. The recess 5 is deep enough to accommodate the required number of plates 7 and the dielectric discs 9, the number of plates being varied by unscrewing a nut 10 and removing a clamping plate 11.

NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

EDISWAN VACUUM GRID LEAK.

A grid leak of standard dimensions and enclosed in a frosted glass tube is a recent product of the Edison Swan Electric Co., Ltd., 123-125, Queen Victoria Street, London, E.C.4. The leak consists of a short piece of glass rod, deposited upon which is a substance



Ediswan grid leak

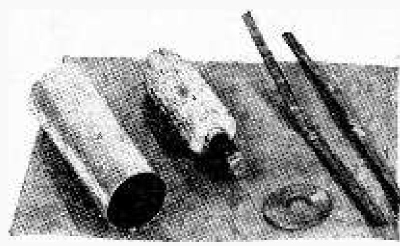
forming the leak resistance. The wires to the end caps are actually sealed in the outer glass tube to entirely prevent the corrosive action of the atmosphere acting upon the material of which the leak is composed.

o o o o

PYRAMID HIGH-TENSION BATTERIES.

Users of high-tension batteries have no doubt observed that many of the batteries on the market are of foreign manufacture. Foreign competition is so keen that Wates Bros., Ltd., 12-14 Great Queen Street, Kingsway, London, W.C.2, recently decided on establishing a factory devoted entirely to the production of low-priced dry cell batteries, and as a result can offer a high grade of battery at a competitive price.

The elements from which the cells are constructed and a number of cells shown in the cardboard carton before sealing in with wax are shown, as the user does not always realise the large amount of detail work that is necessary in making up a high-tension battery of 60 volts. A carbon rod fitted with a small brass cap forms the centre of a tightly compressed



A dismantled cell removed from a pyramid battery, showing the zinc cylinder, the carbon rod with depolariser and waxed cardboard spacing pieces.

cylinder of depolarising material which, when enclosed in a muslin wrapper, has a diameter of about ½in. The zinc cylindrical container, after being shaped, is seamed by soldering, and a zinc disc is soldered in at the bottom to render the container watertight. The electrolyte covers the interior face of the zinc and the carbon rod is held centrally by means of a small waxed cardboard stamping. The rows of cells are assembled with Empire cloth spacing, and connecting-up is carried out with soldered wire leads, so that there are no fewer than 87 soldered connections in a 60-volt battery. With the tapping plugs soldered in position the top is filled in with paraffin wax.

An examination of the interior of a specimen battery submitted showed that no endeavour had been made to cheapen production by using materials of inferior quality or insufficient in quantity, and that every care had been taken in fitting up the battery to render it entirely reliable.

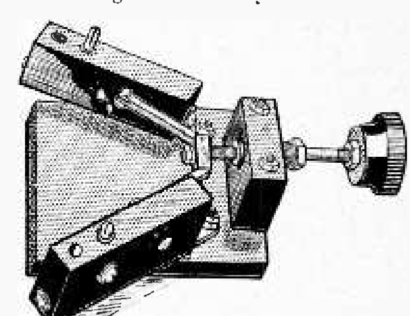
The Pyramid high-tension battery with a portion of the waxed filling removed, showing the cells with Empire cloth spacing.

o o o o

BURWOOD-GLOBE COIL HOLDER.

An ingenious form of two-coil holder is manufactured by Burwood (Concessionaires), Ltd., 41, Gt. Queen Street, Kingsway, London, W.C.2.

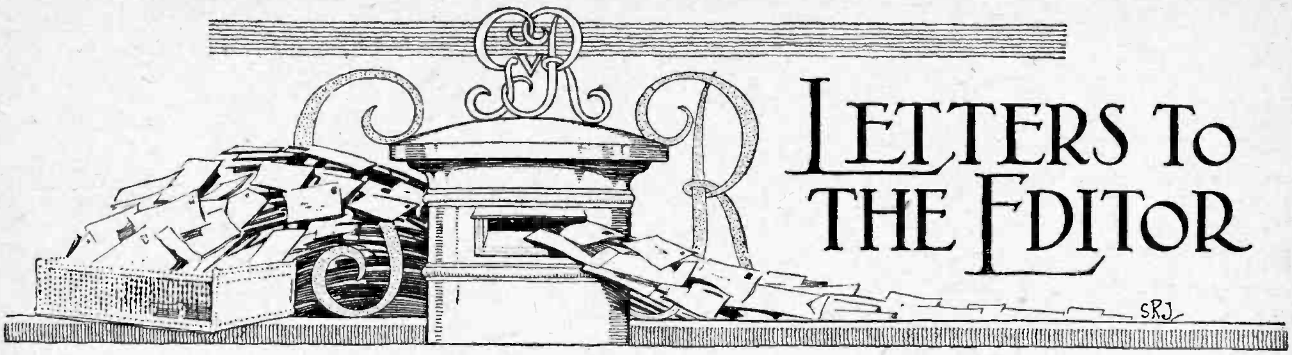
It is designed essentially for mounting



A new idea in coil holder design. The holders are propelled apart by metal arms attached to a bracket which moves on a screw.

behind the instrument panel, yet the ebonite base is of liberal dimensions and can be screwed down, if desired, on one of the exterior faces of the instrument cabinet. The operating knob revolves a threaded spindle which, in advancing through the bush, propels a small cross-bracket to which is attached a pair of arms which drive the two-coil holders apart, rotating them about their points of fixing until they are at right angles.

A very critical adjustment can be obtained, and the extent of coupling between two coils enclosed in a set can be estimated by the extent to which the operating knob is screwed down into its bush. The coil holder can be mounted in any position and will support the heaviest of coils.

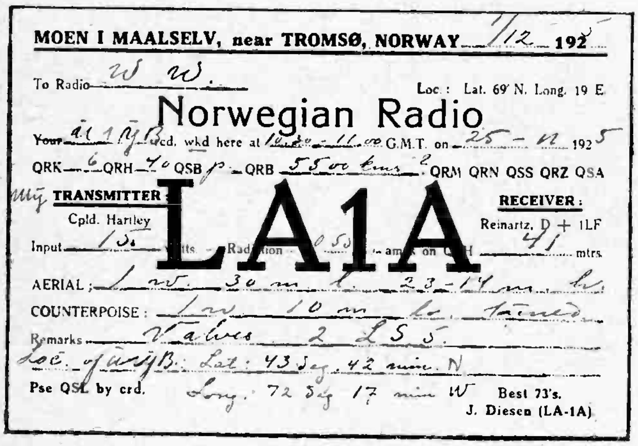


The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addr ssed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

2,200 KILOMETRES WITH 0·24 WATT.

Sir,—With reference to previous correspondence concerning low power tests, I wish to inform you that on November 6th, 1925, between 18.00 and 19.00 G.M.T., a communication was established and tests carried out with British G6DO (Mr. Dorté, Lynwood, Weybridge, Surrey). Transmissions from


MOEN I MAALSELV, near TROMSØ, NORWAY 1/12 1925

To Radio W. W.

Loc.: Lat. 69° N. Long. 19 E.

Norwegian Radio

LA1A

Your ... rcd. wkd here at ... G.M.T. on 25 - 11 1925

QRK 6 QRH 40 QSB ... QRB 5500 kms. QRM QRN QSS QRZ QSA

TRANSMITTER: Cpld. Hartley

RECEIVER: Reinartz, D + 1LF

Input 15 watts. Radiation 0.50 amps on QRH 41 mtrs.

AERIAL: ... 30 m ... 23-14 m ...

COUNTERPOISE: ... 10 m ... tuned

Remarks Valves 2 LS 5.

Loc. of ...: Lat: 43 deg. 42 min. N

Pse QSL by crd. Long. 72 deg 17 min W

Best 73's.
J. Diesen (LA-1A)

QSL card received from LA1A.

LA1A were made on a wavelength of 42 metres and on following inputs :—8.64, 4.68, 1.68, and finally 0.24 watts. G6DO, who was using a two-valve receiver, reported the strengths to respectively R6, R6, R3-5, and for input 0.24 watt, R2-3. The distance from here to London is about 2,200 kilometres.

J. DIESEN (LA1A).

Moen i Maalselv, near Tromso, Norway.

PRESS CRITICISM OF B.B.C. PROGRAMMES.

Sir,—I have read the leading article in your issue of the 9th instant entitled "A Ministry of Broadcasting" with considerable interest.

Although in professional life a solicitor, I have taken great interest and spent a great deal of time in the science and practice of wireless receiving sets, and have, during the past two years, spent many happy hours with the 'phones or loud-speaker.

I am at a loss to understand the severe criticism levelled against the British Broadcasting Company in certain sections of the daily Press. In my opinion the British Broadcasting Company have exceeded all expectations. When one considers the number of hours per annum during which the Broadcasting Company have to be active, the general tone of the material put out is excellent. The lectures and talks which seem to have come in for the severest criticism are most interesting, and well worth the time spent in hearing them.

The fact that the broadcasting service in this country is under one control in my opinion leads to greater efficiency in the service, and the issue seems to me to be the nature of that control.

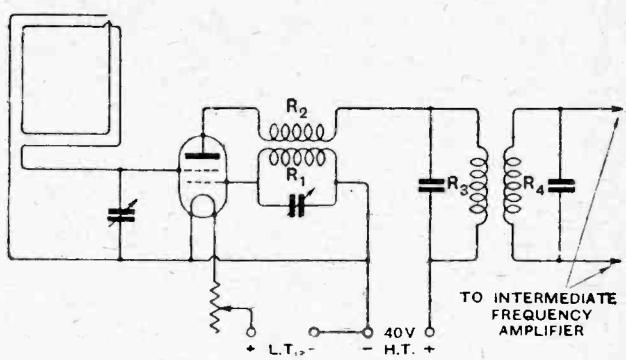
It is common knowledge, I think, that Government control of any industry is not efficient, and I do not think that Government control of the broadcasting industry would be efficient.

I therefore most heartily reciprocate your own exhortation: "Leave well alone." GEORGE R. PAWSON.

Gosforth, Newcastle-upon-Tyne.

FOUR-ELECTRODE VALVE SUPERHETERODYNE.

Sir,—The accompanying circuit diagram, which illustrates a method of applying the supersonic heterodyne principle to a receiver by means of a four electrode valve, may possibly be of interest to some of your readers. I have lately been using a receiving apparatus of French design[1] which embodies this principle; and find it extremely satisfactory, both as regards



The circuit diagram of Mr. Herbert's four-electrode valve superheterodyne receiver. The coupling between R_1 and R_2 is fixed and fairly tight. R_1 is tuned by a variable condenser to the heterodyne frequency. R_3 and R_4 are loosely coupled and are tuned to the intermediate frequency.

sensitiveness and selectivity. The four-electrode valve combines the functions of the high-frequency amplifier, oscillator, and detector valves of a normal superheterodyne circuit, and for this reason the arrangement would be highly suitable for portable receivers.

Using the French dull-emitting "*micro-bigril*" valve, the anode voltage should be between 40 and 50, and it is important to note that the oscillations due to the signal should be applied to the *outer* grid. C. V. C. HERBERT.

Cambridge.

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[1] "Radio Modulator, A.M.6," by Ducretet, of Paris.

B.B.C. AND ADVERTISING.

Sir,—With reference to your editorial remarks in *The Wireless World* of November 11th and December 9th, it is clear that the broadcasting service is being used too much for direct and indirect advertising purposes. There is, of course, the glaring instance of *The Radio Times* and *The Radio Supplement*, and it may be remarked in passing that this particular bit of advertising is both annoying to listeners and entirely superfluous.

Another sort of advertising to which I have heard strong objection raised is certain appeals for charitable or semi-charitable objects. It would be hard to suggest that charitable appeals should be barred altogether, although a good many arguments could be put forward in support of that contention. The specific objection is to the simultaneous broadcasting from London, Daventry, and often other stations as well, of purely local appeals which concern London. In the case of a really national appeal, by all means let it be "S.B. to all Stations," but at present it seems that London is taking an unfair advantage, and particularly is forgetting that Daventry is *not* simply one of the London stations.

As regards the broad question of the future control of broadcasting as a whole, while it is obviously necessary that supervision, especially in certain matters, should be exercised by some Government department, this is really to be regretted, and the less of it the better. *Any* alternative would be preferable to complete management by a Government department. Think of railways and coal mines under Government control. Think of the telegraph and telephone services, and of buying a postal order in a hurry. Think of Income Tax, Dora, and Government ale, and then try to visualise Government broadcast programmes! J. H. S. FILDES.

Llandudno Junction, North Wales.

A QUESTION OF SIGNAL STRENGTH.

Sir,—In "Crystal Reception from 5XX," in your issue of December 9th, Mr. H. L. Cape has measured the distance from Chelmsford to Daventry wrongly. It is only 78 miles. I do not know where the Birmingham station is located, but the centre of the city is only 36 miles, giving a total of 114 miles.

He does not appear aware that the signal strength received would follow a square law. His figures which cause him surprise show the Daventry signal strength ten times that of Chelmsford, but this is almost exactly the ratio of 114^2 to 36^2, and, assuming the power of the two stations equal, is correct.

Braintree. H. E. ADSHEAD.

NORTHOLT'S "MUSH."

Sir,—May I confirm the statement made by E. T. Pierce, of Pinner, in your issue of December 9th, that the DX listener gets Northolt instead of carrier waves of the stations he wants. I also sat up till 3.0 a.m. on three recent mornings to receive America, but came up against this huge wall of "mush" from Northolt, from which I enjoyed no thrill of success. My enjoyment of wireless has waned since Northolt has been attacking the ether during the last four months. Night after night I have been cut off from listening to my favourite British and foreign stations through the Northolt terror. Lately it has been quiet on some nights, but on others it has been decidedly worse, even interfering with London concerts. I wish the P.O. would stop this terrible nuisance (in the wireless sense) and so benefit the listeners in general. F. A. KEATES.

Sudbury, Middlesex.

EUROPEAN BROADCASTING STATIONS.

Sir,—May I call attention to an error which appears in the very useful map of European broadcasting stations published with your issue of December 9th? The town of Oviedo is shown as being in the southern part of Spain, whereas its true position is on the north coast, about 20 miles inland and roughly 150 miles west of Bilbao. The position in which Oviedo is shown on your map is actually occupied by Cordova.

Barcelona. G. M. ROOKER.

Sir,—With reference to the list and map of European broadcasting stations in your issue of December 9th, a point which might be misleading to many of your readers is that the powers indicated for the Spanish stations are the input powers and not radiation powers (I believe the same occurs in many other instances of Continental stations), and therefore cannot be compared, as they stand, with the list of British stations.

Barcelona. BASIL HASTINGS.

SOUTH AFRICA—U.S.A. DX.

Sir,—Noticing in your issue of October 28th last (in connection with an achievement of Mr. C. W. Goyder, G2SZ) a statement that "The Pacific seaboard has long been a tempting goal for British amateurs," I think it may interest you to know that I have recently effected two-way working with U6HM (Mr. Clair Foster, Carmel, California), communication having been maintained for about one hour on November 6th, when we had to close down as it was time for me to go to business.

Cape Town. J. S. STREETER.

TRADE NOTES.

Manchester Wireless Agent.

Messrs. L. Ormsby and Co., wireless manufacturers, have appointed Mr. C. J. Procton, of 35, Wellington Road North, Stockport, as their sole agent for the Manchester district.

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New Wireless Depot.

The F.T.H. headphone, the Eccentro crystal detector, the W.J. headphone distributor, and other wireless stocks are now available at 29, Rosebery Avenue, E.C.1, where Messrs. W. Joanes, who are agents for these products, have opened a new branch.

oooo

Constructional Work to Order.

A new department has been opened by the Jervis Radio Co., 244, Goldhawk Road, Shepherd's Bush, W.12, to undertake special wireless constructional work, such as coils, relays and transformers, to the customer's specification. An outdoor staff also carries out repairs anywhere and erects aerials

"Ecco" Valves.

With regard to the TE and TZ "Ecco" valves referred to in *The Wireless World* of November 11th, we hear that the sole selling rights for these valves in the British Colonies, Dominions and Dependencies have been secured by Messrs. E. F. Batchelor-Foulger and Co., 173, Bank Chambers, 329, High Holborn, London, W.C.1.

oooo

A Valve Record?

The Edison Swan Electric Co. recently had returned to them by a London customer one of their AR type receiving valves which had been in use for an average of three hours a day since 1919. It had therefore withstood 6,500 hours' burning. Does this constitute a record for a bright emitter type receiving valve?

The M.H. Ash Tray.

Christmas gifts among the wireless trade have frequently assumed novel forms. This year Messrs. L. McMichael, Ltd., are presenting their friends with an original souvenir in the shape of an ash-tray supporting a realistic model of one of the well-known M.H. high frequency transformers.

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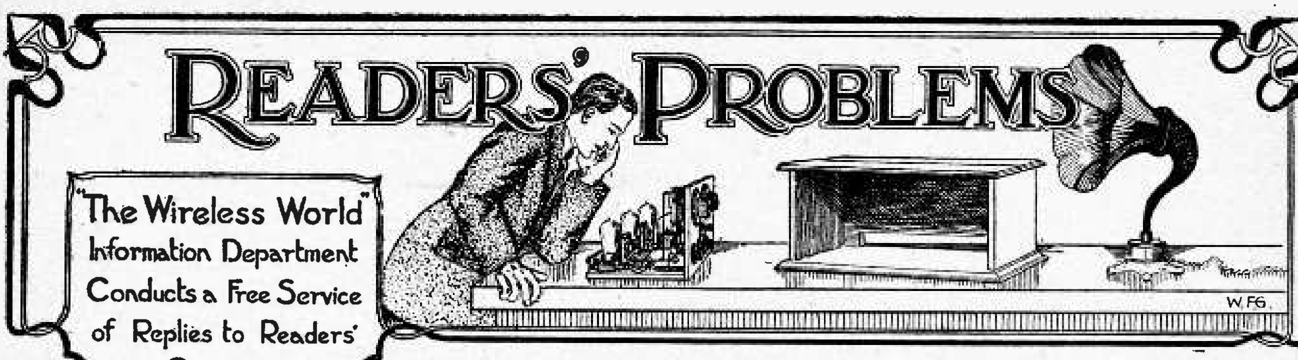
The Brown Budget.

The first number of the *Brown Budget*, the monthly journal of S. G. Brown, Ltd., of North Acton, contains an interesting history of this well-known firm, and articles on the "Brown" Electro Megaphone, the new "Brown" Power Loudspeaker, and other topics relating to the company's productions.

oooo

A "Dagenite" Souvenir.

Messrs. Peto and Radford have sent us a useful and seasonable present in the form of an ash-tray moulded in "Dagenite," the special composition used in the manufacture of the containers for Peto and Radford portable batteries.



Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Adding an Efficient H.F. Stage.

I have been obtaining excellent results on a conventional 0-v-1 regenerative circuit on a normal aerial and earth system, but lately having taken up my abode in a flat where an outdoor aerial is out of the question, I have been endeavouring to use a short indoor aerial, but without appreciable results, except on the local station, and have decided to build an H.F. amplifier to use in front of this receiver, and should be glad if you could indicate a suitable circuit.

D.D.E.

It is quite possible for you to construct a suitable H.F. amplifier for use in front of this receiver. Since, however, you intend making use of a short indoor aerial, you would in all probability find that an ordinary H.F. stage would be prone to instability, and it becomes necessary to make use of the neutrodyne method of balancing out the effects of valve inter-electrode and associated capacity. We give in Fig. 1 a suggested circuit for your purpose. It is advised that the H.F. transformer be very carefully constructed, and it would be well that you follow out some recognised design, such as that given in our issue of October 21st. A plug-in coil may be used for aerial tuning, and if desired a two-way coil holder may be used so that if necessary a reaction coil inserted in the plate circuit of the detector valve could be coupled to the aerial coil, although in our opinion it would be preferable to insert a short-circuiting plug in place of the reaction coil in your existing receiver, and to abandon the plug-in aerial coil in favour of an aperiodic aerial transformer such as was described in our October 21st issue, page 530, in conjunction with the neutrodyne transformer mentioned. With regard to the method of coupling this amplifier to your existing receiver, you should first remove the aerial coil from your receiver and then connect the output of the unit to your aerial and earth terminals. Your existing aerial tuning condenser will then tune the secondary of the neutrodyne transformer, the variable condenser shown in dotted lines being merely inserted to illustrate theoretical principles. The reaction coil socket of the existing receiver should either be short-circuited as suggested, or a plug inserted having flexible wires leading to any reaction coil that may be coupled to the aerial coil. Needless to say, the same batteries may be used for both the H.F. amplifying unit and the receiver.

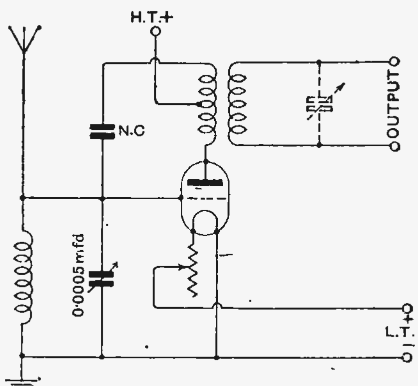


Fig. 1.—Circuit arrangement for an efficient H.F. stage.

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The Correct Value of Grid Leak.

I have recently been informed that it is possible to considerably increase signal strength by using a high value of grid leak, and should value your comments on the matter. *C.D.F.*

Within certain limits it is true that greater signal strength can be had by raising the value of the grid leak, and when searching for distant stations a value of 5 megohms should be used, and will enable many stations to be tuned in which would otherwise not be heard. A higher value is not recommended. When listening to the nearer stations, however, quality will be considerably impaired by such a high value, and the more usual value of 2 megohms should be used. In the case of the local station, when it is desired to obtain the utmost quality possible, the value may be reduced to a quarter of a megohm with a very salutary effect on the distortion due to cumulative grid rectification, but, of course, at some sacrifice of signal strength. The customary value of 2 megohms is purely an arbitrary value, intended to serve as a compromise between quality and quantity, and is by no means the "technically one and only correct value." It would seem an advantage, therefore, to incorporate a variable grid leak, not for the purpose of fine tuning, but for the purpose of effecting a change in value according to whether distant or local reception is to be carried out. Unfortunately the average variable grid leak is too "variable," and by no means consistent in its settings, and a far better method is to mount the actual grid leak clips on the panel and keep a selection of fixed grid leaks of various values close at hand.

○○○○

Using Telephones of Different Resistances.

I wish to use two pairs of telephones on my crystal receiver, and have in my possession one pair of 4,000 ohms and one of 120 ohms. Is there any method of operating these two pairs together from my receiver?

A.R.D.

It is quite a simple matter to operate these two pairs of telephones from your receiver. You will need a step-down telephone transformer and a 1 mfd. condenser. Connection should be made as shown in Fig. 2. If you are contemplating using one of these pairs at a distance from the receiver, it is recommended that the low resistance pair—that is, of course, the pair connected to the transformer secondary—be used for the extensions.

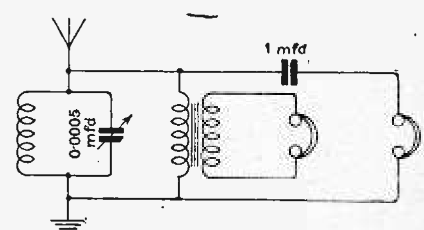

Fig. 2.—Using high and low resistance telephones together.

The Wireless World AND RADIO REVIEW

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

COMPETITION WITH PRIVATE ENTERPRISE.

THE recent evidence given before the Broadcasting Committee by Lord Riddell and Sir James Owen on behalf of the London, Provincial, and Scottish newspapers brought to light some interesting points additional and incidental to the main argument on that occasion, which was the extent of the powers which should be granted to the B.B.C. to act as distributors of news.

In the evidence it was stated that the newspapers do not claim that they are entitled to any special consideration, but that they consider that, since broadcasting is more or less a Government monopoly, it should, as far as possible, be conducted on lines which would ensure avoidance of injury to existing industries, and should not endanger the prosperity, or in some cases even the existence, of local newspapers which perform essential social services not open to broadcasting. It is a recognised tradition that the Government should not compete with private enterprise, and since we must recognise the broadcasting organisation as virtually a Government-backed concern, it is essential that the B.B.C. should not be given powers which would entitle it to violate this tradition.

CONTENTS.

A Government Tradition.

We have, then, a choice either of maintaining the tradition, if Government support of broadcasting is to continue, or, alternatively, the broadcasting service must be put on a basis where it is no longer nursed by the Government, but has to stand on its own legs and compete as a private concern on the same footing as other industries. The quite exceptional facilities which are placed at the disposal of the B.B.C. render it a very serious factor in competition with any private concern or industry with which it may conflict in common interests, and it is this fact, too, which renders it so essential that the scope of the B.B.C. in the direction of making advertising announcements should also be most clearly defined. Just as the newspapers are dependent for their prosperity on the distribution of news, so many other industries depend for their existence upon revenue derived from the sale of publicity services which they are in a position to offer.

Defining the Limits of Advertising.

We have referred above to a part of the evidence on behalf of the newspaper proprietors, where it was argued that broadcasting should be conducted so as to avoid injuring already existing industries. Perhaps in this argument we can find a definition which should assist in deciding upon the limit which should be put to microphone advertising, for if we agree to the principle that any advertising or other publicity matter which is broadcast must be of such a character that it does not conflict with or injure the interests of any private enterprise which may be in competition with the concern receiving microphone publicity, we shall in this way, we believe, eliminate all types of publicity which have hitherto given offence or are likely to do so in the future. This definition would leave the field open for collective advertising calculated to benefit an industry as a whole, but would eliminate all possibility of individual advertisement of a unit of that industry. In this way publicity talks of a collective character and those which might be proposed by concerns which, by virtue of their activities, were not in competition, would be eligible, but every such talk would be approved or rejected by those responsible for editing the programmes, who would naturally be guided by a consideration of the interest which the listeners would attach to the subject. Appeals for charity would still be accepted, as hitherto, on their merits and at the discretion of the directors of programmes.

oooo

COIL TESTS.

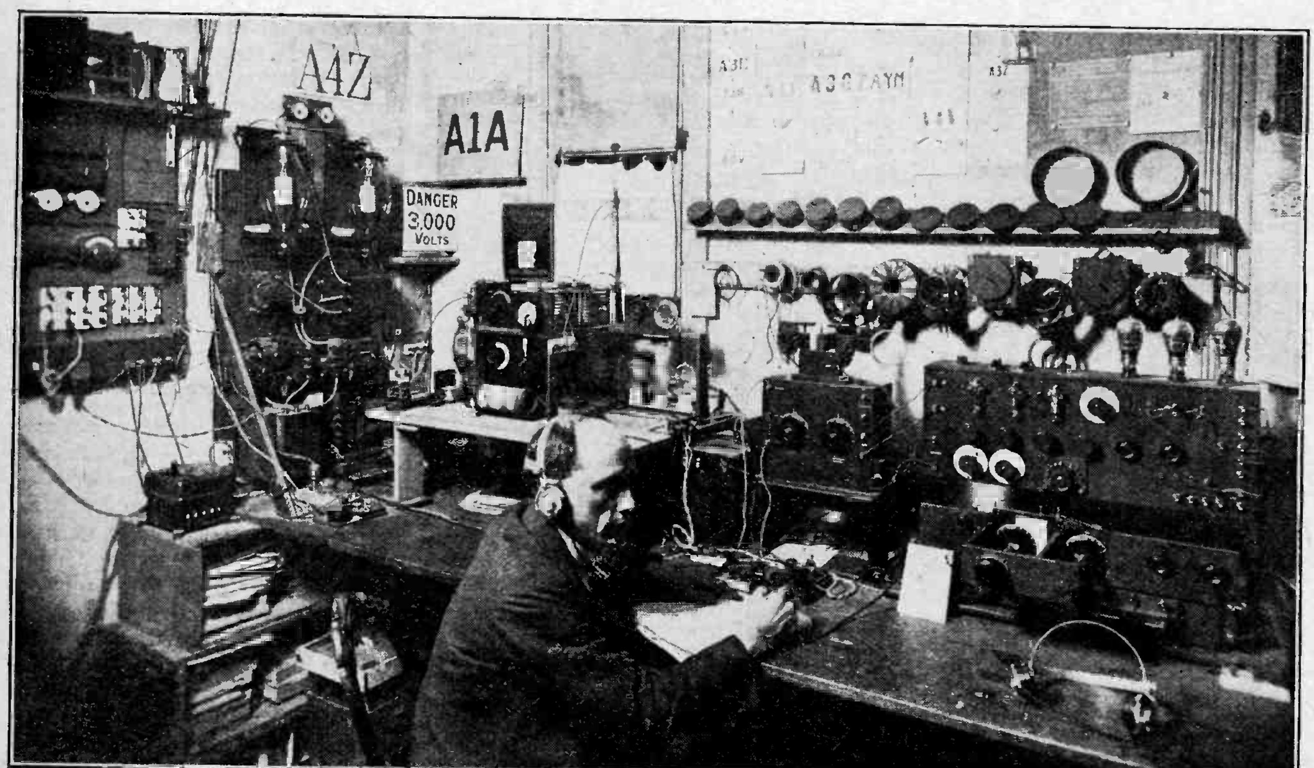
A FEW weeks ago we invited those readers who are interested in the design of tuning coils to submit specimens for test in *The Wireless World* laboratory. We thought that those who have studied the subject would be interested to know the electrical properties of their pet coils, and that a good deal of valuable and hitherto unobtainable information would be obtained from a careful examination of a large number of coils, more especially as they would be built by the experimenters who developed them.

As was expected, great interest was shown in this experiment, and parcels of coils of all shapes and sizes have arrived from all quarters. Instead of the hundred or so which we expected to receive, however, a much larger number has been sent in, accompanied, in many instances, by letters giving reasons for the choice of the particular shape of coil, style of winding, and gauge of wire used. These letters show that a great deal of care has been given to the design and construction, some writers even going so far as to give complete calculations.

The Single-layer Coil.

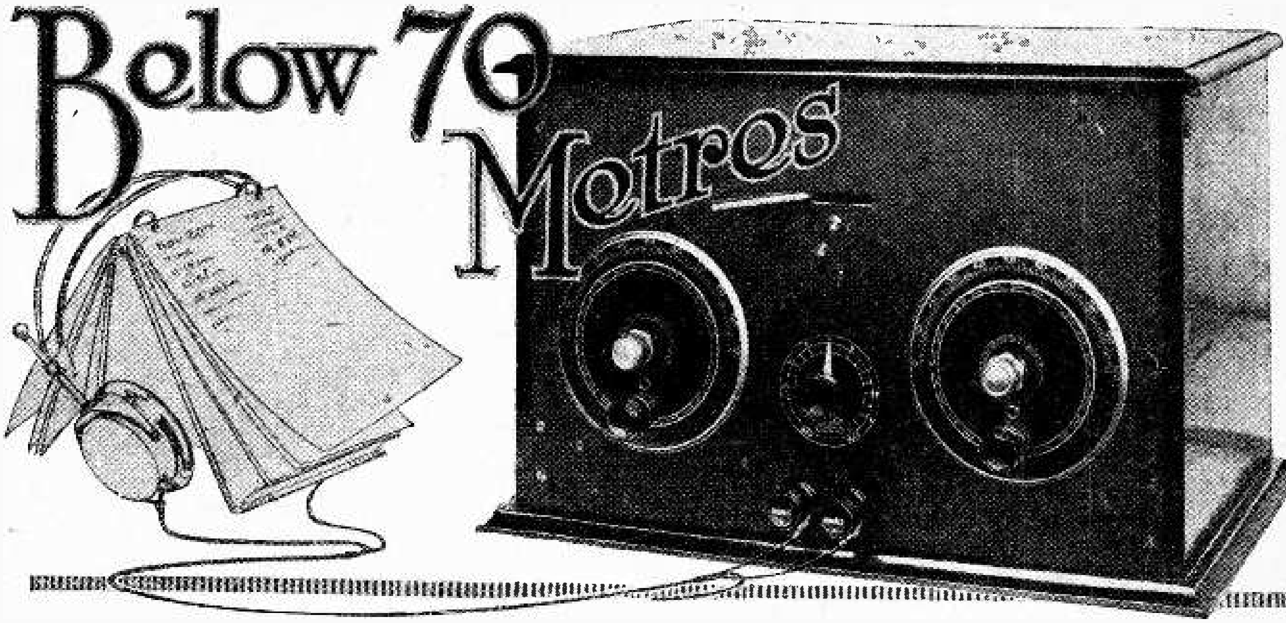
Already much interesting and extremely valuable data has been collected, and it is quite obvious that, instead of a well-made coil of 200 microhenries inductance having a resistance at 400 metres of 10 ohms or more, as would be expected according to some of the literature on the subject, it appears to be fairly easy to make reasonably compact single-layer coils having a much lower H.F. resistance than this. A 200-microhenry coil having a resistance of 4 ohms at 400 metres is the best one so far tested, and it is quite clear that single-layer coils are, on the whole, far superior to coils of the multi-layer type.

The work is proceeding with all speed consistent with careful measurements, and the results are being recorded in a form which, it is thought, will be most helpful to our readers. A short time must elapse before all the coils are tested and checked and the coils returned to their owners; in the meantime we wish to thank all those who did their part in making this experiment such a huge success.



AMATEUR TRANSMISSION IN SOUTH AFRICA. Mr. J. S. Streeter (OA4Z), the well-known Cape Town transmitter, whose signals have been heard in Great Britain, the United States, Argentina, Australia, Chile and Brazil. The high tension panel, carrying two Phillips rectifying valves, can be seen on the left. In front of the window stands the transmitter, the four lamps beside it composing the grid leak. The receiving apparatus occupies the right half of the bench.

Below 70 Metres



Constructional Article for Short-wave Enthusiasts.

By F. H. HAYNES.

Specification.

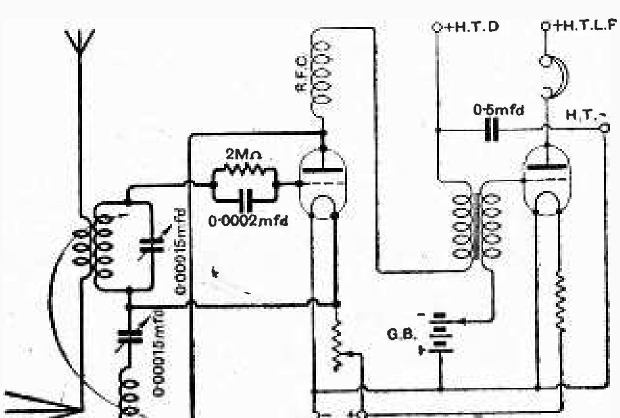
1. A two-valve set with oscillating detector valve and transformer coupled note magnifier.

2. Loose coupled aerial with tuned closed circuit and series-tuned reaction coil, giving critical control over self-oscillation, and consequently rendering the set particularly suitable for the reception of telephony.

3. Apparatus in the tuning circuits arranged to be uninfluenced by hand capacity effects, and the front of the instrument is, as regards high-frequency potentials, dead.

4. The tuning coils are of low self-capacity, and a minimum amount of dielectric material is used to support them. The tuning condensers have specially low zero values, and the detector valve is of low inter-electrode capacity.

5. The components are standard, and can be fitted without adaptation. The set is constructed making use only of a fine tenon saw or hack saw, hammer and centre punch, hand brace with set of drills, a six-inch steel square, several files, including a small flat key file and a rat-tail file, a screwdriver and soldering equipment. The cabinet is of standard dimensions.



Short-wave tuning circuit with variably coupled tuned reaction.

Materials Required.

This list is given in the order in which the parts should be obtained so that construction can be proceeded with :—

Cabinet, type No. 400 (Compton Electrical & Radio Trades Supplies, 63, Old Compton Street, London, W.1). 12in. × 8in. × 7½in. deep with baseboard.

Ebonite for front panel to measure 12in. × 8in. when finished and ¼in. in thickness.

A piece of ebonite 12in. × 3in. × 3/16in. for sub-panel.

2 cast angle brackets 2¾in. (A. J. Dew & Co., 33-34, Rathbone Place, Oxford Street, London, W.1).

A piece of ebonite 4in. × 3½in. × 3/16in. for the construction of the closed circuit coil.

A piece of ebonite 6in. × 3in. × ⅛in. for constructing aerial, reaction coils and spacing strips.

4 oz. No. 16 tinned copper wire for aerial and closed circuit inductances, also a small quantity of No. 22 bare copper wire for the reaction coil.

2 feet of ebonite tube ½in. outside diameter with ¼in. hole. It should be of clean finish and absolutely accurate to size.

4 inches of ¼in. hard brass rod.

2 variable condensers 0.00015 mfd. capacity. Bremmer Tully "seven plate" or 0.00025 mfd. for wider tuning range referred to below.

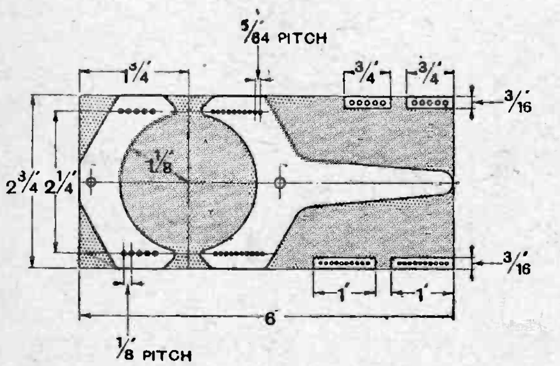
Filament rheostat "Siren" (H. C. Tofield, 30, Church Street, Birmingham).

Below 70 Metres.—

2 geared dials. These need not be provided with a quick movement as well as that through the gearing, and for easy searching the reduction ratio should not be excessive.

4 clips for mounting V.24 type valve.

2 inches of 1½in. ebonite tube.



Details for making the formers for the aerial and reaction coils.

Small quantity of 38 or 40 D.S.C. wire.

Gambrell low-ratio intervalve transformer.

Valve holder (Athol Engineering Co., Ltd., Cornet Street, Higher Broughton, Manchester).

Grid condenser and leak, 0.00025 mfd. and 2 megohms, Dubilier type 610.

Terminals marked "Phones +" and "Phones –," Belling Lee.

6-volt grid battery with plugs.

T.C.C. condenser, capacity between 0.1 and 1 mfd.

"Cabelug" battery connector with five leads for H.T. and L.T. batteries (R. A. Rothermel, Ltd., 24-26, Maddox Street, Regent Street, W.1).

Among the various screws required should be one dozen No. 6 B.A. cheeseheaded brass with washers and nuts, also three ½in. No. 4 B.A. countersunk with nuts for fixing the bent brass bracket which carries the reaction coil.

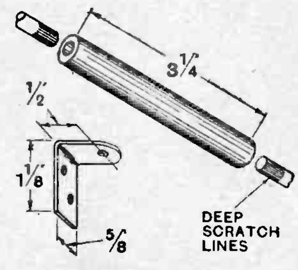
12 yards No. 20 india-rubber wire for connecting up (Ripaults, Ltd., King's Road, St. Pancras, N.W.1).

A small quantity of No. 22 resistance wire for fixed filament resistance of note magnifier.

Approximate cost of components and all necessary materials, £7 5s.

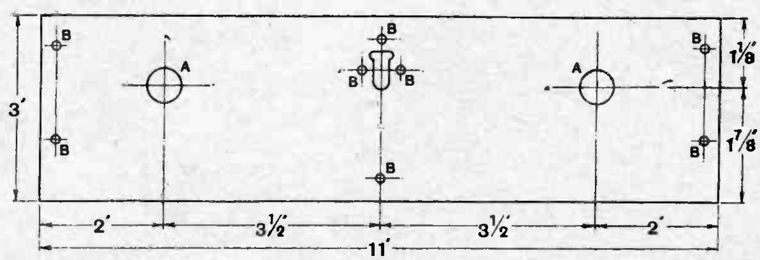
Panel, Sub-panel and Baseboard.

The front panel is accurately adjusted, by filing, to fit the cabinet, and is attached to the baseboard, which measures 7in. deep, ⅜in. in thickness, and is battened with pieces 1in. × ⅜in. The battens should be glued (Seccotined) as well as screwed to the baseboard to prevent warping, and three No. 4 × ⅜in. countersunk brass screws used for attaching each batten. It is important that the panel fits quite squarely to the baseboard, and, in order to hold it rigidly in position without the use of angle brackets, four No. 4 × ¾in. screws pass into the baseboard itself, and two into the battens.



An ebonite spacing piece, showing method of securing to the condenser spindle and the brass angle bracket on which the reaction coil revolves.

The sub-panel, which carries the condensers and is only 3/16in. in thickness, should be next trued up and adjusted to length to leave ½in. clearance on each end of the baseboard, so as to pass the battens on the cabinet.



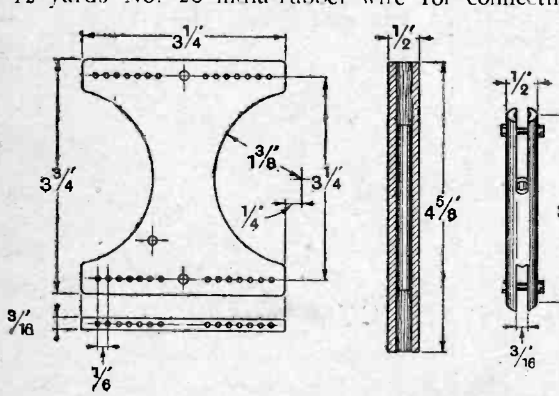
The sub-panel which carries the detector valve and tuning condensers. A, 9/16in. B, 1/8in.

The end brackets are attached, using No. 6 B.A. screws and nuts, taking care that the panel fits accurately down on to the baseboard. If accuracy is not exercised in fitting up the sub-panel, difficulty will be experienced in aligning the extension spindles of the condensers. Do not screw the brackets down to the baseboard at this stage.

Working to the drawing of the sub-panel, the condenser and valve holder clips are accurately set up in position. Before drilling the holes for the clips, verify that they are of the same type as shown in the working drawing.

Fitting Up the Condensers.

After making sure that the front panel is exactly square with the baseboard slide the sub-panel with brackets and condensers removed into position behind the front panel, and very accurately mark the centres for the dial spindles. The ¼in. holes are carefully put through the panel, making a 1/16in. hole first as a guide. The hole should

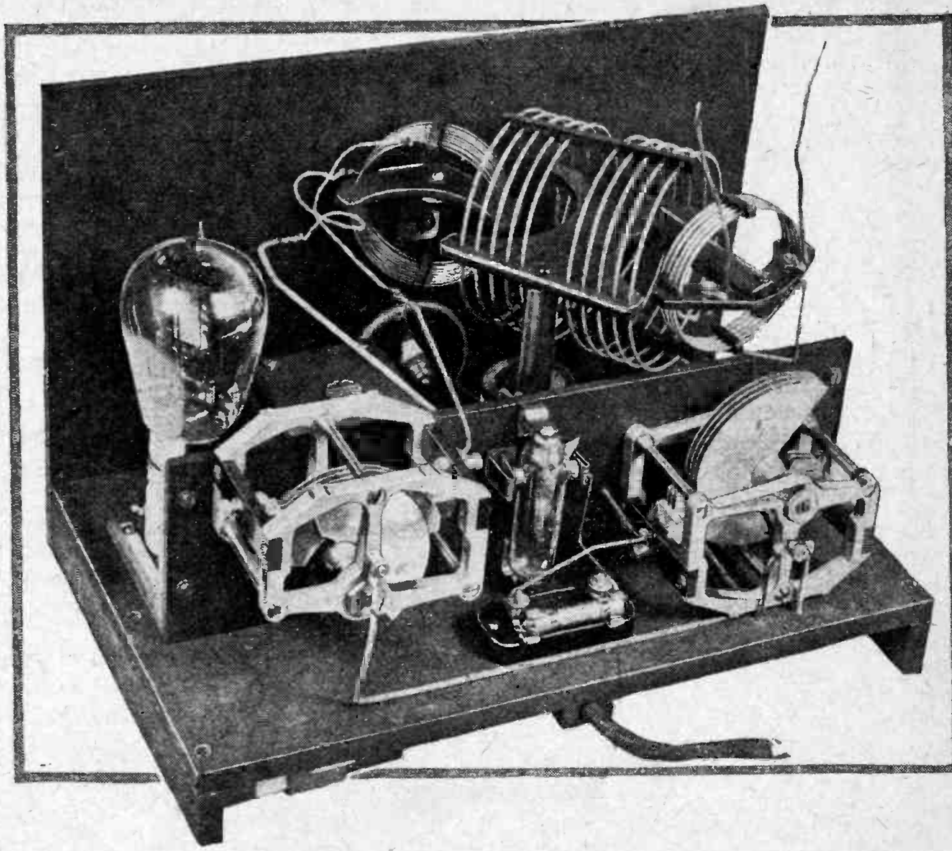


Dimensions of the closed circuit former, its supports, which are fitted with wooden plugs and the ebonite piece, which carries the aerial coil. The latter is made from 1/2in. tube.

Below 70 Metres.—

be slightly enlarged with a rat-tail file to give easy clearance for the $\frac{1}{4}$in. brass rod.

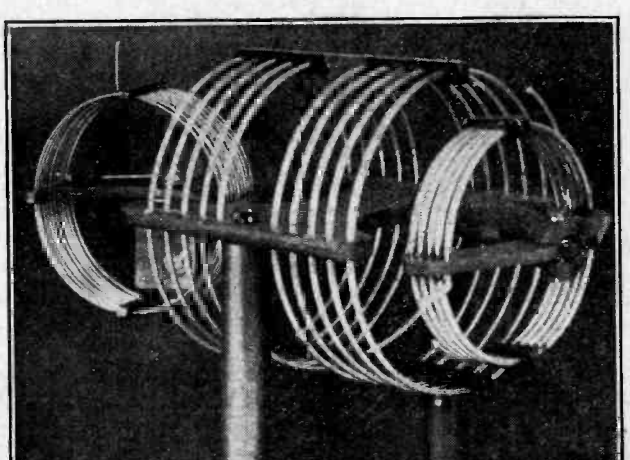
Two pieces of brass rod are then prepared $1\frac{7}{8}$in. long and the ends slightly rounded. By making scratch lines with the edge of the file for a distance of about $\frac{3}{4}$in. on one end of each of these pieces, they can be driven into the $\frac{1}{2}$in. ebonite rod, and will securely hold without the use of grub screws or pinning. Similar scratch lines should be made on the spindles of the condensers, and when finally assembling it will be found that the ebonite tube can be forced on without unduly straining the condensers. The pieces of ebonite rod are about $3\frac{1}{4}$in. in length, while the space between the two panels is $4\frac{1}{8}$in.



The tuning equipment is assembled so as to be well removed from the manipulating controls on the front of the set.

The Coils.

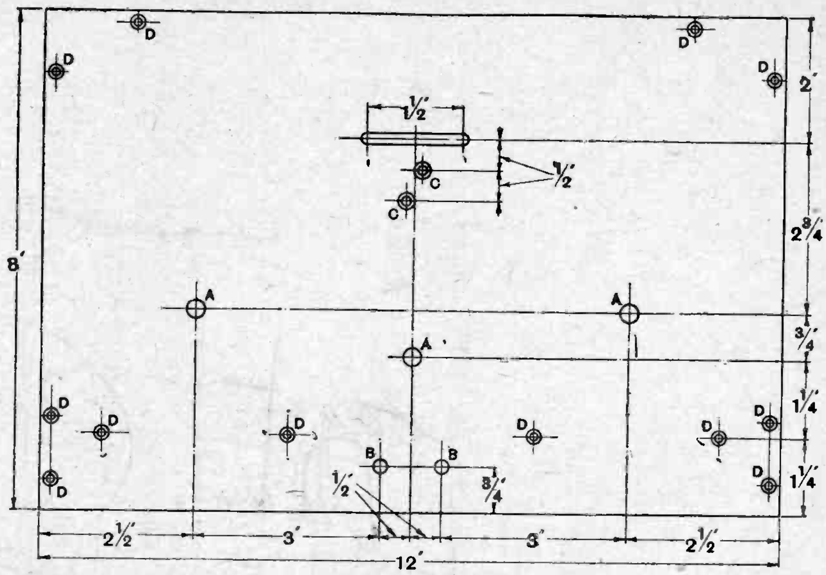
The centre frame for the large closed circuit coil is made from $\frac{3}{16}$in. sheet, and it should first be accurately outlined on the face of the ebonite, including the positions for the holes, and the lines worked down to with a file. The semi-circular pieces, which are removed to give clearance to the aerial and reaction coils, can be cut out by linking up a number of small holes or by the use of a small fret saw if one is available. A piece of ebonite shaped in this manner is apt to be weak, and should therefore be gripped low in the vice when working on it, and on no account must a hammer be used to assist in breaking away the cut-out pieces. A $\frac{1}{16}$in. hole usually gives good clearance for No. 16 wire, but, owing to the thickness of this piece of ebonite, the holes along the sides should be $\frac{5}{64}$in., and the edges of the holes may be just cut away with the point of a larger drill. The top and bottom spacing pieces are made from $\frac{1}{8}$in. ebonite, and the holes are $\frac{1}{16}$in. It is important that the holes should be accurate in spacing, or otherwise the wire will not slide through easily when threading on the turns. The coil is $3\frac{1}{4}$in. in diameter, and therefore the wire must be wound, after having been previously straightened by stretching on a cylindrical former about $2\frac{5}{8}$in. in diameter with turns touching. The actual diameter required will depend upon the hardness of the wire. Do not release the tension when winding on the former.



A close-up view of the tuning coils.

Tuning Range.

If the holes through which the wire is threaded are spaced $\frac{1}{8}$in. apart, five turns can be threaded on each side of the centre supports, and this coil, in conjunction with the others, as shown in the working drawings, will tune from about 30 to 58 metres, and would be suitable for the interception of amateur transmissions on 35 metres, and WGY (2XAF) on 41.9 metres. In order to include KDKA on its wavelength of just over 60 metres the pieces can be drilled as shown in the drawings. A wider waveband can, of course, be obtained by substituting condensers with a maximum capacity of 0.00025 mfd., and sufficient depth has been provided in the



The front panel. Thickness, 1/4in. Sizes of holes, A, 5/16in.; B, 1/4in.; C, 5/32in.; D, 1/8in.

Below 70 Metres.—

design of the set to accommodate them. With a limited waveband, however, the smaller tuning condensers are easy to manipulate, self-oscillation is more easily controlled, and slightly greater signal strength is obtained than when the 0.00025 condensers are used near a maximum setting.

The aerial and reaction coils shown may be used over the waveband of 30 to 70 metres, though, as already suggested, a larger reaction condenser should be used when a larger parallel condenser is adopted in the closed circuit. The construction of the aerial and reaction coils requires no explanation, and full details can be obtained from the drawings and illustrations. Details for the construction of the rod which supports the aerial coil are also given. The coil pivots about the hole in its centre, the arm being rigidly fixed in position. In setting up the coils, the reaction coil should be placed in position first, the bracket providing a pivoting point ½in. behind the panel. The coil will be found to turn through approximately a right angle. By holding the closed circuit coil in position the supporting rods can be marked off as to length, and positions for fixing determined, so that the reaction coil moves as near as possible to the closed circuit coil, and that at the position of maximum coupling the coils are concentric with turns lying parallel.

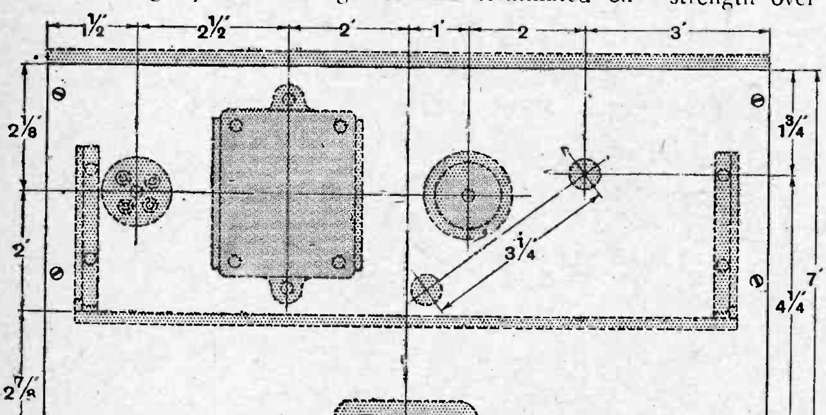
The choke coil carries 1⅝in. of winding of No. 38 or 40 D.S.C., and it is advisable to terminate at each end with two or three turns of No. 30 wire.

Wiring.

The wiring up can be carried out from the practical wiring diagram, and the arrangement of the components in the tuned circuits will be found to provide short and direct connections. The flexible leads to the reaction coil consist of twelve strands of the wire used to wind the choke coil lightly twisted together and terminated on pieces of stiff wire suitably placed to allow for the swinging of the coil. The actual method of connecting up shown will cause the set to oscillate, assuming that the coils are wound in the same direction.

In Operation.

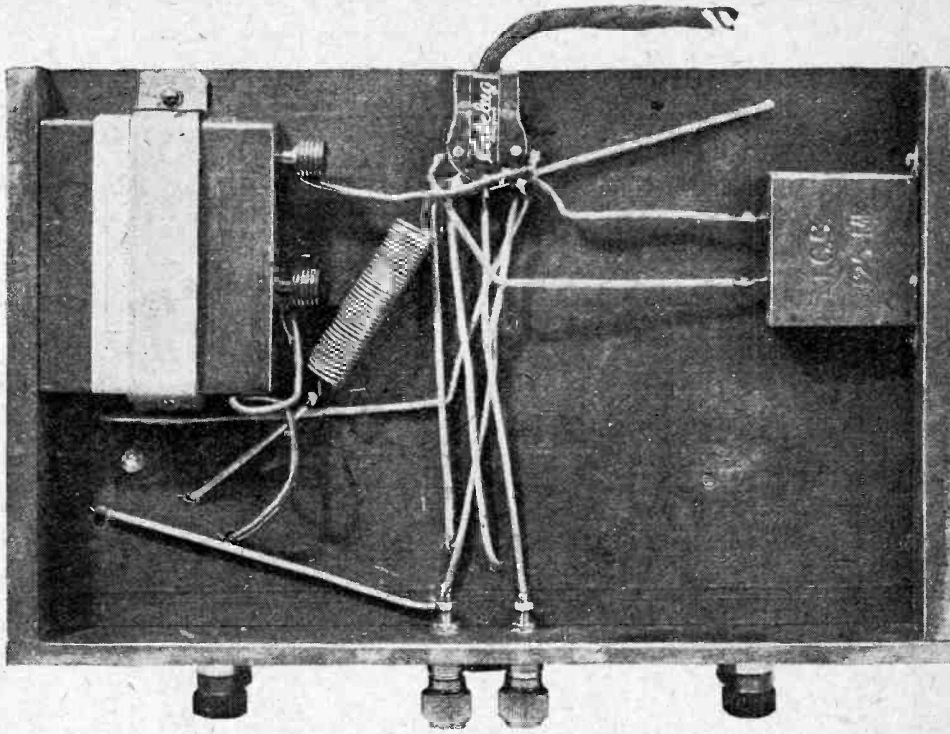
The most important factor to consider in the design of a short wave set is that of obtaining a smooth reaction control. This can be accomplished with the series tuned reaction circuit, assuming that the inductance and capacity values are suitably chosen, and depending also upon the correct size of grid condenser and leak, the proper adjustment of plate voltage, a suitable and sometimes critical regulation of filament brightness, and the elimination of certain stray capacities acting in a way to bring about self-oscillation. It is principally for this reason that a valve of the V.24 type is adopted for detection. For the reception of Morse signals the manipulation of self-oscillation is not critical and will not alter signal strength over an appreciable range of adjustment, but when receiving telephony it is most important that the circuit shall move into a state of oscillation without emitting a click. It has been shown that the grid to plate capacity of an "R" type valve is about twice that of the tubular type, whilst the filament to grid capacity is about five or six times as great. In the "R" type valve the filament to grid capacity is about 6 micro-microfarads, being greater in value than either the self-capacity of the coil or the zero capacity of the condenser, and being set up across the glass dielectric of the pinch of the valve, not the best of dielectric materials, a degree of damping will be produced which will tend to counteract the advantages gained by the use of specially constructed tuning equipment. There is little point in



Positions for assembling the components on the baseboard.

Below 70 Metres.—
carefully distributing the electrostatic strain between adjacent turns in the inductances, if the entire winding is to be bridged by a short path in the glass foot tube of the valve and where, in consequence, electrostatic strain is likely to be dense.

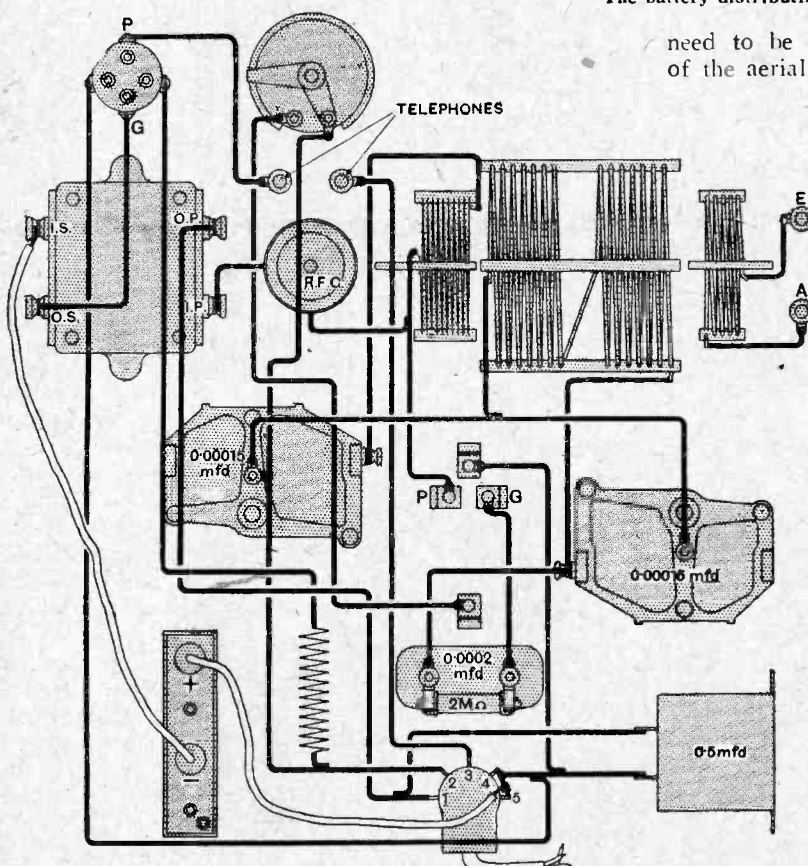
In operating the set just on the oscillating point the two dials should advance more or less together, and a position of coupling with the reaction coil can be found where this will result. Points will be found in the tuning range, however, where the closed circuit comes into tune with a harmonic of the aerial, and the damping produced is best compensated for by swinging the reaction coil to restore self-oscillation. The aerial coupling will need to be experimented with, depending on the size of the aerial, and, once set, requires no adjustment.



The battery distributing leads beneath the base.

The receiver should be used with a counterpoise, and, consequently, it is advisable to stand the batteries on an insulated board immediately behind the set. The writer has made up a choke coil unit consisting of a pair of coils similar to the one fitted in the set, which are connected to the telephone terminals immediately in front of the set, and eliminate the varying capacity effects produced by wearing the head telephones. For loud-speaker reception a resistance coupled amplifier with optional second stage and working from H.T. and L.T. batteries, which are independent of the receiver, replaces the telephones keeping the choke coils in circuit. By this means the amplifying equipment with several pairs of telephones or loud-speaker can be handled, and in no way is the tuning of the set disturbed.

If a very short earth lead is employed these precautions may not be found necessary, particularly as the aerial and earth connections joining to the aerial coil do not connect up either directly or through an appreciable capacity with the tuning apparatus of the set. Even the spindle side of the variable condensers which are at L.T. battery potential cannot be handled without slightly unsettling a beat note or marring the merits of a telephony transmission on the very short wavelengths when the



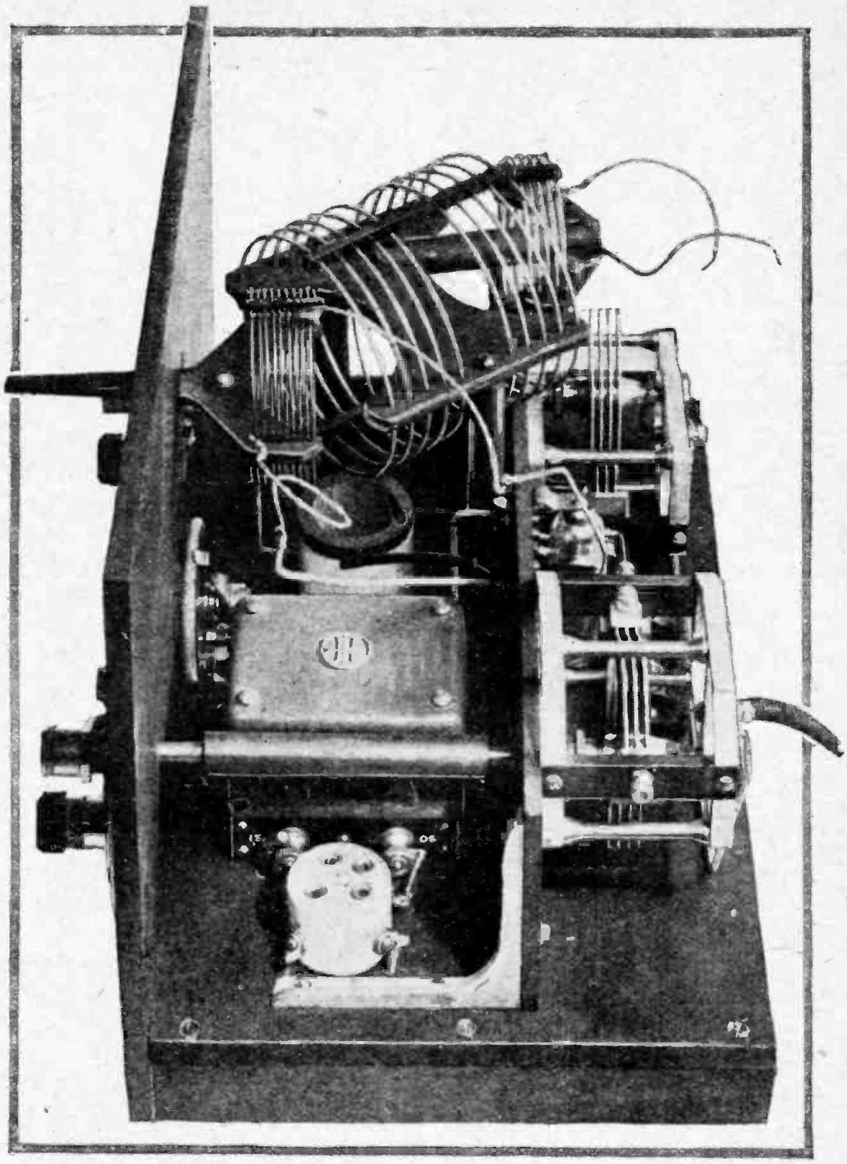
Practical wiring diagram. The components are shown in approximately their correct relative positions.

Below 70 Metres.—tuning capacity is at a low value.

With this particular set, using the larger coil and condensers, the programme of KDKA was received at good loud-speaker strength without the omission of a single announcement on three valves, with excellent quality and entire absence of noise, fluctuation, or evidence of oscillation. On this occasion the tuning coil consisted of fourteen turns and the tuning condensers were of 0.00025 mfd. maximum capacity. Sixty feet of single wire was used as an aerial sloping down to a first floor window from the top of a mast, and the counterpoise was also a single wire 40ft. long falling away to a height of about 7ft. from ground level at the far end.

Working on a Small Aerial.

The connections between the leading-in wires and the set must be short and well spaced. It is not essential to erect a small aerial for short wave work, and better results are usually obtained by harmonic tuning of an aerial between 60 and 100ft. in length. On the other hand, if an elevated outdoor aerial is not available, quite good results can be obtained on a few feet of wire stretched across a room with a counterpoise wire some feet beneath it. The relationship between the natural wavelength of the coupled aerial circuit and the wavelength of the signal has a definite bearing on the range and distance of best reception, and some valuable investigation work can be conducted by the amateur into this matter. Other factors also probably bear upon it. The natural wavelength of small aerials can be estimated with accuracy, and nodal points established by small series connected condensers.



View showing the assembly on the baseboard.

With the set completed and in operation, the short wave enthusiast should turn his attention to the construction of a suitable wavemeter with valve oscillator and enclosed filament heating and H.T. batteries.

THE AMATEUR'S EDUCATION.

Must He Learn Languages?

"IT is beginning to look as if a knowledge of Greek will soon be a necessary part of the wireless amateur's mental equipment," writes Prof. G. W. O. Howe, D.Sc., in *The Electrician.* "Physics and electrical technology may assist him in the invention, design, and operation of new radio circuits, but they will not help him to find names for them, nor to understand the names given to them by other people.

"There was a time, not long ago, when 'dyne' was known only as a unit of force, but it seems now to have become a unit of wireless construction.

"We have heterodyne and neutrodyne, tropodyne and solodyne, unidyne and molodyne, and many more; it certainly looks as if those who interest themselves in wireless matters are expected to have a classical education."

CHARGING FROM A.C. MAINS.

Advantages of the Tantalum Electrolytic Rectifier.

By PROF. E. V. APPLETON, M.A., D.Sc.

MOST people would agree that the trouble of charging accumulators and of replacing high-tension batteries is one of the chief disadvantages of wireless. This trouble has been recognised by the valve manufacturers, who have done a good deal for us in reducing filament current consumption, so that the charging of one's accumulator need not be a weekly affair. But, unfortunately, that is not a complete solution of the problem.

Battery Maintenance Problems.

To solve the battery problem we must have some simple apparatus, with a simple switching device, by means of which the battery may be charged *in situ*, thus eliminating the trouble of disconnecting the accumulator and of transit to the local charging establishment. In this article I describe what I consider to be the most convenient solution available at the present day.

In the first place it should be stated that the battery problem can only be solved when there is an electrical supply available. In remote country districts, where charging is impossible, dry cells have, of necessity, to be used for both low- and high-tension batteries, but I think that most people who are able to choose would prefer accumulators to dry cells, so that medium-current filament valves can be used. When the electrical supply is a direct voltage one there is no difficulty, and resistance and switching systems for charging accumulators in such cases have been described many times. The difficulty arises when the supply is an alternating one, as is so often the case nowadays, and a form of rectifier has to be used. Then one has to make a choice from the three types of rectifiers available, namely: (a) vibrating reed rectifiers, (b) vacuum tube (including gas discharge) rectifiers, and (c) electrolytic rectifiers. For home use class (a) can be ruled out because of the noise and liability to get out of order, so that the real choice is between class (b) and class (c).

Electrolytic Rectifiers.

Now if this choice had had to be made some years ago there is little doubt that most people would have chosen the gas rectifier as requiring less attention than the electrolytic rectifier. But this would have been because the aluminium electrolytic rectifier was the best of its type available in those days. The whole problem has recently been completely altered by the introduction of the tantalum rectifier which, unlike the aluminium rectifier, does not get hot and requires no special supervision whatever. There is, to me, little doubt that the tantalum rectifier, because of its simplicity, will be preferred by all who have to make the choice nowadays.

It may be useful to consider first the general scheme of using a rectifier before going on to discuss the tantalum rectifier in particular. In the first place it should be noted that a rectifier which is always readily put into circuit can be used to keep the accumulator fully charged; that is to say, it can be put into action daily during the hours when the set is not in use. In this way the battery is never allowed to run down, and its full voltage is always available. Also it is not necessary to get expensive cells of specially large capacity (30 to 50 ampere hours rating is sufficient). If a large current is taken from the cells during the evening period the same quantity of energy can be replaced during the day-time, if necessary at a lower current rate, but over a longer period. This system of slowly replacing energy used is called "trickle charging," and its success depends on having a rectifier which needs no attention whatever. The battery can be connected by means of a change-over switch either to the set, or to the charger, or left disconnected. The alteration of the connections is a matter of one second.

Choice of Electrodes.

It has been known for many years that certain metals when used as electrodes in a suitable electrolyte offer a high resistance to the flow of current from electrode to electrolyte, but practically no resistance to the current flowing in the opposite direction. Such a device will obviously act as a valve for an alternating current circuit. A lot of metals may be used for producing this valve effect, among which may be mentioned aluminium, tantalum, tungsten, bismuth and magnesium, but only two of them have been successfully used in practice as electrolytic rectifiers, namely, aluminium and tantalum. Quite recently the Bureau of Standards in America (which corresponds to the National Physical Laboratory in England) has made a very close study of these two substances when used as rectifiers, and has given many weighty reasons why tantalum is to be preferred to aluminium for the charging of accumulators. These may be briefly summarised as follows:—

(a) The aluminium rectifier has a very low efficiency and requires careful and constant attention.

(b) The aluminium rectifier, when not in constant use, loses its rectifying power, and, after it has been standing idle for some time, it is necessary to re-form the film of oxide on the aluminium by means of direct or alternating current.

(c) Tantalum is very much more resistant to the action of the electrolyte than aluminium, and its use permits the passage of much larger rectified currents.

The Story of Tantalum.

Although tantalum was discovered over a hundred years ago it is only recently that tantalum of a high state of purity, and capable of being worked into sheet rod or wire, has been available. In 1824 Berzelius, the distinguished chemist, obtained a specimen with 60 per cent. of tantalum, while Moissan later produced a still purer specimen. In 1902 Dr. von Bolton developed a process for making drawn filament wire for

Charging from A.C. Mains.—
incandescent lamps, but, as is well known, its use is gradually being replaced by the use of tungsten. Anyone who is interested in the chemistry of tantalum will find much of interest in a paper on tantalum read before the American Institute of Chemical Engineers on December 6th, 1922, by C. W. Balke. In that paper the fascinating story of the production of pure tantalum and of the rise of its importance in industry is told.

Some Tantalum Rectifier Circuits.

Let us now consider some simple rectifier circuits. If two plates of tantalum are immersed in dilute sulphuric acid, and are also connected to a source of alternating potential, current will only flow for a few seconds, during which time a thin film, which often shows beautiful colours, is formed on the surfaces of the plates. Now if, instead of using two plates of tantalum, one plate of tantalum and one plate of lead are used we find that one-half of the alternating current wave will be suppressed, current passing only from lead to tantalum. An example of a simple practical circuit for such rectifying operations is shown in Fig. 1. It will be noted that the alternating current supply is first stepped down by means of a transformer to 40 volts or less, for it has been found that 40 volts is the maximum voltage giving constant operation in the rectifier. The secondary winding of the transformer is connected to the tantalum electrolytic cell, and direct current can be taken from the terminals marked "to accumulator."

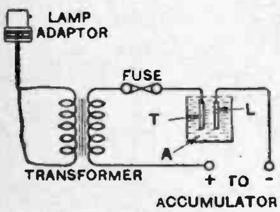


Fig. 1.—Tantalum and lead electrodes immersed in dilute sulphuric acid and connected to give half-wave rectification.

Another type of rectifier circuit is shown in Fig. 2 by means of which both halves of the alternating current wave are used. This full-wave rectification may be accomplished by using two cells or series of cells or by using (as is illustrated in Fig. 2) a single cell with two tantalum electrodes.

The Use of Depolarisers.

In the case of the tantalum rectifier it has been recently found that the introduction of certain salts to the sulphuric acid reduces polarisation, and thus greatly decreases the internal resistance of the cell. This effect is of the greatest importance, for by means of it the current output of a rectifier cell may be multiplied several times. When the highest current output is required sulphuric acid of specific gravity 1.100 to 1.250 (which is approximately the same as is used in lead-type storage batteries) to which has been added ferrous sulphate crystals (not more than 1 gm. in 100 c.c. of solution) has proved the most satisfactory. Moreover, as has been found from an exhaustive series of tests, this combination of electrolyte and depolariser has been found not to result in undue heating, which assists enormously in preventing excessive evaporation of the electrolyte.

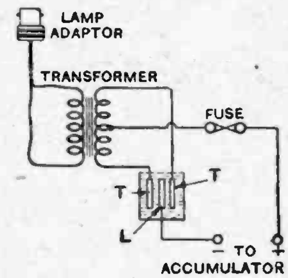


Fig. 2.—Full-wave tantalum rectifier.

The Balkite Battery Charger.

For those who do not wish to be troubled with the construction of a tantalum rectifier there is on the market a rectifier complete with suitable transformer, fuse, and leads. This is a full-wave rectifier, and will charge a 6-volt accumulator at 2½ amperes, so that a 50-ampere-hour accumulator can be completely charged in about 20 hours. This charge can be obtained for two ranges of supply voltage, namely, 200-240 volts and 100-115 volts. The only connections to be made with it are to the electric mains by means of the adaptor and to the accumulator to be charged by means of spring clips.

Calls Heard.

Extracts from Readers' Logs.

Dublin.

(November 29th to December 6th.)

Australia: 2CM, 2YI, 3EF. New Zealand: 2AC, 2XA, 4AC, 4AS. Argentine: AA8, RFH4. Brazil: 1AC. Canada: 1AR, 1AK, 2AX, 2FO, 9BJ. U.S.A.: 1AAO, 1ADI, 1AHG, 1AHV, 1AIU, 1ANZ, 1AOF, 1AOU, 1APZ, 1AXA, 1AZD, 1BV, 1BX, 1CAL, 1CH, 1CMF, 1CPQ, 1GA, 1KA, 1RD, 1SAL, 1SE, 1YB, 1ZA, 2ADM, 2AES, 2AG, 2AGQ, 2AHM, 2AIU, 2AKB, 2AX, 2ANM, 2APV, 2AUM, 2BM, 2BRB, 2CNS, 2CRP, 2CTH, 2CVJ, 2CVS, 2CW, 2FK, 2GX, 2KX, 2LD, 2ME, 2UK, 2XU, 2ZV, 3BHV, 3BOB, 3BNU, 3BSS, 3BUP, 3WN, 4RR, 5AHP, 6BJD, 6HM, 8AKS, 8ALY, 8AM, 8AZU, 8BGN, 8BTH, 8BKN, 3BPN, 8BWR, 8CAU, 8CBI, 8CIB, 8CYI, 8DCB, 8DGP, 8MC, 8RT, 8SE, 8SI, 8XE, 9AAD, 9AKD, 9APN, 9CTR, 2DS, 9GXX, 9PU, 9UA. Norway: LA, 1A. Germany: KI8, KK4LV. Unknown: LS1, and 2CTF.

(0-v-1) all below 80 metres.

D. M. and D. F. O'Dwyer.

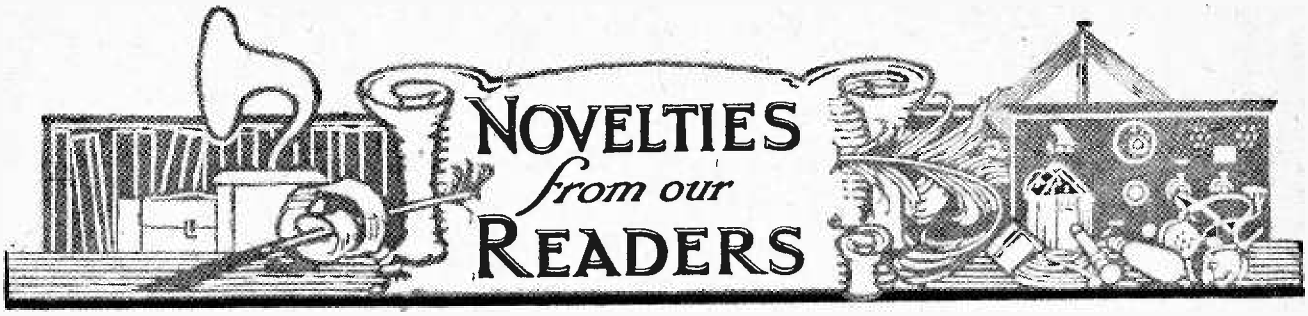
Howden, Yorks.

(September 10th to December 10th.)

France: 8AAA, 8ACA, 8AL, 8AS, 8BYB, 8CA, 8CAX, 8CQ, 8CT, 8CU, 8DAS, 8DD, 8DGS, 8DTD, 8EB, 8EE, 8EP, 8FW, 8GR, 8GZ, 8HA, 8HLL, 8HU, 8JA, 8JEH, 8JGP, 8JO, 8JYZ, 8KK, 8KR, 8LMH, 8LMP, 8LX, 8LZ, 8MB, 8MCQ, 8MD, 8MH, 8MIU, 8MS, 8MUL, 8NA, 8NFT, 8NN, 8NNN, 8OWB, 8PAX, 8PGL, 8PPC, 8PR, 8PRD, 8RA, 8RAT, 8RBE, 8RG, 8RLH, 8SSC, 8SSM, 8SU, 8TH, 8TK, 8TMK, 8TOK, 8VTI, 8UV, 8WAG, 8WK, 8WS, 8YB, 8YNB, 8YNP, 8YOR, FW, YG, YZ. Belgium: 4AO, 4AC, 4GB, 4KR, 4LK, 4RE, 4RG, 4SR, 4UC, BA8, BB7, BE2, BK3, BN4, BQ2, BS5, BU3, BU5, BX3, B2cm, B3UC. Holland: 0AW, 0AX, 0BD, 0BLN, 0BX, 0F3, 0HB, 0HTS, 0KW, 0MO, 0OL, 0PM, 0PO, 0PX, 0RB, 0REN, 0RM, 0RO, 0WB, 0WC, PCLL, PBIO. Italy: 1AF, IAS, IBD, IBA, IGB, IGN, IGV, ILP, IMT, IRB, IRM, ITV. Germany: K1K, K3BB, K3K, K56, KK4, KK5, KL3, KR7, KX5, KY4, KY5. Scandinavia: L1WAG, S2CO, S2NM, S2NX, 83NB, SGBR, SMTX, SMUI, SMXU, SMYU. U.S.A.: 1ARF, 1CH, 1DO, 1WGH, 1GB, NRL, WGH, WIR, WIZ, WQO. Tunis: OCDB, OCDJ, OCML, OCTU. Switzerland: 9BF, 9BR, 9BZ. Spain: EAA8, EAR0, EAR21. Morocco: MAROC. Portugal: PIAF. Philippine Islands: PI, 1HR. Miscellaneous: DFY, BXO, PMS, HTH, GFD, NOT, Y7XX, PKX, BYZ, 96TM, C23.

(0-v-1) (30 to 100 metres.

D. E. Scarr.



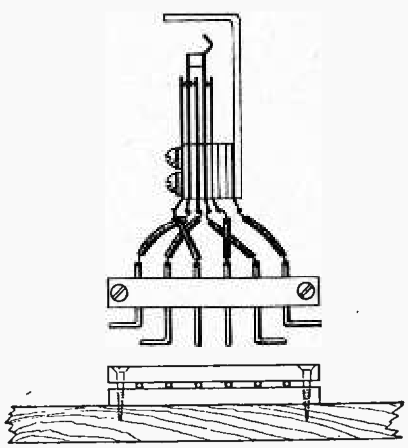
A Section Devoted to New Ideas and Practical Devices.

WIRING TELEPHONE JACKS.

Double filament telephone jacks are difficult to wire with the No. 16 S.W.G. tinned copper wire which is generally used for wiring up receiving apparatus.

There are six contacts, and difficulty is often experienced in manœuvring the iron into a suitable position for soldering. Further, the rigidity of the thick wire is apt to cause subsequent breakage.

The diagram shows a method by means of which these difficulties may be overcome. A clamp consisting of two wide strips of ebonite or hard



Improved method of wiring telephone jacks.

wood soaked in paraffin wax is screwed to the baseboard or panel of the receiver near to the telephone jack and the wiring which goes to the jack terminates at the clamp with about $\frac{1}{4}$in. projecting. Thin wires of say No. 30 gauge D.S.C. are soldered to the tags on the telephone jack before assembling in position, the final operation being the connection of these wires to the thick connecting wires projecting from the clamp. If the distance between the clamp and telephone tag is small, short lengths of systoflex may be used for safety.—H. D.

oooo

EBONITE CUTTER.

When cutting receiver panels from a large sheet of ebonite some form of cutter is necessary unless a special hack saw is available. A hack saw blade can be used for this purpose if the end is first broken off with a pair of pliers with the teeth pointing towards the hand. A straight-edge is placed across the ebonite sheet in the required position, and the pointer of the blade is lightly drawn across the panel several times to start the cut. The straight edge may then be removed and the pressure increased, when it will be found possible to part the ebonite in a remarkably short time leaving a clean square edge. The ebonite will soon destroy the cutting edges of the leading teeth of the saw, when it will be necessary to break off a further small portion of the blade to bring fresh teeth into action.—C. B.

oooo

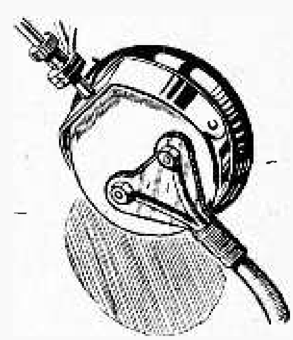
FLEXIBLE SHIELDS.

In experimenting with two or more stages of H.F. amplification with tuned coupling, screening is necessary if the components are to be mounted within a receiver cabinet of standard dimensions. There is no standard method of adequately screening valves and coupling coils, and individual methods have to be worked out for each particular case. It is therefore desirable to have some form of flexible shield which can be inserted between different parts of the circuit and for this purpose the shield may conveniently consist of a sheet of hard rolled copper foil covered on both sides with sheets of thick drawing paper or Bristol board. An overlap of at least $\frac{1}{4}$in. should be allowed at the edge to prevent short-circuiting of the wiring in the receiver.—H. M.

oooo

PROTECTING TELEPHONE CORDS.

Trouble is frequently experienced through flexible telephone leads pulling off the terminals of the earpieces. When the terminals are fitted externally, the leads may be relieved from tension at their weakest point, where they are clamped under the terminal screws by fitting a celluloid plate cut to the shape shown in the diagram. Holes are drilled a suitable distance



Telephone cord attachment.

apart in order that the plates may be clamped under the terminals together with the ends of the telephone cords. The edges of the narrow portion of the celluloid tag are serrated, and the telephone cord is securely bound to the celluloid at this point with waxed thread. By this means the tension is transferred from the thick part of the cord directly to the earpiece terminals instead of through the delicate loops at the end of the two internal wires.—V. I. N. W.

H.T. ACCUMULATORS.

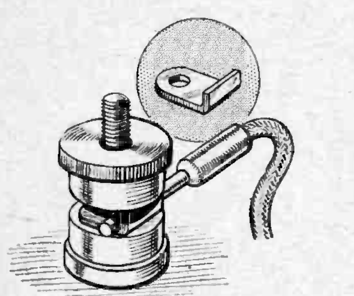
Considerable difficulty may be experienced with certain types of H.T. accumulators now on the market, owing to the vents being of so small a size that the ordinary method of filling with solution in the first case, or with distilled water afterwards, merely causes the liquid to flow over the top.

If a fountain pen filler is fitted with a suitable length of rubber tubing of the kind used for the valves of cycle tyres, it will be found that no difficulty will be experienced in filling the cells without any overflowing, as the air can escape round the outside of the rubber tubing, and thus an even flow is assured.—D. H. S.

oooo

TELEPHONE TAGS.

Telephone leads with straight terminal tags can be gripped in ordinary telegraph type terminals without the necessity of bending the tag in the form of a hook if a special washer of the form shown in the diagram is inserted between the two faces of the terminal. The washer is cut from brass strip, a clearance hole being drilled at one end for the terminal screw. The other end of the washer



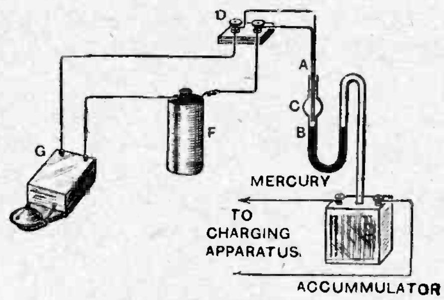
Retaining washer for telephone tags

is turned up at right angles and filed down until the height of the lip so formed is less than the diameter of the terminal tag. It will then be seen that the terminal screw will bind on the telephone tag, while the washer will prevent it from being forced out at the side.—B. W. W.

oooo

CHARGING ACCUMULATORS.

The diagram illustrates an automatic warning device for indicating the commencement of gassing of accumulators on charge. A manometer tube containing mercury is connected to the vent of the accumulator by means of rubber tube. Two wires from a terminal board D are inserted at the point A and adjusted until their points reach the base B of the reservoir bulb C. The wires may be in-



Warning device for indicating the commencement of gassing in accumulators.

sulated from each other by means of suitable lengths of systoflex. A local circuit consisting of a dry cell F and electric bell G are connected across the terminals D. During the early stages of the charge the amount of gassing is quite small, and the pressure inside the accumulator is relieved by leakage round the terminals. When the charge is nearly completed, however, and vigorous gassing is taking place, the mercury in the manometer tube will be forced round until the wire points at B are short-circuited. This will ring the bell and indicate that the time has arrived for a reduction in the charging current.—H. J.

oooo

LOUD-SPEAKER IMPROVEMENT.

Metal loud-speaker horns which are inclined to resonate, can often be improved by stretching over the neck of the horn a rubber band, 2in. or 3in. wide, cut from an old motor car inner tube.—E. P. H.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A receiving valve will be despatched to every reader whose idea is accepted for publication.

Letters should be addressed to the Editor, "Wireless World and Radio Review," 139, Fleet Street, London, E.C. and marked, "Ideas."

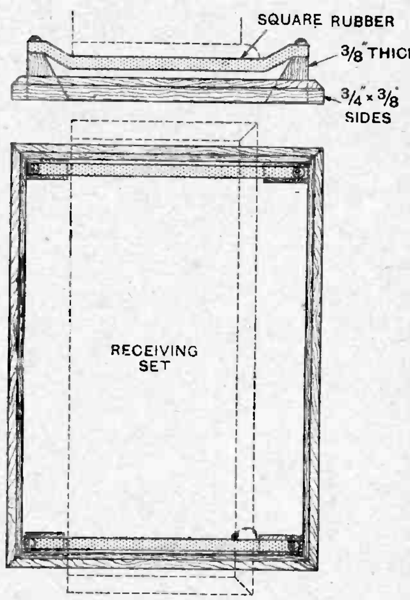
PORTABLE FRAME AERIAL.

A square piece of strong cartridge paper approximately 3ft. square is obtained and a layer of strong paste or gum applied evenly to one side. Thin flexible wire of approximately No. 36 gauge is then fixed to the paper in the form of a spiral with a spacing between the turns of ½in.; for the B.B.C. band of wavelengths 12 to 15 turns will be required. Before the paste dries a second sheet of paper of the same size is glued over the wire to keep it in place. When dry the aerial may be rolled up and carried in a postal tube, being unrolled and hung vertically when it is required to receive signals.—D. C. G.

oooo

MICROPHONIC NOISES.

Instead of replacing rigid valve holders by means of special anti-vibration valve holders when changing from bright to dull emitter valves, it is possible to suspend the set as a whole on rubber bands, on a special baseboard constructed in the manner shown in the diagram. The width of the baseboard is slightly greater than that of the receiving set, and the



Rubber suspension for receiver cabinet.

rubber suspension is attached to four pillars at the corners of the board.

It is important to use flexible battery loud-speaker leads, as it is found that vibrations are transferred from the table to the receiving set through thick leads.—L. P.

AERIAL AND EARTH SYSTEMS.

Directional Effects in Small Receiving Aerials.

By R. L. SMITH ROSE, Ph.D., M.Sc., A.M.I.E.E.

IN a wireless receiving system the aerial is the agent by which the energy of the passing waves is extracted for the purpose of giving intelligible signals in the telephones or loud-speaker. However much the received currents or voltages may be magnified subsequently by the use of valves, the net amount of energy absorbed from the ether is determined by the aerial circuit. To obtain the best results, therefore, in any given circumstances, it is necessary to ensure that the aerial is arranged in such a manner that the maximum possible E.M.F. is induced in it by the incoming waves, and also that the dead losses in it due to its ohmic resistance should be reduced to the minimum.

The manner in which these conditions can be met in any given case depends upon what limitations, if any, are imposed on the aerial and earth system from other considerations. For example, in one situation the space occupied by the system may be immaterial, and the aerial will then be limited in the matter of its length to 100 feet on the ordinary receiving licence. In other situations both the height and length of the aerial may be limited, and the problem is then reduced to that of utilising to the best advantage the space available.

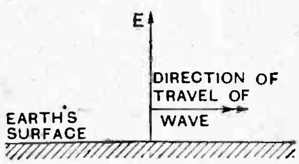


Fig. 1.—Direction of the electric field of force E in a wireless wave travelling horizontally over a perfectly conducting earth.

Conformation of the Aerial for Maximum Induced E.M.F.

Let us take first the case of getting the maximum E.M.F. into the aerial. In an elementary study of the travel of wireless waves over the earth's surface, the earth is usually assumed to be a perfect conductor, and one is informed that the electric lines of force must always be perpendicular to such a conductor. Therefore, the wireless waves are represented as travelling horizontally along the earth with the electric force perpendicular to it; and for open ground, which is sensibly horizontal, the state of affairs is as represented in Fig. 1. Where the ground is not flat, but is subject to the undulations of hilly country, the above boundary condition must still obtain. Thus for a hill or mountain of moderately gentle slope, the manner in which a wireless wave surmounts it is shown in Fig. 2. If the change in slope is very abrupt, as in the case of a precipice, the state of affairs is not quite so straightforward as that represented, and other secondary effects must be taken into consideration.

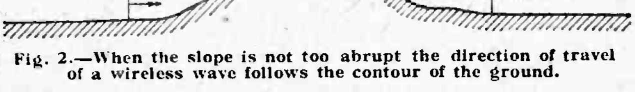


Fig. 2.—When the slope is not too abrupt the direction of travel of a wireless wave follows the contour of the ground.

In the next stage of the study of wireless waves one appreciates, in some cases very forcibly, that the earth is, after all, not a perfect conductor; in fact, that it is a very bad conductor as compared, for example, with copper. This departure from perfection was shown theoretically by Zenneck to result in a tilting forward of the lines of electric force as the wave is travelling forward in the manner shown in Fig. 3. If this forward tilt of the wave is at all large, it is evident that a vertical aerial will not have such a large E.M.F. induced in it as an aerial which is arranged parallel to the electric force, as in Fig. 4 (*a*). Further, the direction of the slope of the aerial will depend upon the direction from which the waves are arriving. For instance, a wave arriving from the left (P) will induce a greater E.M.F. in an aerial sloping, as in Fig. 4 (*a*), than in one arranged as in Fig. 4 (*b*); while if the wave is approaching from the right (Q), the state of affairs will be reversed.

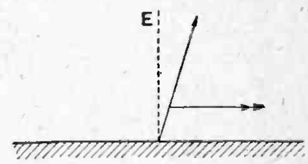


Fig. 3.—Tilting forward of the electric force due to imperfect conductivity of the earth's surface.

Although this forward tilt of the wave-front was predicted by Zenneck nearly twenty years ago, no experimental verification of it was made until quite recently, and our knowledge as to the possible values of the tilt in any practical cases has been very indefinite. It was known from the theoretical analysis that the angle of the tilt would increase as either the wavelength or the conductivity of the earth was reduced, but no satisfactory data were available as to the effective conductivity of the earth's crust at wireless frequencies. During the last two years, however, a series of experiments has been carried out in different parts of England in which the

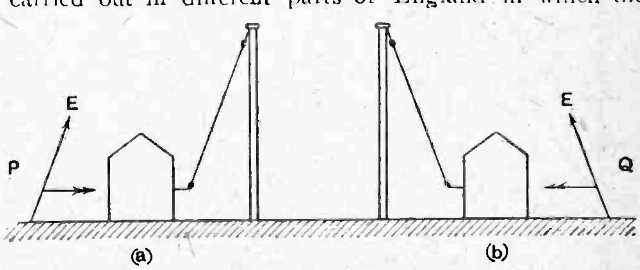


Fig. 4.—The E.M.F. induced in an aerial is greatest when the wire is parallel to the direction of the electric field.

inclination of the electric force was directly measured for wavelengths ranging from 300 to 12,000 metres. The results show that for wavelengths in excess of 2,000 metres the electric force in waves arriving under any conditions is never inclined at an angle of more than 1° to a line drawn perpendicularly to the earth's surface at the place in question. As the wavelength is diminished this angle increases to a value in the neighbourhood of 3° for a wavelength of 300 metres. In the course of

Aerial and Earth Systems.—

these experiments some measurements were carried out on the side of a hill sloping at 16° to the horizontal, and it was verified that the waves were travelling sensibly in the manner depicted in Fig. 2. It is evident from these results that in order to get the maximum E.M.F. induced in an aerial on wavelengths in or above the normal broadcasting band the major portion of the aerial should be arranged to be as far as possible vertical; or rather, perpendicular to the average direction of the ground in the immediate neighbourhood. The slope of the wavefront of 3° above mentioned may be interpreted in another way as indicating that the strength of the horizontal component of the electric force is only about five per cent. of the strength of the vertical component. Hence if a given length of wire be arranged first vertically and then horizontally, the E.M.F. induced therein will be twenty times as great in the first case as it will in the second. There is an important difference between the two cases, however, for with the vertical wire the E.M.F. is the same for all directions of arrival of the wave, whereas with the horizontal wire the E.M.F. varies with the direction of arrival of the waves. This effect can probably be best understood by supposing the vertical and horizontal wires joined together to form an inverted L aerial as in Fig. 5. A little consideration of the case when waves are arriving from the left-hand side (P) will show that the E.M.F.s induced in the two portions of the aerial depicted in Fig. 5 (*a*) will be in opposition as indicated by the arrows; while with the aerial reversed as in Fig. 5 (*b*) the two E.M.F.s are assisting each other. If the two aerials are rotated through a right-angle so that the horizontal portions are perpendicular to the direction of arrival of the waves, no E.M.F.s will be induced in these portions, and the vertical parts of the aerial will alone be operative in receiving an E.M.F. from the waves.

Directional Properties of Receiving Aerials.

These considerations taken in conjunction with the numerical results quoted above indicate that an inverted L aerial can have appreciable directional receiving properties only when the wavelength is moderately short and when the horizontal length of the aerial is several times its vertical height. The directional effect is not quite proportional to the ratio of the E.M.F.s induced in the two portions of the aerial, owing to the fact that the more distant parts of the aerial are less effective in producing current through the receiver, which is assumed to be located near the earth connection. In some direct measurements which have been made of the relative currents obtained in inverted L aerials oriented in different directions with respect to the transmitter, it was shown that with an aerial 20ft. high and of 80ft. horizontal length used on a wavelength of 365 metres, the difference in current received by the aerial in its worst and best positions (*i.e.*, as indicated in Fig. 5 (*a*) and (*b*) respectively) was about twenty per cent. of the mean current. The most favourable position was, of course, that in which the free end of the aerial pointed away from the transmitting station. In considering the importance of the directional effect in this case, which is one that might easily arise in a broadcast receiving aerial, it is to be noted that the same increase in current could have been brought about by increasing the height of the aerial by only three or four feet. Further, calculation and measurement both show that to produce the same directional effect on a wavelength of 7,000 metres, the ratio of the horizontal length to vertical height of the aerial would have to be increased from four to twenty. If the case is carried to the extreme in which the height becomes negligible compared with the horizontal length, we see that while an appreciable E.M.F. can be received such an aerial will have very marked directional properties. This deduction has been verified from time to time in experimental work, which has been carried out on horizontal aerials laid on the ground. A particular case of this arrangement, also, is that of the Beverage antenna.

The general conclusions which may be drawn from the discussion in this section are therefore as follows. With a view to securing that the maximum E.M.F. is induced by the arriving waves, a receiving aerial should be erected with its vertical height as great as possible. Except on the shorter wavelengths and with long, low aerials, the directional effect in reception is not of primary importance; but if other conditions permit, the greatest efficiency will be gained by arranging that the free end of the aerial points away from the transmitter. On the very short wavelengths now being used for experimental inter-communication some of these conclusions may need serious modification. Sufficient experimental evidence on this point is not so far available, and its discussion is considered to be outside the scope of the present article.

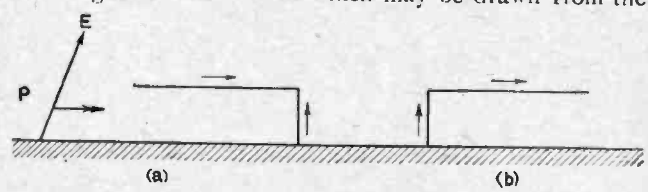


Fig. 5.—E.M.F.s induced in two inverted L aerials by the vertical and horizontal components of the electric force in the wave approaching from P.

Measurements of Received Current with Different Aerial Arrangements.

To confirm and extend the conclusions reached in the last section a series of measurements was carried out with different aerial arrangements, using a rectifying valve in conjunction with a mirror galvanometer. The deflections of the galvanometer enabled a direct interpretation to be made of the current induced in the aerial by the carrier wave from the London broadcasting station at a distance of about 10 miles. In the conduction of the experiments it was decided to apply the limiting condition that the total length of the aerial should not exceed 100ft., and the experiments were made partly with a view to ascertaining in which way this length of wire could be used to the best advantage.

In the first case, using a single wire aerial of the above total length, measurements were made of the received current, when the aerial was given heights varying from 7½ft. to 25ft., the remaining length of wire being arranged horizontally in a fixed direction. The results obtained are shown in Fig. 6, from which it is seen that up to a height of about 20ft. the received current increases uniformly and is proportional to the height. Beyond this

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point the current still increases, but not so rapidly, and the results indicate that when the height is about 40ft. any increase in this height will produce only a small percentage increase in the received current.

In the next experiment the height of the aerial was fixed at 25ft. With a total length of wire of 100ft., this leaves an available length for the horizontal portion of 75ft. It was then desired to ascertain what was to be gained by any increase in this horizontal length, and also how much would be lost should other circumstances, such

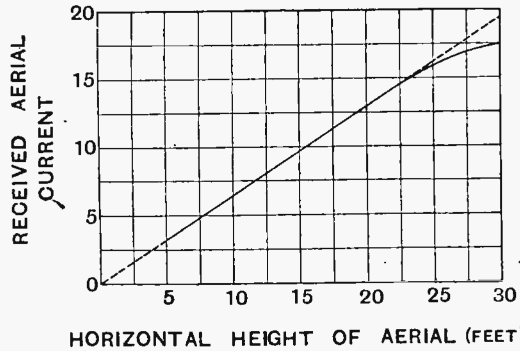

Fig. 6.—Curve showing the relation between the height of an inverted L aerial 100ft. in total length and the received current measured in arbitrary units.

as limitations of space, preclude the utilisation of the full 75ft. The results of measurements on these lines are shown in Fig. 7. It is seen that as the length of the horizontal part is increased from zero to about 40ft., the received current increases in a linear manner. Above this point the rate of increase falls off very considerably, and beyond the permitted length of 75ft. the increase in received current is almost negligible.

Having thus investigated the effect of height and length of the aerial, the next point was to ascertain what advantage is to be gained by using more than one wire in the horizontal portion of the aerial, and if two or more wires are used, at what distance apart these should be. For this set of measurements an aerial was constructed in the form of two stranded wires of No. 3/19 S.W.G. enamelled copper 75ft. long, supported at a height of 25ft. above the earth screen employed therewith. Successive measurements of the received current were made while the distance between the wires was reduced in steps from 8ft. to zero; and finally, a single wire of No. 20 S.W.G. was substituted for the two adjacent wires. The results are shown in Fig. 8 in terms of the ratio of the current

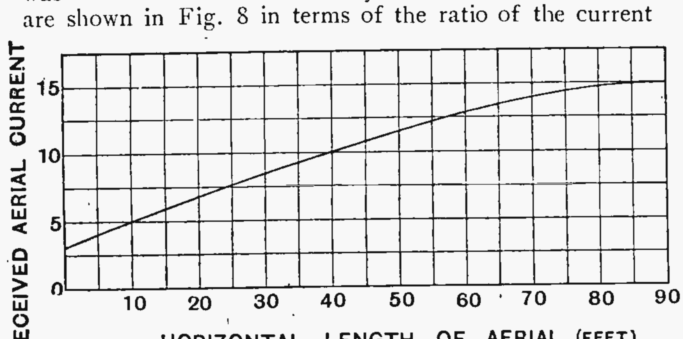

Fig. 7.—Effect on the aerial current produced by lengthening the horizontal portion of the aerial, the height being fixed at 25ft.

received on the aerial to the current received on the single wire aerial. It will be seen that if two wires are used they should be at least six, and preferably eight, feet apart. Even with this spacing, however, the increase in current obtainable over that on a single wire aerial is not large, being about 30 per cent. in the case quoted. Using the full 8ft. spreader space, further measurements made with three and four wires arranged symmetrically showed that nothing was to be gained by increasing the number of wires in this way.

Measurements with Different Earthing Arrangements.

It should be pointed out here that all of the above measurements were caried out on the aerial used in conjunction with a fairly efficient earth-screen, the lowest actual resistance of the aerial circuit in the last case being about 11 ohms. If, as might easily be the case, a much higher resistance were associated with the earthing arrangement, then it is evident that any improvement of the aerial alone will have less effect on the magnitude of the received current. As an illustration of this point the case of the last measurements above may be cited. The substitution of a single wire of No. 20 S.W.G. for two stranded wires of No. 3/19 gauge made an almost negligible difference in the received current, although the resistance of the former is nearly eight times that of the

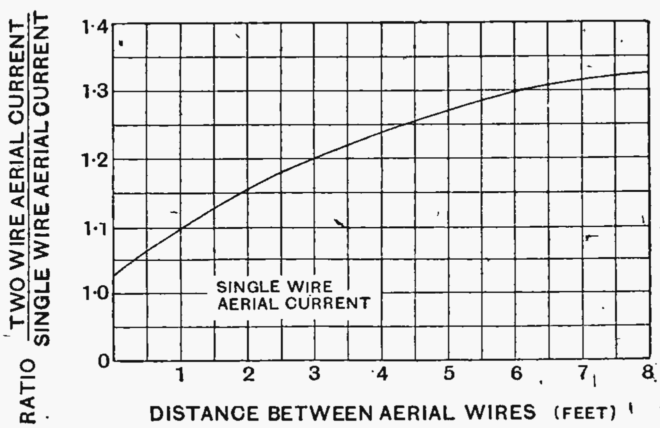

Fig. 8.—Curve showing how the received aerial current varies with the distance between the wires in a twin wire aerial.

latter. The explanation is, of course, that the actual ohmic resistance of the aerial wire in this case is only one or two ohms, even at high frequencies, and that the change in the total resistance of the aerial circuit produced by the substitution is practically negligible.

In another series of experiments measurements were made of the received current and the aerial circuit resistance, when a fixed aerial was used with several different earthing arrangements. The aerial used was the two-wire flat-top type, which the measurements described above showed to be the best available, and for the earthing connection three systems were used. First, a good water main was available, which lay in damp ground for an uninterrupted length of about 100 yards; second, a buried earth was constructed by burying a sheet of tinned iron, 4ft. by 3ft., at a depth of 3ft. immediately underneath the aerial lead-in; and thirdly, an experimental earth screen was arranged below the aerial and covering a

Aerial and Earth Systems.—piece of ground 100ft. long by 30ft. wide. Measurements were made of the received aerial current when using these different types of earth connection, and the effect of varying the arrangement of the earth screen was also investigated. Taking the current received with the water pipe earth as unity, that obtained with the buried plate was about 15 per cent. less. (See points A and B in Fig. 9.) With a screen comprised of a single insulated wire immediately underneath the aerial and at a height of 3ft. above the ground, the received current was over 60 per cent. greater than with the water-pipe connection. The effect of adding further parallel wires to the screen at a distance of about 3ft. is shown by the curve in Fig. 9. It is seen from this diagram that the use of four wires in the screen enables the received current to become about twice as great as with the water-pipe earth connection; and that the addition of further wires to the screen is of no practical advantage. The total resistance of the aerial circuit in this optimum condition was about 10 ohms, while with the water-pipe and buried plate earth connections, the corresponding resistances were 22 and 25 ohms respectively. These results serve to emphasise the advantage of the screen over any other form of earth connection when used with the ordinary 100ft. receiving aerial, particularly when it is appreciated that the result is not only increased current in the aerial but improved selectivity of the whole receiving system.

On obtaining the above results it was realised that the use of four wires at 3ft. apart would be a serious disadvantage in many practical cases, and further experiments were therefore carried out with a view to finding a more convenient disposition of the screen wires. The measurements were therefore repeated first, with four wires distributed equally over the whole space, *i.e.*, at about 10ft. apart; and secondly, with only two wires running parallel to the aerial along the edges of the 30ft. space available. In each case the height of the wires was about 3ft. above ground level, as in the first series of measurements.

The results are indicated by the points C and D in Fig. 9. The four-wire screen was found to be quite equal to the eleven-wired screen covering the whole space, while the two-wire arrangement was only slightly inferior to it. The two-wire screen has the considerable practical advantage that it leaves unobstructed the whole of the space under the aerial, and in the case where an aerial is erected more or less centrally above the longest dimension of a garden, two well-insulated wires running parallel with it down the extreme sides of the garden will form an efficient earth screen.

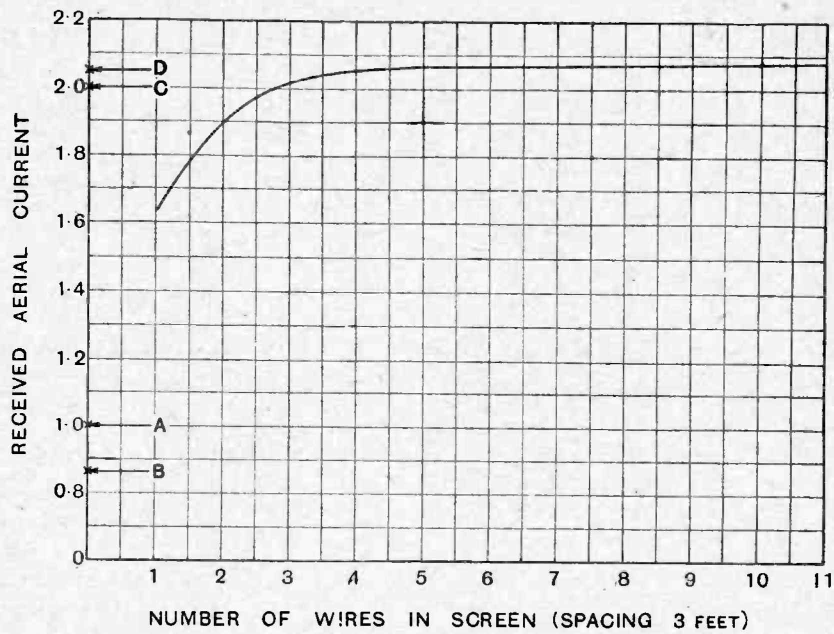

Fig. 9.—Received aerial currents with various earthing arrangements. The curve shows the relation between the aerial current and the number of wires in the counterpoise. A, represents the aerial current received with the water-pipe earth; B, with buried plate earth. C, with twin-wire screen, 30ft. apart; D, with four-wire screen, spaced 10ft. apart.

TRADE NOTES.

Wireless Cabinets.

Many home constructors lack the time or opportunity to construct their own cabinets; others have reluctantly to admit that the job is better left to the expert. A firm specialising in the construction of wireless cabinets is the Caxton Wood Turnery Co., Salisbury Square, Fleet Street, London, E.C.4, who make a practice of supplying cabinets built to the instructions of their customers.

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A Proprietary Name.

It may not be generally realised that the word "Leclanché," as applied to cells and batteries, is as much a proprietary name as are "Vaseline" and "Tabloid." The name "Leclanché" is the trade mark of Messrs. Ripaults, Ltd., the well-known firm of manufacturing engineers.

New "Super Het" Kit.

The popularity of the superheterodyne type of receiver has resulted in the production of a number of interesting "kits" embodying all accessories and components for building a complete instrument. One of the latest outfits of this kind is the "Gecophone" Six-Valve Constructors' Super Heterodyne Set, which comprises all the components necessary to build up an efficient receiver. A full-sized blue print is supplied, which can be used as a template for marking off both the front and the rear of the panel.

Electric Ovens for Headphone Magnets.

From the Automatic and Electric Furnaces, Ltd., 173-175, Farringdon Road, we have received a well-illustrated booklet describing electrically heated industrial ovens. It may not be generally known that ovens of this kind are very largely used by the leading makers of headphones and instrument magnets for maturing the magnets after quenching.

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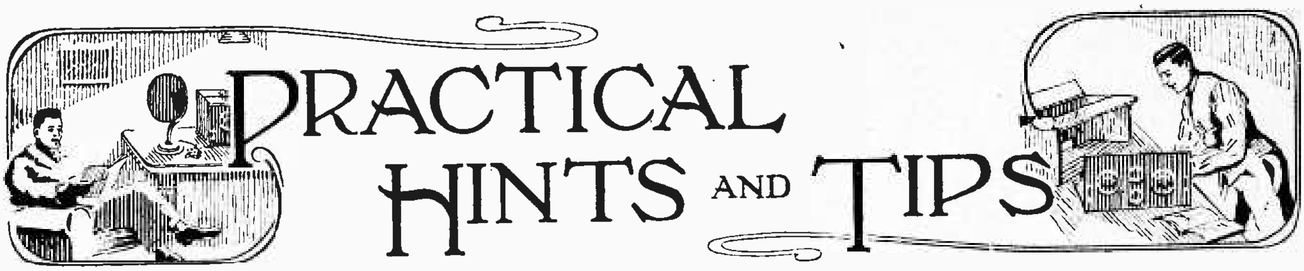
An Exide Exit.

The Chloride Electrical Storage Co., Ltd., are shortly leaving their London repair depot in order to occupy much larger premises at Lexden Road, Acton. This is the third time in ten years that a removal has been necessary owing to the great expansion of their maintenance service in the London area.



A Section Mainly for the New Reader.

L.F. SWITCHING.

In a two-valve low-frequency amplifier, where different types of valves are used, with different values of high-tension voltage on each, the problem of arranging a suitable switching arrangement is not quite so simple as would appear at first sight. Unless suitable precautions are taken, an excessive value of H.T. may be applied to the first-stage valve when the last valve is switched off.

It is, of course, possible so to arrange matters that the loud-speaker is always connected in the anode circuit of the last valve, in which case the switch would transfer the detector valve output from the primary of the first L.F. transformer to that of the second. Such an arrangement is very desirable under many conditions, but it may well be that the second transformer primary will have too low an impedance to follow the detector valve.

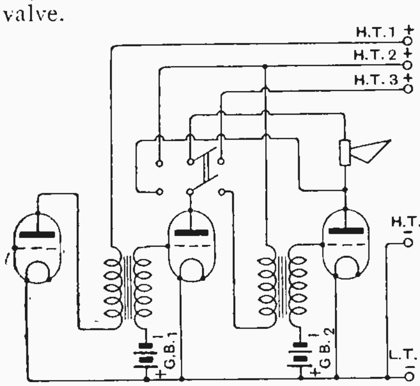


Fig. 1.—L.F. switching.

In this latter case the use of the switching connection suggested in Fig. 1 will be correct. It will be seen that when the output of the first L.F. valve is passed through the loud-speaker, the H.T. voltage applied is the same as when both valves are in use.

It will be found convenient in many cases to use a three-pole switch, the third arm of which will serve to break the filament circuit of the last valve when it is desired to cut it out of circuit.

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CHOOSING A CRYSTAL DETECTOR.

Too little attention is generally paid to the mechanical details of crystal detectors. In many cases it will be found that the rod carrying the catwhisker is not a good fit in its guide, while the ball joint does not work smoothly in its seating. A detector having these faults will never give satisfactory results, and will lose its sensitive adjustment if the set is subject to any vibration. Care should be taken to see that the contact is reasonably certain to stay in a set position.

Many detectors which are unsatisfactory in this respect may be improved by the use of simple tools and a little patience. Time expended in this way will be amply repaid by better results and more permanent adjustment.

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CONNECTIONS OF A POTENTIOMETER

The method of connecting a potentiometer shown diagrammatically in Fig. 2 will be found convenient in many cases. Instead of joining the resistance winding directly to the L.T. battery leads, it will be seen that it is bridged across the filament terminals, with the result that, when the rheostat is turned to the "off" position, there is no current flow, with consequent waste, when the set is out of use.

If the valve is used as a "leaky grid condenser" detector, it will generally be found in practice that it is possible to impress a sufficient positive voltage on the grid without the use of an extra battery, but where a negative voltage is required it will be necessary to provide a small dry battery connected as shown.

If the L.T. battery is of 4 volts, and the bias battery of 4.5 volts, it will be possible to vary the grid potential between 4.5 volts and 0.5 volt negative (neglecting any drop of voltage in the rheostat).

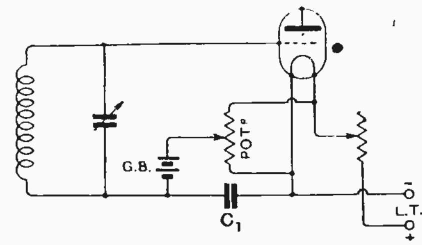

Fig. 2.—Potentiometer connections.

A by-pass condenser C1 connected in the manner shown serves as a low impedance path for oscillatory currents (the resistance of the potentiometer winding is generally high). If dealing only with H.F. currents, the capacity may be as low as 0.001 or 0.002 mfd., but for low-frequency work condensers of from 0.25 to 1 mfd. should be used.

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THE POWER VALVE.

There seems to be a good deal of uncertainty as to the correct use of a power valve. Novices are often under the impression that it is intended to give more power, or, rather, greater amplification. Actually, the contrary is the case. These valves do not give so high an amplification of a given voltage applied to them, but adequately *handle* very much more power than the "general-purpose" type.

The matter is complicated by the fact that the substitution of a power valve in the early stages of a receiver actually often results in a noticeable improvement in signal strength. One is liable under these circumstances to doubt the accuracy of the above statement; what is actually happening, however, is that the substituted low impedance power valve suits the coupling device which is connected in its anode circuit better than did its predecessor. It may, therefore, be safely assumed that the transformer, choke, etc., used in such a case as this is incorrectly designed for use with a general-purpose high-impedance valve.

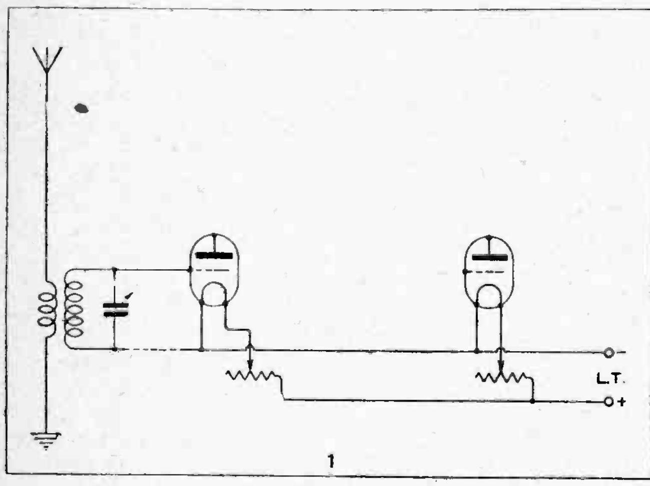
It is safe to say that for very many purposes the low impedance valve is to be preferred, as a coupling device suitable for use with it is comparatively easy to design. This hardly applies, of course, to resistance-coupled or tuned anode amplifiers, and only to a slight degree to L.F. choke magnification.

Amateurs who are choosing a valve for use in any particular capacity should always be guided by the published impedance values rather than the usual arbitrary classifications of "H.F." and "L.F." Under certain conditions a so-called "L.F." valve would be distinctly suitable for H.F. work.

DISSECTED DIAGRAMS.

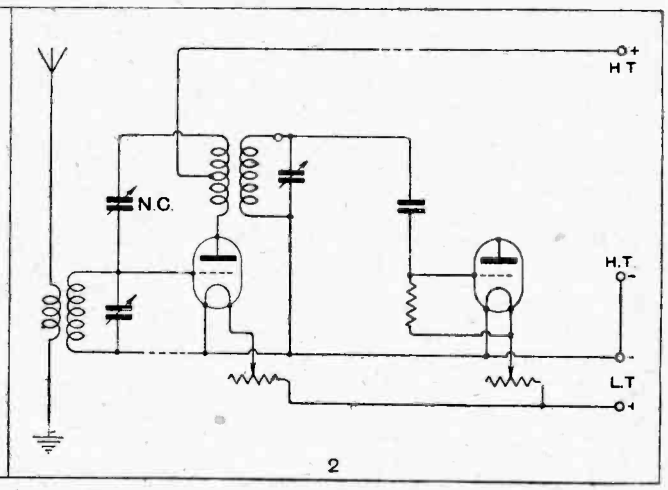
No. 12.—A "Reflex Neutrodyne."

For the benefit of readers who find difficulty in reading circuit diagrams we are giving weekly a series of sketches showing how the complete circuits of typical receivers are built up step by step. Below is shown a circuit which has proved very popular.



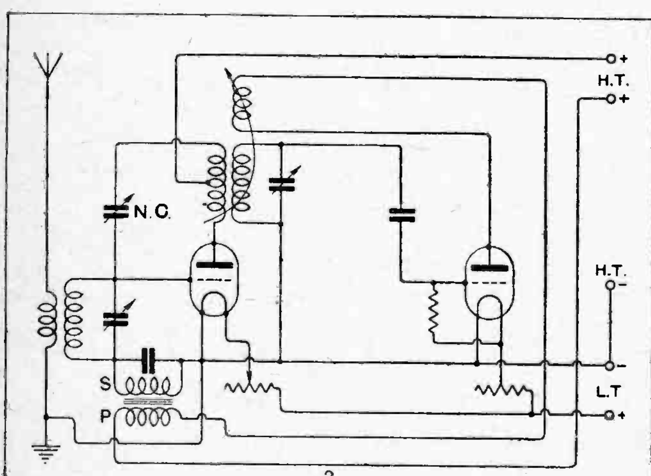
1

Two valves with filaments connected in the usual manner. A tuned circuit is connected between grid and filament of the first valve (which should generally be of low impedance). To this circuit is coupled the aerial inductance, which is not separately tuned. For greater selectivity, coupling between aerial and secondary coils may be variable.



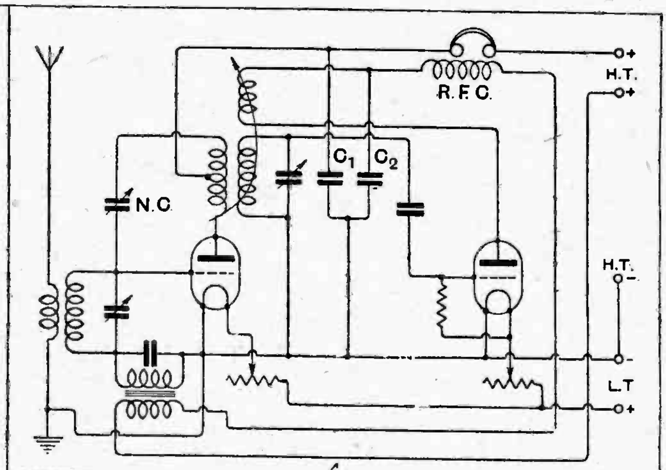
2

The plate circuit is completed through the primary winding of an H.F. transformer and the H.T. battery. A neutralising winding, in inductive relation with the primary, is connected back to the grid through a small condenser (N.C.). The tuned secondary is connected between grid and filament of detector valve, with leaky grid condenser.



3

The plate circuit of the detector valve is completed through a reaction coil, the primary of an L.F. transformer (the secondary of which is in the grid circuit of the dual valve) and the H.T. battery. A small condenser across the L.F. transformer secondary acts as a by-pass for H.F. currents.



4

Telephones are inserted in the anode circuit of the first valve and are operated by magnified low frequency currents. By-pass condensers C_1 and C_2, in conjunction with the radio-frequency choke, help to separate L.F. and H.F. currents. The batteries are earthed. Negative grid bias may be applied to the dual valve.

VALVE-CRYSTAL RECEIVERS.

Two-valve Circuit for Loud-speaker Reception from the Local Station.

By J. W. CANHAM, B.A.

THE distinction between the design of radio receivers for long-distance reception and for reception from the local or high-power station is of some importance. For the former a stage of radio-frequency amplification is generally to be recommended, while for the latter this may often be dispensed with, particularly if economy of valves and simplicity of tuning are important factors.

Perhaps the circuit most generally used for loud-speaker reception up to moderate distances from the broadcasting station is a straight three-valve consisting of detector and two-valve L.F. amplifier. The detector valve in this receiver generally has three functions. It provides rectification, acts as a L.F. amplifier, and provides the necessary amplification of high-frequency current to enable reaction to be used on the aerial.

High-frequency Amplification.

It is this last function of the detector valve we miss the most when, without employing a high-frequency amplifier, we use crystal in place of valve rectification. A simple crystal receiver, followed by a two-valve amplifier, does not give the necessary power unless the station is only a few miles away, due to the low intensity of the high-frequency currents in the aerial circuit. It is, however, from the local station that good quality reception is the most important, since it is mainly on this station that we rely for broadcasting as a form of entertainment. In view of the fact that crystal rectification is generally considered to lead to reception of a higher quality than the condenser and grid leak method, a form of circuit, without the use of a high-frequency amplifier, yet retaining the benefits of reaction, will probably be of interest.

The circuit in its final form is shown in Fig. 2, but can best be understood by reference to the first circuit shown in Fig. 1, which shows the first valve only with the transformer connected somewhat differently. The main action of the valve is that of a L.F. amplifier, the aerial current being rectified by the crystal. The difference between this circuit and that of a crystal receiver followed by an amplifier is that the usual positions of crystal and transformer primary are reversed, and that the aerial inductance is included in the grid circuit of the valve. Due to the latter, amplified high-frequency currents pass in the anode circuit through the reaction coil, which is coupled to the aerial inductance to obtain reaction effects.

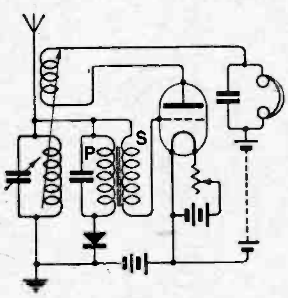


Fig. 1.—Reacting crystal and L.F amplifier unit.

Somewhat improved results are obtained by including the transformer primary in the grid circuit as well as the secondary, as shown in the final circuit, Fig. 2. The transformer is here acting as an auto-transformer, and care must be taken that the windings are in the right direction to ensure that the P.D. in the primary is not opposed to that in the secondary. For a transformer used with a crystal detector, a high ratio of transformation is generally the most satisfactory, owing to the comparatively low resistance of the crystal, and the advantage gained by the inclusion of the primary in the grid circuit in that case, though appreciable, is not very great. It would be interesting to use with this circuit an auto-transformer provided with tappings so that the best ratio of transformation could be obtained.

It will be noticed in the reflex circuit in Fig. 3 that the primary of the L.F. transformer is connected to the H.T. battery either through the telephones or the input to a second valve. This results in a form of capacity coupling between the grid and the anode circuits, since, due to the amplified L.F. current through the telephones, the transformer primary is at an alternating low-frequency potential. The capacity coupling is provided by the mutual capacity between the windings of the transformer, leading to a tendency of the valve to oscillate at an audible frequency, and to inferior quality of reception.

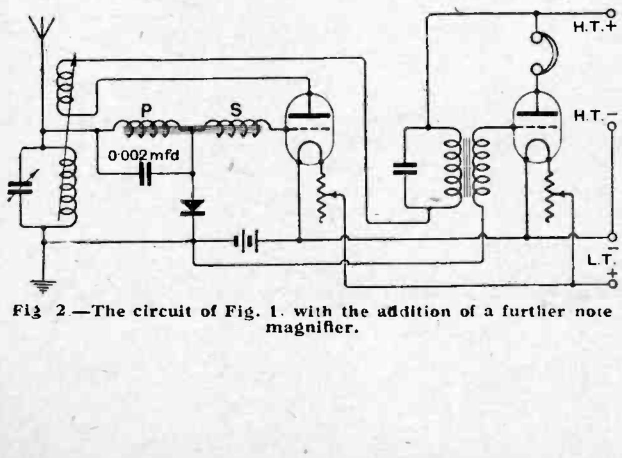


Fig. 2.—The circuit of Fig. 1. with the addition of a further note magnifier.

Reflex Circuits.

Another disadvantage of the reflex circuit is the necessity of introducing the fixed condenser across the transformer secondary. The object of this condenser is to act as a by-pass for the high-frequency current in the aerial circuit in which the transformer secondary is included. If this condenser is too small, the efficiency of

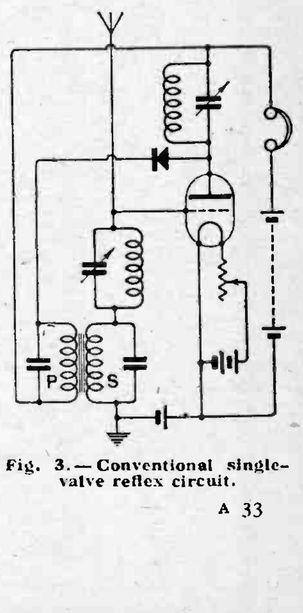


Fig. 3.—Conventional single-valve reflex circuit.

Valve-Crystal Receivers.

the aerial circuit is decreased, if too large the quality of the reception is affected. This latter effect is particularly evident when the ratio of transformation is high, which is usually advisable when a crystal detector is used. On the other hand, a series condenser in the aerial should be of fairly high capacity, and as a compromise a condenser of capacity 0.0004 mfds. is sometimes suggested.

In view of the considerations noted above, the first alteration of the circuit, as shown in Fig. 3, was to place the crystal and transformer primary across the aerial inductance. By this the advantage of obtaining reaction was retained, but with the sacrifice of H.F. amplification, as will be seen by reference to the final circuit. A single tuning operation only was involved, and the adjustment to obtain reaction simplified, as the reaction coil no longer formed part of a tuned circuit. In addition, the tendency for the valve to oscillate at an audible frequency was avoided, as there was no longer any interaction, as explained above, between the grid and anode circuits provided by the transformer, both windings of which were then in the grid circuit. The loss of H.F. amplification was not important, considering the advantages obtained and the fact that long-distance reception was not a primary object.

An examination of the circuit thus obtained then showed how the inclusion of the transformer in the aerial circuit could be avoided without introducing any other disturbing factors. To render this possible, the transformer secondary was placed between the aerial and the grid. This secondary was then at high-frequency potential, and the primary had necessarily to be at the same potential. To achieve this, the usual positions of the crystal and transformer primary were reversed, the circuit shown in Fig. 2 being obtained. The capacity between the turns and windings of the transformer was found to provide sufficient high-frequency connection between the aerial and the grid.

Having, it is hoped, given sufficient theoretical justification for the circuit, the remaining points to be noted are mainly those common to most types of receiver. Negative grid bias should be used for both valves; it is particularly necessary in the case of the first valve to prevent it from acting partly as a rectifier. A power valve is recommended for the amplifying stage, and freedom from distortion can also be ensured by using one for the first valve, as, unless this is working on the straight part of its characteristic, the reaction will be variable, and the distortion normally produced by a non-linear characteristic will be accentuated. The type of crystal detector used also deserves attention. Readers are reminded that some of the so-called permanent detectors on the market fully justify the name given to them, and are to be recommnded for this type of circuit.

In conclusion, it may be stated that, comparing the results obtained with the receiver and one consisting of a detector valve followed by two low-frequency stages of amplification, the latter was only slightly superior as regards the loud-speaker strength obtained, while with the receiver described the reception was of a distinctly higher quality.

TRANSMITTERS' NOTES AND QUERIES.

General Notes.

Cards for the Dutch transmitting stations NOWB, NOWC and NOPX may be sent *via* Mr. D. Mollerus, 148, Barchman, Wuytierslaan, Amersfoort, Holland. (This corrects the similar notice which appeared on page 678 of our issue of November 11th.)

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With reference to the note on page 713 of our issue of November 18th, concerning the audibility of South African stations, Mr. F. H. Taylor, of Acocks Green, Birmingham, informs us that on Sunday, December 13th, at 6 p.m., he heard O A6N and A 6AG in communication with each other.

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We understand that M1DH. Flight-Sergt. Hall, who was recently at the main wireless station of the R.A.F. in Mosul, has now moved to Egypt, where he will use the call-sign E1BH, his address being: Head Quarters, Middle East R.A.F., Villa Victoria, Cairo.

oooo

Mr. J. R. Evans (U9ECL), Great Bend Kansas, established communication with the Norwegian whaler "Sir James Clark Ross," ice-bound in the Antarctic on November 13th about 69° S. and 178° E. A steady working schedule was kept up and messages transmitted from the ship for friends and agents in U.S.A. and other countries. Several days later the vessel reported that she had broken clear of the ice-pack and was steaming southward towards the Ross Sea.

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The following American amateurs would welcome reports from Great Britain:—

U4VS.—W. H. More, 315, N.E. Second Avenue, Miami, Florida.

U8AKS.—E. B. Castor, 9, Wilson Avenue, Amsterdam, New York State.

U9EAR.—R. Schweiger, 709, South Spring Street, Beaver Dam, Wisconsin.

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Change of Address.

2ARG, W. E. Rhodes, advises us that his present address is "Wayside," Luard Road, Cambridge.

F8QQ, R. Cizeau, 30 bis, Boulevard National la Garenne-Colombus (Seine).

G5GF, H. Stopher, The Holt, Hare Hatch, Twyford, Berks, transmits on 45 and 90 metres.

G2KV, W. J. Crampton, has moved from Weybridge to "Huntingdon House," South Cliff, Bexhill. Transmits on 45 and 440 metres.

Activity in Northern Ireland.

Mr. F. I. Neill (G5NJ), Chesterfield, Whitehead, Co. Antrim, established communication on December 5th with 8QQ of Saigon, French Indo-China, using 100 watts input. This is believed to be the first direct communication between amateurs in Great Britain and French Indo-China. 5NJ has also worked with many stations in Australia, New Zealand and America.

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Stations Identified.

G2RK.—C. St. V. Roper, 7, Yale Court, Honeybourne Road, N.W.6.

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G5PM is the experimental and instructional station of the Royal Military College, Sandhurst. Reports are welcome and will be acknowledged by Capt. G. H. Leslie, the Director of the station.

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G 2ACI.—S. Williamson, 22, Hurst Grove, Bedford.

G6AT.—F. Aughtie, 28, Terry Street, Dudley, Worcs.

I 1BD.—Enrico Pirovaso, Viale Varese 11, Como, Italy, transmits on 44 metres.

S3NB.—Arvi Hanvonen, Tapionkatu 29, Tampere, Finland.

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New Call-Signs Allotted.

G5ZG.—R. P. Hawkey, Tregenna, Grange Avenue, Woodford Green, Essex, transmits on 45 and 150 metres and will welcome reports.

CURRENT TOPICS

News of the Week in Brief Review

A HAPPY NEW YEAR.

The Wireless World takes this opportunity of wishing all its readers a Happy and Prosperous New Year. May reception grow in strength and signals never fade!

oooo

CHRISTMAS BROADCASTING IN AMERICA.

As in this country, so in America, broadcasting was recognised as a necessary public service at Christmas time. Most of the stations provided programmes on Christmas Day, WGY, Schenectady, beginning transmission at the early hour of 6.30 a.m., when a "Candle Service" was broadcast from the Lutheran Church at Albany, N.Y.

oooo

ABD EL KRIM'S WIRELESS.

According to the Fez correspondent of the *Matin*, Abd el Krim is already making preparations for a spring campaign. All along the front dug-outs and huts are being constructed, a number of them incorporating telegraph and wireless gear.

oooo

WIRELESS TELEPHONY ON GERMAN TRAINS.

Beginning on January 4th a wireless telephone service will be available for the use of passengers on express trains running between Hamburg and Berlin. The carrier current system is employed, and users will be able to ring up the exchange and obtain their number as easily as if they were at home.

oooo

ANOTHER LICENCE PROSECUTION.

For installing wireless apparatus without a licence, Arthur Plowman, of Kentish Town, was fined 10s. under the Wireless Telegraphy Act at the Marylebone Police Court on December 19th. The defendant said he had since taken out a licence.

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WIRELESS STRIKE AFFECTS DIVIDEND.

In view of the general uncertainty caused by the strike of wireless operators the directors of the Marconi International Marine Communications Co., Ltd., state that they do not feel justified in paying an interim dividend during the period of the strike. The matter will be reconsidered when the operators go back to work.

HIGHER WAVELENGTH AT EIFFEL TOWER.

The evening programme from the Eiffel Tower, beginning at 7.30 p.m., is now transmitted on 2,740 metres.

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BROADCAST BREAKDOWNS.

At the request of the Wireless League the B.B.C. has undertaken to make an immediate announcement in the event of a station being unable to transmit on its full power. This should save listeners many anxious moments.

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SWEDISH D.F. STATIONS.

Plans are in preparation in Sweden for the provision of a chain of stations along the coast fitted with wireless direction-finding and submarine signalling apparatus. The most important lightships will first be equipped. The apparatus will be of simple construction, so that ordinary lightship crews will be able to keep it working.

GREETINGS FROM BELGIAN AMATEURS.

Just after closing for press with the last number of *The Wireless World* we received a cordial message from M. Marcel Ocreman, conveying, on behalf of the Reseau Belge, the compliments of the season to British amateurs. Our readers will warmly reciprocate this spontaneous indication of good will, and echo the hope expressed in M. Ocreman's letter that the existing spirit of fellowship among the amateurs of all countries may flourish and grow.

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TAKING WIRELESS SETS TO INDIA.

Many travellers to India carrying with them wireless sets as personal luggage are confronted with an annoying Customs regulation which forbids them to bring wireless equipment into the country without an import licence. Import licences can be obtained on arrival, but, according to information we have received from the Indian States and Eastern

ALL THAT WAS LEFT OF IT. Captain Eckersley's experimental station at Hendon was destroyed by fire in the early morning of December 18th. It can be seen from the photograph that little remains of the short-wave transmitter, though the valve on the left appears to have withstood the flames remarkably well.

Agency, Bombay, this procedure usually involves a delay of two or three weeks, during which time the apparatus remains with the Customs authorities.

Those who wish to take a wireless set to India would be well advised to arrange for the firm from which the set is purchased to export it through trade agents.

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MR. FORD'S WIRELESS LICENCE.

Any idea that the last had been heard of the dispute between H.M. Postmaster-General and Mr. Robert Moffat Ford on the question of the latter's wireless licence was dispelled on December 19th, when Mr. Ford made a communication to the Press.

Referring to his recent prosecution and fine, he said: "The preliminary skirmish to bring the cards on the table is over; the real test case has yet to be fought."

oooo

CAPTAIN M. H. RIALL SANKEY.

The late Captain Matthew Henry Phineas Riall Sankey, C.B., of Ealing, W., director and consulting engineer of Marconi's Wireless Telegraph Co., Ltd., left £12,538, with net personalty of £1,087.

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CONSISTENT AMATEUR TRANSMISSION.

As an example of the consistent efficiency of modern amateur wireless, the American Radio Relay League cites the case of Mr. Don C. Wallace, owner and operator of 9ZT, of Minneapolis, Minn. During one week Mr. Wallace established communication with five European countries, and worked with British G6TM (Mr. W. A. S. Butement, of West Hampstead) on nine consecutive mornings. On the last day communication was effected successively with a Swedish vessel in mid-Atlantic, the French amateur 8DK, and the Danish station 7EC.

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JOURNALISTS AND BROADCASTING.

At a Birmingham meeting of the Council of the Institute of Journalists it was decided to represent to the Government Committee on Broadcasting that no further material extension of the system of transmitting news by broadcast should be sanctioned.

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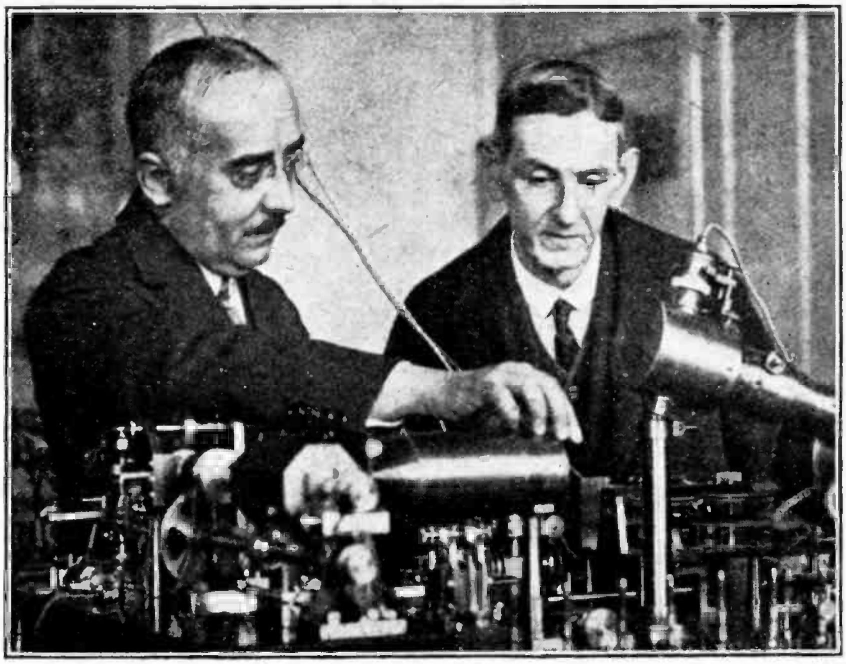
AEROPLANE WIRELESS FOR NIGHT FLIGHTS.

Experiments are to begin on January 15th with a new type of direction-finding equipment making use of frame aerials fitted into the wings of the Vickers-Rolls-Royce air express of the Imperial Airways. Tests will be conducted during night flights in guiding commercial pilots by wireless signals.

An automatic identifying signal will be sent out at regular intervals from Croydon, and the pilot, on hearing the signal, will manœuvre his machine until signal strength reaches its loudest, which will tell him that he is flying directly towards the transmitter.



PHOTOGRAPHS BY WIRELESS. M. Edouard Belin (left), lecturing in Paris, has made the interesting announcement that he has solved the problem of transmitting photos by wireless. A successful demonstration was given before the French Society of Photographers.

BERLIN HEARS DAVENTRY.

Germany is showing great interest in the relaying of distant programmes. The Daventry transmission was relayed from Königswusterhausen last week with great success.

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R.A.F. WIRELESS.

Evidence of the growing importance of wireless in the R.A.F. is afforded by the activities of the great Electrical and Wireless School at Flowerdown Camp, near Winchester. Last week it was recorded that not a single failure had occurred among the aircraft apprentices due to pass out.

Sir Philip Sassoon, Under-Secretary of State for Air, heartily congratulated the lads when he carried out an inspection of the School. They had, he said, taken up a career in a young but progressive service. Their future work required intelligence and application of a very high order, as wireless became more and more important to the operations of the Air Force. It was becoming increasingly evident that no pilot, however skilful, could realise the maximum efficiency without a knowledge of wireless.

oooo

LABRADOR LISTENS TO 5XX.

Captain Jackson, of the Moravian Mission boat, *Harmony*, which has just returned to London from her annual trip to Labrador, reports that a four-valve wireless set has been installed at the Mission boarding school at Makkovik, the southernmost station on the Labrador coast. When first installed last June the set failed to function satisfactorily, but the timely arrival of the Macmillan Arctic Expedition, including their expert, John Reinartz, soon enabled matters to be put right. Daventry is now regularly heard in Labrador, 2,000 miles away. The British programmes, though fainter than those from America, are more popular among the inhabitants.

oooo

BROADCASTING, THE PRESS AND THE STAGE.

Lord Riddell, giving evidence before the Broadcasting Committee on December 17th on behalf of the London morning, evening, and Sunday newspapers, said that the newspaper proprietors had no wish to impede the progress of broadcasting. He contended, however, that the existing restrictions on the broadcasting of news should be retained. The newspapers did not claim any special consideration, but they maintained that as broadcasting was more or less a Government monopoly it should be conducted to avoid injury to existing interests. It was pointed out that if the present limitations were removed, the newspapers and the news agencies providing the news would have to reconsider their position.

Mr. Walter Payne, president of the Society of West End Theatre Managers, gave evidence before the Committee on December 18th. The main objection to unlimited broadcasting of West End entertainments, he said, was that it constituted a very serious competitive factor. Whether broadcasting was controlled by a monopoly or by the State alone it was considered that not more than ten per cent. of entertainment of a kind usually given in theatres or music halls should be broadcast. Otherwise the entertainment industry would ask for an agreed percentage of the revenue derived from receiving licences.

CRYSTAL SAFETY RESISTANCES.

A Practical Application of the Threshold-Effect in Carborundum Crystal Rectifiers.

By H. M. DOWSETT, M.I.E.E., F.Inst.P., M.Inst.R.E.

EVERYONE is familiar with the voltage-current characteristic of a good rectifying carborundum crystal, but there is one feature of this characteristic—generally overlooked—distinguishing it from the characteristics of other crystals, which should enable carborundum to be adapted to a variety of other uses besides that of a rectifier.

This feature is that a definite threshold voltage is required to be applied to the crystal before any current passes at all. The crystal acts as a valve, and the threshold potential at which it opens is greater where the current passes through the crystal in one direction than when it passes in the other.

Carborundum Crystal Curves.

Thus, as indicated in Fig. 1, the threshold voltage required for a certain crystal was 0.2 volt where the crystal point was connected to the positive pole of the battery and the crystal cup to the negative pole, but where the connections to the crystal were reversed the threshold voltage rose to 1.9 volts.

Obviously this valve action of carborundum has possibilities, even if it is two-way, but with a single crystal, and one way at least, the threshold potential required is very low; if it could be increased, then this property might be considered in respect to a wider range of applications.

Can any better result be obtained by using a large block of carborundum instead of a chip?

The characteristics shown in Fig. 2 were obtained from a mass of this material approximately $3\frac{1}{2}$in. × $3\frac{1}{2}$in. × 4in. It was given three areas of good contact at extreme distances apart by welding on steel buttons, and two point contacts were employed, the curves being obtained by connecting the adjustable battery circuit to each point contact in turn with each steel-faced contact.

It is seen that the characteristic obtained when a large mass of crystal interposes between the point and wide area contact is almost identical with that obtained when the distance separating the two contacts is very small, the greater distance through the block simply adding to the ohmic resistance of the circuit, and therefore altering slightly the slope of the characteristic without affecting the threshold voltage appreciably, if at all.

Crystals in Series.

The next obvious thing to determine is the effect of connecting a number of good rectifying crystals in series. The results are given in Fig. 3 for six selected crystals suitably mounted. This shows that the threshold voltage increases with the number of crystals used, and, further, that while the smaller value obtained on the working side of zero is increased very nearly in proportion to the sum of the threshold voltages of the same sign given by the individual crystals, on the other side of zero the increase is at a very much faster rate.

This is encouraging, and no doubt by working on these lines something can be accomplished, but when one considers that, in order to obtain a valve action at 23 volts positive, six crystals had to be picked, mounted in cups, and fitted with circuit connections, it does not appear to be a practical method of working.

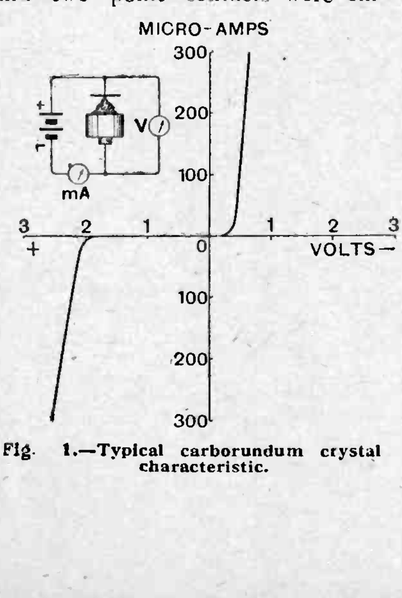


Fig. 1.—Typical carborundum crystal characteristic.

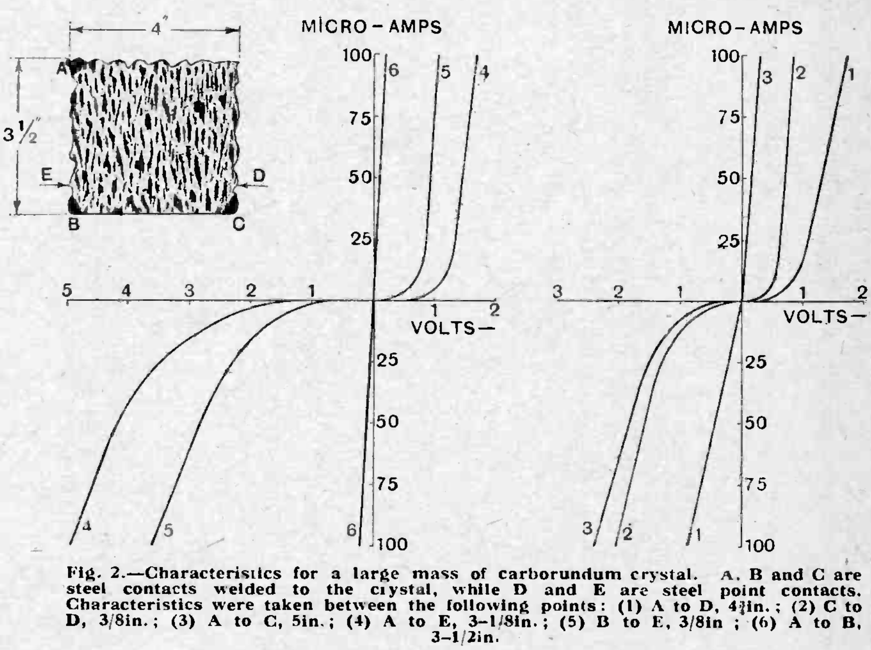


Fig. 2.—Characteristics for a large mass of carborundum crystal. A, B and C are steel contacts welded to the crystal, while D and E are steel point contacts. Characteristics were taken between the following points: (1) A to D, 4½in.; (2) C to D, 3/8in.; (3) A to C, 5in.; (4) A to E, 3-1/8in.; (5) B to E, 3/8in; (6) A to B, 3-1/2in.

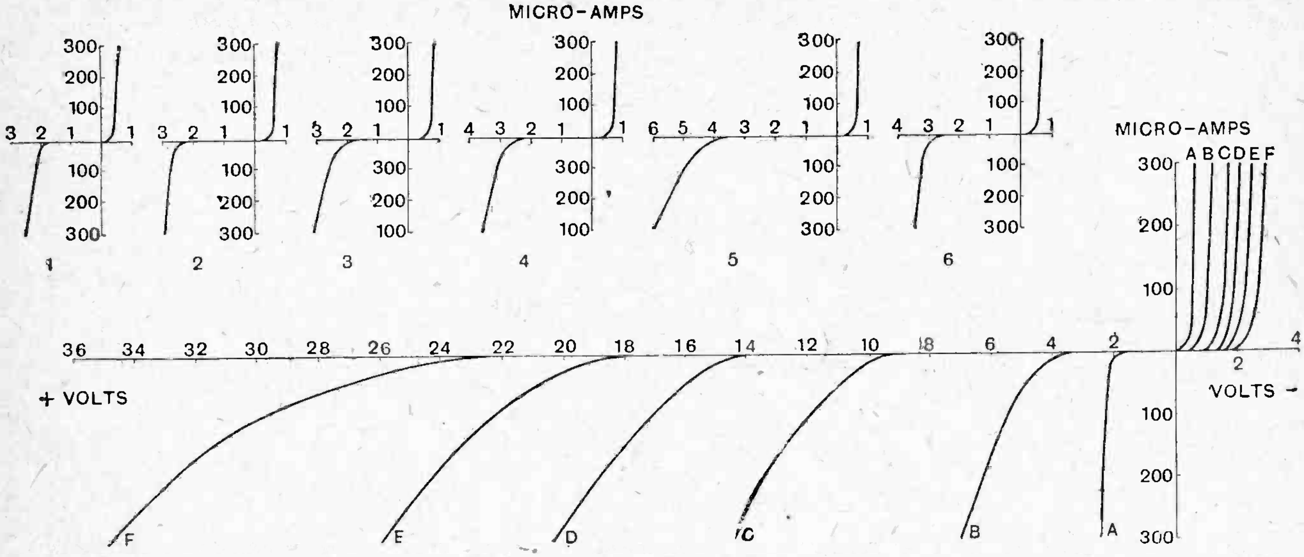


Fig. 3.—Characteristics of crystals connected in series. The upper curves were taken for individual crystals, while the lower characteristics A, B, C, D, E and F show the effect of connecting 1, 2, 3, 4, 5 and 6 crystals in series respectively in numerical order.

The problem can be investigated along other lines. The crystal chip employed as a detector is usually pointed at one end and blunt at the other, and it is asymmetric as regards the behaviour of its two ends. Taking a typical case, with the blunt end mounted in the cup and a steel plate contact made at the point of the crystal, the characteristic was BB, Fig. 4. When the crystal was reversed in the cup, the characteristic obtained was as shown by AA.

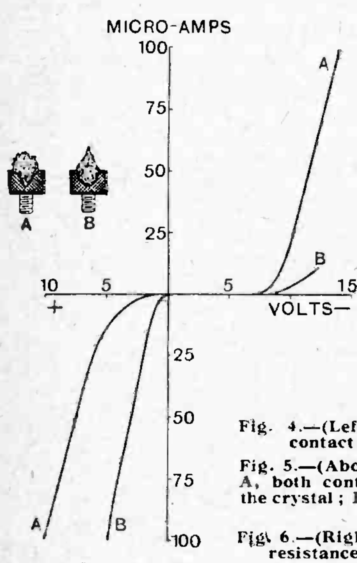
Suppose contact is made with the crystal at two points, instead of at one point, and a contact of wide area, then the working resistance of the crystal will be more, and the threshold voltages, positive and negative, will be the greater values of those found when the points are tested individually with a wide area for the other contact.

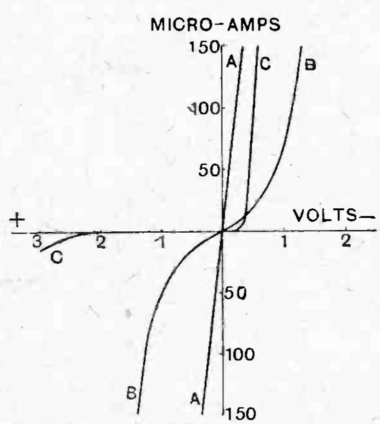
Take a chip of carborundum, and, instead of discriminating where to make contact on to it, grip it between two metal plates Then its characteristic will be one of the three types shown in Fig. 5. The curve A is obtained when contact is made on to an impurity at one end, and on to an impurity or badly fractured crystal at the other; curve B when there is a fractured crystal contact on both ends, and the curve C when contact at one of the two ends is on a perfect crystal surface, or one or more perfect crystal edges or points.

Crystal Powder Resistances.

If a number of crystal chips are taken, put in a tube and, clamped tight between two electrodes, contact between them and to the electrodes will be made indiscriminately, and the composite characteristic of such a combination will be made up of the individual characteristics of the parts, which must resemble the three types illustrated in Fig. 5.

Clearly the ultimate threshold voltage obtained by using a given number of crystal chips in series in this





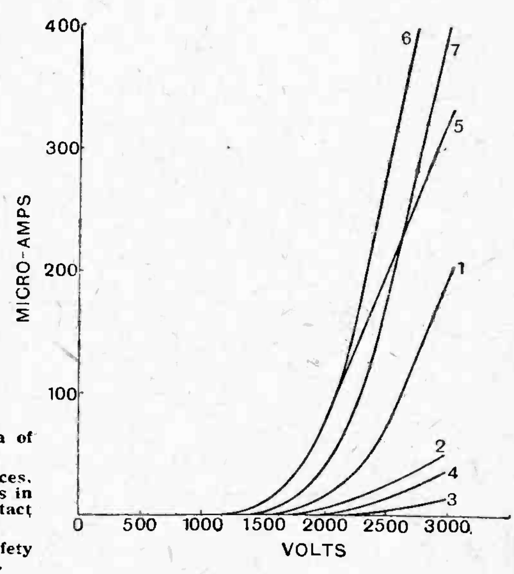


Fig. 4.—(Left) Characteristic curve (A) for a large area of contact (B) for a single contact (crystal reversed).

Fig. 5.—(Above) Crystal clamped between two metal surfaces. A, both contacts to badly fractured surfaces or impurities in the crystal; B, both contacts active rectifiers; C, active contact at one end only.

Fig. 6.—(Right) Characteristic curves of crystal powder safety resistances showing high threshold voltages obtainable.

Crystal Safety Resistances.—
way will not be so great as if the same crystals were individually mounted and connected in series, but there is the great advantage that only one pair of end fittings is required, and as the number of crystal chips employed is a secondary matter, the loss can be more than made good by greatly increasing their number.

It has been shown that there is no advantage as regards greater threshold voltage in the use of large blocks of crystal, and it can equally well be shown that there is no disadvantage in this respect if pieces of carborundum as small as possible are used, provided these pieces have unbroken crystal surfaces.

Taking now the extreme case, the author carried out a number of tests, using the carborundum chippings from a good variety of crystal formation, sifted through a screen having a mesh of about 80 to the inch.

This powder was put into tubes of insulating material, the end electrodes holding it under pressure, and characteristics were taken in the normal way.

The tabulated particulars of these tests are given below, and the corresponding curves in Fig. 6.

No.	Tube.	Length. Cms.	Area. Sq. Cms.	Total Pressure. Lbs.	Threshold Voltage.	Max. Current. Micro-amps.	Highest Voltage Applied.
1	Glass	1.7	0.159	5	1,200	190	3,000
2	,,	2.5	0.159	5	1,400	50	3,000
3	,,	2.5	4.15	5	1,500	12.5	3,000
4	,,	2.5	4.15	10	1,500	35	3,000
5	Ebonite	2.0	1.13	25	900	328	3,000
6	,,	2.0	1.13	50	900	525	3,000
7	,,	2.5	1.13	50	1,100	400	3,000

The results show that with short tubes and with small and medium pressures very high threshold voltages can be obtained.

If these carborundum valve-resistance units are to be used as guard resistances to protect a circuit against dangerous surges, there is first the threshold voltage to consider at which the units commence to act, and then the current capacity of the units at the maximum surge voltage contemplated.

These values are given in the last three columns of the table.

In one particular case a unit was required to withstand a potential of 5,200 volts. This was met by a tube having a length of 6.5 cms. and area of 0.28 sq. cm. and under a pressure of 10 lb. the maximum current through the carborundum was 750 micro-amps.

If the current capacity of the valve-resistance unit is required to be in milli-amps instead of micro-amps this can be obtained by :—

(1) increasing the area of the tube;
(2) using crystal powder of smaller grade;
(3) increasing the pressure applied to the powder.

Some typical results are shown in Fig. 7.

An insulating tube, $1\frac{3}{4}$in. in diameter and $3\frac{1}{2}$in. long, was filled with crystal powder and submitted to a pressure of one ton. The curves show that the finer the powder the greater its conductivity, the threshold voltage being about the same in each case, namely, 300 volts.

For use on normal low voltage circuits a more practical form of unit can be made up in a steel tube having suitably bushed connections and an insulating lining.

A steel tube unit of this type of 1in. diameter was tested under pressures ranging from $\frac{1}{2}$ ton to 2 tons. As the pressure is increased, the threshold voltage falls, and 2 tons appears to be excessive.

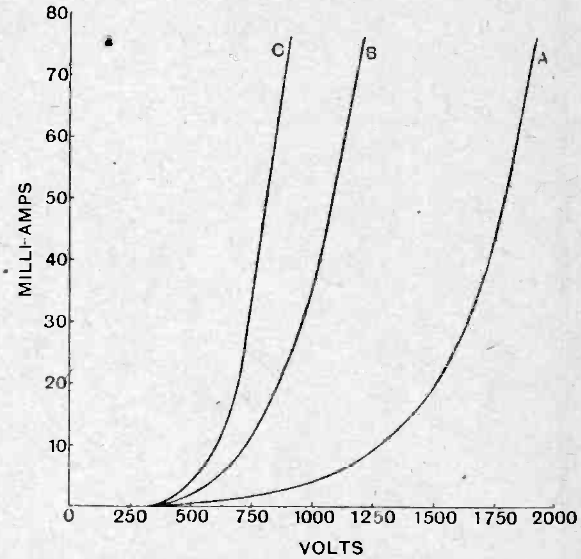


Fig. 7.—Characteristics of resistances of high current carrying capacity. Containing tube $1\frac{3}{4}$in. dia., $3\frac{1}{2}$in. long; pressure, 1 ton; size of crystals: A, 12 to 24 mesh; B, 24 to 80 mesh; C, 80 mesh and upwards.

Crystal valve-resistance units constructed as described above can be employed with advantage in place of the standard form of guard resistance; and as lightning protectors on aerial circuits they remain inert and do not affect the aerial constants until the threshold voltage at which they work is exceeded, when they act as effectively as a spark-gap, but with the advantage that they are completely self-recovering, less erratic in their operation, and require less attention.

In this manner the threshold voltage, which is peculiar to carborundum, can be turned to useful account.

HIDDEN ADVERTISEMENTS COMPETITION.

The Hidden Advertisements Competition, recently inaugurated by "The Wireless World," continues to be extremely popular among our readers, and will be continued until further notice.

The correct solution for the Third Competition is as follows :—

Clue No.	Name of Advertiser.	Page.
1.	Pettigrew and Merriman (1925), Ltd.	21
2.	Dubilier Condenser Co. (1925), Ltd.	3
3.	Bretwood, Ltd.	6
4.	Mullard Wireless Service Co.	9
5.	A. J. Stevens and Co. (1914), Ltd.	15
6.	Maywood Engineering and Electrical Mfg. Co., Ltd.	21

The following were the prizewinners :—

F. Carter, Edgware, £5.
E. Evans, London, N.W.11, £2.
Wm. C. J. Halford, St. Margaret's-on-Thames, £1.

Ten shillings each to the following four :—

C. W. Adamson, London, W.C.1.
Wilfred C. Turner, London, S.W.11.
Mrs. K. Staygle, Worthing, Sussex.
W. F. Howard, London, S.E.20.

GRADED EBONITE.

Standard Specification for Instrument Panels drafted by the British Engineering Standards Association.

ABOUT twelve months ago a joint request was made to the British Engineering Standards Association by the Radio Society of Great Britain and by the Ebonite Manufacturers' Association, for a standard specification to be drawn up for ebonite suitable for wireless purposes.

A committee was immediately set up, and devoted its attention to establishing a standard as regards size and quality for ebonite panels used in the construction of receiving sets. It was felt that the need for standardisation was a very urgent one, as there was on the market at that time a considerable quantity of poor grade ebonite, quite unsuitable for use in the construction of wireless apparatus.

It would seem that in certain sections of the trade almost anything could be sold as ebonite so long as it was black, and it is therefore considered that new specifications should now be drafted which would go a long way towards eliminating the doubtful qualities of ebonite.

Composition of Ebonite.

The specification calls for use of good quality raw rubber and sulphur in the manufacture, and that these constituents shall be free from grit and metal dust, and from "loading" materials of any description. It must be well vulcanised, tough and elastic, of good black colour, and capable of taking a good polish. Not more than 30 per cent. of sulphur by weight may be introduced, and of this not more than one-sixth shall be in a free or uncombined condition, such as can be extracted by acetone as a solvent. The total amount of resins or other organic matter extractable by acetone shall not exceed 10 per cent., while the ash left after thorough incineration must not exceed 3 per cent. The density at 20° C. shall not exceed 1.2 grams per cubic centimetre, and to conform with the specification the ebonite must be capable of being drilled, tapped, turned and sawn in a satisfactory manner.

Electrical Properties.

When tested for surface leakage with an instrument of the magneto-ohmeter type, working at 1,000 volts and capable of indicating a resistance of not less than 2,000 megohms, an indication of infinity shall be obtained between surfaces consisting of 25 points spaced in a straight line with ¼in. gaps, and arranged alternatively as positive and negative. The breakdown voltage is specified as not being less than 1,200 volts per $\frac{1}{1000}$ in. The dielectric loss which is so important in defining ebonite to be used in the construction of wireless apparatus is expressed as a power factor, and must not exceed 0.6 per cent. when tested at a frequency of the order of 1,000 cycles.

A very useful introduction is the drafting of a series of standard-sized panels, and in this connection careful consideration was given to the sizes generally used by amateurs in the construction of their sets. The range of sizes is as follows:—

Sizes	Thickness
5 × 5, 5 × 8, 5 × 10	Thickness $\frac{3}{16}$"
6 × 6, 6 × 8, 6 × 10, 6 × 12	Thickness ¼"
7½ × 10, 7½ × 12, 7½ × 15, 7½ × 18, 7½ × 24	Thickness ¼"
9 × 12, 9 × 15, 9 × 18, 9 × 24, 9 × 30	Thickness ¼"
9 × 12, 9 × 15, 9 × 18, 9 × 24, 9 × 30	Thickness $\frac{5}{16}$"
1¼ × 36, 2½ × 36	Thickness ¼"

Amateurs will do well in immediately adopting these sizes in their sets, as it is probable that before long the ebonite manufacturers will supply these panels already cut to size and with well-finished edges. A tolerance on these dimensions is also referred to, and, with regard to thickness, ⅛in. ebonite must be correct to within $\frac{4}{1000}$ in. Between ⅛in. and ⅜in. the error must not exceed $\frac{6}{1000}$ in., and for thickness exceeding ⅜in. a maximum tolerance of $\frac{8}{1000}$ in. is permitted. As to the length and breadth of standard panels, an amount of plus or minus $\frac{20}{1000}$ is specified. It is also stated that the panel should be rectangular and uniformly and smoothly finished.

Ebonite which complies with this specification may carry the mark of the British Engineering Standards Association ("BESA").

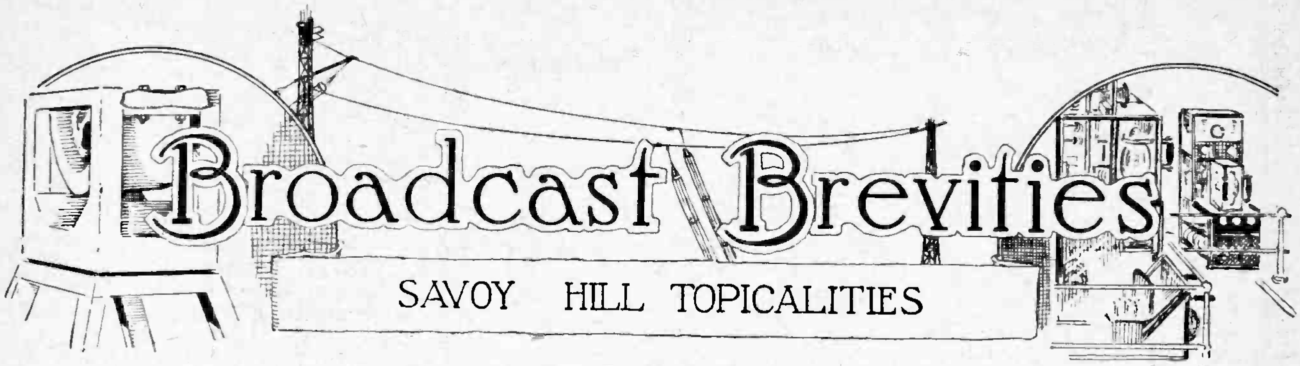
The complete specification is set out in the British Engineering Standards Association Specification No. 234-1925, just issued, together with details of the methods of applying the tests for determining whether or not the ebonite conforms with requirements. The specification may be obtained from the Publisher's Department of the British Engineering Standards Association at 28, Victoria Street, London, S.W.1, price 1s 2d. post free.

INTERNATIONAL BROADCASTING UNION.

ON December 16th the Council of the International Broadcasting Union, sitting in Brussels, decided that preference should be given to systematic endeavours, based on a plan submitted by the technical committee, to arrive at the best means of reducing the present interferences between the numerous European broadcasting stations, and a committee was appointed, composed of Capt. Eckersley (Great Britain), Herr Harbich (Germany), M. Dendron (France), Signor Bachini (Italy), and M. Braillard (Belgium).

The committee will meet frequently under the chairmanship of M. Braillard, and will report to the next general assembly of the Union, which will take place at Geneva.

In the meantime, technical experiments will be made to determine the practicability of a proposed scheme whereby the present broadcast waveband can be divided up among the stations of Europe, Asia, and North Africa.



By Our Special Correspondent.

What to Do with Critics.

"If I were financial adviser to the B.B.C." says a North Country listener in championing the broadcast programmes, "I'd larn people who criticise the stuff you broadcast; I'd double, if not quadruple, the charge for the yearly licence at once." Very kind, to be sure; but he would need to be something more than the B.B.C.'s "financial adviser" to do that. The B.B.C. has to be content with what the gods, in the shape of the Government, send it in the way of hard cash.

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A New Listeners' Club.

Cardiff and Swansea stations have set the pace for other stations in the formation of a Radio Guild (or Listeners' Club) to enable listeners to supply comments and suggestions in reference to broadcast matter. Members of the Guild will be supplied with reception cards on which to make reports to the local Guild committees, or to the Cardiff station, at regular intervals. A social service section of the Guild will ensure that no sick or aged people shall be prevented through poverty from hearing the programmes, and a scheme is being prepared by which such people may be supplied with apparatus. The Guild intends to cover the area from Pembroke to Cheltenham and Exeter, and North Wales. The Lord Mayor of Cardiff is the first president, and Mr. E. R. Appleton is chairman of the Committee.

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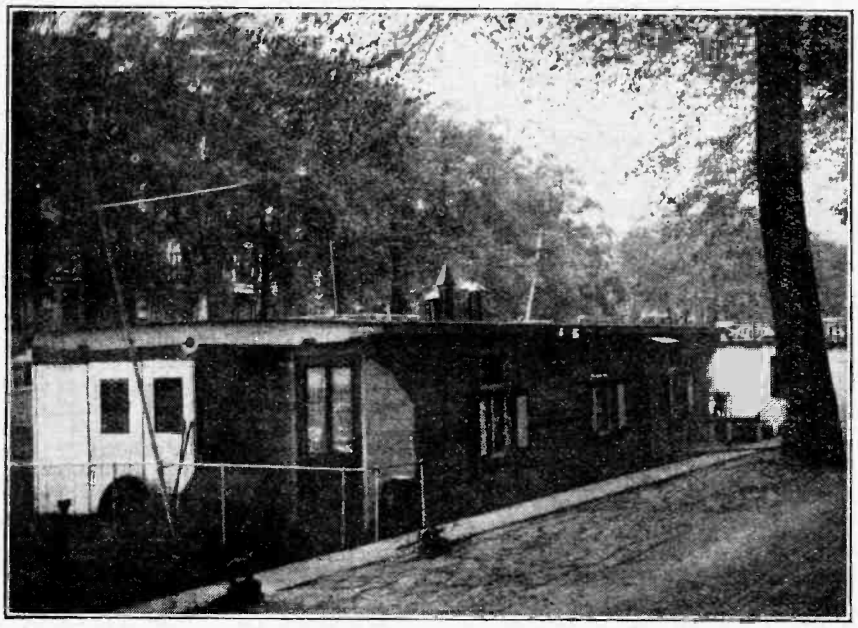
"Bach" Broadcast.

Of all the old masters of music that broadcasting has helped to popularise (if such a word can be applied to the classics) Bach is perhaps the most prominent. A shortened version of his "Christmas Oratorio" is to be conducted by Mr. Percy Pitt in the London studio on Sunday next (January 3rd).



AERIALS ON DUTCH CANALS. Many thousands of Hollanders, who make their permanent residence on canal boats, are resorting to broadcast reception to while away tedious hours. The photograph shows a typical canal boat fitted with wireless.

A Prolific Master.

Of all the vocal works which this prolific master produced—and he was in the habit of writing one a week for the magnificent choir at his disposal—the "Christmas Oratorio" is probably one of the best known and most popular with general audiences all the world over. The solo parts will be taken by Dorothy Silk, Enid Cruikshank, Leonard Gowings and Roy Henderson.

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Christmas Day Broadcasting.

Someone was spending a good deal of money in the Personal column of a daily paper for a week or two before Christmas, in protesting against broadcasting on Christmas day. The argument was that the poor radio engineer deserved a rest on this day of all days in the year. Listeners were asked to support the protest and to petition for the closing down of stations.

oooo

A Public Service.

The attitude of the B.B.C. was that as a public service it was bound to provide programmes at Christmas, just as a railway company is bound to run trains. There are probably thousands of listeners who have neither kith nor kin and to whom broadcasting is a solace in their loneliness. Other listeners rely on broadcasting for the entertainment of their guests, and the appreciative comments received in previous years and again this year are a reliable guide to the feeling of the majority of listeners on the subject of Christmas Day broadcasts.

oooo

"Treasure Island."

Mr. Arthur Bourchier and his company are to give a dramatised version of "Treasure Island" from 2LO on Tuesday next (January 5th), which will be a Robert Louis Stevenson night for listeners, and will include the "Songs of Travel," set by the English composer R. Vaughan Williams, musical settings of some of the poems from "A Child's Garden of Verses," and a reading from Stevenson's works.

oooo

5XX Breakdown.

The frequent interruptions in the service from 5XX recently have all been due to faults over which the engineers had no control. Circumstances seem to have conspired against the staff ever since the aerial was brought down through the weight of frost three weeks ago. I am informed that in the event of any further breakdown during the morning transmissions will be put out from 2LO. Listeners, therefore, should not be too ready to search for defects in their sets if nothing comes through from 5XX, but should first tune in to 2LO.

oooo

The Announcers' Pronunciation.

A Scottish newspaper gives a gentle admonition to the announcers at 2LO for their pronunciation of Scottish words, over which, according to the critic, less care is taken than over the pronunciation of French, German, Spanish, Italian, Russian and Chinese. But the announcers regard the criticism as too meticulous, and are asking whether listeners north of the Tweed deserve anything better than bad Scots; for haven't more than 600 wireless pirates been detected in one town alone?

oooo

A Repeat Performance.

The only criterion by which the B.B.C. can judge the value applied to its programme is the view expressed by the listener. It is for this reason that a repeat performance of "The Dweller in the Darkness," which was written specially for broadcasting, is to be given on January 4th. So great was the number of requests for a rebroadcast of this work that the opinion of the Dramatic Department as to its suitability for broadcasting was fully justified.

oooo

An Earlier Weather Forecast.

A wide demand appears to exist for the earlier broadcasting of weather forecasts from 5XX, the general opinion among farmers and agriculturists being that the present morning forecast at 10.30 is delivered too late to be of definite service. Opinion mostly converges upon 8 a.m. as being more suitable.

oooo

A Question of Expenditure.

So far as the B.B.C. is concerned, a 7.30 or 8 a.m. weather broadcast would mean an additional expenditure of approximately £1,000 a year and practically a 20-hour day service from Daventry; but the service would be provided by the B.B.C. if it were found practicable by the other interests concerned.

oooo

Collecting Weather Data.

It may, however, be recalled that when the facilities were introduced it was explained that 10.30 was the earliest hour at which the Air Ministry could get the message out. The message is the result of data collected by the Air Ministry over a wide area of sea and land from 7.30 each morning. Naturally, the collation and arrangement of the necessary details to give a reliable forecast is a matter which must take time and consideration. The Ministry of Agriculture has stated that if it were possible to give the forecast earlier, that would be done. This would indicate that the Ministry considers an earlier forecast impossible.

FUTURE FEATURES.

Sunday, January 3rd.

LONDON.—8 p.m., Organ Recital relayed from St. Stephen's, Walbrook.

BIRMINGHAM.—9.20 p.m., Orchestral Concert.

BOURNEMOUTH.—3.30 p.m., Symphony Concert.

CARDIFF.—3.30 p.m., A Light Concert.

MANCHESTER.—3.30 p.m., "Charm'd Magic Casements."

NEWCASTLE.—3.40 p.m., "X—O," by John Drinkwater.

GLASGOW.—9.15 p.m., Light Orchestral Programme.

Monday, January 4th.

NEWCASTLE.—10.30 p.m., Novocastrian Nights, No. 2, "The Black Gate Mystery."

ABERDEEN.—8 p.m., Auld Yule Night—Sowens Nicht.

BELFAST. — 7.30 p.m., Musical Comedy. 9 p.m., 16th and 17th Century Instrumental Music.

Tuesday, January 5th.

LONDON. — 8 p.m., "Treasure Island."

Wednesday, January 6th.

LONDON.—8 p.m., "The Dogs of Devon."

BIRMINGHAM.—8 p.m., An Hour with Mozart.

MANCHESTER.—8 p.m., Lancashire Talent Series—III., a Contribution by Oldham.

Thursday, January 7th.

CARDIFF.—8 p.m., "An Ideal Husband," by Oscar Wilde.

MANCHESTER.—7.30 p.m., Hallé Concert relayed from the Free Trade Hall.

Friday, January 8th.

BIRMINGHAM.—8 p.m., Ballad Concert.

BOURNEMOUTH.—7 p.m., Dramatic and Orchestral.

CARDIFF.—7.30 p.m., "Carmen" (Bizet).

NEWCASTLE.—8 p.m., Violin Recital by Godowsky.

GLASGOW.—8 p.m., Variety.

BELFAST.—8 p.m., Scandinavian Music. 9 p.m., Gipsy Music.

Saturday, January 9th.

MANCHESTER AND 5XX.—7.45 p.m., "Romeo and Juliet" (Gounod).

ABERDEEN.—9 p.m., An Hour of Choral Music.

Then—and Now.

As showing the hold that broadcasting has gained in rural districts, it is interesting to note the estimate that upwards of ten thousand persons are interested in receiving the forecast from 5XX. When, about two years ago, a similar forecast was obtainable from telephone exchanges after 5 p.m. each day, only a few hundred people throughout the British Isles regularly availed themselves of the facility, and it was eventually dropped.

oooo

Disproportionate Criticism.

The attitude of captious criticism adopted in certain quarters over the alleged refusal of the Post Office, or some other Government Department, to allow the B.B.C. to transmit alternative programmes from Marconi House during the Christmas season is very short-sighted and shows an absolute lack of proportion on the part of the critics. Everyone most closely concerned with broadcasting and other wireless services in this country admits the vital necessity of considering applications for specific facilities in their relation to, and probable effect on, other claims on the use of the ether; and it has yet to be shown that broadcasting facilities are curtailed through mere capriciousness on the part of Government officials.

oooo

Gramophone Records.

A revision of great importance is to take place in the programmes in the New Year. At present the 7.25 p.m. musical interlude has been provided by gramophone records.

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Changes Contemplated.

But it is probably true that variety is the keynote of success in broadcasting. The B.B.C., therefore, propose to devote part of the gramophone transmission time to another kind of musical entertainment. This will take the form of broadcasts of the standard works of pianoforte and other musical literature.

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Weekly Series.

The first week of the series, beginning on January 4th, will consist of Preludes and Fugues chosen from the "48" by Bach, played by that able Bach exponent, Mr. Claude Biggs. Many other important piano and other musical works will be broadcast in weekly series; in the week commencing January 11th, for six nights, the whole of Chopin's pianoforte studies will be played by Mr. Maurice Cole. As a general rule the classics and moderns will be alternated week by week.

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Breaking Up the Talk Periods.

These transmissions will occupy roughly a quarter of an hour. They will provide the variety necessary to break up a long period of talk such as one ordinarily has between 7 and 8 p.m.

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A Brass Band Contest.

The winners of the recent brass band contest from 5NO are to broadcast from the Newcastle studio on January 2nd. This is the Leasingthorne Colliery Prize Band, conducted by E. Smith, Senior.

FADING ON SHORT WAVES.

A Mechanical Model Illustrating Wave Polarisation.

By E. F. W. ALEXANDERSON.

In a previous issue (September 16th, 1925) a description was given of a horizontal loop aerial system used for the transmission of vertically polarised waves. In order to give a clear conception of the waves generated by this aerial, Dr. Alexanderson has constructed an ingenious mechanical device to illustrate polarisation effects.

FROM the point of view of the practical radio engineer it is gratifying to be able to state that enough has now been learned about vertically polarised waves to create a new and promising field of radio communication, as evidenced by the decision of the Radio Corporation of America to proceed with its chain of short wave stations in the Pacific Ocean. The stations which will thus be built will have antenna systems of the type classified as short-wave high-angle radiators. So far these tests have shown that the horizontally polarised radiation is superior to vertical radiation.

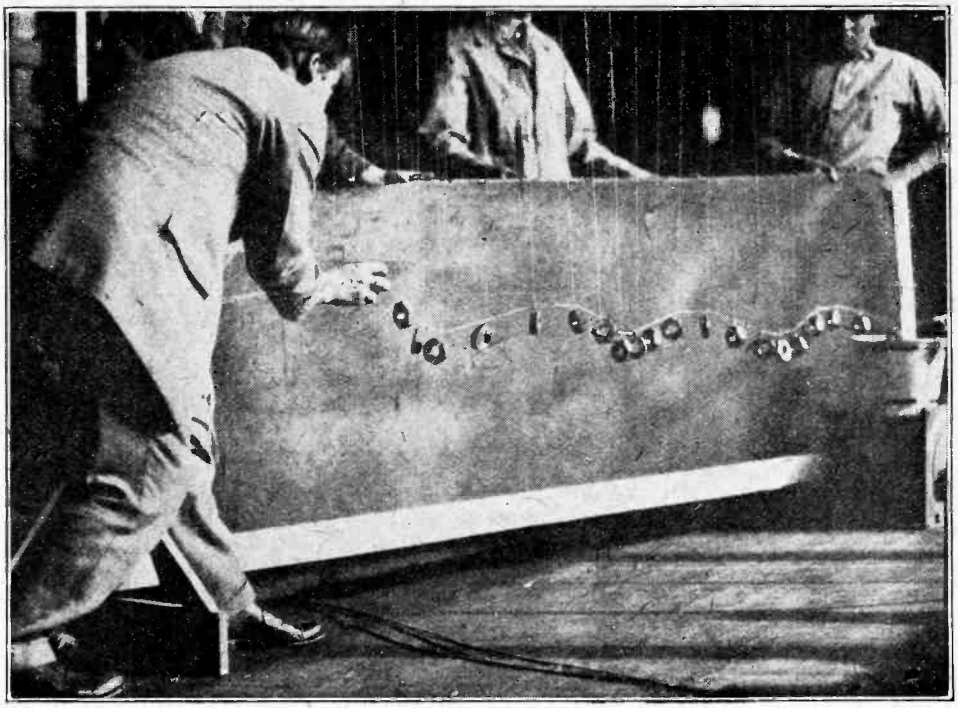
Rotation of the Plane of Polarisation.

I have a mechanical model made up for studying wave polarisation in the General Electric Laboratory, Schenectady. The model consists of weights suspended in such a way that they are free to move in all directions. Twenty-two of these weights are arranged in a row and connected together by rubber bands. Each weight is suspended from a yoke and an equal weight hung on the other side of the yoke to serve as a counter-weight. A screen is set up so as to hide the counter-weight and avoid confusion in observing the wave motion. This model was set up especially to study the twisting of the plane of polarisation, and the experiment has strikingly confirmed the theory which it was intended to illustrate. This theory is briefly the following :—

We will assume that the medium through which the radio waves pass has such characteristics that the velocity of propagation for a vertically polarised wave differs slightly from the velocity of the propagation for a horizontally polarised wave. It is not necessary for the present purpose to try to explain the reason for this difference in velocity. We may assume that the reason for it is due to the electrostatic and magnetic effects, to the retarding effect of the velocity of the vertically polarised wave passing close to the earth, or, on the other hand, due to properties of free electrons in the upper atmosphere. Whatever the cause may be, we may assume that such a difference of velocity exists, and the mechanical model has been constructed so as to reproduce such conditions. The weights on both sides are tied together with rubber bands. Wave motion in the horizontal or vertical planes can thus be studied independently, and these two wave motions may be adjusted for different velocities. A wave started in the vertical plane maintains itself vertically, and a wave started horizontally maintains itself horizontally. If, however, a wave is started in a plane 45 degrees between the vertical and the horizontal, it is found that the wave motion proceeding therefrom assumes the shape of a corkscrew. The straight line oscillation of the first weight is passed along as an elliptical motion which gradually widens into a circle. Then this circle narrowed down again to an ellipse, and finally a straight

Dr. Alexanderson with the demonstration model for studying wave form. A screen is erected between the two sets of weights to avoid confusion when observing the wave motion.

Fading on Short Waves.—



Rotation of the plane of polarisation due to a difference of velocity between the horizontal and vertical components of the waves.

line at right-angles to the original line of oscillation. This is exactly in accordance with the theory. The point where the wave has shifted its plane of polarisation 90 degrees is the point where the faster of the two waves is half a wavelength ahead of the slower wave. From this point onwards the wave proceeds, repeating this peculiar corkscrew motion.

Fading.

The fact that the twisting of the wave is due to different velocities in the two planes of polarisation can also be demonstrated by this model. For this purpose the rubber bands are added to the counter-weights. The effect of this is to change the velocity of propagation in the vertical plane, whereas the velocity in the horiontal plane has not been affected because only the vertical motion is transmitted to the counter-weights by the suspension yokes. The system can thus be adjusted so that the velocities in the horizontal and the vertical planes are exactly equal. After this has been done it is found that the tendency to corkscrew motion disappears and the wave remains strictly in the plane in which it has been started.

While this mechanical experiment does not bring out any new facts that were not known from the classical theory of wave motion, it helps us to visualise the main phenomena in the radio wave propagation which we are trying to explain. The phenomenon of a constantly shifting plane of polarisation, which we discovered experimentally in tests between Schenectady and Long Island, can thus easily be explained.

This conception of the wave motion is also a help in explaining the phenomena of fading. There is already experimental evidence[1] that fading is a phenomenon of interference. In other words, the fading is due to the fact that the radio waves arrive at a certain point through two paths. The waves will sometimes add to each other and sometimes neutralise each other. If we keep in mind the observations on the mechanical model that the waves in the two planes can be traced through separately and distinctly, we may conclude that the two paths of the radio wave which produce fading are not necessarily two separate physical paths, but may be the two paths in the horizontal and the vertical plane of polarisation. For further illustration of this we can, in the mechanical model, introduce a detector. If we place this detector at a certain distance from the origin we find that the detector gives no response when the system is adjusted for different velocities of propagation, whereas it gives a maximum response when the system is adjusted for equal velocity in the horizontal and vertical planes. The phenomena of fading has thus been reproduced mechanically through polarisation in a single wave path.

It is not hereby suggested that this mechanical equivalent is sufficient to explain the fading in actual radio transmission. It is, however, offered for what it may be worth as a help to interpret the many observations in actual radio transmission which are being accumulated.

[1] Appleton and Barnett, Proc. Roy. Soc. A., Vol. 109, p. 621, 1925.

CATALOGUES RECEIVED.

"Radio Communication Co., Ltd." (34-35, Norfolk Street, Strand, W.C.2). Illustrated catalogue of "Polar" sets and components.

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"Marconiphone Co., Ltd." (210-212, Tottenham Court Road, London, W.1). Publication No. 364F, dealing with Marconiphone and Sterling radio receivers, accessories, and components. Publication No. 438, describing Marconiphone receivers, types 21, 31, 41 and V2, V3a, and VB4.

"L. McMichael, Ltd." (Hastings House, Norfolk Street, Strand, London, W.C.2). Pamphlet illustrating and describing MH components.

"A. J. Stevens and Co. (1914), Ltd." (122-124, Charing Cross Road, London, W.C.2. Illustrated catalogue of A.J.S. cabinet receivers and loud speakers. Pamphlet describing 2-valve type "Z." Pamphlet illustrating A.J.S. choke units. Publication No. 115, relating to A.J.S. components and accessories.

oooo

"Dugdill's Patents," (Hazel Grove, Stockport). Card illustrating various patterns of electric light fittings for workshops, etc.

CONDENSERS IN SERIES.

Graphical Aids to Calculation.

By C. F. SMITH.

THE experimenter often spends much time in finding a suitable fixed condenser for his purpose, and the desired result may be obtained by connecting two or more in series or parallel. If the approximate value is known a few calculations show which of the available condensers will give the right combination, and the nearest commercial condenser may be obtained subsequently. The writer recently had occasion to do this, but finding the calculations rather irksome used two graphical methods recommended by him in experimental optical calculations. The capacity of a number of condensers in parallel is equal to the sum of the capacities, and there is, of course, no difficulty in performing the simple addition.

The capacity of a number of condensers in series is expressed by the following formula, in which C = total capacity in microfarads, C_1, C_2, C_3, etc., = capacity in microfarads of each condenser unit :—

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

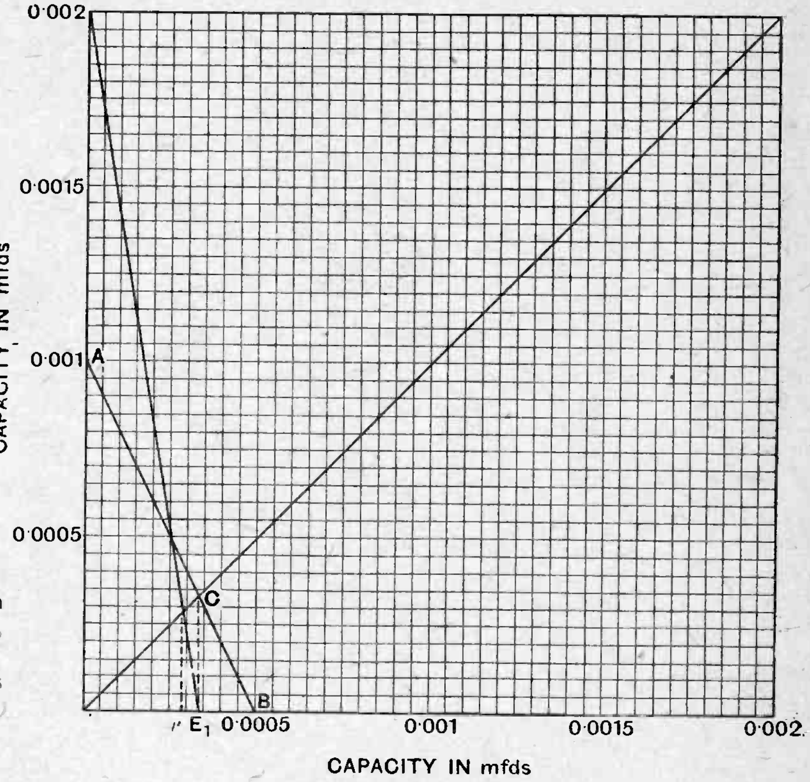


Fig. 1.—Graph for calculating the effective capacity of condensers in series.

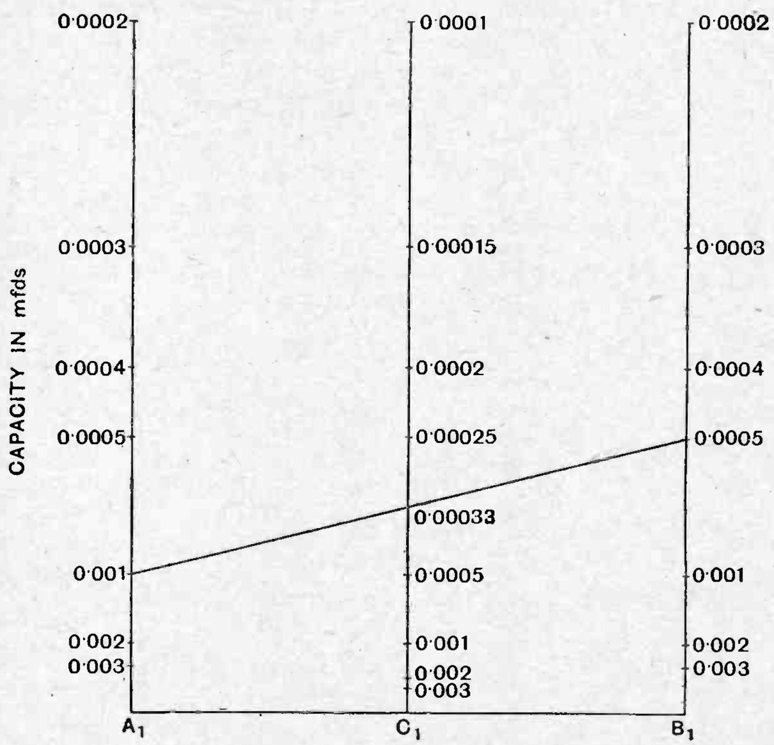


Fig. 2.—Another graphical method. The spacing of the divisions is proportional to the reciprocals of the capacities shown, while the scale used for C_1 is twice that of A_1 and B_1.

or (in the case of two condensers) :—

$$C = \frac{C_1 C_2}{C_1 + C_2}$$

The graphical methods to be described enable the value of C to be obtained quickly and with sufficient accuracy for most purposes. The value of C_1 or C_2 can be obtained with equal facility, but this case is not likely to arise so often.

Referring to Fig. 1, the diagram contains the usual horizontal and vertical lines of the ordinary graph, and is drawn on squared paper. Each of these lines is divided to represent capacity in microfarads. A line may be drawn from 0 at 45 degrees, but this may be omitted without inconvenience when working on squared paper.

To obtain the capacity of two condensers in series marked respectively 0.0005 mfd. and 0.001 mfd., a line is drawn from A (0.001 mfd.) on the vertical axis to B (0.0005 mfd.) on the horizontal axis. This resultant capacity is found by dropping a vertical line from C to the horizontal axis, and the value 0.00033 is read off at E_1.

The effect of the addition of a further condenser of 0.002 mfd. is seen by drawing a

Condensers in Series.—

line from E_1 to 0.002 on the vertical axis, the total capacity then being equal to 0.00028 mfd.

The second graphical method is shown in Fig. 2, and consists of three parallel lines separated by equal distances. The two outside lines are marked off to represent reciprocals of capacity in microfarads.

Thus the reciprocal of 0.002 mfd. $= \frac{1}{0.002} = 500$, and this with other values are plotted to scale. The middle line is marked off to a scale twice that of the outside lines. In order to find the capacity of two condensers in series, a line is drawn from selected points on the lines A, B, the result being read off at its intersection on C. The values shown are the same as in Fig. 1, viz., 0.001 mfd. and 0.0005 mfd., the result being 0.00033 (read off on C_1). The first diagram proves more convenient in practice, and in the experience of the writer saves time and temper.

Although perhaps of less interest to amateurs, it may be noted that the formula for resistance $\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$ etc., may also be solved by the above methods, or, indeed, any formula of the same character. A modification of either diagram enables formulæ such as $\frac{1}{A} = \frac{1}{a_1} - \frac{1}{a_2}$ to be solved.

BROADCASTING AND THE FARMER.

Some Forgotten Benefits.

No one is inclined to doubt the value of broadcasting as a beneficent influence in the lonely life of the countryman. Few city dwellers, however, care to take the trouble to consider precisely what services broadcasting can render to the sons of the soil.

A stimulating address on this topic was recently delivered before the Advertising Club of New York by General J. G. Harboard, President of the Radio Corporation of America. The speaker justified his claim to knowledge of farm conditions by referring to the days of his youth, which were spent in laborious work on a Kansas farm.

After emphasising the lonely rigour of farm life, General Harboard laid stress upon the farmer's lack of contact, not only with the world of events, culture, and entertainment, but with the markets, by means of which produce can be disposed of.

He affirmed that many farmers, lacking immediate knowledge of market conditions, sell their crops on a "hit or miss" basis. Sometimes produce is shipped to markets that are already glutted, while other markets clamouring for this class of product are neglected simply through the farmer's lack of timely information.

Vital Market Information.

Farm news does not necessarily interest everybody, but it is well that the townsman should make allowances for the necessities of his country cousin. "The city listener," said General Harboard, "who tunes in on a station only to hear a voice reeling off the price of White Leghorn eggs, fancy cabbages, red onions, and pork, where he had hoped to hear jazz, may not be much impressed with the value of market reports. But at that very moment there are thousands of men on farms who have laid aside everything else in order to listen in on what is, to them, business information."

The announcer may herald the approach of a cold spell; to the comfortably housed townsman this may mean little, but to the farmer warning of cold weather immediately suggests a long train of duties. The orchard may have to be protected from frost, the hen houses closed. Pumps and pipes will probably require to be drained and the radiators of tractors and cars may have to be emptied. During periods of harvest, broadcast weather reports are of inestimable value, and it must be remembered that the farmer has literally to "make hay while the sun shines."

The question of obtaining the right kind of labour at the right moment can be simplified through the agency of broadcast information. Again, the farmer will be prepared for cattle epidemics, when he has received information and advice from the local broadcasting station, and the same source will also furnish him with help in contending with insect pests. Rapid advance has been made in America in the development of a system of broadcasting stations specialising in agricultural courses and lectures organised in co-operation with the State Agricultural Colleges. Thus the American farmer has access to the latest information regarding modern methods of farm management.

The Lighter Side.

In the course of his address General Harboard drew attention to the lighter side of broadcasting and its influence upon the home life of the farmer and his household. The farmer's life is not confined entirely to the hay field and the fowl run, and entertainment is as welcome to him as to the "man-about-town." In this connection, the versatility of broadcasting is of real service. Seated round the hearth the farmer and his family can listen to Grand Opera with the same sense of exclusiveness as the millionaire, and there are no limits to the variety of entertainment which can be brought within the four walls of the farmhouse. General Harboard, speaking, of course, as an American, went so far as to say that radio had a greater application to the farm than to any other phase of national existence. Not the least important service offered by radio was that of keeping the young people on the farm, a very pressing need at the present day in the majority of civilised countries.

Certain differences undoubtedly exist between farm conditions in America and in Great Britain; but many of General Harboard's remarks apply with equal force to the case of the British farmer. Evidence is accumulating as to the value of the B.B.C.'s weather reports to farmers, and not a few reports go to show that valuable crops have been saved in consequence of timely weather forecasts.

DICTIONARY OF TECHNICAL TERMS

Definitions of Terms and Expressions commonly used in Wireless Telegraphy and Telephony.

This section is being continued week by week and will form an authoritative work of reference.

Permanent Magnet. A magnet made of special tempered steel which holds its magnetism to a considerable degree and for an indefinite length of time after the *magnetising force* has been removed. Cf. ELECTRO-MAGNET.

Permeability. The measure of what may be termed the "magnetic conductivity" of a substance, *i.e.*, the extent to which magnetic *lines of force* will pass through the substance under given conditions. Permeability is defined as the ratio of the *flux density* in the substance to the *magnetising force* producing that flux density. If B is the flux density in, say, a piece of iron and H is the magnetising force (*i.e.*, the flux density which would be obtained in air or any other non-magnetic material with the iron removed but otherwise under the same conditions), the permeability of the iron is equal to B/H and is usually denoted by μ. The permeability of air and all non-magnetic materials is unity, but that of iron varies over a wide range according to the flux density in the iron and the quality of the iron or steel alloy, etc., having a maximum value at that flux density which is reached just before *saturation* commences. See RELUCTANCE.

Permeability Curve. A graph showing the relation between the *flux density* in a magnetic material and the *permeability*.

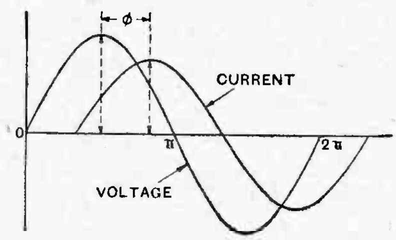
Permeance. The reciprocal of *permeability*, *i.e.*, *magnetising force* divided by *flux density* in a magnetic material.

Phantom Aerial. Another name for *artificial aerial*.

Phase, or Phase Angle. A term applied to an alternating current, voltage, etc., to denote the value at any instant in terms of an angle, one complete cycle representing 360°. See ROTATING VECTORS and PHASE DIFFERENCE.

Phase Difference, or Phase Displacement. Two *alternating* quantities, such as voltage and current, of the same frequency are said to differ in *phase* when they are not in step, *i.e.*, when they do not pass through their respective maximum positive values at the same instant, or through their zero values at the same instants. For a *sine*-shaped wave the instantaneous value can be represented as being proportional to the sine of an angle, one complete cycle being equivalent to 360° or 2π *radians* (see ROTATING VECTORS). Now, when two quantities are not in phase, the respective angles corresponding to each quantity at any given instant are not equal, and the difference between these two angles is called the "Phase Difference."

Suppose a phase difference exists between an alternating voltage and an alternating current in a circuit and that the current reaches its maximum positive value some time less than that of half of a cycle after the voltage passes through its maximum positive value; then the current is said to *lag* behind the voltage by an angle ϕ, where ϕ is the difference of the respective *phase angles* at that instant, or the voltage is said to *lead* the current by the angle ϕ. In terms of *rotating vectors* the phase difference is equal to the angle between the two vectors representing the two alternating quantities in question.



Phase difference. Current lagging behind voltage by an angle ϕ.

In the particular case when the voltage and current are out of phase by 90° (or $\pi/2$ radians), *i.e.*, by exactly a quarter of a cycle, they are said to be "in quadrature." The angle of phase difference cannot be greater than 90° in an ordinary circuit which does not give out electrical power. For a pure inductance without the presence of resistance the current would lag by 90°, and for a condenser the current leads by 90°. See ALTERNATING CURRENT CIRCUITS, POWER IN A.C. CIRCUITS, and ROTATING VECTORS.

Phone. Abbreviation for telephone.

Photographic Recorder. An instrument for recording high-speed Morse signals photographically. A light spot projected from a sensitive galvanometer of special construction is thrown on to a moving photographic film so that the deflections are recorded on the film.

Plain Aerial. Term applied to the arrangement where the sending or receiving apparatus is connected directly to the aerial, without any *inductive coupling* or intermediate tuned circuit. Such an arrangement usually gives *flat tuning*.

Plate. The name commonly given to the *anode* of a *thermionic tube*. It is usually in the form of a cylinder surrounding the *cathode* or filament, and it is due to the difference of potential applied between the plate and the filament that *electrons* are drawn off from the filament.

Plate Battery. See HIGH-TENSION BATTERY.

Plate Circuit. That part of a valve circuit which is connected to the *plate* or *anode*, *i.e.*, the circuit from the plate to the high-tension battery.

Plate Current. The current flowing through the *plate circuit* external to a *thermionic valve* and between the plate and filament inside the valve. With a *hard valve* the current inside the valve is in the form of a stream of negative *electrons* emitted from the filament, and in the case of a *soft valve* it is composed partly of electronic emission and partly of conduction through the *ionised* gas.

Plate Impedance. See INTERNAL IMPEDANCE (of thermionic valve).

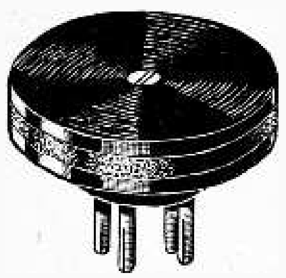
Plate Potential or Plate Voltage. The electrical *potential* or voltage of the anode of a *thermionic valve* above that of the negative end of the filament, *i.e.*, the potential difference between the plate and the negative end of the filament. As the name implies, the *anode* always has a positive potential with respect to that of the filament.

Pliotron. The name sometimes given to a *three-electrode valve* which is particularly *hard*, *i.e.*, one in which the vacuum is particularly high.

Plug-in Coil. A tuning coil or other coil with a plug and socket attached to it for making quick connection and disconnection with a circuit which is provided with a corresponding plug and socket. The arrangement is such that the plug on the coil fits into the socket connected to the circuit and *vice versa*.

Plug-in Transformer. A *high-frequency transformer* which forms a separate unit from the receiving circuit and in

Dictionary of Technical Terms.— which the ends of the two windings are connected to two pairs of pins which fit into a suitable combination of sockets connected to the receiving circuit, for example an ordinary valve



Plug-in H.F. transformer.

holder. Such a transformer is easily and quickly interchanged with similar transformers of different wavelengths, so that with a suitable set of such transformers any desired range of wavelengths can be covered.

Polarisation (of a battery). In some types of *primary cells* hydrogen accumulates on the positive electrode and sets up a *counter electromotive force* which lowers the effective voltage of the cell, this effect being known as "polarisation." In cells which have this tendency an oxidising agent known as a "depolariser" is provided to absorb the hydrogen as it is liberated. See LECLANCHÉ CELL.

Polarised Electro-magnet. A magnet which is partly an electro-magnet and partly a permanent magnet, so that only part of the *magnetic flux* is due to the *magnetising current*. A flow of current in the coil may either increase the magnetic flux or decrease it according to the direction of the current. Such an arrangement is used in order that the iron may be operated at the steepest part of its *magnetisation curve*, thus giving a maximum change of flux when the magnetising current is increased from zero to some *small* value.

Polarised Relay. A *relay* in which a soft iron armature is kept magnetised by a permanent magnet, one end of the armature being situated between the poles of an electro-magnet so that its deflection will be in one direction or the other according to the direction of the current through the magnetising coils of the electro-magnet.

Pole. (*a*) That part of an electro-magnet or a permanent magnet where the lines of magnetic force enter or leave the iron. (*b*) The terminals of a battery or cell or a generator are commonly referred to as poles, the positive terminal being called the positive pole, etc.

Polyphase. Refers to a system in alternating currents in which the circuit consists of a number of separate branches or "phases" in which the currents all have different *phase angles*, the current in any one phase being displaced from the current in the next by a definite phase angle. See THREE-PHASE.

Polystage Amplifier. See MULTISTAGE AMPLIFIER.

Positive Charge. The *quantity of electricity* carried by a body when it is positively electrified. See POSITIVE ELECTRIFICATION

Positive Electrification. According to modern theory a body is said to be positively electrified when its molecules contain a deficiency of negative *electrons*. Cf. NEGATIVE ELECTRIFICATION.

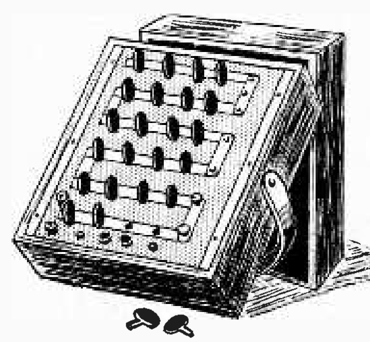
Positive Electrode. See POSITIVE POLE.

Positive Electron. See PROTON.

Positive Ion. See IONS.

Positive Pole. In any piece of apparatus, the pole or electrode which is at a positive *potential* relatively to the other pole, and therefore in a generator or cell, the positive pole is the one through which the current leaves the cell or generator, whereas in the case of a piece of apparatus which absorbs electrical energy the positive pole is the one by means of which the current enters.

Post Office Box or Post Office Bridge. A *Wheatstone bridge* for measuring resistances, made in a compact form for portability. The resistance of the various "arms" of the bridge are enclosed in the box and are controlled by plugs inserted in, or withdrawn from, sockets between brass blocks to which



Post Office box.

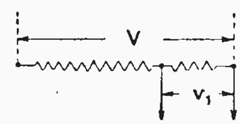
the ends of the resistance coils are connected. A plug inserted between two of these brass blocks *short-circuits* the ends of the resistance connected between them.

Terminals are provided for connecting the battery, galvanometer, and unknown resistance, and also two tapping keys for closing the battery and galvanometer circuits.

Potential and Potential Difference. In electrostatics the potential at a point is defined as the work done in bringing a unit positive charge from an infinite distance away to that point and the potential difference between two points as the work done in moving a unit positive charge from the one point to the other. Thus potential is that which tends to drive electricity from one point to another, and may be looked upon as a sort of electrical "pressure" which tends to drive electricity from a point where the potential is high to a point where it is low. It is analagous to fluid pressure which tends to drive a current of fluid from a place where the pressure is high to a place where it is low.

Likewise in current electricity the potential difference between two points (such as the ends of a resistance) is the difference of electrical pressure between those points driving or tending to drive current from one point to the other. A potential difference is set up at the terminals of a cell as a result of the *electromotive force* exerted inside the cell or at the terminals of a generator by the E.M.F. induced in the windings. Potential and potential difference are measured in the same units as E.M.F., *i.e.*, in *volts*, and for this reason potential difference is often called *voltage*. One volt is the pressure or potential difference required to drive a current of one *ampere* through a resistance of one *ohm*.

Potential Divider. A high resistance connected up in the manner of a *potentiometer* so that a known fraction of the P.D. across its ends can be tapped off a fixed portion of the resistance.



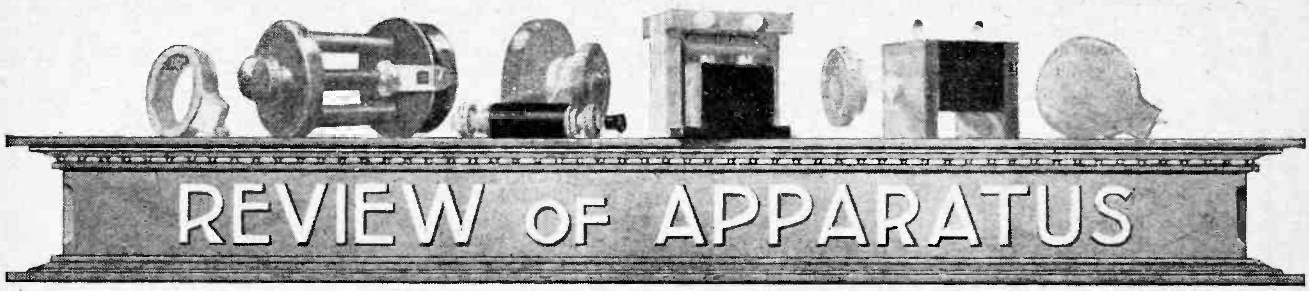
Connections of a potential divider for deriving a small voltage V_1 from the main voltage V.

Potential Drop. The potential drop in any part of a circuit is the *voltage* or *potential difference* which is "used up" in driving the current through that part of the circuit. For D.C. it is given by the product of current and resistance, and for A.C. by the product of current and *impedance*.

Potential Gradient or Potential Slope. The number of volts per centimetre between two points in a dielectric or insulating material; it is a measure of the electric stress set up in the dielectric and the maximum potential gradient which a dielectric can stand without breaking down is called the *dielectric strength* of the insulating material.

Potentially Operated Device. A piece of electrical apparatus which is operated by changes of potential alone, and thus takes no current (except perhaps a negligibly small capacity current). The ordinary three-electrode valve provides an example of such a device when used in such a manner that no *grid current* flows.

Potentiometer. A resistance arranged so that a fraction of the total P.D. across its ends can be tapped off a portion of the resistance. It is usually understood that the position of one of the tappings is variable, so that any voltage from zero to the full value of the P.D. across the resistance may be obtained between the tappings. When the tappings are in fixed positions the device is termed a *potential divider*. In nearly every case one of the tappings is taken from one of the extreme ends of the resistance.

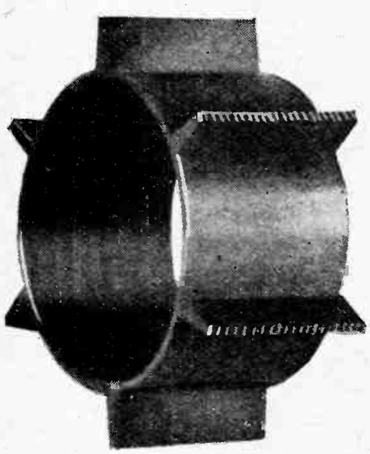


Latest Products of the Manufacturers.

LOW LOSS INDUCTANCE FORMERS.

A number of very good designs have been put forward for the construction of low loss coils, though the making of a really efficient coil usually involves somewhat difficult constructional work. Apart from considerations of shape and the relationship between length and diameter, the general aim is to remove solid dielectric material from between and beneath the turns, making the coil, as far as possible, self-supporting.

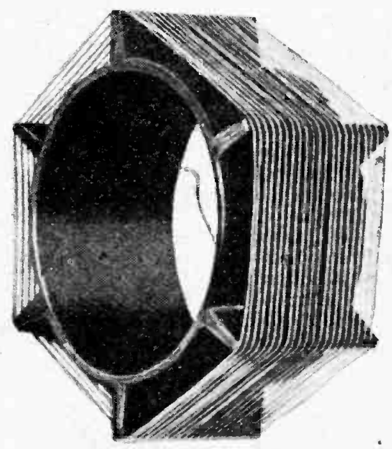
To achieve this object Fuller's United Electric Works, Ltd., Sparta House, 176, Tottenham Court Road, London, W.1, have introduced a new form of moulded ebonite tube carrying six slotted ribs upon which the wire is wound. The slots keep the turns of wire in place, rendering a uniform distance from turn to turn, and provide the necessary air spacing. With turns of wire resting on the face of a former the turn to turn electrostatic strain is partly set up through the solid material of which the former is composed, and thus by the use of the supporting strips an improvement in the efficiency of the winding is brought about.



Low loss ebonite former, a recent product of Messrs Fuller's United Electric Works, Ltd.

The slots produce a winding with a pitch of 14 turns to the inch, with a mean diameter of 3¼in. The height of the supporting strips above the cylindrical tube is approximately ½in. and the maximum diameter is 3½in., while, the former being supplied in lengths, pieces can be cut off to any required dimensions. The entire absence of screws or other metal parts in the construction of coil formers of this type is a good feature.

The introduction of moulded ebonite strips which would fit over the supporting pieces having slight projections to engage between the turns would facilitate the construction of coupled inductances, as it is invariably the case that coils of this sort need to be fitted with primary windings.



A 1¼in. length of low loss former wound with 22 turns of No. 24 S.W.G. wire.

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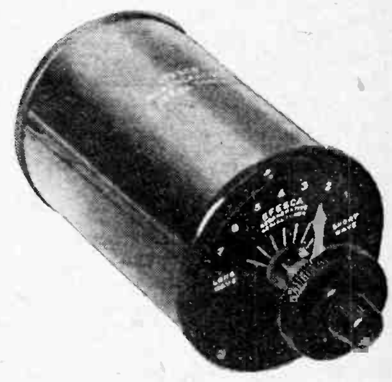
THE EFESCA REGENERATIVE AERIAL TUNER.

The tapped coil is a very convenient method of tuning over a wide wavelength range, and, provided the switch arm short circuits a pair of studs to screen that part of the winding which is not in circuit, there is probably little to choose as regards efficiency between the plug-in type of coil with its two-pin mounting and specially shaped multi-layer winding and the single layer tapped solenoid.

The Efesca aerial tuner manufactured by Falk, Stadelmann & Co., Ltd., 83, Farringdon Road, London, E.C.1, consists of a single layer cylindrical coil enclosing a pair of coupled coils for providing aerial loose coupling or reaction. The reaction coil, therefore, only couples with a portion of the tuning inductances, and the extent of coupling is not materially affected by changes in the size of the tuning inductance. The switch contacts are totally enclosed, and the reaction coupling is operated by a small concentric knob with spindle passing through the hollow spindle of the switch.



The Efesca regenerative tuner. A device for aerial tuning up to a wavelength of 2,600 metres and which gives the necessary reaction control.

In conjunction with a variable condenser having a maximum capacity of 0.0005 mfd. and connected in parallel across the inductance, the manufacturers state that the tuning range is from 150 to 2,600 metres, and it is therefore a useful instrument for tuning over all wavelengths used for broadcasting. The end discs are of ebonite, all terminals and screws are lacquered, and the winding is protected by a polished ebonite covering. A dial is supplied for attaching to the front of the instrument under the nut which is used for one-hole fixing, the inductance value increases by rotating the knob in an anti-clockwise direction.

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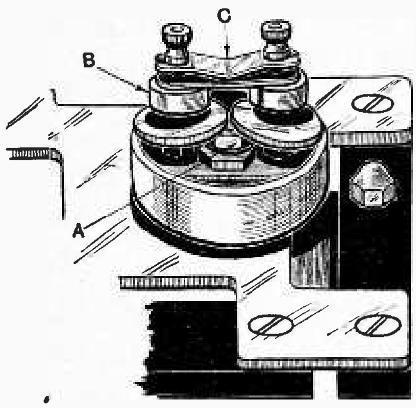
THE ORMOND REDUCTION GEAR.

The recent trend in the development of condenser design is to dispense with the vernier plate and substitute a reduction gear so as to permit of calibration. Many forms of reduction gearing for propelling the moving plates of the condenser have already appeared, the majority of them making use of a train of pinions which in many instances permits of play between the operating spindle and the plates due to the almost unavoidable slackness which occurs when meshing toothed wheels.



The Ormond friction reduction gear. The end of the spindle makes friction contact with the pair of discs which engage on the rim of the container. Ball races and adjusting screws are provided.

The new Ormond design consists of producing a slightly bevelled face, shown at A in the accompanying diagram, on the end of the concentric spindle used for producing critical adjustment. This face engages on the rims of a pair of discs, causing them to revolve as the central shaft is rotated. These discs in turn engage on the raised rim of the metal piece used to contain the reduction gearing, and thus when rotated travel round the rim and carry the moving plates with them. The correct operation of a device of this sort depends essentially on obtaining a critical degree of friction at the faces of contact through which the drive is obtained, and very careful consideration has been given to this matter in developing the design. It will be seen that an adjustable two-ended spring C controls the friction produced by the revolving discs, and end friction in the bearings is eliminated by thrust ball races B. Another improvement to be found in the new type condenser is the substitution of the spring washer formerly fitted at one end of the spindle by a substantial ball race housed in a plated brass cup. The other bearing, moreover, is split to provide a smooth friction contact with the spindle.

Although marketed at a popular price this new Ormond condenser is fitted with a movement which definitely avoids back lash, and the reduction ratio, whilst not being excessively low, provides for obtaining a most critical adjustment. A quick motion is also provided.

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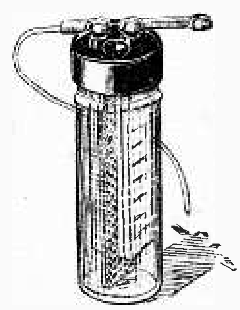
THE STORAD H.T. BATTERY.

Although it may at first be thought that the sections of a high-tension accumulator battery need be of only the simplest construction in view of the low ampere hour capacity required, many points must be considered if the battery is to give long service. The cells being small, the required charging rate is apt to be excessively low, and in consequence will often be exceeded, bringing about a consequent deterioration of the plates. For this reason the Storad battery, an American product marketed in this country by R. A. Rothermel, Ltd., 24-26, Maddox Street, Regent Street, W.1, is provided with plates which are supported on leaden frames over ¼in. in thickness. Liberal ampere hour capacity is produced by using plates of ample size, about $3\frac{1}{2} \times 1$in. The plates are pasted right into the interior of the hollow cast grids and there is little danger of the paste falling out as the discharge rate even for a small battery is extremely low.

Both wood and perforated ebonite separators are placed between the plates, the outer container being of glass, and



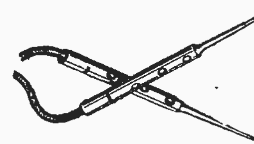
One of the cells of the Storad battery.

the screw on top of moulded ebonite. Nearly an inch of clearance is allowed beneath the bottom of the plates to provide ample space for sediment. The cells are interconnected by means of cast lead bars and the use of brass terminals is entirely avoided.

The Storad battery is undoubtedly capable of giving long service without deterioration, and the method of sealing the cells prevents free acid or acid spray appearing on the tops of the cells, while the use of glass containers avoids any risk of frothing.

GENERAL RADIO TELEPHONE TAGS.

To make provision for connecting a number of pairs of telephones either in series or parallel to a single pair of telephone terminals the General Radio Co., Ltd., 235, Regent Street, London, W.1,



The General Radio Co.'s telephone tags permit of connecting several pairs of telephones either in series or parallel to a single pair of terminals.

have produced a tapering tag fitted with several holes into which the tags of other pairs of telephones can be plugged. Series and parallel connections can thus be obtained.

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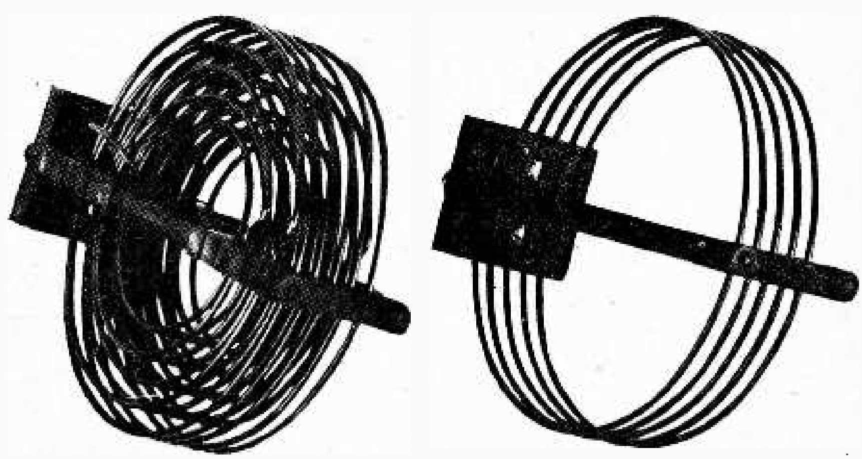
LOW LOSS COILS.

A series of beautifully constructed inductance coils of the low loss type is manufactured by A. B. Callingham, 107, Hartham Road, Isleworth, Middlesex.

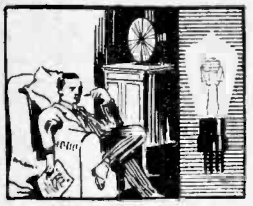
The pin-and-socket type of connector is fitted so that these coils can replace any of the standard types of plug-in coil. The winding is of No. 16 enamelled wire, used, no doubt, to retain a clean surface and to produce a coil that is reasonably robust. Liberal spacing is provided between both turns and layers, which are clamped between grooved ebonite strips.

An important feature is the avoidance of metal parts in the neighbourhood of the turns, and for this reason the screws and nuts used to clamp the spacing pieces together are all of ebonite This must, of course, add materially to the difficulties of manufacture, and the user must accordingly handle the coil with care.

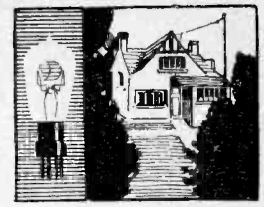
The large size coils make use of multilayer windings linked across at the ends in preference to taking the connecting wire across the turns. It is doubtful which of these two practices is better in this instance, in view of the liberal spacing provided between the layers.



A pair of low loss coils manufactured by Messrs. A. B. Callingham.



NEWS FROM THE CLUBS.



Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

The Manchester Radio Scientific Society.

"Low Frequency Amplification and its Difficulties" was the title of a lecture given on December 9th by Mr. A. Hall, A.R.C.Sc., chief radio engineer at Messrs. Ferranti, Ltd., of Hollinwood.

The lecture was accompanied by a demonstration which showed the exceedingly fine results which may be obtained with the use of transformers that are nearly perfect.

The lecturer showed curves plotted from actual measurements comparing the relative amplification throughout the musical scale given by various well-known makes of transformer.

It was shown that if the amplification of a transformer and valve were reduced so as to give the same maximum amplification as the two-stage resistance capacity set, the transformer curve approximated so closely to that of the resistance capacity unit as to make the difference aurally unnoticeable.

The meeting concluded with an animated discussion on the relative merits of transformer and resistance capacity coupling.

Hon. Secretary: Mr. Geo. C. Murphy, Meadow View, The Cliff, Hr. Broughton, Manchester.

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Ilford Radio Society.

Mr. F. H. Haynes, Assistant Editor of *The Wireless World*, visited the society on December 8th, giving an interesting talk on "Circuits for Broadcast Reception." Useful information was imparted regarding correct condenser values for primary and secondary circuits, and details were given for the construction of a short-wave receiver for picking up KDKA.

Various circuits were discussed in turn, including the "tuned anode" and "straight reaction," and it was explained that manufacturers invariably adopted the latter to give their customers a chance to get distant stations—with varying results! This did not condemn the reaction set, but Mr. Haynes stated his own preference for the "neutrodyne" arrangement.

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Sheffield and District Wireless Society.

A very interesting exhibit of members' apparatus was a popular feature at the recent "All Wireless" Exhibition held in the Drill Hall. The exhibits ranged from crystal to superheterodyne sets, and included several wavemeters and receivers designed on "low loss" principles for short waves. A complete 45-metre 50-watt transmitting and receiving station, as used by G2LH, was also on view and attracted much attention. The whole of the apparatus was made by members of the society.

Forthcoming Events.

WEDNESDAY, DECEMBER 30th.
Golders Green and Hendon Radio Society.—Social evening.

THURSDAY, DECEMBER 31st.
Walthamstow Amateur Radio Society.—At 8 p.m. At the Y.M.C.A. Informal meeting.

MONDAY, JANUARY 4th.
Swansea Radio Society.—Lecture: "Tracing of Faults for Practical Wireless Amateurs." By Mr. Turpee.

TUESDAY, JANUARY 5th.
Physical Society of London and the Optical Society.—At 3 p.m. Exhibition at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington. (Exhibition closes at 10 p.m. on January 7th.)

WEDNESDAY, JANUARY 6th.
Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Reception on Low Waves.

THURSDAY, JANUARY 7th.
Institution of Electrical Engineers.—At 6 p.m. (Light refreshments at 5.30 p.m.) At the Institution, Savoy Place, W.C.2. Lecture: "Past, Present, and Future Developments in Wireless Telephony." By Captain P. P. Eckersley.

Demonstrations of the taking of valve characteristics were given at intervals, and as a result of the members' missionary efforts the society has added a further 25 members.

On December 11th a paper on "Design of Audio and Radio-frequency Transformers" was given by the president, Mr. W. Burnet. The various factors governing present-day design of L.F. transformers were very lucidly dealt with and comparisons of the ideal and "almost" ideal types were made. Very keen interest in the subject was evidenced by the somewhat lengthy discussion which followed.

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Muswell Hill and District Radio Society.

A helpful lecture on "Valve Characteristics" was given by Mr. L. Hirschfeld, B.Sc., on December 16th. Four different types of valve were tested, their characteristic curves being plotted on the blackboard. Many useful hints were given on how to obtain valve data and to secure the best working results.

The programme for the New Year includes lectures by several authorities and a visit to 2LO.

Full particulars of membership may be obtained from the hon. secretary: Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

North Middlesex Wireless Club.

At a recent meeting Mr. L. C. Holton, a member of the club since its foundation in 1914, was presented on the occasion of his marriage with a token of the esteem of the members of the club.

A loud-speaker competition was held on the same evening, and proved very interesting, both to competitors and audience. A good number of loud-speakers were entered for the competition, and the judges had no easy task to discover the best. Quality of reproduction was the first consideration, volume coming second. The loud-speakers were operated by a receiver and amplifier provided by Mr. Kirlew.

Hon. Secretary: H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

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Croydon Wireless and Physical Society.

At the society's recent annual general meeting new officers were elected for the ensuing session. Mr. W. Thompson, M.A., B.Sc., has kindly consented to remain president, and a number of distinguished gentlemen continue to be vice-presidents.

The society meets for lectures at 128, George Street, Croydon, at 8 p.m., on alternate Mondays, and arrangements have been made to hold "practical evenings" every other Monday, when instruction will be given in set-building. Visitors are welcome at all meetings.

Hon. Secretary: Mr. H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

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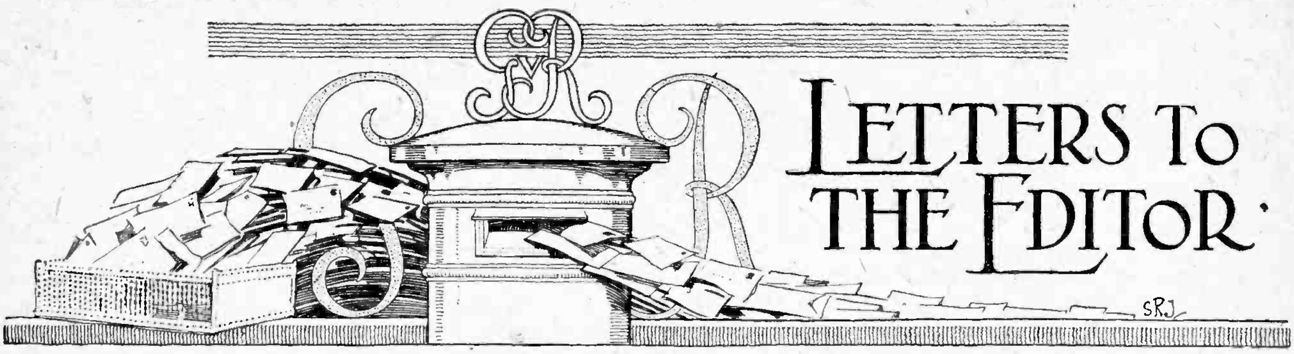
Club Activities in the New Year.

To judge from the programmes of the wireless societies for the remaining half of the winter session those enthusiasts who have realised the benefits accruing from club membership will find plenty to interest them during the next few months.

A glance through the syllabuses we have received shows that short-wave work occupies a prominent place, while the super heterodyne also comes in for a large share of attention. It is also interesting to note that the value of the practical demonstrations is being increasingly recognised: secretaries are finding out that the unadorned lecture, unless given by a master of the art, is not always capable of holding the undivided attention of even a keen audience.

The discussion evenings, competitions, and other attractive items promised for the New Year should have a stimulating effect on club membership. Now is the time for every serious amateur to *join a club.*



LETTERS TO THE EDITOR

The Editor does not hold himself reponsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

THE FUTURE OF BROADCASTING.

Sir,—I read with the greatest interest and satisfaction your remarks last week on the future of broadcasting. May I be permitted to put forward some personal opinions quite baldly?

(1) It is not merely a case of "letting well alone." Broadcasting has not reached finality, and therefore should not be in Government hands where things are apt to become stereotyped. The B.B.C. has proved its capacity for development.

(2) The B.B.C. is quite sensitive to the opinions of listeners when they take the trouble to express them reasonably. I trust it will never become too sensitive to organised stunts having little real backing.

(3) It is far more satisfactory that one should pay a small sum and know that the B.B.C. depends upon its listeners than that it should depend on the whims of advertisers. Advertisements would be an abomination.

(4) The B.B.C. "delivers the goods" without undue profit.

(5) The B.B.C. depends on Parliament for its contract and is therefore subject to the free discussion of the House. A Commission under the Government would naturally tend to be defended by the Government.

(6) The retention by the P.M.G. of one-quarter of the fees cannot be justified, but what might not be done were the broadcasting organisation a creature of the Government?

(7) The B.B.C., by refusing to crowd stations together on neighbouring waves, has rendered the use of cheap crystal sets—naturally unselective—easy. This is surely not possible under American conditions where, perhaps, there is more money to buy expensive sets.

(8) The B.B.C. is independent of interests which might desire limitations put upon the scope of broadcasting—*vide* evidence given on December 17th.

(9) The limitation put upon the broadcasting of news seems to be generally extremely unpopular, especially with listeners in country districts, and should be removed. We are far behind Continental countries in this respect. R. E. TARRANT.

Temple, London, E.C.4.

POSERS FOR THE POST OFFICE.

Sir,—Does a wireless licence apply to the individual who is a user of a wireless set, the wireless set itself, the aerial, or the premises in which the set is used?

Is the holder of a licence permitted to take his set into a neighbour's house, erect an aerial there, and operate it?

Is a separate licence required for a portable set?

Does an experimenter who in the course of his studies constructs more than one set need to apply for additional licences to cover the number of sets he possesses?

Is a licence required at a club headquarters where only an aerial is erected and used for the purpose of demonstrating members' sets and where no apparatus is retained?

It is not uncommon for amateurs to possess a two- or three-valve set for listening to the local station and Daventry, a neutrodyne set for bringing in European stations, a superheterodyne set with frame aerial, and a short wave set for tuning to KDKA, and in addition the ordinary outside aerial is often supplemented by a loft aerial, a piece of wire across the room for short-wave work, with counterpoise as well as earth connection. Does one licence cover the use of all this apparatus by one individual on certain specified premises? Should a friend making frequent use of any of the sets at the premises hold a licence, and should a neighbour take out a licence who sometimes borrows the superheterodyne?

Do manufacturers, designers, and retailers and those interested in the sale of wireless sets take out a broadcast licence in respect of their premises, or does being in the trade qualify them for exemption? If so, should the amateur who makes and sells sets hold a licence, though in the course of his work he may hold sets in stock and make use of an aerial and earth for demonstration purposes? S. G. SANDERSON.

Oxford.

A TALK TO HOME MAKERS.

Sir,—Captain Eckersley, in an article in the *Radio Times* of December 18th, appealing for less interference by oscillation, implores the public to discontinue the practice of constructing sets at home. He raises the following points:—

1. The issuing of cut-and-dried designs is unfair to those whose livelihood it is to sell sets, robs them of their market, their knowledge and their chance of progress.—Surely, the encouragement of the home building of sets has created an enormous market, supported by persons who could not otherwise afford to interest themselves in broadcasting. Captain Eckersley must not forget that wireless, after all, is a hobby. It must be admitted that the amateur is contributing his share of the "knowledge."

2. Captain Eckersley recommends the use of the neutrodyne and the supersonic heterodyne if *properly designed* (the italics are his).—To how many manufacturers can one go to buy receivers of these types? I would prefer to buy a complete set, but was recently forced to make up my own neutrodyne. I was unable to buy one, and, like Captain Eckersley, I will tread on dangerous ground and say that the design I followed incorporated points which made an obvious appeal and were not to be found in any commercial design.

3. He points out that the purchased broadcast set is less likely to cause interference—Why? Surely an oscillating detector valve with note magnifier, a typical commercial set, will cause interference, but I would suggest that the man who takes the trouble to build his own oscillating detector valve receiver probably knows more about its operation than the technically disinterested listener.

His observations on "intensive reaction" draw attention to a most obvious evil, yet no definite suggestion is made as to how to stop interference. When will he cease his "Don't do it" plea? Only when the use of reaction is limited to experimenters working under special authority from the Post Office.

West Hampstead. A. S. C.

Readers' Problems

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Obtaining H.T. and L.T. from A.C. Mains.

I set up the arrangement for obtaining L.T. from my A.C. mains in accordance with the instructions given me in your "Readers' Problems" pages for November 25th, and after a great deal of trouble due to the use of an unsuitable transformer designed for operating electric bells from A.C. mains I am now obtaining very satisfactory results. I have recently constructed a number of small electrolytic cells and shall be glad if you could give me a circuit for using them to obtain H.T. from my A.C. mains, in conjunction with my present L.T. arrangement. D.L.C.

We reproduce in Fig. 1 a circuit showing how to obtain both H.T. and L.T. from your A.C. mains. Since full details of that portion of the circuit dealing with filament lighting were given in our Nov. 25th issue we shall not consider these further. For obtaining H.T. you will require in the first place a special transformer having five output terminals. The reason for the large number of output terminals is in order that two separate H.T. tappings may be obtained for detector and L.F. and also in order that full wave rectification may be brought about by making use of both alternations of each complete A.C. cycle. The transformer is so arranged that a voltage of 120 for the L.F. valve is obtainable between the common centre tapping and each "outer" of the secondary winding. This will mean that in your particular case of 240 volt mains the number of secondary turns will be exactly the same as the number of primary turns. The two inner tappings of the secondary are arranged so that 60 volts is available between the centre tap and each "inner." This is, of course, for the detector valve. Although full details of the construction of both this and the filament transformer were given in our issues of Aug. 27th and Sept. 24th, 1924, we think it would be advisable for you to obtain these instruments from some experienced firm such as the "Zenith" Company. With regard to the smoothing chokes, these can consist of 20,000 turns of No. 38 D.S.C. wound on an iron core which is about four inches long and 1 square inch in cross-sectional area. Do not fall into the error of using incorrectly constructed electrolytic cells. You are advised to check your design by following the full details given on page 363 of our April 22nd issue. Valves may, of course, be used as rectifiers in place of the electrolytic cells, if desired, in accordance with the details given in our June 17th issue.

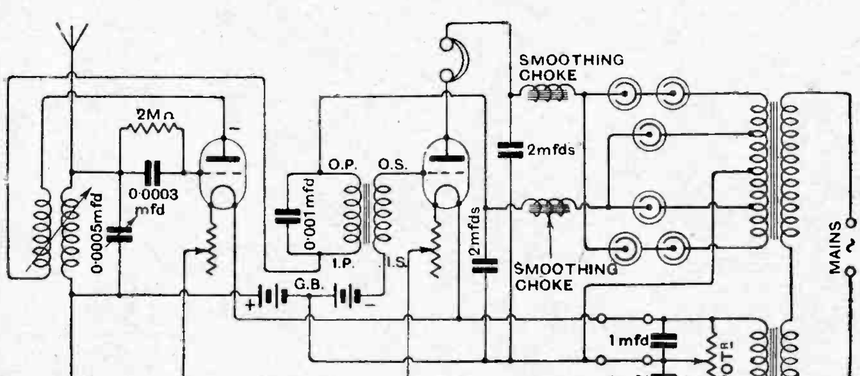


Fig. 1.—Obtaining H.T. and L.T. from A.C. mains.

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Using a Single Wire for Loud-speaker Extension.

I wish to use a very long extension wire on my receiver, so that it is possible to operate a loud-speaker in a building situated at the bottom of my garden, the receiver being, of course, in the house. I understand it is possible to do this by means of a single wire, and shall be glad of your suggestions in this matter. J.B.

It is, as you suggest, perfectly feasible to make use of only a single wire extension, and, indeed, under your particular circumstances, we think that this method is really the best for you to adopt. This method of extension necessitates the use of the choke filter output system, as will be seen on reference to Fig. 2. The method is really quite simple. The single

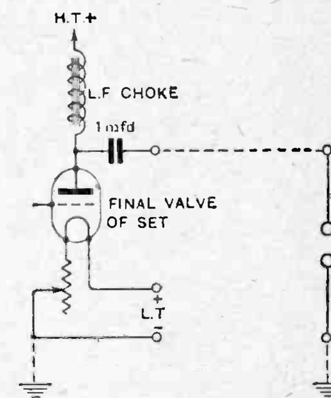

Fig. 2.—Single wire loud-speaker extension.

wire extension acts as the high potential conductor, the return path being via the earth. Since the receiver, and therefore the filament, is already earthed in the customary manner, it will be only necessary to provide an additional earth connection at the far end.

We suggest that your extension wire takes the form of an elevated wire stretched between the house and the building in which it is proposed to instal the loud-speaker. In this manner the capacity between the wire and earth is minimised. If this wire is laid along the ground or tacked to a fence, the capacity between wire and earth, and therefore across the loud-speaker terminals, will be considerable, with the result that considerable "muffling" of the loud-speaker tone will take place. A similar effect will be noticed if the extension is made in the customary manner by means of two wires in the form of lighting "flex," since the high capacity existing between these two long lengths of wire will have the same effect as if a large condenser were connected across the loud-speaker terminals. By adopting the system we recommend this detrimental capacity is avoided, and at the same time the steady high tension current is confined to the receiver, and, apart from benefiting the loud-speaker windings by its absence, will run no risk of running down the H.T. battery by leakage at any point in the long extension wire. The elevated extension lead can consist of ordinary bare aerial wire stretched between insulators attached to the two buildings, whilst the additional earth connection can consist of any reasonable type of connection, such as one of the "spikes" or "tubes" sold for the purpose.

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Obtaining Different Valve Combinations.

I wish to construct a receiver employing a detector with reaction followed by two transformer coupled L.F. stages. I wish to incorporate a switch so that I can use detector only, detector followed by either the first or the second L.F. valve alone, or detector followed by both L.F. valves. The switches must also switch out the filaments of those valves not in use, and the circuit must be so disposed that all H.T. values applied to individual valves remain unaltered, no matter what the setting of the two switches. D.L.R.

We give in Fig. 3 a circuit which successfully employs the somewhat complicated switching arrangements which you devise. It is obvious that the disposition of switches we give enables any possible combination of the three valves to be used at will. Only the filaments of those valves actually in use light up, and the pre-determined values of H.T. applied to each valve remains unaltered, no matter how the switches are set. This latter is a very important consideration often neglected in receivers employing complicated switching arrangements. Should you at any time desire to substitute a choke or resistance coupled stage in place of either or both of the two transformer coupled stages, this may be done quite simply without involving any change in the switching arrangements, by merely substituting the choke or resistance coupled unit inset in Fig. 3. The connection of choke or resistance unit marked "IP" should be substituted for the IP connection of the transformer, and so on. The following table gives the combination of valves obtainable according to the setting of the switches.

S 1 to Right.	S 2 to Right.	Det only.
S 1 to Left.	S 2 to Left.	Det. followed by both L.F.
S 1 to Left.	S 2 to Right.	Det. followed by first L.F.
S 1 to Right.	S 2 to Left.	Det. followed by second L.F.

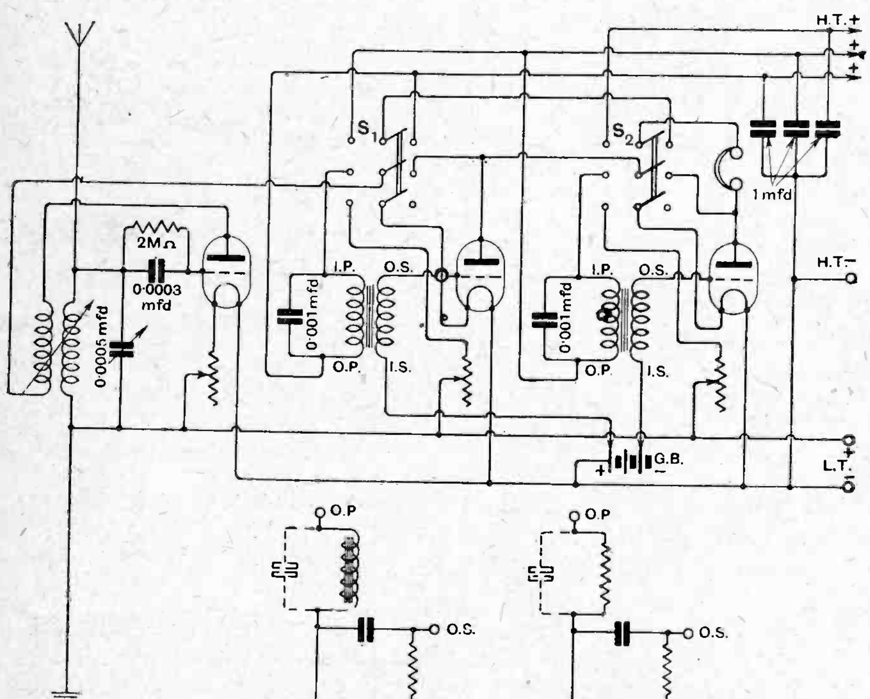

Fig. 3.—A circuit giving all possible valve combinations.

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Uses of a Solid-dielectric Variable Condenser.

I have by me a variable condenser of large type extracted from ex-Government stores, which has a maximum capacity rating of 0.01 mfd. Can you suggest a use for this instrument? Shall I obtain better results if I use it for aerial tuning in place of my existing condenser? T.G.R.

We do not advise you to substitute this instrument in place of your present aerial tuning condenser, since it possesses a solid dielectric, and it will therefore be less efficient than the aerial tuning condenser you are at present employing. We suggest that you connect this instrument in shunt with your loud-speaker, where it will be found extremely useful as a tone control, taking the place of a number of "clip-in" type fixed condensers which amateurs are in the habit of employing for varying the tone of their loud-speakers.

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An Efficient Four-valve Circuit.

I propose building a four-valve receiver of the conventional type (1-v-2). I propose to use a D.E.V. type valve as H.F. in order to obtain increased efficiency due to the low inter-electrode capacity of this valve. A D.E.Q. will be used as an anode rectifier. I shall be glad if you will criticise my proposals, and also tell me the best method of arranging for filament lighting for all valves, as I intend to use six-volt power valves in the L.F. stage. L.D.M.

Your proposals are quite sound and should be productive of very good results indeed. The use of the D.E.Q. as an anode rectifier will be conducive to good quality, whilst the actual efficiency will be good, since this valve is specially designed for anode rectification, no biasing battery being needed. At the same time, in order to prevent the good quality gained by anode rectification being dissipated in the L.F. amplifier, you are strongly advised to use choke coupling in the first stage of your L.F. amplifier. Owing to the exceptionally high impedance of your rectifier, the choke used should have a very high inductance value. You should then follow the power valve in your first L.F. stage by a good type of transformer having a ratio of 6 to 1. With regard to filament supply, your best plan would be to run the filaments of your D.E.V. and D.E.Q. valves in series directly on to the 6-volt accumulator without any intervening filament resistances. This method is by far the safest and most economical one for you to pursue.

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