

# THE WIRELESS WORLD

AND  
RADIO REVIEW



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INTERNATIONAL  
RADIO WEEK

No. 277 [No. 10  
Vol. XV]

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# THE WIRELESS WORLD AND RADIO REVIEW

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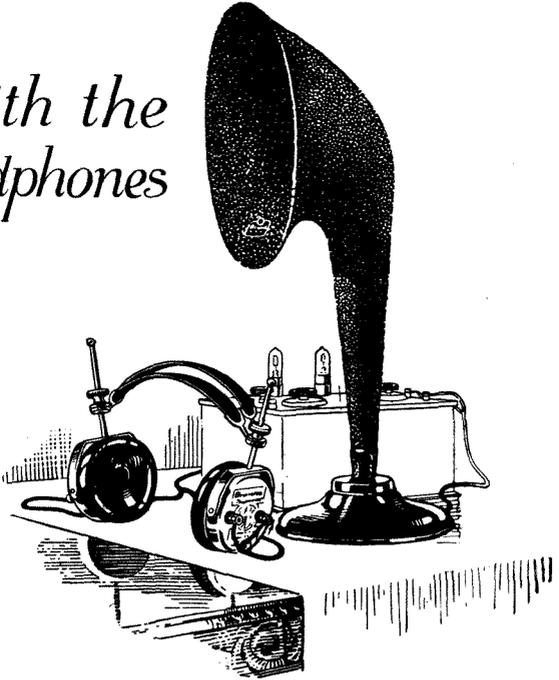
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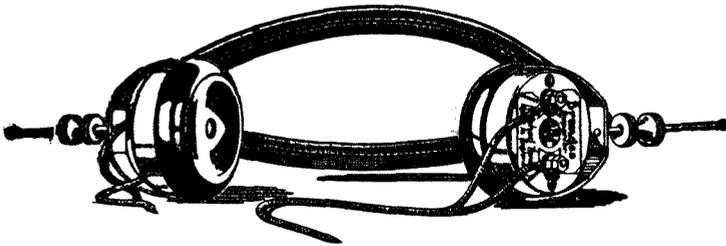


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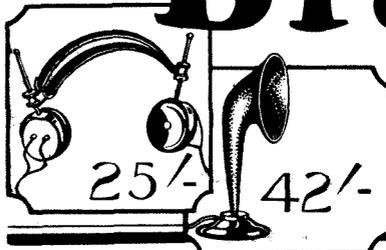
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# THE WIRELESS WORLD AND RADIO — REVIEW



## RADIO TOPICS.

### INTERNATIONAL RADIO WEEK.

By THE EDITOR.

**A**T the time of writing the degree of success attained in reception across the Atlantic of the American and European broadcast transmissions is not known, but yet the tests provide an opportunity to reflect on the future possibilities of international broadcast programmes.

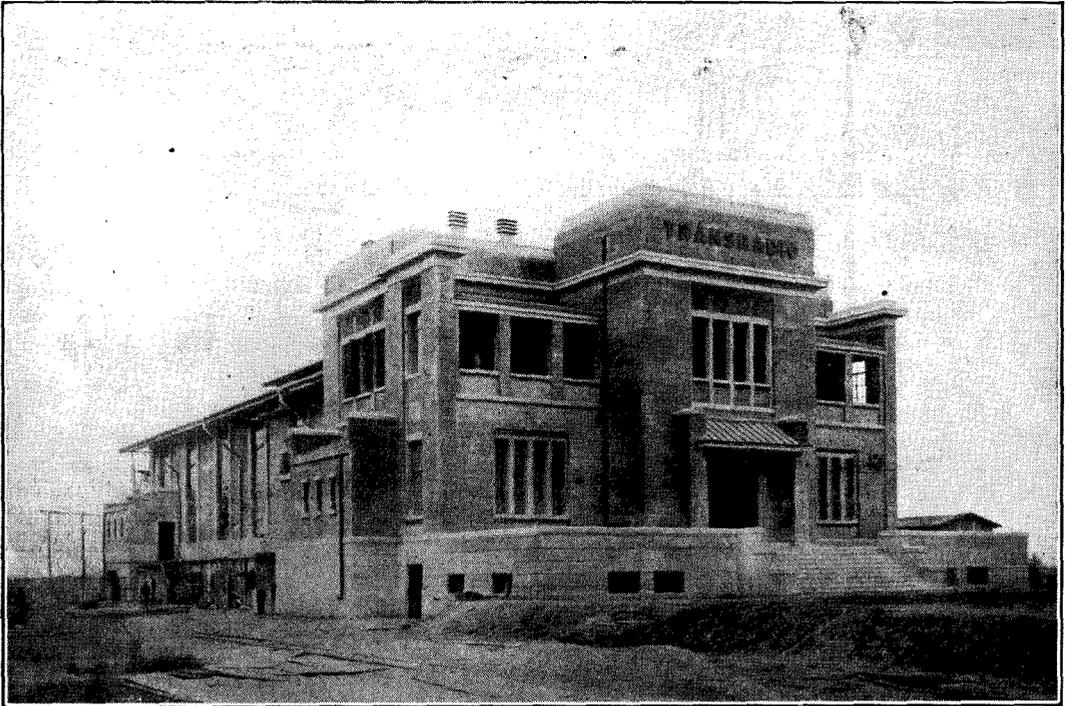
One fact still remains abundantly clear and that is that however successful reception may be on any one occasion, it is impossible to depend upon results to any pre-arranged schedule since the causes which contribute to "good" and "bad" reception periods are not yet understood and certainly cannot be foretold.

Because it is frequently possible to receive direct across the Atlantic intelligent, though imperfect, speech and music in all parts of the country, and especially in view of the success which has attended the recent demonstrations of re-broadcasting of American transmissions by the B.B.C. here, one is justified in having an optimistic outlook upon the future, and in believing that, in principle, at all events, the ambitious programme of the present international tests foreshadows the very definite achievements which the future holds in store.

The need at the present stage of development of long distance wireless telephony is for more data upon which to work, and from which assumptions may be deduced. Then step by step the accuracy of these assumptions can be checked by practical work, but

the first requirement is certainly reliable data collected from observations on reception under varying conditions. Dependable wireless telephony communication over such great distances must not be looked forward to as an achievement to be realised at an early date, because everything points to the fact that many obstacles have yet to be surmounted before such a goal can be reached.

Even when all other considerations have been met, and the technical efficiency of both the transmitting and receiving equipment has been perfected, the problem of atmospheric interference is still likely to prove the greatest stumbling block as it still is in all long distance communication. Perhaps the utilisation of very short wavelengths, which present observations indicate are comparatively free from atmospheric trouble, may be the solution, but here again progress is likely to be proportional to the amount of data which can be collected from a multitude of observations. The amateur is in a position to provide a large percentage of data such as is likely to be of value, and perhaps reports of reception in connection with these international tests may contribute towards supplying much information which will ultimately assist in the solving of outstanding problems. It is only by organised effort such as this that sufficient data can be collected to provide information of value after it has been sifted and examined.



*Fig. 1. A photograph of the station building taken shortly before its completion.*

## “LPZ” — THE HIGH POWER STATION AT BUENOS AIRES.

(By A SPECIAL CORRESPONDENT.)

**A**NOTHER of the world's giant wireless stations has reached completion at Monte Grande, near Buenos Aires, in the Argentine. This station has not been built entirely by one commercial wireless company, but is the outcome of the efforts of several companies which have combined in the production of Argentine's largest wireless installation.

The station is erected for communication not only with the continents of both North and South America, but, in addition, conducts traffic and maintains communication between the Argentine and nearly all other countries of the world. The fact that the station has been designed and erected by a combination of the greatest wireless com-

panies in the world facilitates this object, because, in planning the station, consideration was given to the fact that it was destined to communicate with other stations belonging to various companies, or installed by them, all over the world.

The transmitting station is erected on a site some 12 miles from the City of Buenos Aires, whilst the receiving equipment is located at Villa Elisa, some 30 miles from the city. The aerial at the transmitting station is directional north-west to south-west—that is to say, directional to Europe—and it consists of two halves forming a giant T supported by ten high masts of approximately 680 ft. each. Each half of the T aerial is composed of 16 wires about 1,270 metres

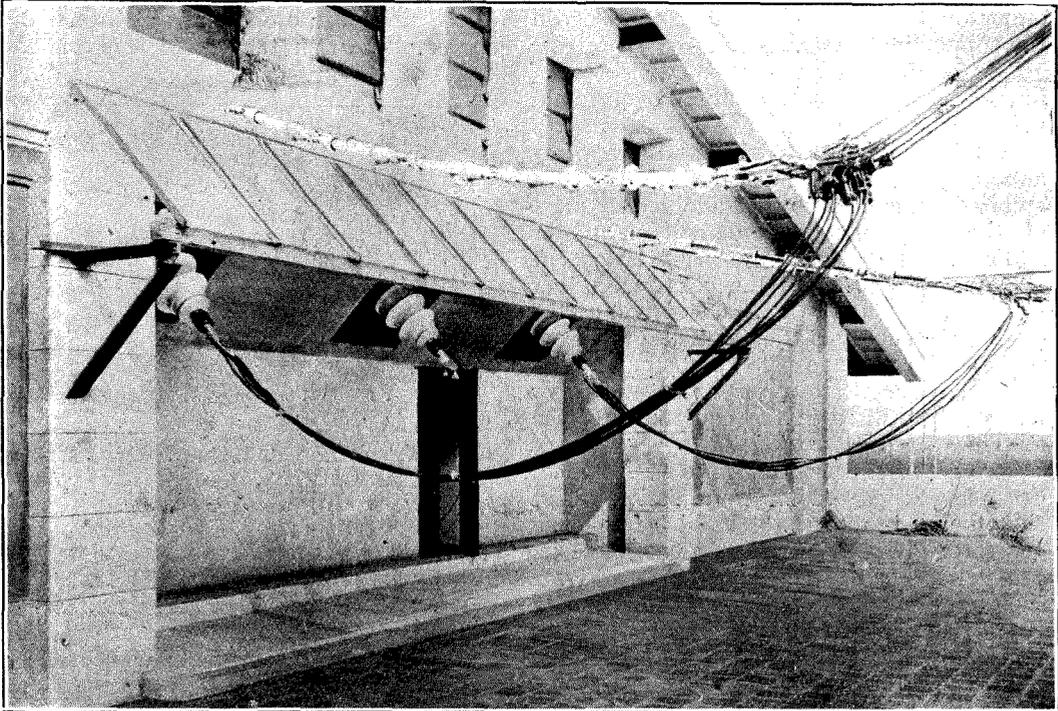


Fig. 2. Aerial lead-in to the transmitter building, showing the method of support.

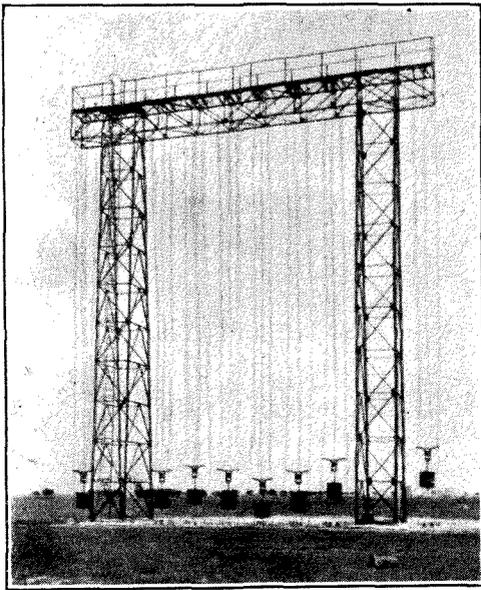


Fig. 3. Counter-weights to maintain the requisite tension on the aerial wires.

in length. Six of the masts are built by the Telefunken Company, and the remaining four by the French company, C.T.S.F. The aerial is supported in some 200 places, and 1,000 insulators are used for this purpose. The masts which support the aerial wires are in pairs, with supports of steel cables run between them. These supports carry the aerial wires, which are on insulated rollers, and at either end of the aerial the wires are weighted as shown in the photograph, Fig. 3. these weights being 40 kg. each, and serving to maintain the requisite tension and to compensate for any variation in the length of the aerial wires due to differences of temperature. It is perhaps difficult when one is in the habit of thinking of aerial wires of, say, 100 ft. in length, to realise the enormous strain which can result from expansion or contraction of the wires constituting the aerial system of one of the high power stations.

By employment of the compensating weight, these differences in length due to variations in temperature are self-adjusting

without exercising any additional strain either on the aerial wires themselves or on the supporting masts.

The earthing arrangement consists of a buried network, and in addition, overground wires supported at a height of 10 metres from the ground. Fig. 1 shows the appearance of the main building, which is of an architecture similar to that adopted by most of the designers of modern high power stations. The central power station at Buenos Aires provides the electrical power for operating the station. On arrival at the station the supply is transformed down from 12,500 volts to 3,200 volts, and supplies two motors, which drive the dynamo and other machinery utilised in the equipment of the station.

Two high frequency machines are installed, one being employed for transmission whilst the other is in reserve. The high frequency generator gives an output of 1,000 amperes, 750 volts at a frequency of 6,000. Fig. 2 shows the method employed for leading in the aerial wires to the transmitting room. Fig. 4 gives an indication of the method of

supporting the aerial lead-in as it is brought to the station in order that all strain should be removed from the actual leads as they

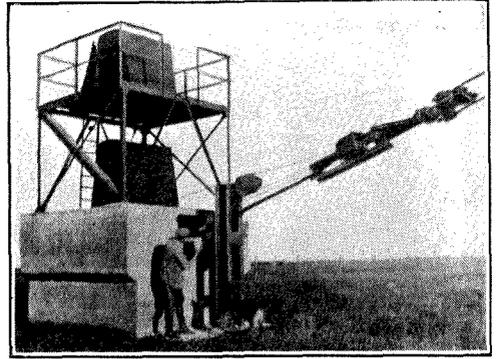


Fig. 4. Anchorage for the aerial lead-in.

enter the building. Fig. 5 is a view taken inside the transmitting building. Fig. 6 shows the interior view of the receiving station at Villa Elisa.

The station which is now conducting

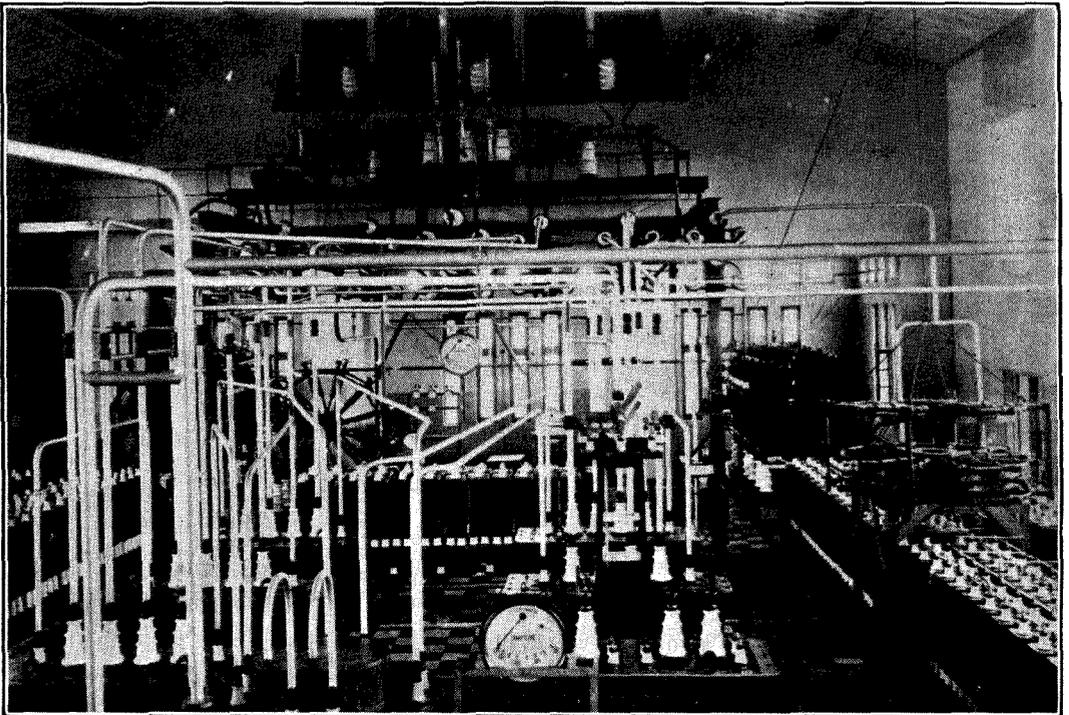


Fig. 5. Interior of the station building.

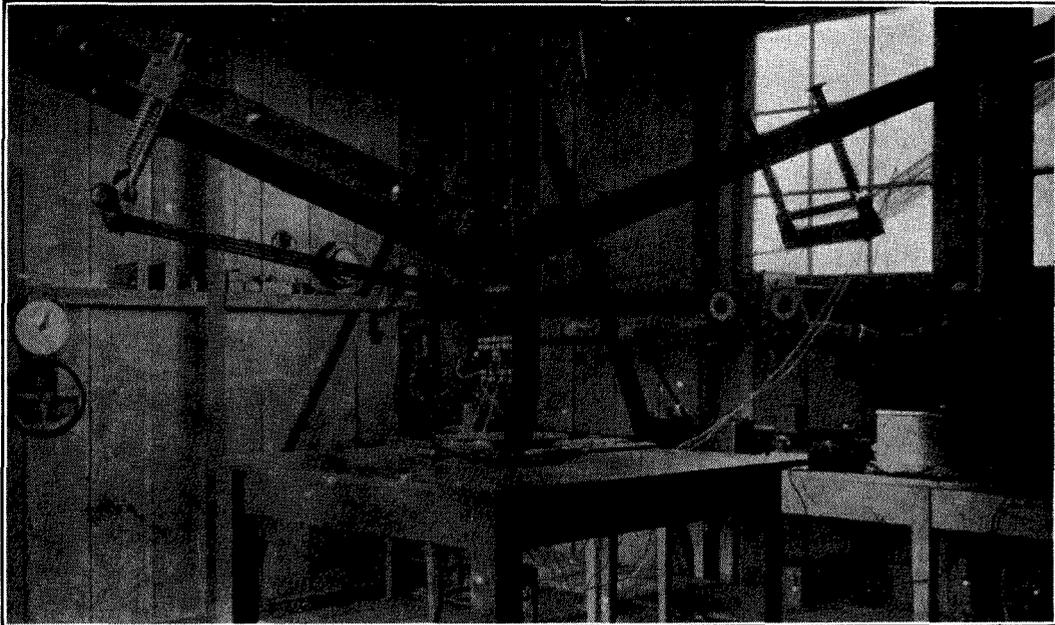


Fig. 6. A corner of the receiving room at Villa Elisa.

constant traffic with Europe operates on a wavelength of 17,300 metres when communicating with this country, whilst other

wavelengths are used for communication with North and South America, the Continent, and other parts of the world.

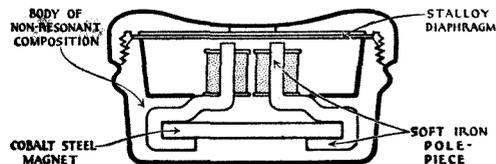
## TELEPHONE RECEIVER MANUFACTURE.

### SOME INTERESTING PROCESSES AT THE B.T.H. WORKS.

As the telephone receiver came into being many years ago it would be expected that its design would have become entirely standardised, particularly as it is such a simple instrument composed of so few components. A recent visit to the Coventry works of the British Thomson-Houston Company revealed that the process of evolution is still going on in both the design and manufacturing methods brought about by the present enormous demand.

In brief, manufacture starts with the preparation of a short cobalt steel bar used to provide the polarising field, which is a departure from the more usual form of circular magnet. The adoption of cobalt steel is a new feature, and has been developed for use in the telephone receiver as a result of the extensive experience which the B.T.H. Company possess in the manufacture of permanent magnets for ignition magnetos. Soft iron pole pieces are clamped on to the ends of the bar, making a good magnetic union. The entire case is next moulded around the magnet, thus holding it firmly in position and eliminating any chance of vibration, and at the same time obviating the use of screws. The moulding material, which is a form of Bakelite, has been specially developed to possess good insulating and dielectric properties, and is brown in colour. The remaining manufacturing operations, consisting of winding, setting up, and packing, are

carried out mostly by women and girls working in sections or teams, each team producing complete head telephone sets. The finished product is transported by a belt conveyor, and means are provided for automatically indicating and registering the output of each team. The output of the various teams, as the day progresses, is recorded on electrically propelled dials, so that comparisons



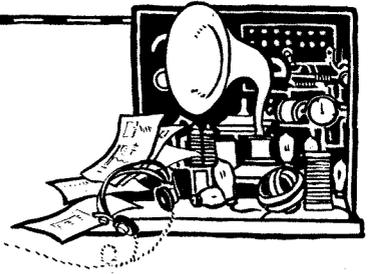
A section through the receiver.

can be readily made and a competitive spirit created.

Testing is accomplished by blind workers, trained by St. Dunstons, and these men are found to possess extraordinary powers of aural observation.

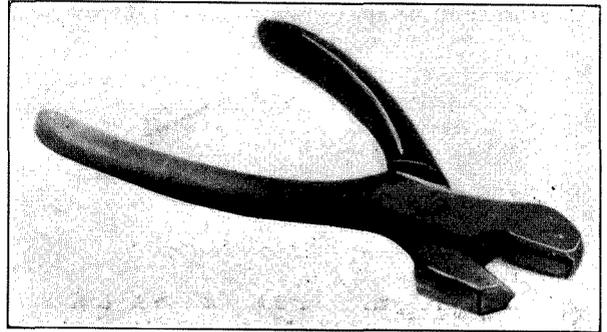
While passing through the workshops and laboratories one notices the large scale on which the manufacture of wireless equipment is carried out, and realises the extent to which broadcast reception has been taken up by the public.

## NEW APPLIANCES.



### Right Angle Bending Pliers.

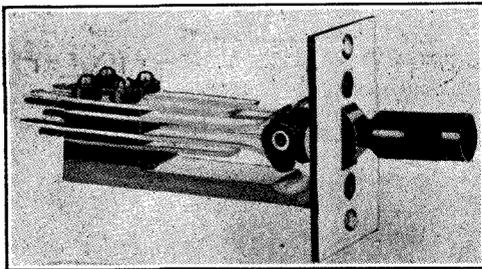
The beginner may find some difficulty in correctly shaping the leads when using No. 16 S.W.G. tinned copper wire for connecting up a receiver. The principal difficulty which arises is that of making the bend at the point where it is precisely needed, for when using ordinary square-nosed pliers the actual bending point takes place a little way from the jaws, depending upon the stiffness of the wire. The pliers shown in the accompanying illustration have V-shaped jaws, and when closed on to the wire, create a bend exactly where required and at a precise right angle. For neat wiring these pliers considerably simplify the operation, giving a neat and workmanlike appearance.



*The Aermonic pliers, with grooved jaws for producing right angle bends.*

### A New Key Switch.

The utility of a receiving set is considerably extended when fitted with switches for changing the circuit arrangement, though every care must be taken to ensure that the



*Double-pole Dewar key switch.*

introduction of a switching device does not render the receiving set inefficient.

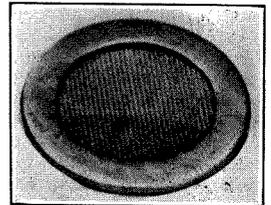
Of the many types of switches obtainable, those have the best appearance in which the contacts are behind the panel and are

operated by means of a key on the front. The well-known Dewar type is an excellent example, although not always suitable for use in H.F. circuits. A switch of good clean construction is shown in Fig. 2, and is a product of International Wireless Manufacturers, Limited.

Liberal spacing has been provided between the contact blades and the switch is substantially built. The springs are of German silver tipped with non-oxidising contacts, while the body of the switch is machined all over to give a good clean precision finish.

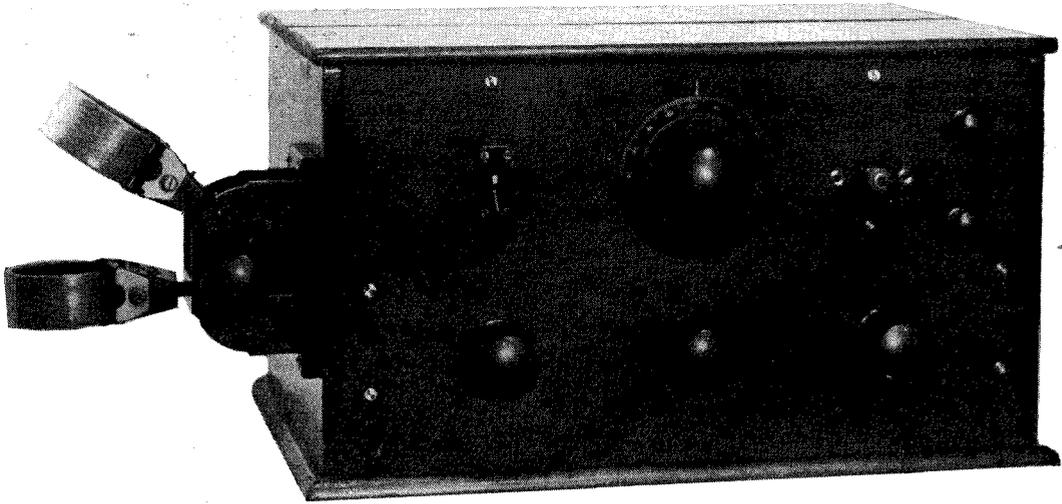
### Valve Window.

The manufacturers of the Aermonic products have added a valve window to their range of components. It is a little larger in diameter than the type usually seen, and



is well finished bright nickel with fixing screws. No screw-heads appear on the front rim.

*The Aermonic valve window.*



## IDEAL RECEIVERS—I.

*Under this heading the author will describe a number of receivers. Each instrument is to be built to meet certain requirements. A full discussion of the principles underlying the design and operation of the receiver, and, of course, complete constructional details will be given.*

### A THREE VALVE RECEIVER

With Valve Detector and Two Stages of Choke-coupled L.F. Amplification.

By W. JAMES.

**T**HIS instrument was designed for the man requiring a receiver (A) with only one tuning control, and, of course, adjustable reaction, (B) giving high quality amplification, and (C) strong loud speaker reproduction from at least the local and high power broadcast stations.\*

The receiver is tuned by a variable condenser and a plug-in coil, which are connected in the aerial circuit. The coil is accommodated in one of the plugs of a two-coil holder, and a switch is employed to connect the condenser in series or in parallel with the coil. This switch is employed because it is usually better to have the tuning condenser in series with the coil when receiving short wavelength signals,

and to have them in parallel when receiving long wavelength signals.

Now there is a break in the band of wavelengths which may be tuned in with a given coil when the condenser is connected in series and then in parallel. For instance, suppose the aerial acts as a fixed condenser having a capacity of 0.0003 microfarads, and that the tuning condenser has a range of 0.0001 to 0.001 microfarads. When the condenser is in series (Fig. 1A) the effective capacity—which may be found from the formula  $\frac{C_1 \times C_2}{C_1 + C_2}$  has a minimum value of 0.000075  $\mu$ F, and a maximum value of 0.00023  $\mu$ F. With the tuning condenser in parallel (Fig. 1B) the minimum capacity is 0.0004  $\mu$ F and the maximum capacity 0.0013  $\mu$ F. That is, the wavelength range, assuming the coil has an inductance of

\* Under normal conditions several other stations can be heard with satisfactory volume.

100 microhenries, is approximately 163-285 metres when the tuning condenser is in series, and 375-680 metres when in parallel. Therefore wavelengths between 285 and 375 metres cannot be tuned in unless the coil is changed.

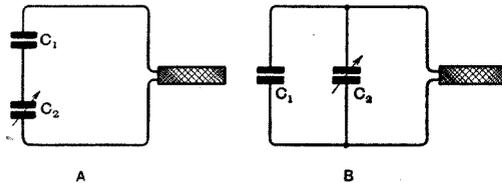


Fig. 1. Explaining the effect of (A) connecting the aerial tuning condenser in series with the aerial and (B) in parallel.

To remove this disadvantage the circuit has been so arranged that when the tuning condenser is switched in parallel with the coil a fixed condenser is connected in series with the aerial to lower the effective capacity of the circuit to a value which is a little less than the maximum capacity of the circuit when the condenser is in series. The connections of the series-parallel switch are given in Fig. 2. It will be seen that when the left-hand contacts are connected, the tuning condenser and coil are in series with the circuit, and when the right-hand contacts are connected the tuning condenser and coil are in parallel, and the aerial is connected to the tuned circuit through the fixed condenser.

A suitable value for the fixed condenser is easily found, for as the minimum capacity is to be a little less than  $0.00023 \mu\text{F}$ , and

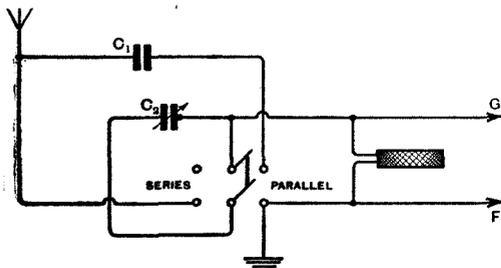


Fig. 2. The special connections of the series-parallel switch and the fixed condenser,  $C_1$ .

the minimum capacity of the tuning condenser is  $0.0001 \mu\text{F}$ , the remaining capacity in the circuit should be less than  $0.00013 \mu\text{F}$ . Now we have assumed the aerial to act as a fixed condenser of  $0.0003 \mu\text{F}$ ; therefore the

fixed condenser may have a value of  $0.0002 \mu\text{F}$ —when the resultant capacity is  $0.00012 \mu\text{F}$ . As most aerials have a capacity of rather under  $0.0003 \mu\text{F}$ , a fixed condenser of  $0.0002 \mu\text{F}$  will be satisfactory. The band of wavelengths which may be covered when the tuning condenser is in parallel is now lower, being 280-630 metres.,

It is usual to connect the moving plates of the tuning condenser to earth or to the aerial, and the fixed plates to the grid of the first valve. With the connections of Fig. 2 the fixed plates (indicated by a dot) are permanently connected to the grid, and the moving plates are connected to earth when the condenser is in parallel with the coil, or to aerial when the condenser is in series. The condenser used in the receiver under consideration is a Burndept, maximum capacity  $0.001 \mu\text{F}$ , which has a metal case.

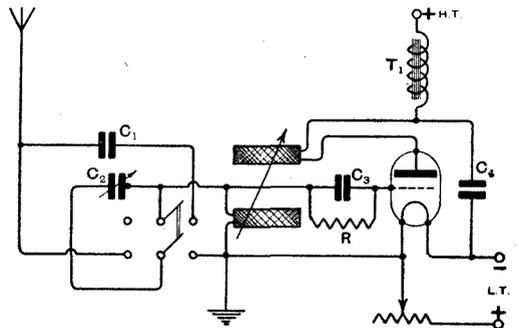


Fig. 3. The aerial circuit connected to the detector.

This case, the metal end plates, and the moving plates, are all at the same potential, and the fixed plates are insulated.

A valve detector is employed in this receiver, and the ends of the tuned circuit are connected to the grid—through the grid condenser and leak, and to the filament (Fig. 3). It will be observed that the grid leak is connected across the grid condenser, the reason for this being that grid condensers are usually provided with clips to accommodate a grid leak, and that it is usually necessary to try several values of grid leak before best results are obtained.

The valve is, of course, a voltage operated device. That is, the effect produced is bigger the larger the voltage applied to the grid. Therefore the grid circuit of the valve is connected across the aerial inductance, and the aerial circuit is so adjusted that the

largest possible voltages are set up by the signal.

The largest voltages, for a given signal, are usually set up when the tuning condenser has a small value of capacity; consequently the largest coil which will enable the signal to be tuned-in should be employed. When the condenser is in series with the aerial, however, the signal strength may be reduced if the condenser is set at a very low value.

To obtain good selectivity, it is advisable to employ either a small value of capacity in series with the aerial, or a large value of capacity in parallel with the aerial tuning coil.

In this receiver a condenser having a maximum value of  $0.001\mu\text{F}$  is employed. It will be found that tuning is critical, particularly when the condenser is set near its minimum value. Tuning is easier when an extension handle is fitted to the condenser.

The advantages of employing a large tuning condenser are that the desired selectivity may be obtained, and a wide range of wavelengths may be tuned in with one coil.

Selectivity and signal strength are considerably improved by reaction. The reaction coil, which is connected in the anode circuit of the detector, is mounted in the movable plug of the two-coil holder (Fig. 3). Fixed condenser  $C_4$  carries the high frequency currents from the top of the reaction coil to the filament of the detector.

#### THE METHOD OF COUPLING.

There are three types of coupling—transformer, resistance-capacity, and choke-capacity. In this receiver the choke-capacity method of coupling is employed. When transformers are used it is not always possible to obtain high quality amplification, and the disadvantage of the resistance-capacity method of coupling is the high anode voltage required, and the low value of amplification per stage. With choke-capacity coupling, however, it is fairly easy to obtain high-quality amplification, a reasonable degree of amplification per stage, and there is very little waste voltage in the choke.

To ensure good quality with choke-capacity coupling, it is necessary to use a choke having a sufficiently large inductance; to use a coupling condenser of large capacity; and to operate the valves in such a manner

that the grids do not become positive during any part of the signal.

From the point of view of signal strength it is necessary to employ chokes having an impedance at the lowest frequency in the signal (say 100 cycles), which is two or three times the impedance of the valve, and to employ valves having a high amplification factor combined with low impedance.

The valve chosen for use in this receiver is the D.E.5 B, which has an amplification factor of 20, and an impedance of 30,000 ohms. From the point of view of quality and signal strength, therefore, the choke connected in the anode circuit should have an impedance of 60,000 to 90,000 ohms, or an inductance of about 100 henries at a frequency of 100 cycles. Chokes having this value are not, so far as I know, readily obtainable; hence, transformers with their windings connected in series are employed in this receiver.

The required inductance may be obtained by the use of a relatively large iron core and few turns of wire, or a large number of turns and a smaller iron core may be employed. It is preferable to use as little iron as possible, provided the self-capacity of the winding and its resistance are kept at reasonably low values. In this receiver Burndept transformers are employed, the windings being connected in series to give the maximum value of inductance.

The total inductance is probably higher than 100 henries. That being so, a signal of 1 volt applied to the grid will set up a voltage of approximately 18 across the choke connected in the anode circuit. This voltage is transmitted to the grid of the next valve by a fixed condenser.

#### THE COMPLETE CONNECTIONS.

Referring now to the diagram of the complete receiver (Fig. 4), an incoming signal is rectified by the grid condenser and leak  $C_3 R_1$ , and appears as magnified voltages across the choke  $T_1$  connected in the anode circuit. These voltages are passed to the grid of the second valve by condenser  $C_5$ , which has a capacity of  $0.125$  microfarads. The grid is held at a suitable negative mean voltage by the grid leak of  $0.3$  megohms and the grid battery. There will be no appreciable fall in voltage over the coupling condenser, because its reactance to currents of speech frequencies is negligible compared with the effective resistance of the grid leak

in parallel with the grid filament path of the valve.

As the second valve is being used for voltage amplification, a D.E. 5 B type valve is employed, and a choke  $T_2$  connected in its anode circuit. The magnified voltages set up across choke  $T_2$  are transmitted to the grid of the last valve by condenser  $C_6$ , and the grid has connected to it in the usual manner a grid leak and grid battery.

Now the purpose of the last valve is to supply the current to operate the loud speaker. It must be a power valve, that is, a valve having an impedance comparable with that of the loud speaker (or a coupling transformer). As we require *power* to operate the loud speaker the valve must

to carry this current, and the loud speaker and a fixed condenser ( $C_7$ ) are connected in shunt. The choke does not require such a large inductance as those employed in the anode circuits of the other valves because the impedance of the last valve is much lower. The choke used has an inductance of 20 henries, and is a Burndept choke, which is wound with a relatively thick wire. Condenser  $C_7$  has a capacity of 0.5 microfarads.

It will be observed that three grid leaks (each having a value of 100,000 ohms) are connected to the grid side of  $C_6$ , and that the grid of the last valve may be connected to points A, B or C. When the grid is connected to point A, the full voltage of choke  $T_2$  is applied to the valve; when it is connected

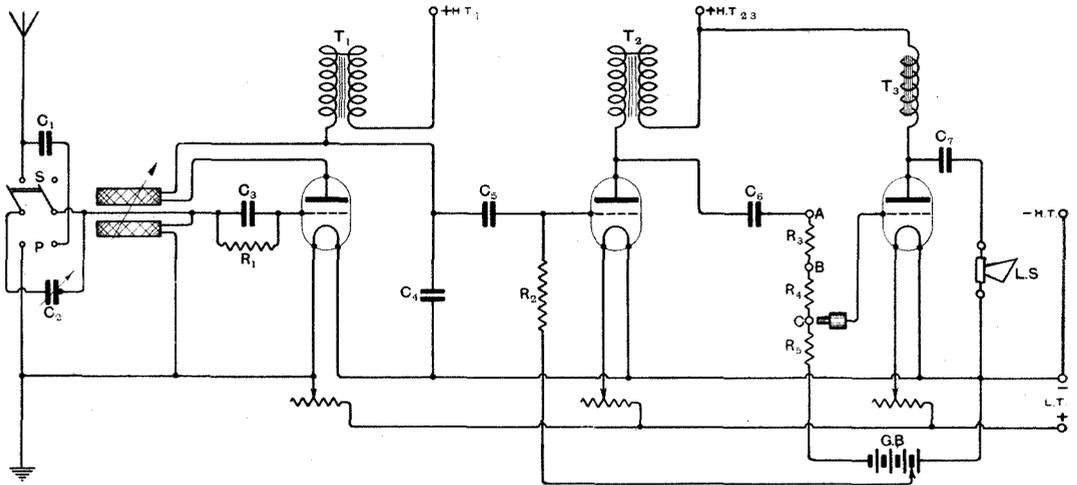


Fig. 4. Connections of the complete receiver.

have ample emission, and because of the low impedance required it will have a fairly low amplification factor. The valve used is a D.E.5, which has an impedance of 7,500 ohms, and an amplification factor of 7.

For good loud speaker results a signal peak voltage of 5, or a total grid voltage swing of 10 volts is required. As the grid of the valve must not be allowed to become positive (to prevent grid current distortion) the grid should have a negative bias of 5 volts, plus, say, 1 volt, to allow for the "free" grid potential and for safety. A grid battery of 6 volts (4 dry cells) is therefore employed.

As the normal anode current of the last valve is of the order of 6 milliamperes a choke ( $T_3$ ) is connected in the anode circuit

to B or C about two-thirds or one-third of the voltage is applied to the grid.

The reason for the provision of tappings in this way is as follows. We have assumed that the last valve will satisfactorily operate the loud speaker when the signal voltage applied to the grid has a maximum value of about 5 volts. The grid voltage of the second valve is therefore  $5/18$  volts, and this grid, therefore, has a negative bias of  $1\frac{1}{2}$  volts. Strong signals will probably set up  $\frac{1}{2}$  to 1 volt across the first choke  $T_1$ , and therefore the voltage developed across the second choke  $T_2$  may rise to between 9 and 18 volts. A voltage of this magnitude would overload the last valve, so the tappings mentioned above were provided.

(To be concluded.)

# INTERNATIONAL RADIO WEEK.

## NOTES ON THE PROGRESS OF THE TESTS.

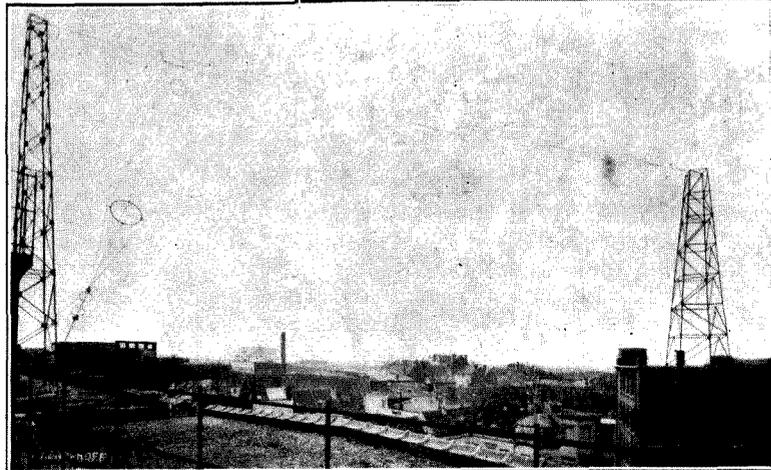
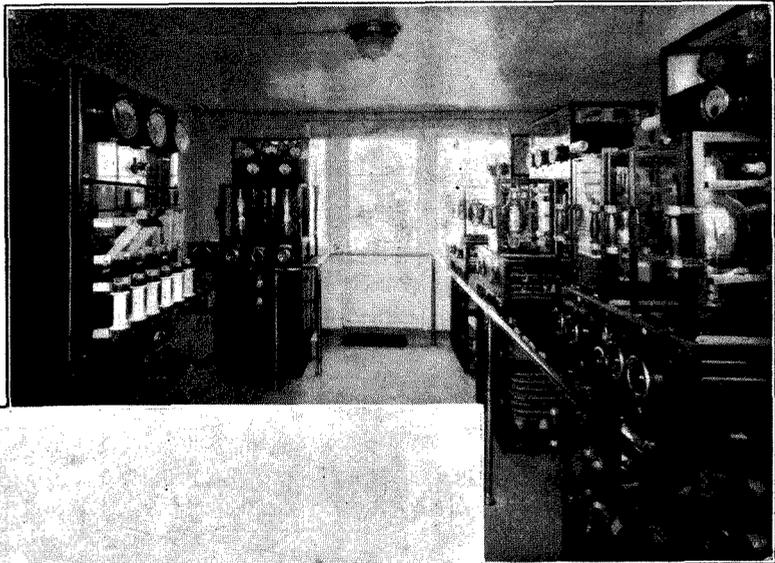
**B**EFORE any definite statement on the results of the international tests can be published it will be necessary to wait until it has been possible to check reports with the details of the programmes from the various stations.

Programmes transmitted from the European stations are being sent to *Radio Broadcast* in America, whilst *The Wireless World and Radio Review* will be supplied with

telegrams and telephone calls making reports."

The reports which have so far been received indicate that the reception of Continental stations and the stations of the British Broadcasting Company has been very much more satisfactory than the reception of the American transmissions on this side. This is partly accounted for, no doubt, by the fact that atmospheric conditions here

⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘  
⌘ *Brussels Broad-* ⌘  
⌘ *casting Station.* ⌘  
⌘ *Views of* ⌘  
⌘ *the transmitting* ⌘  
⌘ *room, and masts* ⌘  
⌘ *and aerial.* ⌘  
⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘



⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘  
⌘ *This station has* ⌘  
⌘ *been mentioned* ⌘  
⌘ *in the first* ⌘  
⌘ *report from* ⌘  
⌘ *America.* ⌘  
⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘⌘

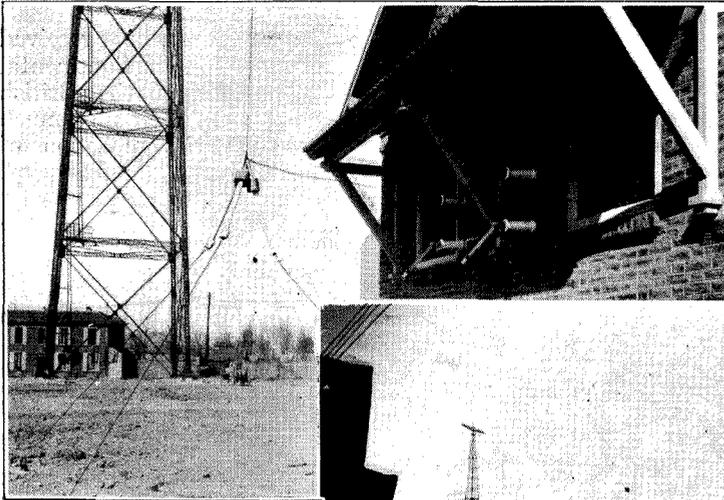
the programmes of the American stations. A cable received from *Radio Broadcast* states: "Reception your stations remarkable over entire continent. Thousands of

have been unfavourable during the first days of the tests, whilst in addition it must be expected that the number of persons listening to the American pro-

grammes is not so great as would be the case if this occasion were unique for American reception as in America it is unique for the reception of European stations.

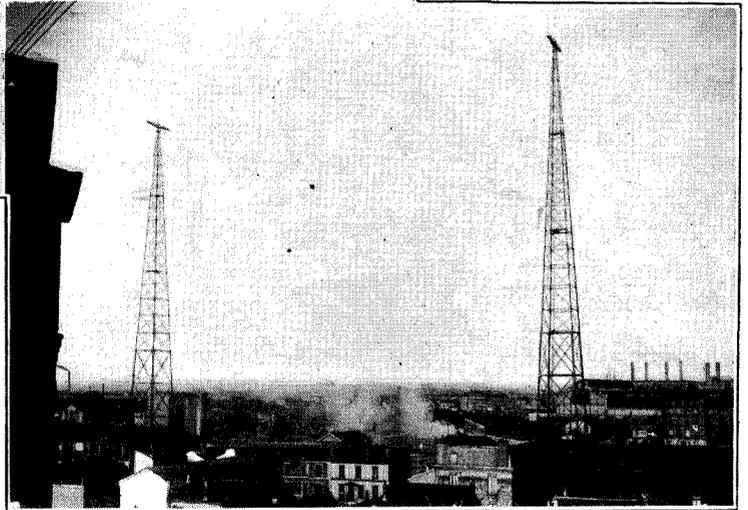
Listeners here have much the same

are PTT, Paris, Rome IRO, and Madrid, whilst early information establishes that several of the B.B.C. stations were identified. How much of the programmes was received in America will be ascertained at a later date.



Radio Paris Broadcasting station.

Views of the masts and aerial and the aerial lead-in to the station building.



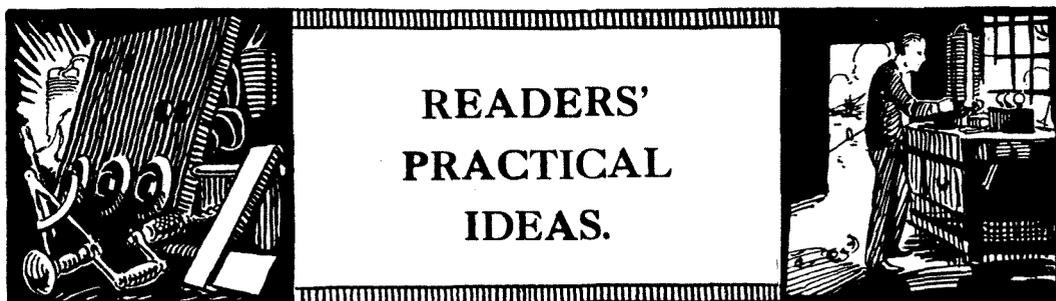
opportunity for receiving American stations on any night since they can listen in during the ordinary hours of American programmes. But our normal transmission hours, of course, are made whilst it is daylight in America, and it was therefore imperative that special times for the European transmission should be arranged.

Judging from the early reports received, one of the Continental stations heard best in the United States is the Brussels broadcasting station. The equipment of this station is similar to that at the London station 2 LO and illustrations of the transmitting room and the masts and aerial equipment are given here. Other stations so far reported heard but not yet confirmed,

The interest in the tests which has been displayed throughout the world is truly remarkable. Both here and on the Continent newspapers have devoted special articles to describing the arrangements and reporting results. By arrangement with *The Wireless World and Radio Review* a representative of *The Times* listened in throughout the test period of the morning of the 27th, and recorded his experiences in the issue of *The Times* for November 28th.

In America the enthusiasm displayed has been even greater, this being accounted for by the reasons referred to above.

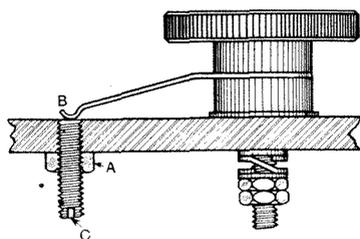
When all reports have been received there is no doubt that they will compile a most remarkable record.



This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

### H.T. Battery Switch.

WHEN constructing a switch for tapping out the cells of a high tension battery to provide the required critical potential, care must be taken to avoid short-circuiting the studs as the switch arm passes over them.



Switch arm and stud for tapping out the cells of the H.T. battery.

One method is to insert "dead" studs intermediate between those connected to the battery, but a simple arrangement consists in the use of short pieces of threaded 2 BA rod arranged almost flush with the surface of the panel. The diagram explains the construction, and it will be seen that threaded holes are made in the panel and 2 BA screws or short pieces of threaded rod inserted (C). These are locked in position by means of nuts (A), whilst a small indentation (B) arrests the switch arm when exactly over the studs.

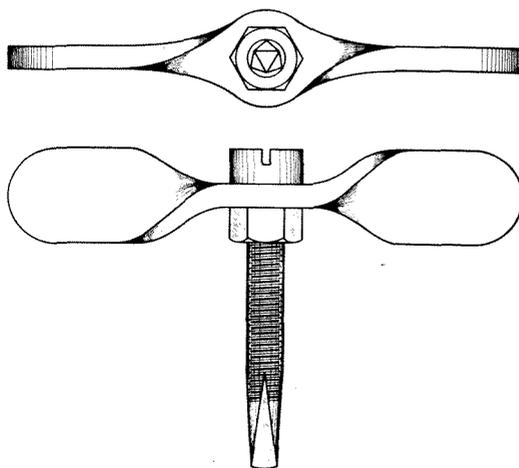
W. A. C.

### A Useful Tap for Ebonite.

IT is not generally known that a brass threaded spindle is sufficiently hard for tapping ebonite, and, in fact, is often more durable than a steel tap. A useful range of taps

can easily be made up by filing a taper on the ends of a screw of the correct size so as to reduce it to three faces, or, alternatively, a bottoming tap may be constructed by filing three V slots down the sides of the thread. A suitable key is made by locking a piece of bent brass under the head of the screw by means of a nut.

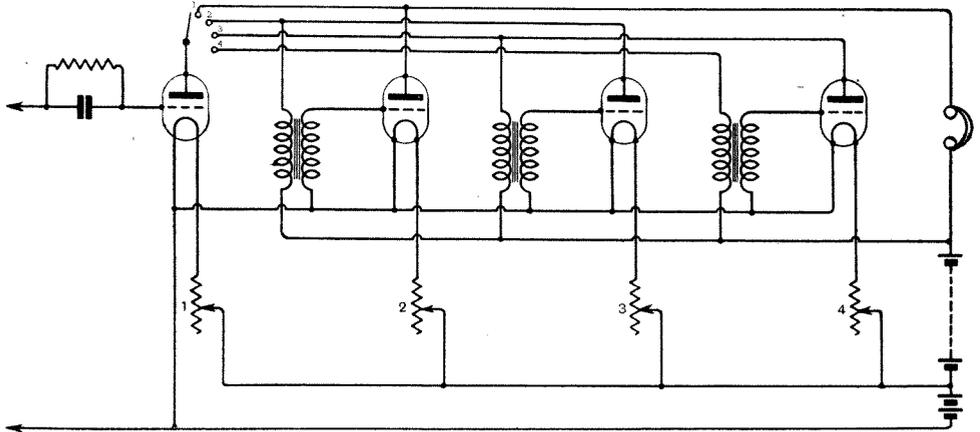
G. A. S.



An easily-made brass tap for ebonite.

### Switching L.F. Valves.

IT is not often realised that a single pole switch with four contacts can be used for bringing three L.F. amplifiers in circuit as required. The accompanying diagram makes no provision for correcting grid potential with grid cells or for the use of additional plate voltages and shows only the principle for connecting up the low

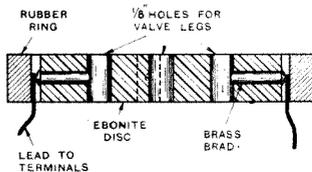


*Cutting L.F. valves in and out of circuit by a single arm switch.*

frequency amplifying stages. If the circuit is carefully examined it will be seen that the switch effects the necessary circuit changes efficiently and that there are no shunted circuits across the telephone receivers when only one or two of the amplifiers are in use.

With the switch on stud 1, and No. 1 filament rheostat in the "on" position the circuit consists of detector valve only. With the switch on stud 2, and with filament rheostats 1 and 2 on, the circuit is detector and one L.F. amplifier. On stud 3 filament rheostats 1, 2 and 3 should be switched on, giving detector and two L.F. amplifiers. With the switch on the 4th stud and all rheostats on, the circuit is a detector with three L.F. amplifiers.

W. B.



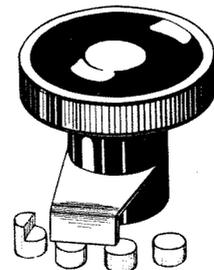
*A novel valve holder.*

**A Simple Low Capacity Valve Holder.**

A CIRCULAR piece of ebonite about  $\frac{1}{8}$  in. or  $\frac{3}{8}$  in. in thickness can be used to construct a useful valve holder. Holes are drilled through in the usual positions for

the pins of the valve, while others are drilled in the sides so as to penetrate those already made. Brass brads or rivets are inserted in the side holes, and leads soldered to their heads. If a rubber band is now passed round the outside of the disc the rivets will be driven inwards with a spring action, causing them to make reliable contact on the pins of the valve.

C. O.



*Stop for switch arm.*

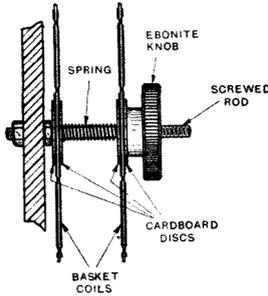
**Limiting Switch Arm Movement.**

STOP pins are usually employed to prevent a switch arm from passing off the studs, though a much simpler arrangement consists of filing down the studs, leaving raised portions on those at the ends. These raised pieces will engage on the arm and limit its movement, which has the advantage that less panel space is taken up than when pins are fitted.

M. H.

**Compact Variable Coupling.**

MANY amateurs will find the device shown in the accompanying diagram a most useful component in the construction of receiving apparatus. It can be used as a coupling between aerial and closed circuit,



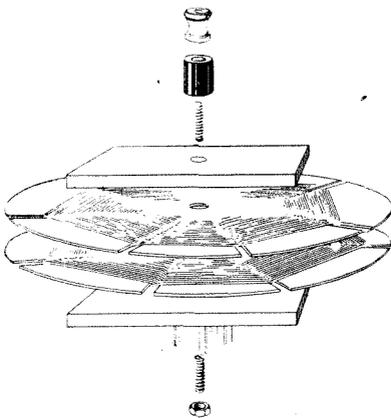
*Useful variable coupling for basket coils.*

or it can be incorporated when constructing intervalve high frequency transformers. It is quite easy to construct, and the drawing is almost self-explanatory. It will be seen that a screw thread carries two basket coils pressed apart by means of a spring, while a threaded knob is used to vary the distance between them.

R. H. R.

**Plug-in H.F. Transformer.**

FIXED coil inductances wound upon cards, provide efficient tuning. A pair of these inductances can easily be built up



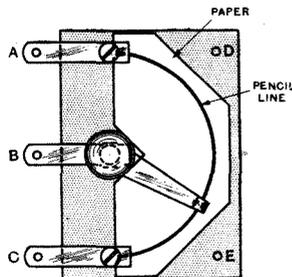
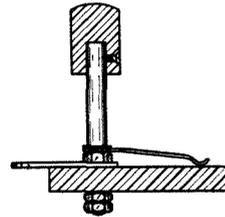
*An easily made H.F. transformer.*

to form an H.F. intervalve transformer in which the coupling between the two coils is fixed. The construction will be seen from the illustration, in which valve pins are tapped into a 3/16 in. piece of ebonite and used to support the two inductances which are spaced apart by a 1/8 in. ebonite washer, and clamped down by another piece of ebonite held under a screw.

E. A. A.

**Another Variable Grid Leak.**

A PENCIL line on good tough paper is well known to be useful as a variable high resistance, though care must be taken as to the method adopted in making a reliable contact. The accompanying sketch shows the paper mounted on the face of a piece of ebonite, the tags A and C being used to make contact with the ends of the pencil.



*Variable grid leak.*

A spindle and knob is set up with a light bronze spring arm, which is suitably rounded so as not to produce undue wear on the lines or the paper, travelling smoothly over it and picking up reliable connection. The contacts A and C may be made of springy material and slightly bent over at the ends before being attached by the screws. This will cause them to bind down firmly on to the pencilled surface. The holes D and E serve for attaching this variable grid lead to the instrument panel.

A. L. de S.

# PATENTS AND ABSTRACTS



### A Method of Generating High Frequency Currents.

An interesting method of producing high frequency currents consists in setting up oscillations by means of a microphone, buzzer or other suitable arrangement, and exciting a circuit tuned to a harmonic of these oscillations. The tuned circuit may be connected to the grid circuit of a valve whose anode circuit is also tuned to the

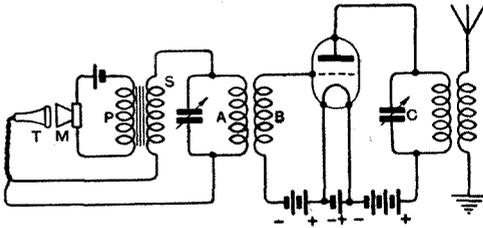


Fig. 1. Explaining a method of generating H.F. currents.

frequency of the oscillations. The invention, which is described in Patent No. 212,563, may be understood by referring to Fig. 1. A microphone, M, is connected to the primary winding of the transformer P, and a telephone receiver T, which is situated in front of the microphone, is connected in the secondary; therefore low frequency oscillations are set up in the secondary circuit. In this circuit is included a circuit A, tuned to a harmonic of the fundamental oscillation.

The inductance of circuit A is coupled to the inductance of circuit B, which is connected to the grid of a valve. Connected to the anode is the usual tuned circuit C which is coupled to an aerial.

### Tuning Coils.

Multi-layer tuning coils of the plug-in type are usually wound in such a manner

that the finished coil has a low value of self-capacity. There are many types of winding, but they all have spaced turns or layers, and in some of them the turns and layers are spaced. The construction of a new type of coil may be gathered from Fig. 2. A band or tape of paper or other suitable material is formed of a width corresponding to the axial length of the coil desired, with a number of wires arranged parallel to the edges of the tape and secured to the tape by a strip of insulating material. The appearance of the tape may be seen from Fig. 2A, and the section of Fig. 2B. The wires may be spaced a suitable distance, preferably at least equal to their diameter.

The tape is wound into a coil having as many layers as are necessary to give the required inductance. When the coil is

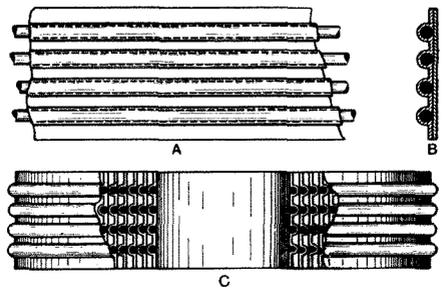
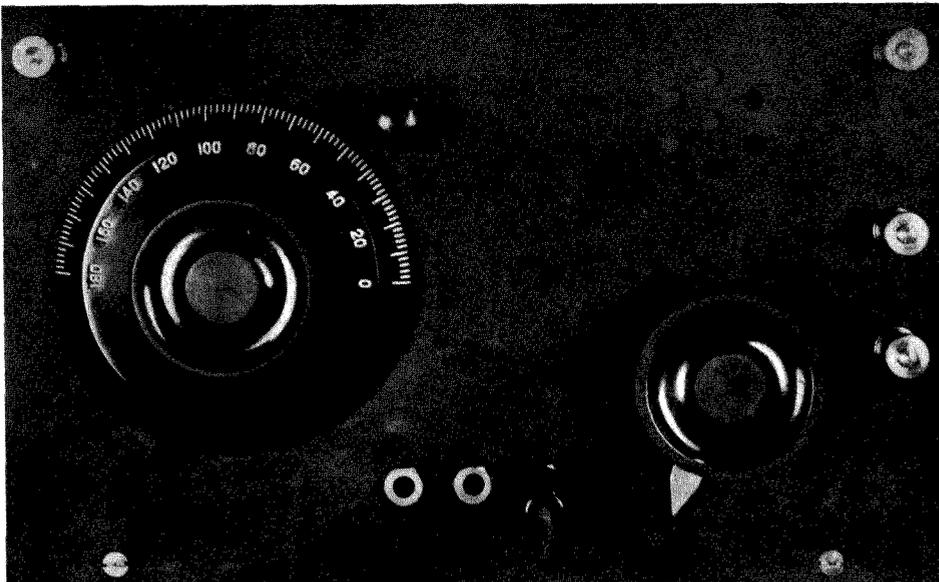


Fig. 2. Construction of a multi-layer coil.

wound the wires at each end of the tape are brought out, and the ends connected to form a continuous winding. Fig. 2C is a sketch of a complete coil. Coils of this type are patented (No. 221,594) by N. P. Hinton and Metropolitan Vickers Electrical Co.



*The panel. The terminals at the top are aerial and earth, with telephone terminals on the right. Near the condenser dial is the fine tuning knob. The sockets at the lower edge tap out the tuning coil.*

## INSTRUCTIONS FOR MAKING A SINGLE VALVE RECEIVER.

Repeated requests for simple constructional details of a single valve receiver prompted the preparation of this article. The circuit is an old favourite, and no elaborating features have been introduced. The skilled experimenter can recommend this set to his less experienced friend. Constructional details all work out easily, and the merest novice should find no difficulty in carrying the job through while the finished set forms a good starting point in valve reception.

**T**HE first valve circuit the amateur adopts as he progresses is invariably one consisting of a tuned aerial with variable condenser and inductance, detector valve with grid condenser and leak, with reaction coil and telephones connected between the plate and the high tension battery. Although the number of circuits developed for reception purposes is almost unlimited, it can be said that this simple arrangement is very popular for amateur work and is employed in more than half of the varieties of broadcast receiving sets to be found on the

market. It has its place also in the experimenter's laboratory, and it is of interest to observe that many of those who achieve distinction by receiving over immense distances confess to its use.

A vertical panel screwed at its lower edge or bracketed to a baseboard is the simplest form of construction for experimental apparatus while producing a set of good appearance. The components requiring adjustment and which usually need to be carefully insulated are attached to the ebonite, whilst the remainder of the fittings are secured by wood screws to the baseboard

and, as a rule, possess the requisite insulation.

A full size drawing is given of the front panel and the dimensions can be transferred either with the aid of a rule or by pricking through, using the page as a template.

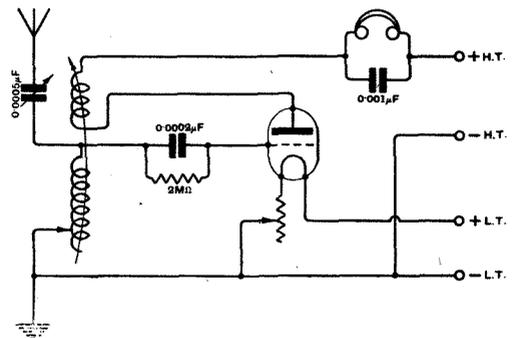
The beginner might be advised that ebonite panels are shaped up first by filing one of the longer edges true as tested by laying a steel rule along it and at right angles to the face by means of a square. The edge may be finally finished by drawing it across a piece of carborundum paper laid flat on the table, applying an even pressure to both ends while the straight line scratches may be removed if desired by still holding the panel quite vertically and employing a rotary motion. The two ends are next squared up to the required length and at right angles to the first edge, while the other long edge is finished by filing down to a scratch line indicating the width of the panel. When filing or sawing ebonite the work should be clamped so as to only just project above the edge of the vice, or, if this is not possible, a piece of hard wood should be placed behind it and extending nearly to the edge under treatment so as to prevent vibration and chattering.

The centre indicating the position of the condenser will be found suitable for almost any type, while an additional hole is shown in the drawing of the panel to accommodate the fine adjustment knob fitted to the "J.B." condenser used in this instance. It has capacity of 0.0005 mfd. If the reader does not possess a drill sufficiently large for making the centre hole it can be produced by enlarging a small hole with the tag of a file or by working to a scribed circle of the required size with a round or rat-tail file. Positions for holes for fixing an Ormond filament resistance are given, whilst the valve is viewed through a grating of seven holes set out by marking off a radius around a circle.

The baseboard is constructed from  $\frac{3}{8}$  in. planed mahogany, the long edges being planed to give the correct width and the ends filed down true to lines set out across the face. It should be rubbed down with fine glasspaper and treated on both sides with shellac varnish or quick drying French polish. This treatment closes the pores of the wood and prevents warping. The terminal strip may also be made up from

wood which possesses ample insulating properties for the direct current potentials of the H.T. and L.T. batteries.

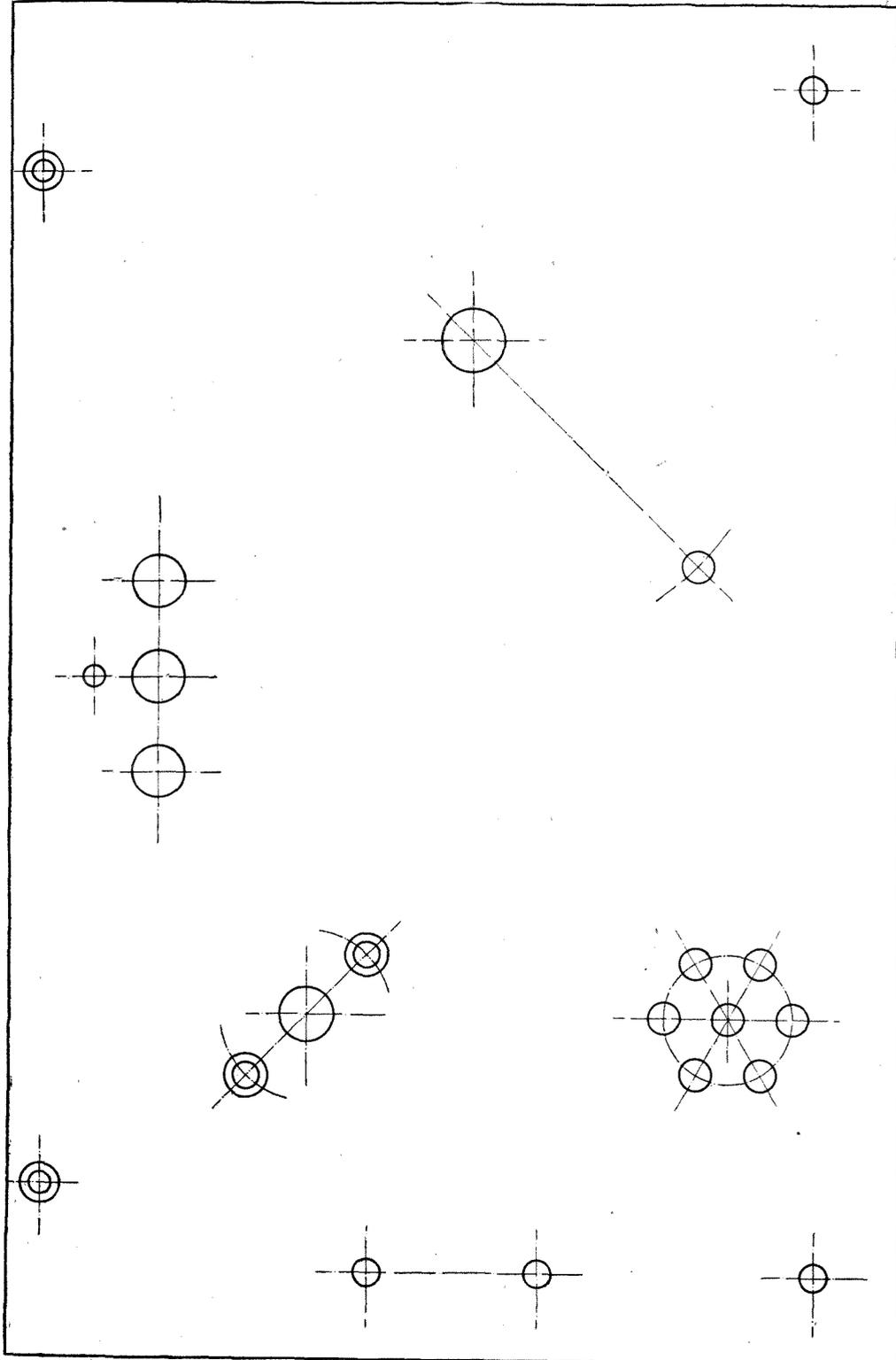
The tuning inductances are wound on cards of the stiffness of postcard. They can be pricked through from the drawing showing the lay-out of the components on the baseboard, taking care when cutting out not to make the slots so deep as to weaken the sections. Three cards are required and are wound full with No. 26 double cotton-covered wire. To avoid difficulties when connecting up, one should see that the direction of winding is the same on each card. The middle turn on one card is slightly lifted up by levering with the blade of the screwdriver, scraped clean and a spare piece of the



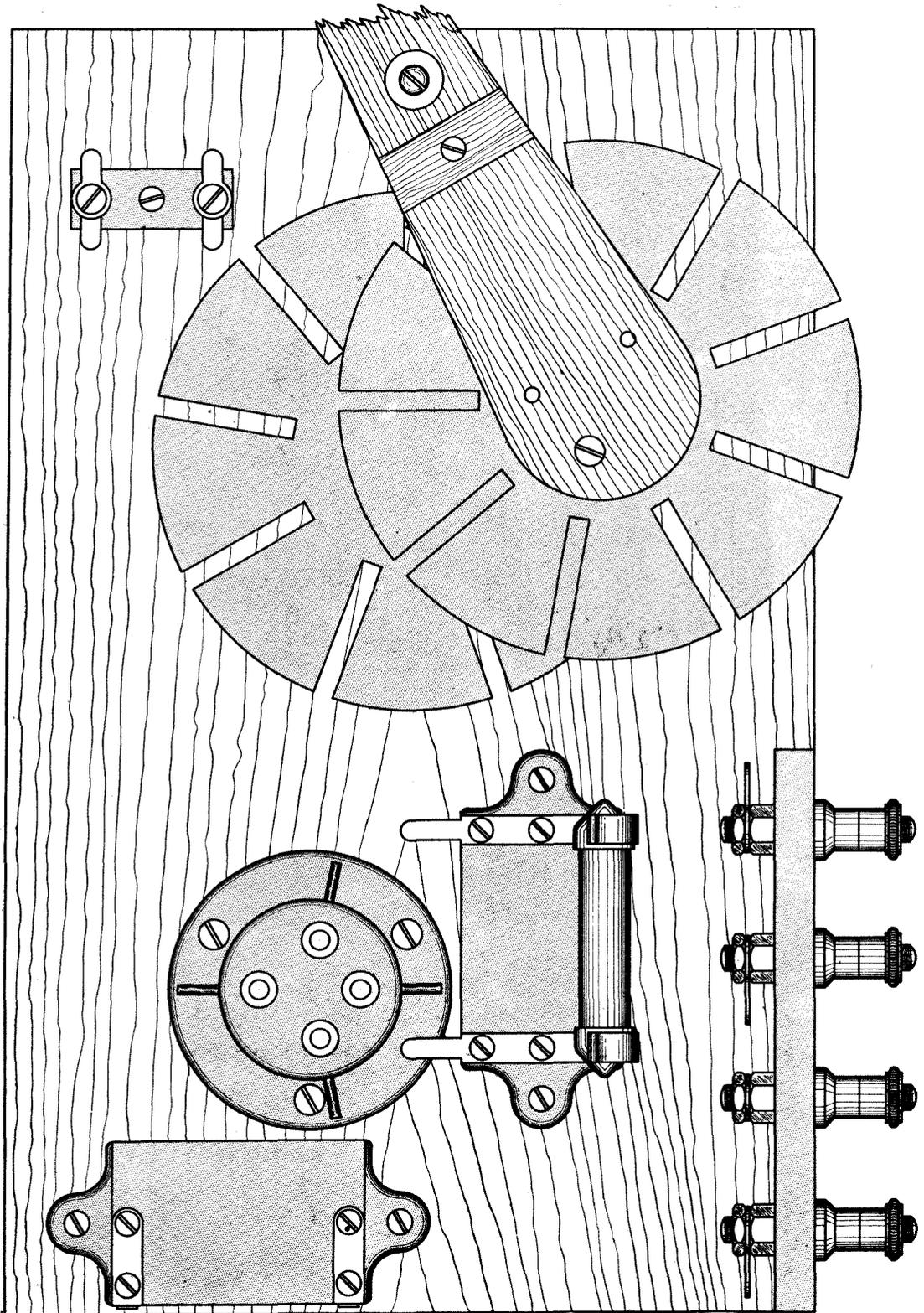
*The circuit.*

No. 26 wire soldered to it. A small piece of paper, silk ribbon, or empire cloth should be inserted under the joint. This card is laid flat on the baseboard in the position shown and the three wires which pass from it connected to the three Aeronmic tapping sockets, the centre lead being connected to the socket on the left as viewed from the front. This centre lead is also joined to the outside end of another coil, and it is most important to examine the two windings to observe that the direction of rotation of the wire as it passes from one inductance to the other is continuous. A piece of paper is inserted between the two inductances, and they can now be screwed down to the baseboard with three small screws, placing thin pieces of cardboard over the centres on the top and underside before putting the screws through.

The other inductance, which is the reaction coil, is arranged to swing by means of a short wooden arm over the two



EXACT FULL SIZE

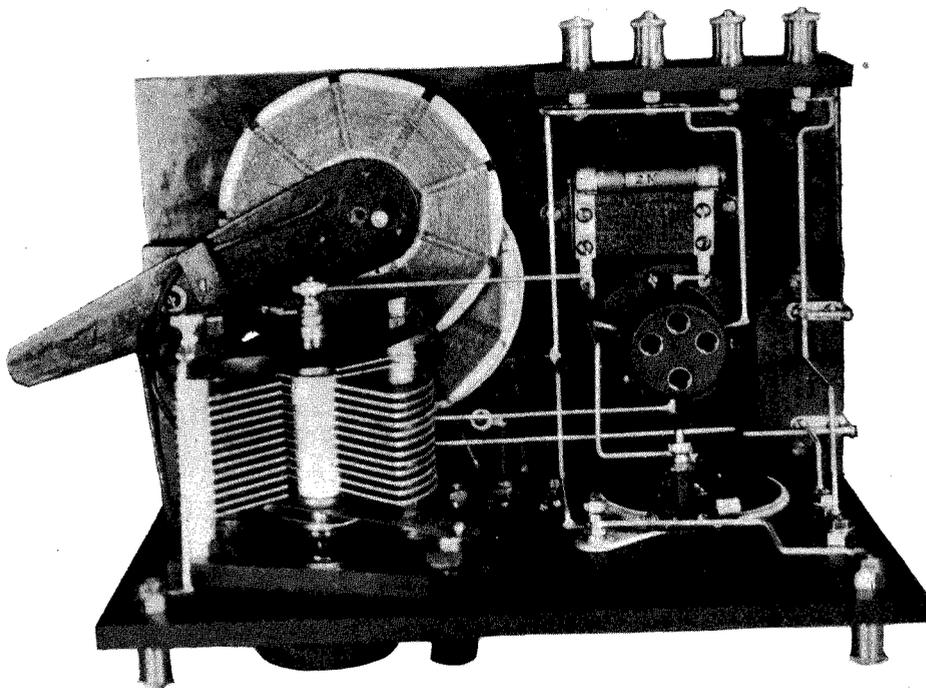


EXACT FULL SIZE.

inductances secured to the base. Liberal clearance may be given, but this is governed, of course, by the amount of space available beneath the condenser. A thin piece of mahogany (cigar box wood) may be used for making the arm. The inductance is attached by means of three screws, and the arm pivots on a round-headed screw carrying a brass washer and mounted on a small block of wood to support it at the correct height.

When the other components are attached and the terminating pieces made for the flexible leads from the reaction coil

essential to use connecting tags, for by so doing the overheating of components is avoided, and particularly is this important when, as in the case of the sockets, they are carried in ebonite. A good clean well-tinned iron must be used for soldering, and resin-cored solder will simplify the job, while the *merest trace* of "Fluxite" may be applied to the work. Only right-angle bends should be made in the wire. The connections to the reaction coil should be provisionally twisted off and not finally soldered until after the set has been put on test.



*Back view showing the arrangement of the components*

the set is ready for wiring. It might be mentioned, however, that when using the type of variable condenser illustrated it will be necessary to cut away portions of its ebonite mounting plate.

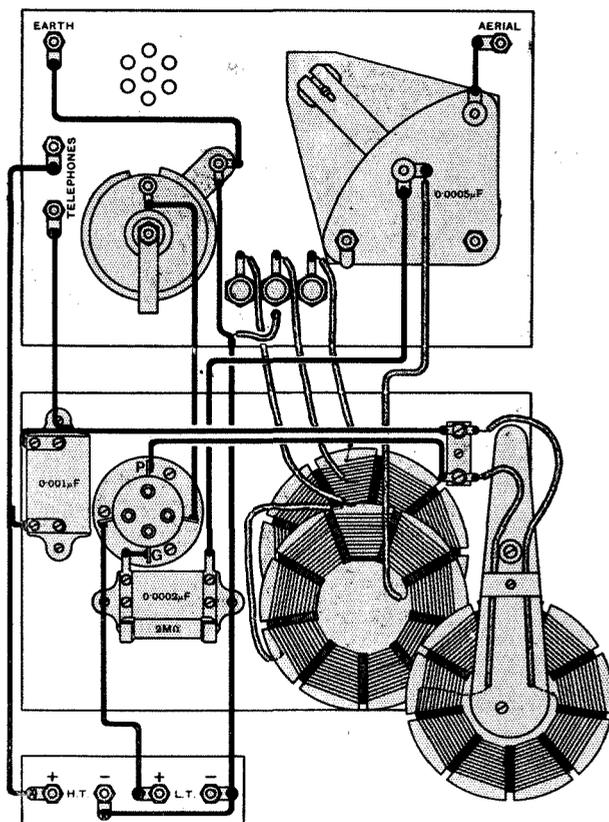
Connecting up is carried out with No. 16 tinned copper wire, and the practical wiring diagram can be followed. A length of wire should be paid out with one end attached to some secure object, then with the pliers gripping the wire a pull is exerted until the wire can be felt to appreciably stretch. It can then be cut up into lengths of about a yard each ready for use. It is almost

With all terminals joined up it will probably be found that self-oscillation will be produced with moderately loose coupling of the reaction coil. Owing to the large area presented between the moving and fixed inductances, self-oscillation will be set up not only by the inductive feed back, but also as a result of the capacity existing between the coils. Thus, the set will oscillate whichever way round the leads to the reaction coil are connected, though by changing the leads about one direction of connection will produce smoother and more easily manageable reaction effects.

In operating the receiver it will almost immediately be observed that the reaction coupling has to be loosened as the capacity of the aerial tuning condenser is reduced. The series method of connecting the aerial tuning condenser used in this set readily stimulates self-oscillation, and at times in a somewhat erratic manner, rendering tuning a little difficult. One soon becomes

and although self-oscillation may distort, good intelligible telephony may be obtained on telephone receivers.

The question of the oscillating set causing interference can scarcely be discussed here, for all sets making use of reaction, however it may be arranged, will energise the aerial circuit in the course of adjustment. It would appear that an amateur, in foregoing the use



*Practical wiring diagram. The under coil is shown displaced to expose the connections.*

acquainted with this peculiarity, however, and this system of connection is preferred to the parallel tuned circuit, in which the condenser is connected across the inductance, inasmuch as a greater signal potential is created across the ends of the coil.

For long range reception the receiver must be used in an oscillating condition,

of reaction, will be penalising himself, while the less technically interested listener, unskilled in the control of oscillation, is provided with apparatus arranged to oscillate. The principal cause of interference by oscillation is brought about by the continual adjustment of a set in the endeavour to tune in distant stations.

# MEASUREMENT OF AERIAL CURRENT.

## DESCRIPTION OF AN IMPORTANT METHOD.

By N. W. McLachlan, D.Sc., M.I.E.E.

(Concluded from page 275 of previous issue.)

### A Current Transformer.

A CURRENT transformer designed for 150 amperes at 10,000 metres would operate satisfactorily at 100 metres. In general a current of 150 amperes at 100 metres would cause undue heating of the secondary winding, but, as we have seen above, such currents at this wavelength are quite unusual.

Before dealing in detail with the design of iron-cored radio frequency current transformers, it will be well to state their advantages. These are as follows:—

1. They are accurate to 1 per cent. or less over a very wide range of wavelengths.
2. They are cheap and very easily constructed.
3. They can be placed within a few feet of an aerial tuning inductance, and although situated in a strong alternating magnetic field, there is no perceptible error if the primary and secondary are wound symmetrically to give astaticism.
4. For large currents the combination of a transformer and small ammeter is more economical and flexible than a large ammeter. It is also likely to be more accurate than either a multi-strip ammeter or one with a shunt, especially over a fairly wide range of wavelengths.
5. It is possible to have the primary of the transformer connected in the aerial earth lead, whilst the ammeter can be situated at a distance.\* This facilitates

\* The leads can be twin flex stranded, to avoid inductance and the effect of external fields, but care must be taken not to introduce excessive resistance or capacity. Assuming concentrated capacities the current due to the latter is 90 degs. out of phase with the main current and can be relatively large without introducing appreciable errors. The capacity is of course distributed and care would have to be taken when using (long) leads on short wavelengths owing to the possibility of nodes. The instrument can, of course, be calibrated with its leads.

handling the set for tuning purposes, since the instrument is placed in the position of optimum visibility. The ammeter ought always to be situated at a position in the circuit as near earth potential as possible.

Following a series of investigations into the magnetic behaviour of iron at radio frequencies,† the author outlined a simple theory of iron-cored current transformers.‡ This analysis showed that the transformation ratio, in the absence of capacity effects and of inductance in the secondary circuit, could be expressed by the formula—

$$\frac{I_1}{I_2} = \frac{n_2}{n_1} \left( 1 + \frac{kR_2}{\omega L_2} \right),$$

where  $I_1 I_2$  = r.m.s. primary and secondary currents respectively,  $n_1 n_2$  = primary and secondary turns respectively,  $R_2$  = resistance of the complete secondary circuit at radio frequency,  $k$  = factor depending upon the iron and  $L_2$  = inductance of secondary winding.

For 0.25 or 0.5 mm. stalloy rings in which there is no air gap,  $k$  may be taken as unity, so that the formula becomes

$$\frac{I_1}{I_2} = \frac{n_2}{n_1} \left( 1 + \frac{R_2}{\omega L_2} \right).$$

It is obvious that the error in the transformation ratio is  $\frac{R_2}{\omega L_2}$ . This means that the secondary current, as measured on the indicating instrument is  $\frac{100 R_2}{\omega L_2}$  per cent. too small. Moreover, in designing a current transformer we must aim to make  $\frac{100 R_2}{\omega L_2}$  small compared with unity.

† See references already quoted.

‡ *Electrician*, December 22nd, 1916, and *Wireless World*, July, 1917.

Let us take a concrete case and design a transformer for a definite purpose. Assume the conditions to be as follows:—An aerial current of 50 amperes is to be measured at wavelengths from 1,500 to 500 metres, the accuracy being within 1 per cent. This means that in the above range the value of

$$\frac{R_2}{\omega L_2} \text{ must be less than } 0.01. \text{ Equating } \frac{100 R_2}{\omega L_2} \text{ to unity at the longer wavelength}$$

we have  $\frac{R_2}{\omega L_2} = 0.01$ , or

$$L_2 = \frac{100 R_2}{\omega} = \frac{100 R_2}{2\pi \times 2 \times 10^5} = 8 \times 10^{-5} R_2.$$

Thus  $L_2$  must not be less than  $8 \times 10^{-5} R_2$ . Now  $L_2$  for an uniformly wound iron-cored anchor ring is approximately

$$\frac{4\pi n^2 A \mu_a}{l} = \frac{4n^2 A \mu_a}{d_m}$$

where  $A$  = cross section of iron,  $\mu_a$  = apparent permeability of iron at radio frequency and  $d_m$  = mean diameter of ring. At radio frequencies the eddy currents in the iron are such that the magnetisation decreases rapidly as we pass from the skin to the interior of a plate, unless the latter be exceptionally thin. With stalloy plates either 0.25 or 0.5 mm. thick at a wavelength of 1,500 metres ( $f=2 \times 10^5$  cycles) the flux density at the centre is insignificant compared with that at the skin. At a certain depth below the skin the flux is in opposite phase to that at the surface. Suppose we pass an alternating current  $f=2 \times 10^5$  cycles through an anchor ring coil with a core of stalloy sheets. If we assume the voltage across the coil is sinusoidal in wave form and the resistance of the winding is negligible, it is possible to calculate the apparent flux density in the iron from the expression so familiar in power transformer design, namely,  $V=4.44 Afn B_{max} \times 10^{-8}$  where  $A$  = cross-sectional area of iron,  $f$  = frequency,  $B_{max}$  = apparent flux density in iron,  $n$  = turns on coil.  $B_{max}$  is really the maximum value of the flux density when uniformly distributed over a plate, which would give the same voltage across the coil as the actual non-uniformly distributed flux. Moreover, although the apparent flux density may be relatively small, it must be borne in mind that the density at the skin of a plate may be large.

In the experiments on the magnetic behaviour of iron at radio frequencies already cited, data was obtained from which it is possible to find the apparent permeability of the iron. § The magnetising forces and apparent flux densities used in the experiments were in excess of those usually encountered in radio-frequency current transformers. The flux density in these is never more than, say, 10 lines per square centimetre when reading currents of 100 amperes or more. With smaller currents it is very much less than 10 lines per square centimetre. Thus, in order to obtain an approximate estimate of the apparent permeability it is essential to extrapolate with the author's experimental data. Although the values secured by this means are liable to error—because we must assume the "shape" of the permeability curve||—they

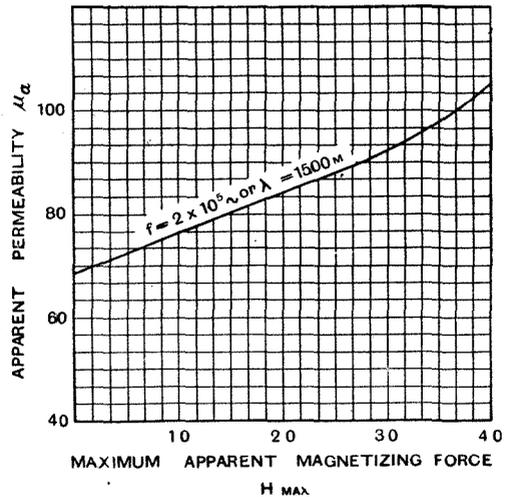


Fig. 4.

are a valuable guide for design. What we actually desire to design is a transformer in which the ratio  $\frac{R_2}{\omega L_2}$  is a minimum for the range 1,500 to 500 metres. Now the value of  $R_2$  at radio frequencies is not readily and accurately calculable, and furthermore the data for  $L_2$  has been obtained by extra-

§ For a general article on iron at H.F. see p. 880 Year Book of W/T, 1918.

|| The shape in the neighbourhood of the origin may be quite different from that at low frequencies, and is really a point which can only be settled empirically.

polation and not directly from experiment. Thus the probability of finding the optimum  $\frac{R_2}{\omega L_2}$  by computation is rather remote, and it is advisable to adopt an alternative mode of attack. If in the calculation of the transformer we allow a "factor of safety," the error in the transformation ratio will fall within the required limits. Proceeding on these lines, and assuming the value of  $R_2$  to be 30 ohms, the factor of safety will probably be of the order of 2 to 3. We can therefore equate  $L_2$  to  $8 \times 10^{-5} \times 30 = 2.4 \times 10^{-3}$  henry. Now

$$L_2 = \frac{4n^2 A \mu_a \times 10^{-9}}{d_m} \text{ henry.}$$

Assume the mean diameter of the stallo rings to be 8 cm., the radial width 1 cm., and the thickness 0.25 mm. By using 80 rings the cross-sectional area of the iron will be 2 square centimetres. By extrapolation from Fig. 4 the apparent permeability of the iron is roughly 6 per cent. at a wavelength of 1,500 metres. Substituting the above data in the formula for  $L_2$  we find that the number of turns required on the secondary winding is 200. Using a hot-wire

ammeter reading to 1 ampere in the secondary circuit the ratio of transformation for a maximum primary current (r.m.s.) of 50 amperes is obviously 50/1, which means that the number of turns on the primary will be 4. Assuming the actual resistance of the secondary circuit to be 15 ohms, the voltage induced in it when the primary current is 50 amps must be  $15 \times 1 = 15$  volts provided there is no leakage. Taking the formula  $V = 4.44 A f n B_{max} \times 10^{-8}$ , and inserting the known factors, we find that  $B_{max} = 5$  lines per square centimetre. This is about 1/1000th the flux density at which a transformer would be operated at 50 cycles, and the loss in watts per kilogram is very small.

It is customary to use a secondary winding of one layer only, although there is no reason why multilayer coils should not be adopted, provided (1) the radio resistance can be kept adequately low, (2) the leakage is inappreciable, and (3) inherent capacity and resonant effects are avoided, and (4) the insulation between layers is satisfactory. In the present instance we shall legislate for a single layer secondary wound with solid D.C.C. copper wire. In calculating the overall diameter of the wire, allowance must be made for an insulating covering on the iron discs. The latter are varnished and bound together with thin tape. Two strips of leatheroid or suitable insulating material are fitted to the outer and inner curved surface of the core. These are wide enough

to fold over the ends of the core, this operation being facilitated by a series of cuts parallel to the axis. The whole is again bound with strong silk tape, and then suitably varnished. There is then little chance of the rings cutting through the insulation. The inner diameter of the ring is now used as a basis for calculation. We shall suppose the insulation to be 2 mm. thick, so that the internal diameter is now

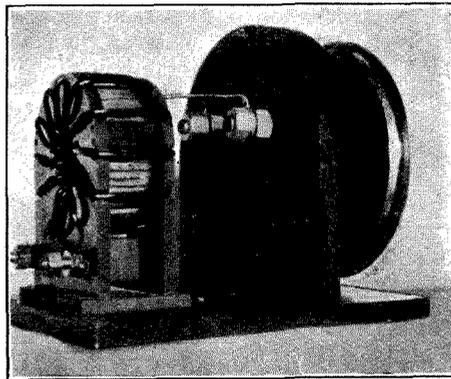


Fig. 5. View of the complete instrument, comprising a hot-wire ammeter and a current transformer.

6.6 cm. The inner circumference is therefore 20.7 cm. Making allowance for the diameter of the wire, for spaces which inevitably occur during winding, and for a distance piece between the first and last turns, this being essential, since, on open circuit there may be several thousand volts across the secondary, the inner circumference may be regarded as 20 cm. Since there are 200 turns, the diameter of the wire over the insulation can be as large as 0.1 cm., i.e., 0.04 in.

From standard tables we find that the wire is No. 20 D.S.C.; the D.C. resistance of the secondary winding will be approximately 0.4 ohm. If the radio frequency resistance were so large that undue heating occurred, the ratio of transformation could be increased

to 100, thereby halving both the primary turns and the secondary current. A hot wire instrument would then be used reading to a maximum of about 0.5 ampere. The appearance of the complete transformer would be somewhat akin to that shown in Fig. 5. The ring is mounted on an insulated framework of stabilite, ebonite or bakelite, and the primary is wound over it and kept in position by the framework.

The type of winding for the primary circuit is rather problematic. It is desirable to keep the primary resistance as small as possible. Now it is usually found in practice that the resistance of stranded wire at a wavelength of 500 metres is much greater than one would expect from calculation. Moreover, it would appear that in our particular case solid wire for tube is a better proposition. The objections to this are twofold—(1) it is much more difficult to wind, (2) if the secondary breaks down the primary is difficult to remove. However, we cannot have it both ways. Although it is possible, especially when the primary turns are few in number, to use a relatively small size of solid wire and wind several in parallel spaced radially in slots round the periphery, this course may lead to relatively high resistance if all the parallel paths are not electrically identical. This, however, is a question of accurate workmanship.

Following standard power practice, a cable can be run straight through the centre of the ring, thereby giving a one turn primary. This gives good results in some cases, and is a good method when hundreds of amperes are to be measured. Unless proper precautions are taken the readings are more

likely to be influenced by external fields than those where the primary consists of more than one turn. In the latter instance, if the turns are equal in size and equally spaced, the arrangement acts astatically, and is practically immune from the action of external fields. A single turn primary can be made astatic by *closing the turn at the transformer* and using two or more parallel paths round the core, the turns being electrically identical and symmetrically spaced. Care must be taken to avoid strong external fields, or there may be a large current circulating round the parallel strands. Moreover, the type of primary winding must be settled having due regard to the various factors which are brought into play. If the transformer is properly constructed so that the possibility of puncture of the insulation between the secondary and the core or between the ends of the secondary is remote, there is justification in the present design for using a solid wire primary of several turns in parallel, say six of No. 10 S.W.G. The primary will therefore consist of six equal lengths of No. 10 bare wire equally spaced, and each taking four turns round the core, being just sufficiently removed from the secondary to give satisfactory insulating requirements. The six wires should preferably be equally spaced, and sweated at their extremities to the external cylindrical surface of a socket. This is probably better than sweating the wires into the hole of the socket, although in practice one cannot always adhere to the optimum conditions.

Where there are many strands of fine wire, the above procedure enables one to see whether *all* the strands are connected.

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### NEW FRENCH WIRELESS DECREE.

The new French Decree concerning wireless installations on mercantile marine and fishing craft, which will come into force on March 15th, 1925, will particularly affect many of the smaller British cargo boats which call at French ports.

For the purpose of the Decree, ships are divided into two sections—(1) Ships of 2,000 gross tons or more, ships carrying 50 souls (including crew), and ships having more than 12 passengers; and (2) Ships of 500 to 1,999 gross tons with less than 50 souls, and ships of like tonnage with not more than 12 passengers.

All ships in section (1) must carry a complete wireless telegraph installation. Ships in section (2)

may carry a wireless receiver only. The British regulations now in force only insist that wireless apparatus shall be carried in passenger steamers or in steamers of 1,600 gross tons and upwards.

It follows that all British vessels between 500 and 1,600 tons which use the French ports, although exempt from the British wireless regulations, will be compelled under the new regulations to carry a wireless receiver at least. Of course, many of these smaller ships already carry Marconi apparatus, not as a compulsory measure, but for the sake of the many advantages it brings them, and especially the assistance it renders to navigation.

## THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

### Valves and "Amplifying Power."

**V**ALVE users are naturally very interested in the "amplifying power" of their valves. They find that one valve, when used for instance in a high frequency stage, results in stronger signals than when another valve is tried. The tendency to oscillate is less with one valve than with another. Perhaps the valve which gives better results when used in the high-frequency stage gives poorer results than another when used in a low-frequency stage.

would be better to express this in another way, and to say that the *valve* should be chosen with regard to the work it must do.

### The Amplification Factor of a Valve.

Before we can choose the most suitable valve for use in one of the amplifying stages of a receiver, it is necessary to understand the characteristics and properties of the valve itself. Naturally, it is important to know the amplification factor of a valve to be used in an amplifier.

The amplification factor (sometimes referred to as the "*m*" value) depends principally on the construction of the valve. It depends, for instance, on the position of the grid with respect to the anode, the number of wires in the grid, and the size of the grid wires. If the number of wires in the grid is increased, there is a corresponding increase in the amplification factor, and the same result is obtained by increasing the distance between the grid and the anode.

The value of the anode voltage usually affects the amplification factor slightly; it falls a little as the anode voltage is reduced. Adjustment of the filament current (about the normal value) may also have a slight effect on the amplification factor.

The amplification factor referred to here is the ratio of the voltage set up in the anode circuit to the voltage applied to the grid, the anode circuit being designed to have the highest possible voltage set up in it (Fig. 1). This value of amplification factor is sometimes referred to as the "theoretical" voltage amplification factor of the valve. In an ordinary resistance-capacity coupled amplifier, for instance, the actual voltage amplification obtained might only be 60 per cent. of the theoretical value; an amplification of higher than 80 per cent. of the maximum is not usually obtained—not because it is impossible to secure a higher degree of amplification, but because it is not economical to do so. The amplification actually obtained would be equal to the voltage amplification factor of the valve

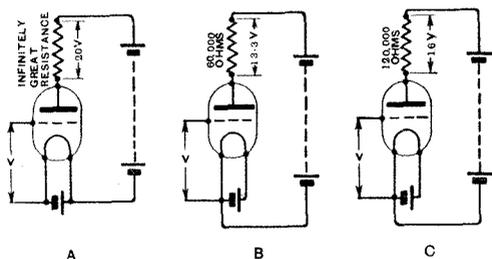


Fig. 1. Showing the amplification obtained when the valve has an impedance of 30,000 ohms and an amplification factor of 20.

It is found that one type of valve gives louder signals when employed in a resistance or choke coupled amplifier, and weaker signals if used in a transformer coupled amplifier.

Probably the experimenter notices a difference in the quality of the signal when different valves are tried.

Thus we conclude that the effectiveness of the amplifier depends partly on the valve and partly on the method of coupling. Valves which are suitable for use in an amplifier employing one form of coupling are not so suitable for use in amplifiers in which a different type of coupling is employed.

The "amplifying power" mentioned above is therefore not decided by the valve alone. The valve is but a part of the amplifier, and to do its work properly must be employed with correctly designed circuits. Perhaps it

when the value of the resistance connected in the anode circuit is infinitely great.

These facts will more readily be appreciated by referring to Fig. 1. In the figure we have a valve which, we will assume, has a theoretical amplification factor of 20, and an impedance (this property of the valve will be explained later) of 30,000 ohms. In Fig. 1A the resistance connected in the anode circuit has an infinitely great value of resistance. Therefore the voltage amplification actually obtained is equal to the voltage amplification factor of the valve. If  $v$  volts are applied to the grid, a voltage of  $20v$  volts are set up in the anode circuit. In Fig. 1B and 1C the anode resistances have values of 60,000 ohms and 120,000 ohms respectively. These are usual values for a valve with these characteristics. The actual amplification obtained is 13.3 for the arrangement of Fig. 1B, and 18 for Fig. 1C. That is, if 1 volt is applied to the grid of the valve in Fig. 1B, a voltage of 13.3 volts is set up in the anode circuit, or 18 volts with the arrangement of Fig. 1C.

#### Finding the Amplification Factor.

There is another way of considering the amplification factor of a valve. In Fig. 2 is given *static* characteristic curves of a valve showing the relationship of anode current to grid voltage, the filament current being of sufficient value to prevent the saturation point being reached.

These curves may be obtained in the following simple manner. Connect in the anode circuit of the valve (Fig. 3) a milliammeter mA, reading up to, say, 10-15 milliamperes, and a dry cell battery of known voltage  $V$ . In the grid circuit connect a few cells (GB) so that the grid voltage, as read by the voltmeter VG, may be varied between, say, 15 volts negative and a few volts positive. Adjust the filament current to its normal value, and fix the anode voltage at, say, 40 volts. Then read off the anode current for various grid voltages, and tabulate the results. The results may be plotted to give a curve such as those of Fig. 2 by marking off on squared paper the anode current corresponding to the grid voltages, and drawing a line through the points.

Having obtained a curve showing the relation between the anode current and grid volts for an anode voltage of 40,

increase the anode voltage to, say, 60 volts, and get the figures for another curve. Repeat the experiment for various anode voltages, in all cases increasing the negative voltage of the grid to the point where the anode current falls to approximately zero. The portion of the curve to the right-hand side of the line representing zero grid volts is not of much interest, because it is usual to operate amplifying valves so that the grid does not become positive.

Now that we have a set of curves showing the relationship of anode current and grid volts we can see the effect of the amplifying property of a valve. For instance, referring to the set of curves of Fig. 2, the line AB

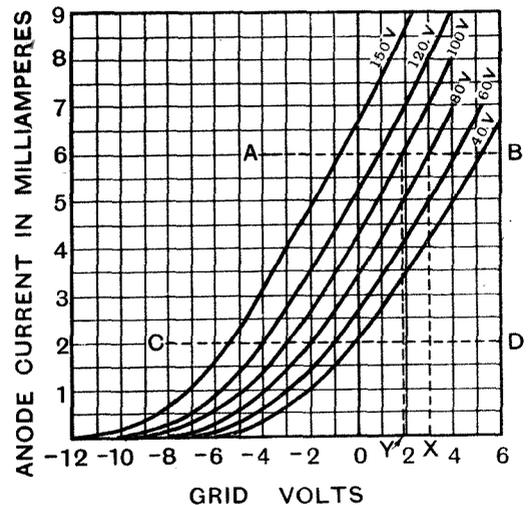


Fig. 2. One method of finding the amplification factor. The static characteristic curves show the relationship of anode current to give volts at various anode voltages.

cuts all the curves at an anode current of 6 mA. At this value the valve may have an anode voltage of 150 and a grid voltage of  $-0.8$ , an anode voltage of 120 and a grid voltage of  $+0.8$ , or 100 volts and  $+1.9$  or 80 volts and  $+3$ .

At point Y, the anode voltage is 100, and the grid voltage is  $+1.9$ . If the grid voltage is increased by  $1.1$  volts, making a total grid voltage of  $+3$  volts, at point X, the anode current increases to 7 mA. To reduce the anode current to 6 mA it is necessary to reduce the anode voltage to 80 volts. That is to say, the effect on the

anode current of adding 1.1 volts to the grid may be counteracted by reducing the anode voltage by 20 volts. A voltage applied to the grid is therefore  $\frac{20}{1.1} = 18.2$  times more effective in producing a change in the anode current than a similar voltage change in the anode volts.

The amplification factor of the valve when the anode voltage is 100 and the grid voltage + 1.8 is therefore 18.2.

**The Average Value of the Amplification Factor.**

The amplification factor of the valve may be obtained from the curves for various average grid voltages. Thus, considering line AB, the amplification factors when the grid has voltages of - 0.8, + 0.8, + 1.9 and + 3 volts, are 18.7, 18.2, 18.2 and 18.2 respectively. If we consider line CD and grid voltages - 5.5, - 4, - 3, - 2 and - 1, we find the values of amplification factor to be 20 in each instance.

**Another Method of Finding the Amplification Factor.**

Instead of determining the amplification factor as above by finding from the curves the ratio of the anode and grid volts for constant anode current we may use the following method.

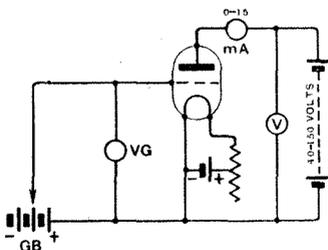


Fig. 3. The connections of the apparatus required when finding the figures for the characteristic curves of Figs. 2 and 3.

Draw a straight line AB through the curves (Fig. 4), and draw lines CD, EF, GH, etc., to scale to represent the anode voltage of the curves. Thus CD represents to scale

an anode voltage of 150 volts, EF 120 volts, GH 100 volts, and so on. Now draw a straight line through the points. This line cuts the grid voltage line at Y.

The amplification factor of the valve may now be obtained by dividing the anode voltage by the grid voltage represented by the distance between point Y and the point where the line drawn down from the anode voltage cuts the grid voltage line. For instance, when the anode voltage is 150 the grid voltage is represented by the distance between points Y and C, or 8.0 volts. The

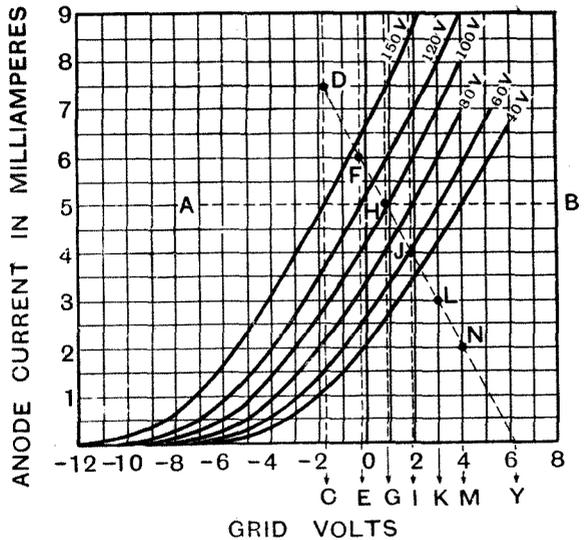


Fig. 4. Explaining another method of finding the amplification factor of the valve.

amplification factor is therefore  $\frac{150}{8}$  or 18.7.

If we take an anode voltage of 100 the grid voltage (Y to G) is 5.3, and the amplification

factor  $\frac{100}{5.3}$  or 18.8.

If the curves are drawn on a large sheet of squared paper the average value of amplification factor may easily and accurately be obtained.

## A COIL WINDING MACHINE.

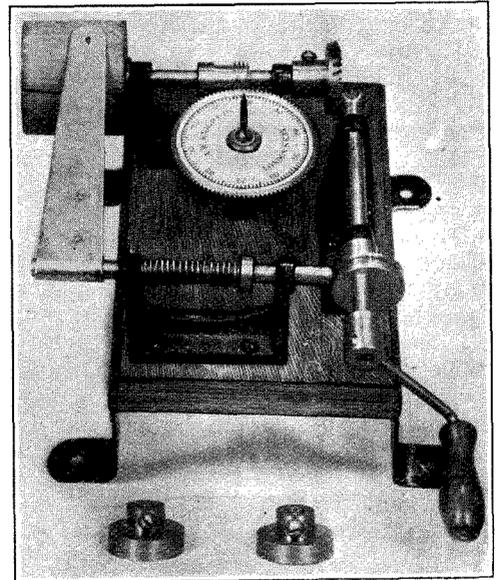
Those who do considerable experimental work and use a number of multi-layer coils will be interested in the simple winding machine described below.

**M**ANY readers may remember that some three years ago a description was published of a coil winding machine, and since that time these winders have been in fairly general use by amateurs for the construction of tuning coils. Some recent improvements have, however, been made, and the machine in its latest form is shown in Fig. 1.

The general construction will be seen to consist of a geared drive operating a wooden drum and fitted with a cam which causes an arm to oscillate for the purpose of zig-zagging the wire across the drum as it revolves. The instrument is rigidly set up, which is a very necessary feature, for any play which may exist in the pinions gives rise to a little slackness of the wire at the edge of the coil under construction and results in the turns falling off.

The winder is supplied with a booklet of instructions containing much useful information on the process of winding coils and the many applications in which they may be used. It gives the number of turns to produce coils of given inductance, and in the tabular matter states the self capacity that these coils will probably possess.

It may be mentioned that when operating a machine of this sort the wire must be pulled quite taut and the oscillating arm kept pressed hard against the cam. A very useful feature which has been added to the machine is the dial counter, which indicates the number of revolutions made by the revolving drum, and indicates the size of the coil more readily than the method of counting the rotations of the handle. Although wire of both fine and comparatively heavy gauge may be wound it will be found that No. 26 D.C.C. can be handled quite easily, as it takes the necessary bend without being too stiff, and the thick insulation gives a certain useful springiness to the layers of the coil.



The "Kaynite" coil winding machine manufactured by A. W. Knight, Ltd.

Particulars of coils wound with this wire are given in the following table:—

Turns of Handle of Machine.	Turns of Wire on Coil.	Self Capacity $\mu\text{F}$ .	Inductance.	Maximum Wavelength with 0.001 $\mu\text{F}$ Condenser. Metres.
100	48	21	0.165	771
200	96	19	0.74	1,585
300	144	14	1.60	2,380
400	192	14	2.76	3,150
500	240	13	3.82	3,720
800	384	10	11.15	6,400
1,200	576	9	30.10	10,450
1,600	768	9	55.70	13,800

This useful machine is worthy of a place in the laboratory of every experimenter.

# NOTES & NEWS



A rumour to the effect that the French Government has been considering the advisability of making wireless transmission a State monopoly has now been denied in Paris.

\* \* \*

A wireless club has been formed at Rangoon and the members are constructing a transmitter.

\* \* \*

Strong reception of the American broadcasting station **WFI**, at Philadelphia, Pa., is reported by a Lancashire reader. **WFI** operates on 395 metres and is worth an attempt to hear.

\* \* \*

A second series of B.B.C. Symphony Concerts will open on December 10th. On this occasion M. Pierre Monteux will conduct a large orchestra at the Opera House, Covent Garden, the concert being simultaneously broadcast to all stations, except Belfast.

\* \* \*

Music is not at present being relayed to the Belfast station owing to the inherent difficulties in transmission over submarine cable.

\* \* \*

We are now in possession of a complete list of New Zealand amateur transmitters, with call signs and other particulars. Readers interested should apply for a copy.

\* \* \*

## TELEPHONY TESTS FROM S.S. "LEVIATHAN."

The reception of broadcast music from the s.s. "Leviathan" (**WSM**) is reported by Mr. E. A. Richardson, who tuned in the vessel at 12.5 a.m. on November 20th, when its position was given as 70 miles west of Cuba. In addition to gramophone records, which included "It Ain't Gonna Rain no More," messages were transmitted to **WML** and **KDL**, and the hope was expressed that British and Canadian amateurs would be successful in receiving the transmissions. The "Leviathan" was also heard by Mr. A. H. Brackensy on Sunday, November 16th, but it is probable that a considerable distance has been covered by the ship since then.

## 2 OD's FURTHER SUCCESS.

Mr. E. J. Simmonds (**2 OD**), of Gerrard's Cross, Bucks, secured further successes in two-way communication with Australia, when, on November 24th, he worked with two Australians in the space of half-an-hour. **A 2 DS** was first

heard at 6.15 p.m., G.M.T., calling **CQ**. At 6.30 **2 OD** replied, and two-way communication was at once established, **2 OD's** signals being reported as very strong. At 6.55 p.m. **2 DS** said, "Please now listen to **A 2 CM**." Signals were immediately received from the latter station, and two-way communication was effected at 7.5 p.m. Five minutes later Mr. Simmonds received the following message from **A 2 CM**. "To His Majesty the King, Greetings from Australian Radio Experimenters. (Signed) Maclurhan, President of Wireless Institute of Australia." The tests concluded at 7.35 p.m. with the message of **A 2 CM**, "The sun is up now."

Mr. Simmonds has now worked direct with Australia on four occasions.

On November 23rd Mr. Simmonds established two-way communication with **U 5 UK**, this being the first occasion on which an American fifth district station has been worked from Great Britain.

## FIRST POLISH RADIO CLUB.

The first Radio Club to be founded in Poland is that just organised in Poznan. The main object of the club is to arouse interest in wireless communication throughout Poland, and to foster the development of the radio industry. In addition to holding lectures and demonstrations, the Poznan Wireless Club itself will sell radio apparatus and appliances, on a commission basis. As the wireless industry is in its infancy in Poland, there is evidently a big scope for British manufacturers to find a considerable new market, though competition from German makers will doubtless be very keen. The club will also publish a magazine dealing with, explaining, and encouraging the use of wireless installations in Poland.

## NEW TRANSPACIFIC WIRELESS SERVICE.

A high speed wireless service will shortly become operative between the Pacific Coast of America, Honolulu, the Far East and all points in the Pacific, following the erection of a powerful transmitter at Bolinas, California. The station will be equipped with Alexanderson high frequency alternators and six self-supporting towers, each 650 ft. high.

## FRENCH SHORT WAVE TESTS.

Some interesting experiments in transmission and reception on wavelengths between 40 and 80 metres have been conducted by the two well-

known French amateurs, M. Menars of Le Blancat Gan, and M. Deloy of Nice. According to reports these experiments would go to show that on this band of wavelengths it is possible to transmit over distances quite as great during the day as during the night; in fact it was observed during the experiments that audibility was sometimes greater during the day.

#### HIGHEST BROADCASTING STATION ?

Said to be the highest in the world, the new wireless station on the Pic du Midi, in the Pyrenees near Tarbes, has undergone its initial trials, which were carried out in spite of the fact that the pylons 100 ft. high, which were to have supported the

#### RADIO SMUGGLING IN BULGARIA.

As a direct result of the strict prohibition of private wireless in Bulgaria the smuggling of wireless receiving sets has recently become a practice in the various parts of the country. Under the pressure of powerful foreign radio interests the Bulgarian Government are considering the possibility of introducing radio under strict official supervision. It is thought that a Bill will shortly be introduced in the Bulgarian Parliament giving the Ministry of Posts, Telegraphs and Telephones discretionary powers in the matter of wireless broadcasting. It is understood that the monopoly of broadcasting will remain with Bulgarian companies.



*A well-known Belgian amateur transmitting station (4 RS), is extremely active, as may be judged from the "QSL" cards. His aerial consists of a twelve-wire cage, 160 feet long and 60 feet high.*

aerial, could not be taken to the summit of the mountain, so a temporary aerial had accordingly to be used.

Besides keeping permanent touch with Bagneves, the new station will be extensively used for broadcasting weather reports.

#### SHORT WAVE SIGNALS FROM NKF.

With reference to the note in our last issue giving the schedule of 54-metre signals from the United States Naval Research Laboratory, NKF, at Bellevue, Anacostia (D.C.), we have received an interesting report of the reception of these tests from Mr. C. M. Denny (6 DIV), of Bebington, Cheshire. Our correspondent states that he has recently been receiving these signals at good strength on a straightforward single valve reaction circuit, the receiver being installed in a Belfast hotel, and the aerial being only 6 ft. long, suspended 1 ft. from the ceiling.

#### CHILI—U.S.A. AMATEUR WORKING.

Messages exchanged during two-way communication between Chili and the United States were intercepted by Mr. E. J. Simmonds (2 OD), of Gerrard's Cross, Bucks, at 7 a.m., on November 18th. The stations participating were R 9 TC calling CQ on 85 metres, and 6 CGO. The following cryptic message was transmitted at 7.15 a.m., "Quist, Hartford. Credit 6 CGO one Chilian hat. (Signed) Ravithart."

#### R.S.G.B. INFORMAL MEETING.

An Informal Meeting of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m. on Wednesday, December 10th, when Mr. W. K. Alford will give a talk on the "Supersonic Heterodyne."

**AN EFFICIENT TRANSMITTER.**

Operating on an average power of 250 watts, Mr. J. H. Ridley (5 NN) of South Norwood, has, since October 5th, worked with the following American and Colonial amateurs:—

**U 1 AJW, U 1 BGQ, U 3 AJD, U 1 MY, U 3 BHV, U 1 SF, U 2 ABD, C 3 BG, C 2 CG, Z 4 AK, Z 2 AC, Z 4 AG.**

5 NN has also received a report from Californian 6 BUR that his signals were heard on November 1st; this has been confirmed and checks exactly with the log at 5 NN.

**NOT AN AUSTRALIAN.**

The report in a recent issue of the reception of an Australian amateur by Mr. W. J. Randall has led to some doubt, as at present no 8th District exists in Australia. It is probable that the station heard was U 8 GZ (Columbus, Ohio), which is frequently heard in this country on the 75-80 metre band.

**AN INGENIOUS MODEL.**

The value of mechanical analogy in wireless instruction was demonstrated at the last Informal Meeting of the R.S.G.B. when Mr. R. C. Clinker exhibited a dynamical model of an oscillating valve circuit.

Opening his talk with some interesting historical notes, Mr. Clinker referred to Clerk Maxwell's early model designed to show the mutual inductance between two circuits. This model had evoked the admiration of Lord Kelvin, whose belief it was that if any electrical phenomenon was fully comprehended, it should be possible to construct a mechanical model to illustrate it.

Mr. Clinker's model consisted of a simple circuit comprising a three-electrode valve placed across an aerial inductance tuned with a parallel condenser. The current flowing through the circuit was represented by a moving string, running on pulleys and actuated by a small electric motor. The inductance of the coil was illustrated by the use of a pivoted rod weighted at each end. When this was mechanically oscillated the inertia of the coil was at once apparent. Equally ingenious was the representation of the condenser capacity by means of an elastic spring.

When the circuit was represented in a state of oscillation, the grid was seen to change in polarity in accordance with the direction of the aerial current, and in other respects the action of the model was perfectly consistent with the electrical phenomena it portrayed.

In the ensuing discussion Mr. R. E. H. Carpenter detailed an interesting mechanical model to show the internal action of the valve, but stated that so far he had been unable to evolve a satisfactory device to represent the space charge effect. Mr. J. H. Reeves urged the need of a mechanical model to instruct broadcast listeners in the proper use of reaction.

**G 2 AWD.**

If G 2 AWD will kindly communicate his address to Mr. W. D. Keiller (6 HR), c/o the offices of this Journal, he will receive a souvenir card relating to his reception of 1 HT's signals during the latter's recent voyage to the Argentine.



Jersey (during October).

French: 8 BF, 8 BO, 8 BN, 8 BRG, 8 BU, 8 BV, 8 CA, 8 CB, 8 CKF, 8 CM, 8 CN, 8 CS, 8 CT, 8 CZ, 8 DA, 8 DP, 8 DW, 8 EK, 8 EM, 8 EN, 8 EP, 8 EU, 8 EX, 8 FK, 8 FN, 8 GF, 8 GH, 8 GI, 8 GUT, 8 HSF, 8 HSR, 8 HZX, 8 IP, 8 JBL, 8 JBR, 8 JV, 8 KC, 8 KN, 8 LL, 8 LPX, 8 MN, 8 NS, 8 OSO, 8 PA, 8 PD, 8 PP, 8 QG, 8 RBR, 8 RK, 8 RQ, 8 SG, 8 SM, 8 SR, 8 SSH, 8 SSU, 8 TPC, 8 UT, 8 WK, 8 WL, 8 WY, 8 WZ, 8 XH, 8 XR, 8 ZM, 8 ZU, 8 ZUT, 8 ZZ. Belgian: 4 GP, 4 KT, 4 QS, 4 UU, 4 YZ, W 1, W 2, B 7. Danish: 7 EC. Dutch: 0 BA, 0 OB, 0 OI, 0 KN, 0 KZ, 0 OW, 0 SK, 0 TP, 0 XQ, 0 XY. Italian: 1 FP. Swedish: SMZV, SMZY. Luxembourg: 1 JW. Canadian: 1 MY. American: 1 FD, 1 GV, 1 IOK, 1 KC, 1 SF, 2 AA, 3 BG, 3 CES, 3 GG, 3 WB. Argentine: CB 8. Various: 3 CA, 3 CM, EAR 3, 1 OKZ, FGH, FL, HBS, ICS, IDO, IHT, LPZ, POZ, MO, UFT 1, WGH, YA 77, DKKA. (0—v—1.) (D. Grove-White, 2 AWD.)

Richmond, Surrey (September 27th to October 27th).

French: 8 AG, 8 AJ, 8 AQ, 8 BN, 8 BP, 8 BR, 8 BRG, 8 CA, 8 CL, 8 CM, 8 CN, 8 CO, 8 CZ, 8 DA, 8 DS, 8 EP, 8 EU, 8 EX, 8 FK, 8 FP, 8 FS, 8 GD, 8 GE, 8 GGA, 8 GI, 8 HSF, 8 JBL, 8 JHL, 8 KK, 8 NS, 8 PA, 8 PD, 8 PP, 8 QG, 8 RBR, 8 SG, 8 SM, 8 SR, 8 SSU, 8 UU, 8 VV, 8 WAL, 8 XH, 8 XV, 8 ZUT, 3 DAX, 3 XO. Belgian: 4 C2, 4 LA, 4 QS, 4 VS, 4 UU, 4 YZ, B 7. Dutch: 0 BA, 0 BU, 0 OI, 0 MS, 0 OX. Danish: 7 EC, 7 ZM. Swedish SMZP, SMZV, SMZY. Finnish: 1 NA, 2 NC, 2 NM. Luxembourg: 1 JW. Algerian: HBS. Italian: 1 GN, 1 FP, 1 MT, 1 DO. American: 1 ABF, 1 ABL, 1 ATJ, 1 AWQ, 1 AXD, 1 BGQ, 1 BMP, 1 ER, 1 GR, 1 KC, 1 XAV, 1 XAW, 1 XAX, 1 XW, 2 AA, 2 ANA, 2 BCF, 2 BCO, 2 BY, 2 BRB, 2 CV, 2 KJ, 3 AJD, 3 AMF, 3 BDO, 3 CC, 4 QF, 4 SA, 8 XBC, 9 ELD. Canadian: 1 AR, 2 CY, 3 LY. New Zealand: 4 AG (October 16th). Miscellaneous: 9 AD, PK, XOX, YA 73. (C. C. Buckle.)

Nice, France (September 27th to October 31st, all about 100 metres).

Belgian: 4 AA, 4 QS, 4 RS, 4 W 2. American: 1 AAC, 1 CGQ, 1 IL, 1 SF, 1 XAV, 2 AA, 3 ZW, 4 XL, 5 UK. French: 8 AP, 8 BG, 8 BN, 8 BRG, 8 BU, 8 CA, 8 CM, 8 CS, 8 CZ, 8 DA, 8 DP, 8 DS, 8 DY, 8 EE, 8 EW, 8 FJ, 8 FS, 8 FV, 8 GIF, 8 JBL, 8 MN, 8 MU, 8 NS, 8 PA, 8 PP, 8 QG, 8 RM, 8 SM, 8 SMP, 8 SR, 8 SU, 8 UU, 8 VV, 8 WAA, 8 WAL, 8 XG, 8 XH, 8 XR, 8 ZM, 8 HBS, OCDJ, OCTU. Finnish: 2 NM. British: 2 CV, 2 DX, 2 FN, 2 KF, 2 NM, 2 WJ, 2 ZG, 5 LF, 5 KN, 5 SL, 5 SZ, 5 UQ, 6 AL, 6 NF, 6 RY, 6 TM. Dutch: 0 BA, 0 KN, 0 OI. Italian: 1 MT, 1 TR, 1 CD, 1 HT, MM, MS, SP. New Zealand: 4 AK, 4 AR. Argentine: DA 8\*. Miscellaneous: 3 AF, 3 MB, 10 KZ. \* Worked. (1—v—0) (Léon Delay.)

East Aberthaw, nr. Cardiff, Glam. (during October).

Swiss: 4 YZ, 9 AB, 9 AD. French: 8 AG, 8 AL, 8 BA, 8 BN, 8 BP, 8 BU, 8 CA, 8 CO, 8 CM, 8 CN, 8 CT, 8 CZ, 8 DA, 8 DP, 8 EM, 8 EP, 8 EU, 8 EV, 8 FK, 8 GI, 8 HI, 8 JV, 8 MN, 8 MZ, 8 ND, 8 NS, 8 PA, 8 PD, 8 PP, 8 PR, 8 QG, 8 SM, 8 SR, 8 WA, 8 WK, 8 WL, 8 WZ, 8 XH, 8 ZM, 8 ZZ, 8 BRG, 8 JHL, 8 FFU, 8 SSU, 8 SSH, 8 WAL, 8 ZUT. Finnish: 3 NB. Dutch: 0 AB, 0 BA, 0 BQ, 0 DP, 0 OI, 0 SK, 0 IIP. Belgian: 4 GP, 4 RS, 4 UU. Swedish: SMZV, SMZY, SMZZ. Danish: 7 ZM, 7 PU. Italian: 1 FP, 3 AF, 3 MC, ICS, IHT, IDO. Unknown: 3 CM, 3 DAX, 3 VO, 3 XO, WGH, WRT, KR 3, B 8. (0—v—0 and 0—v—1.) (C. Prosser, 2 ACK.)

**5 JX MOVES.**

Mr. Marcus G. Scroggie (5 JX), late of Edinburgh, informs us that he has now removed to "Venton," 19 St. Mildred's Road, Lee, London, S.E.12. He welcomes reports on his transmissions from the new address.

**6 QB'S TRANSMISSIONS.**

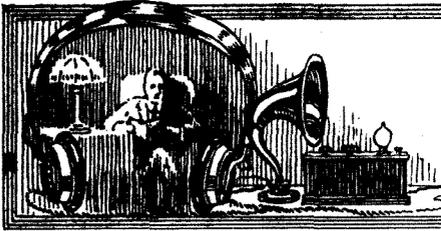
Mr. L. H. Thomas (6 QB), writes that he is now transmitting almost every evening on a power of 5 watts, I.C.W. on short waves. He would be glad to receive reports at 33 Harpenden Road, West Norwood, S.E.27, and to arrange tests with other transmitters.

**WHO IS W 1 PL ?**

Mr. P. H. Brigstock Trasler, of Northampton, enquires whether readers of this journal can shed information on the identity of a station W 1 PL calling CQ at 4.10 G.M.T. on the morning of November 10th. The wavelength was about 80 metres.

**2 KK.**

The above call sign, originally owned by a London transmitter, has been allotted to Mr. Ralph H. Parker, of Wilson Road, Smethwick, Staffs. Reports of signals are welcomed.



## AMONG THE SOCIETIES.

At the opening meeting of the newly-formed Dorking and District Radio Society, Mr. R. J. Hibberd gave a useful introductory lecture on "The Development of Wireless." The lecturer traced the gradual evolution of the art, mentioning the work of Michael Faraday, Joseph Henry, Lindsay, Maxwell and others, up to the time of Marconi. He concluded with some interesting details of the earlier experiments in wireless telephony carried out in conjunction with aeroplanes at Brooklands in 1915.

The Committee of the Cirencester Radio Society was responsible for a successful Radio Exhibition held recently in the Bingham Library, Cirencester. By means of this effort, which was well supported by local wireless enthusiasts, it is hoped that the membership of the Society will be considerably strengthened. Many amateur constructors showed quite a wide range of home-made apparatus and accessories, and a number of attractive trade stands contributed to the success of the event.

On November 14th members of the Wimbledon Radio Society profited by an instructive talk on elementary principles, provided by Mr. C. E. P. Jones. A feature of the meeting was the projection of illustrations on the screen by means of a "Radioptican."

The society held a very successful whist drive and dance on Saturday, November 15th.

An interesting "constructional" meeting was held by the Beckenham and District Radio Society on November 20th, the subject of discussion being an original type of coil holder specially designed for economy of space and cost. The demonstrator for the evening was Mr. A. West.

The Lewisham and Catford Radio Society has prepared an attractive programme for the winter, and a special effort is being made to enrol new members. Much interest was recently provided by a lecture and demonstration dealing with an unusually sensitive "high tensionless" receiver.

Morse practice is a regular feature at the meetings of the North Middlesex Wireless Club. Informal discussions are also held, and have recently covered such subjects as "Short Wave Reception," "Counterpoise Earths" and "An Unusual Crystal Receiver." Meetings of this kind serve to show the topics on which information is most desired, and the Committee are thus assisted in the compilation of programmes for the more formal lecture evenings.

A "gadget" night was recently held with great success by the Barnet and District Radio Society, several members exhibiting accessories of their own design. Special interest was shown in some transmitting gadgets produced by Mr. A. H. Gardner (2 AHM), a local transmitter. It is hoped to hold a similar evening in the near future.

The winter programme of the Dulwich and District Wireless Society is now in full swing, and several instructive lectures and demonstrations have been given. Special enthusiasm has been shown in the morse classes, in connection with which a competition is being held at the end of the season. New members are required, and the hon. secretary will be pleased to answer all enquiries.

The use of long and short waves in commercial wireless was the subject of a paper recently given before the Tynemouth Y.M.C.A. Radio Society by Mr. Sims. Whilst the efficiency of short waves was undoubted, the opinion expressed was that owing to their present impracticability during the hours of daylight long wave transmission was still the best for commercial work.

After the discussion on this paper, Mr. W. A. Matheson, Hon. Secretary of the Society, gave a short talk, with blackboard illustrations, on the "Theory of Electrical Generators."

### FORTHCOMING EVENTS.

#### WEDNESDAY, DECEMBER 3rd.

- Institution of Electrical Engineers** (Wireless Section). At 6 p.m. (Light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "Wireless Telegraphy Valve Transmitters employing Rectified A.C." By Mr. G. Shearing, B.Sc.
- Radio Research Society, Peckham.** At 44 Talfourd Road. Discussion: "The Effect of a Magnetic Field on the Working of Valves." Lecture: "Duplex Telephony."
- Bristol and District Radio Society.** Wireless Lecture No. 6. By Mr. W. A. Andrews, B.Sc.
- Edinburgh and District Radio Society.** At 8 p.m. At 117 George Street. Sixth General Meeting of Series.
- Tottenham Wireless Society.** Business Meeting.

#### THURSDAY, DECEMBER 4th.

- Bournemouth and District Radio and Electrical Society.** At 7 p.m. At Canford Hall, St. Peter's Road. Open Night. Experimental Work, etc.
- Luton Wireless Society.** At 8 p.m. At Hitchin Road Boys' School. Lecture by Mr. H. W. Pope (of S. G. Brown, Ltd.).
- West London Wireless and Experimental Association.** At Belmont Road Schools, Chiswick, W.4. Annual General Meeting.

#### FRIDAY, DECEMBER 5th.

- Bristol and District Radio Society.** Lecture: "Low Frequency Amplification." By Mr. L. Lott.

#### TUESDAY, DECEMBER 9th.

- Radio Society of Highgate.** At 8 p.m. At the Literary and Scientific Institute, South Grove. Lecture: "Continental Broadcasting" By Captain Plugge B.Sc.

# READERS PROBLEMS

*Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.*

## ALTERNATIVE COUPLINGS FOR L.F. VALVES.

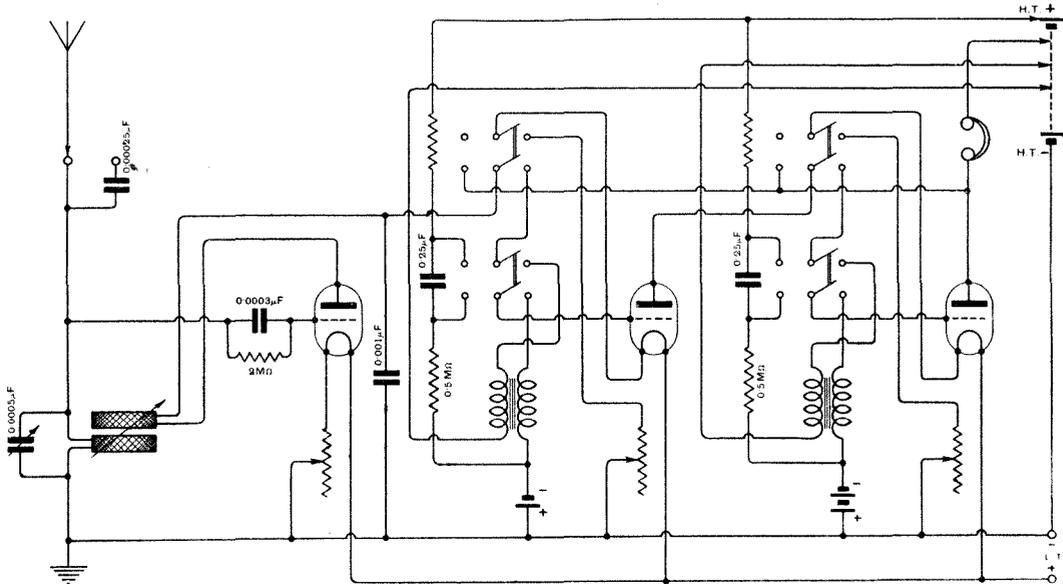
**I**N the diagram given below, switches are provided so that the two L.F. valves may be coupled either by transformers or by the resistance-capacity method. Two D.P.D.T. switches are used for the valve, the upper switches being employed to control the number of valves in use, and the lower switches to change the method of coupling. It will be observed that the centre contacts of the latter switches are connected to the anodes and grids of the valves. The lower contacts connect the grids either to the secondary winding of the L.F. transformers, or to the 0.5 megohm grid leaks of the resistance coupling system. The upper contacts connect the anodes either to the primary windings of the transformers, or to the lower ends of the anode resistances. Whenever the circuit is changed, the H.T. tapplings will have to be redistributed, in order that each valve may receive the correct anode potential. For this purpose wander plug connections on the battery should be used, as the

use of switches to bring about the same results would be impracticable. If the receiver shows a tendency to self-oscillation at audio-frequency, large condensers may be connected between one or more of the + H.T. tapplings, and the minus side of the H.T. battery.

## AERIAL EFFICIENCY.

**A** READER has observed a gradual falling-off in the efficiency of his aerial system, which he attributes to corrosion of the surface of the aerial wire. He asks whether it would be any advantage to silver-plate the wire in order to preserve the surface conductivity.

Corrosion or blackening of the surface of the aerial wire is not likely to bring about any noticeable diminution in the efficiency of the aerial. Any slight losses which the corrosion may cause can be eliminated by the use of enamelled wire, which would be much less expensive than the process of silver-plating.



*A three-valve receiver with alternative couplings for the L.F. valves.*

The inefficiency is more likely to be due to a film of dirt on the insulators, or faulty insulation in the lightning arrester or earthing switch. An examination of the earth connection should also be carried out to make sure that the earth wire is not broken at some point below the surface of the ground, and to ensure that the soil near the earthing plate is slightly moist. It is often an advantage to surround the earthing plate with coke in order to retain moisture, and to make efficient contact with the ground.

#### A NEUTRODYNE H.F. AMPLIFIER.

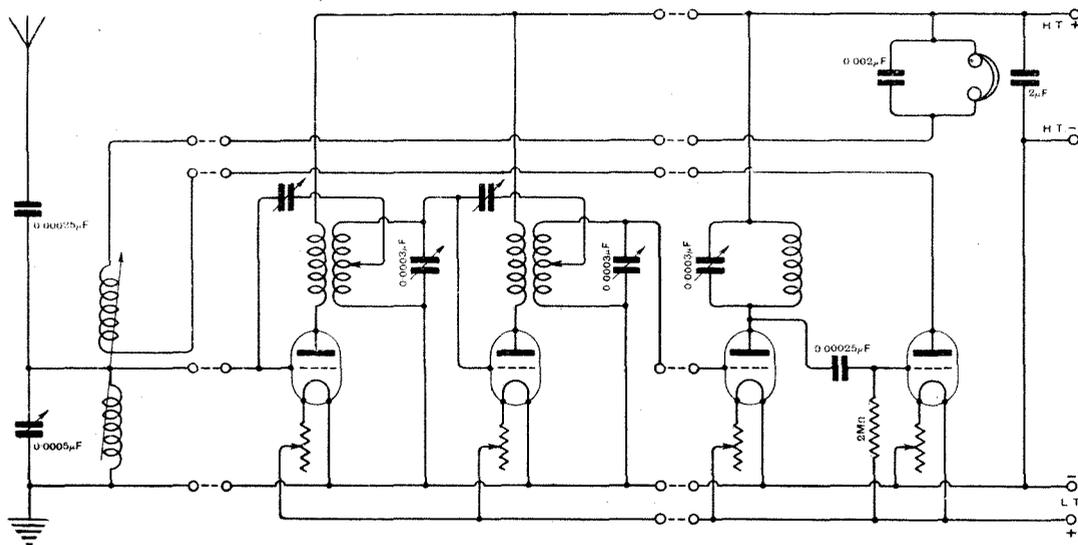
SEVERAL readers have asked for diagrams showing how to add one or more stages of H.F. amplification to their existing receivers, and accordingly a diagram is given below which shows how a two-valve H.F. amplifier coupled on the neutrodyne principle may be added to a two-valve receiver consisting of one H.F. and one

in order to bring the reaction currents into correct phase with the currents in the aerial circuit.

#### GRID BIAS FROM THE H.T. SUPPLY.

A METHOD of obtaining grid bias by connecting a resistance in series with the H.T. battery has been dealt with several times in this journal. A correspondent has asked for particulars of a resistance to obtain a suitable negative bias for two D.E.6 type valves when an H.T. voltage of 60 volts is employed.

Examination of the characteristic curves of the D.E.6 type valve shows that a negative grid bias of 3 volts is necessary when 60 volts H.T. is employed. Under these operating conditions the total anode current to both valves in the amplifier will be 3.5 milliamperes. The resistance necessary to give a potential of 3 volts when a current of 3.5 milliamperes is flowing is given by Ohm's law as 860 ohms.



*Adding a neutrodyne H.F. amplifier to a two-valve receiver.*

detector valve. When two or more H.F. valves are employed, the neutrodyne method of coupling is the only one which gives really satisfactory results. In other methods of coupling, in which damping is introduced by means of resistances, or by causing grid current to flow, inefficiency is bound to occur, and the damping resistance also produces a marked decrease in selectivity.

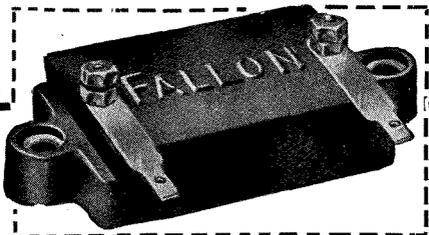
Before adding the amplifier to the receiver, the tuning coils and condensers must be removed from the set and mounted in a separate unit. Terminals may then be fitted to the valve panel for the H.T. and L.T. connections, the grid connection to the first valve, and the reaction connections. Leads for the reaction coil may be extended across the two-valve panel, and since two stages are added, there will be no necessity to cross over the leads. If a single stage had been added, the leads would have had to be reversed,

As the same H.T. voltage is used for both valves, the same grid bias may be used in both cases, the grid return leads being connected to the end of the grid resistance connected to  $-H.T.$  A fixed condenser of 1 or 2  $\mu F$  should be connected across the grid bias resistance to prevent coupling between the grid and anode circuits.

#### THE ALL-PURPOSE RECEIVER.

REFERRING to Fig. 3 on page 99 of the issue of October 22nd, a correspondent asks what value should be given to the condenser mounted below the H.T. and reaction terminals on the upper terminal strip.

This condenser is the telephone condenser connected across the centre contacts of the D.P.D.T. telephone and loud speaker switch. The value of this condenser will be seen from Fig. 1 to be 0.002  $\mu F$ .



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**Ex-Royal Air Force Transmitting Sets** of finest material, containing 1" spark coil with interrupter, high voltage mica dielectric condenser, fine adjustable spark gap, tuning helix on ebonite, etc. The cases of these sets are damaged, but a complete set of parts are guaranteed all in working order that give splendid results over 20 miles on 4 volts. Value of set **£6**, price to clear **8/6**, post **1/-**.

**Portable Telephones** in polished teak cases, all in working order, each a complete unit, highly suitable for office or outdoor work, magneto ringing. Price to clear **12/6** each.

**Potentiometers** by Paul, ebonite ends, slider bar, laminated contact, **4/-** each, post **6d**.

**New Fuller Block Accumulators.** These accumulators are warranted new goods and uncharged capacity 2 v. 120 amp. and still bear the makers' three months' guarantee. This offer can never be repeated. Price **16/-** each, post and packing **1/6** each. **500** in stock.

**Morse Telegraph Sounders,** useful for Morse recording and indicator work, all complete with contacts **8/6** each, post and packing **1/3**.

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**Hot-Wire Milliampmeters.** Reading 0.5 or 0.1-5, **8/-** each, panel mounting. "Sullivans" hot-wire milliampmeters panel mounting, engraved dial, **15/-** each.

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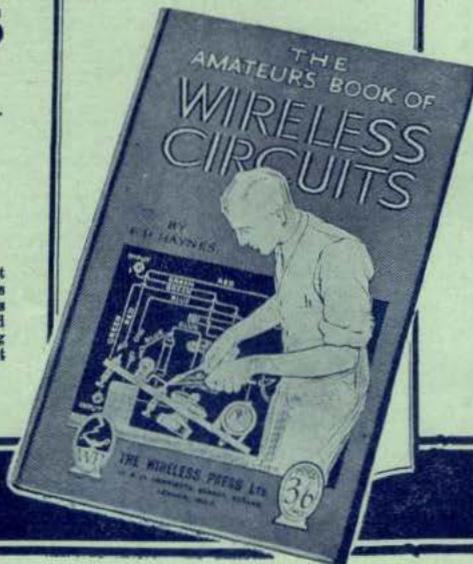
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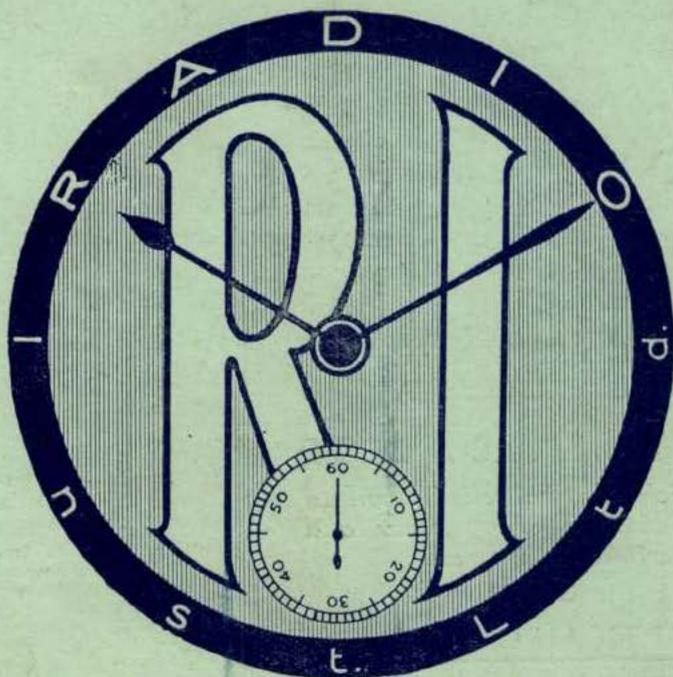
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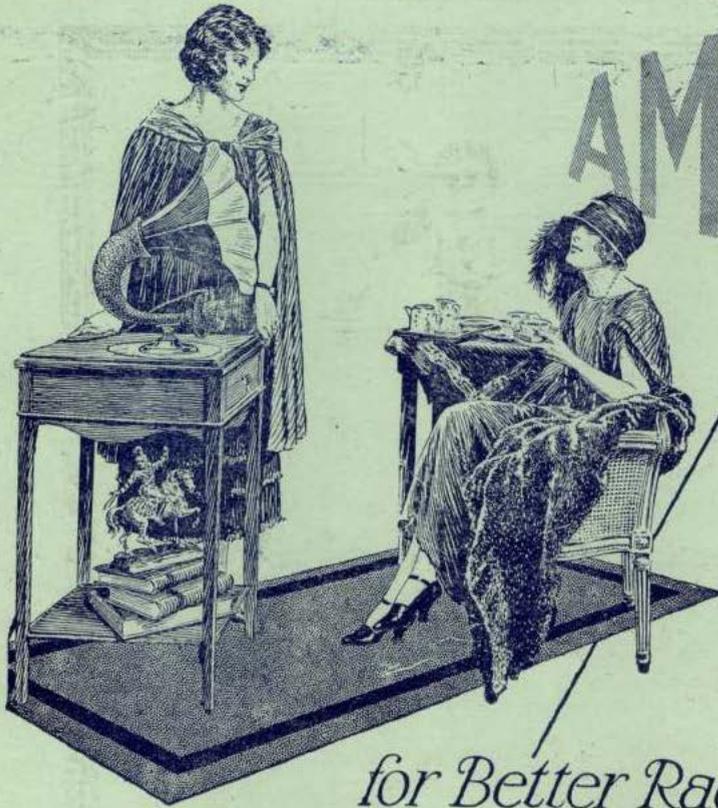
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# THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

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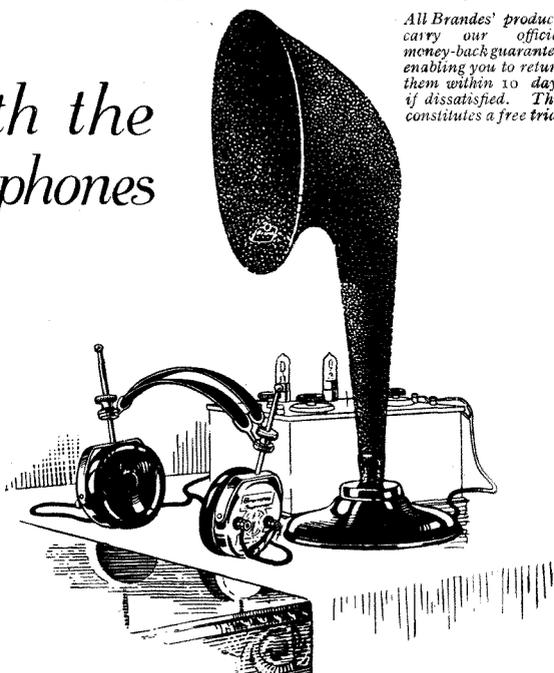
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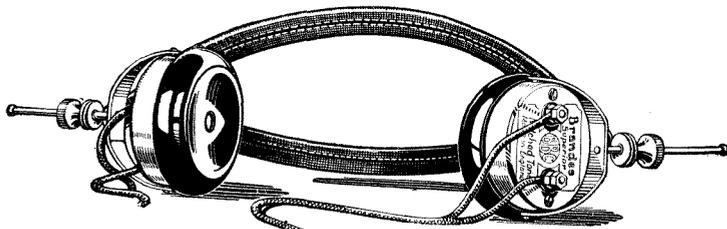
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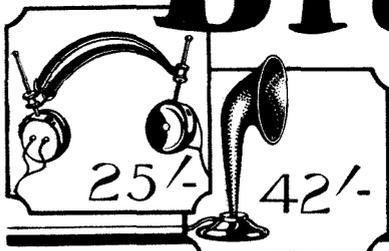
Dear Sirs, November 19th, 1924  
It may interest you to know that I received Australia on your 'phones. I consider that they are the most sensitive phones that I have used, and I am much pleased with their general performance.  
Yours faithfully, (Sgd.) F. Walker.

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# The WIRELESS WORLD AND RADIO — REVIEW



## RADIO TOPICS.

By THE EDITOR.

### THE RESPONSIBILITY OF THE MANUFACTURERS.

**I**NNUMERABLE wireless sets are being made up at the present time by amateur constructors, many of whom have comparatively little technical knowledge and would not be able to trace out any except the most obvious faults after the set had been constructed. Those who construct sets in this way are obliged to follow slavishly in every detail the instructions given in the journal or book from which they obtained the design. Unfortunately it happens not infrequently that although the design from which the set is built is accurate in every detail, and has been copied with equal accuracy, the set may yet refuse to work, due to no fault either of the designer or the constructor.

Every firm of repute undertakes to test complete sets before they are put on the market, but there does not appear to be the same caution exercised with regard to components.

Very obvious defects in apparatus, such, for instance, as variable condensers where the plates are found to touch at certain points, are not the cause of much distress amongst constructors for the reason that they are so obvious that no time is wasted in trying to detect the fault, but there are other types of faults which do not come within this category and may puzzle the most experienced experimenter for some time.

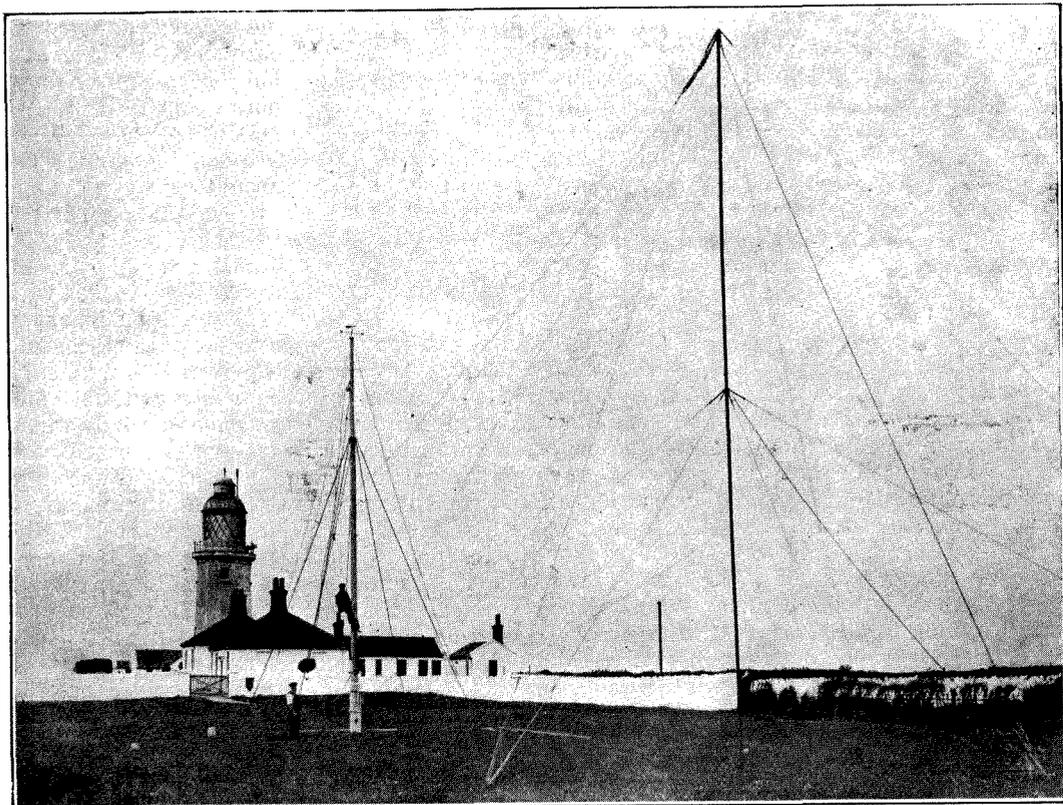
In the course of our experience, and referring only to apparatus by responsible manufacturers, we have met some peculiar defects in components—grid leaks which have come adrift inside and instead of giving their stated resistance value have gone up to a resistance of almost infinity ;

valves have not infrequently been met with where the plate and grid are touching, or the filament may be in contact with the grid ; many other examples of faults might be cited but one of the most remarkable and disconcerting was experienced recently when, after a great deal of time had been spent with an experimental set which refused to operate, it was found that the grid battery supplied by a well-known maker had the poles marked incorrectly. Perhaps one of the most common causes of inefficient results from a set is the quality of ebonite or so-called ebonite, used for the panel. There is at present on the market a quantity of extremely inferior ebonite substitute material much of which is imported from abroad. The responsibility for the supply of reliable material does not rest only with the manufacturers in this country, but also with dealers and retailers who may market imported material of inferior quality.

### BEACON STATIONS.

**O**NE of the post-war developments of wireless has been the perfection of what have come to be known as Beacon Stations for providing an additional aid to navigation. It may not be generally known that there are at present several beacon stations in operation around our coast, and although not much is heard of them, we believe that they are performing useful service. In this issue we publish an article discussing the problem of beacon stations by one who has been largely responsible for the development of this type of equipment since the war.

We hope that by the publication of such an account it will be possible for a better estimate to be made of the scope or limitations of the system as applied to the requirements of navigation.



*Fig. 1. General view of the aerial of one of the coastal beacon stations.*

## THE PROBLEM OF BEACON STATIONS.

The subject of the employment of beacon stations as an aid to navigation is one of very considerable interest. The author of this article, who has had a wide experience in the development of this branch of wireless, describes the purpose of the system, and discusses its advantages and limitations.

By COMMANDER J. A. SLEE, C.B.E., R.N. (Ret.), M.I.E.E.

**A** BEACON station is one whose primary duty is to aid in the navigation of ships by emitting wireless signals of such a character that vessels equipped with their own direction finders can obtain bearings of the beacon with a degree of accuracy sufficient for the purposes of maritime navigation. Some stress must be laid on the fact that the stations dealt with in this article are intended for marine and not for aerial navigation.

The requirements of the two arts are similar in principle, but differ so widely in degree that they cannot be grouped together under an invariable or even under a general rule, although every opportunity must be taken to serve the two purposes with one station whenever it is practicable to do so.

As far as beacon stations are concerned the chief difference lies in the fact that navigators of ships are seldom in need of bearings of points of land at distances

exceeding some fifty miles, whereas, due to the very high speed of aircraft and the comparative difficulty of fixing their position by other means, the requirements of aerial navigation demand bearings of fixed points at much greater distances. The marine navigator requires beacon stations of comparatively short range placed at salient points which themselves constitute dangers that must be avoided, while the aerial navigator requires beacons of long range placed at spots which he can approach in safety.

Beacons for marine purposes must often be placed in positions where the sea traffic is very dense, and such places are usually close to densely populated areas where other wireless services are very numerous, and therefore the requirement that the beacon service shall not interfere with and shall not be impeded by other services becomes very exacting.

In the present state of wireless communications there is room to fit in a marine beacon service on a wavelength of 1,000 metres, though the range of waves which can be made available is not large, and considerable precision of tuning is necessary.

Starting from the idea that the range of the typical marine beacon station will be about fifty miles, it becomes necessary to translate this measurement into some more tangible figure which can easily be verified. The main factor which determines the emission from a wireless transmitting station of ordinary type and working on any particular wavelength is arrived at by multiplying together the aerial current and the radiation height of the aerial. This latter figure is some proportion of its maximum height, and for all forms of aerial likely to be used for beacon purposes this proportion will probably lie between 0.5 and 0.7. It is therefore reasonable to make an arbitrary assessment of the emission in terms of the product of aerial current and maximum height, and if this product is called the "metre-amps" of the station it may be stated with sufficient accuracy that reliable bearings can be obtained by a modern marine direction finder at a distance of about  $1\frac{1}{2}$  miles per metre amp. Thus 35 metre-amps is sufficient for a working range of 50 miles, and experiment has shown that emission at the rate of 35 metre-amps on a wave of 1,000 metres produces a negligible amount of interference with other

wireless services existing at the present day.

In order that this satisfactory state of affairs can exist it is, of course, necessary that the transmitted wave shall be of a high degree of purity. The qualifications of a pure wave are that harmonics of its fundamental frequency shall be as feeble as possible, and the Fourier theorem clearly shows that this necessitates the slowest possible rate of growth and decay in the amplitude of the transmitted wave. This requirement can only be completely met by the use of an unbroken long dash of continuous wave emission, but experience shows that this method is inadmissible on two grounds. The worst trouble is that bearings obtained of continuous wave transmitters are unreliable during the hours of darkness, variations of observed bearing up to and even exceeding 10 deg. being quite common. A theoretical discussion of the causes of this "wandering" is out of place here, but the matter has been explored in Mr. Keen's book on "Direction and Position Finding by Wireless," and in the discussion on the author's paper read before the Institute of Electrical Engineers and published in the journal of that institution for June, 1924.

The unbroken long dash, however it may be produced, is unsuitable as a form of beacon signal because of the difficulty of identifying the station of origin. The use of continuous wave being thus ruled out, the next best method must be sought. This must be either some form of modulated continuous wave or a carefully selected type of spark transmission.

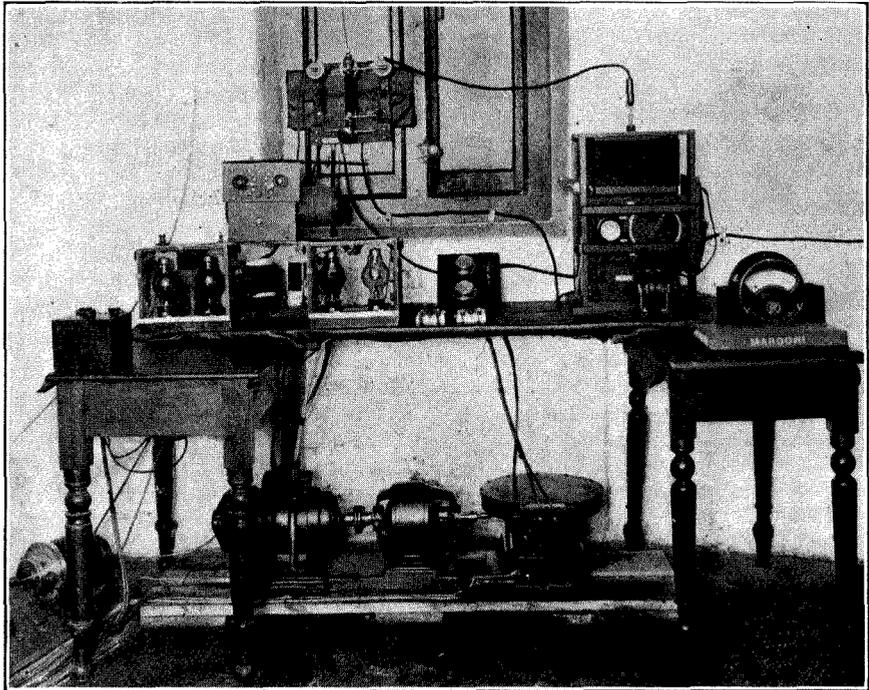
It is a well-established fact that bearings obtained from spark transmitters are almost immune from wandering, except during a period of about half-an-hour, embracing the time of sunset and sunrise, and during these periods the band of zero signal strength, whose position determines the direction, becomes ill defined. This gives the observer warning that bearings are temporarily unreliable. Careful investigation has shown that fully interrupted continuous wave is an equally reliable form of radiation, and as an interrupted continuous wave is more free from interfering subsidiary emissions of all kinds, and as there is no doubt about the availability of completely reliable apparatus, the choice of transmitter for beacon purposes in crowded areas lies with the interrupted continuous wave system. In order to ensure

the degree of reliability of bearings necessary for marine navigation, the interruptions must be such that the emission is reduced to zero between the wave-trains.

Experiments show that the proportion between metre-amps and range for interrupted continuous wave transmitters working to modern direction finders is the same as for spark transmitters. It is worthy of note that this figure must be obtained under conditions of accurate direction finding. If the amplifier in use is allowed to reach, or even to approach very closely, to a state of

interrupted continuous wave than for spark transmission in the proportion of at least two to one.

The site of a beacon station for marine purposes must be chosen with care. It must be placed so that over all the area it is intended to serve no high land shall obtrude between the beacon and the ship making use of it. This requirement can as a rule be met if beacon stations are established at lightships or at lighthouses. If this condition is not fulfilled bearings observed in the arcs covered by what may be called the shadow



*Fig. 2. Spark and C.W. transmitters.*

self-oscillation, the bearings observed will be quite unreliable, and this limitation must be strictly adhered to. Interrupted continuous wave is well known to be a highly efficient form of transmission if the receiving amplifier can be worked at or close to the state of self-oscillation, but under direction finding conditions, when this state must be avoided at all costs, no remarkable efficiency of transmission can be expected. With an absolutely non-oscillating and non-integrating receiver, such as a plain crystal, the proportion of metre-amps to miles is higher for

of the obstruction will be erratic. This trouble is one of the chief causes of the inadequacy for the purposes of navigation of the existing wireless stations used for communication with ships. A glance at the "arcs of good bearings" shown in Fig. 3 will make this point clear.

Turning to the form of signal to be transmitted by the beacon, the first requirement is that it shall be possible for ships within range of it to obtain a bearing about once in five minutes, and a duration of transmission of about one minute is sufficient to enable

a skilled observer to obtain a series of four or five bearings. At a few outlying stations ranges greater than 50 miles may be desirable, and such more powerful beacons might be limited to one period of transmission in 8 or perhaps 10 minutes.

The nature of the signals transmitted must be such that bearings are easy to observe and also such that it is easy to identify the beacon station.

Only protracted trial can show what form of signal is preferred by the majority of observers, but the most promising form seems to be the steady repetition at a fair telegraphic speed of a group of three or four letters forming the identification signal of the beacon. The alternative method is to transmit a few repetitions of the identification signal at the beginning, middle, and end of the period of transmission, linked together by prolonged dashes, or by a regular series of dots and dashes.

In order to get an ideal fix, bearings of three beacons should be obtainable in rapid sequence, though in practice two such bearings are of very great value, and the necessity for covering the more important parts

of the narrow seas with the emissions from two or more beacons introduces a fresh complication. The actual operation of all current types of direction finders takes the form of determining the position of some sort of frame when it is receiving zero signals from the beacon under observation. The position of zero reception by a frame occurs when it lies in a plane at right angles to the plane of direction of the source of origin of

the signal, and the position of maximum reception by a frame occurs when it lies in the same plane as the source of origin, the former position being sharply defined and the latter being very broad. Hence, if the instrument is in a position to determine the bearing of any one beacon it will at the same time be receiving maximum signals from any other beacon that may happen to lie at or anywhere nearly at right angles to the

bearing of the station under observation.

If the times of transmission of two neighbouring beacons coincide, the observation of bearings becomes difficult to an unpractised ear, although a skilled telegraphist is capable of taking accurate bearings under such circumstances.

Since it is impossible to synchronise all beacons without most elaborate and costly apparatus, the next best thing is to run neighbouring beacons definitely out of step with one another, making the "one minute" unit of transmission only nominal, but maintaining the intervals of silence at four times of the length of the period of transmission.

If the actual timing of one beacon is 65 secs. transmission and 4 mins. 20 secs.

silence, and that of the next beacon 55 secs. transmission and 3 mins. 40 secs. silence, complete clashing of the two is impossible, and they will only interfere seriously with one another three times in each hour.

The characteristic musical note of the signal is governed by the frequency of the motor-alternator supplying the transmitter with power, and if standard alternators are used for all beacons the variation in timing

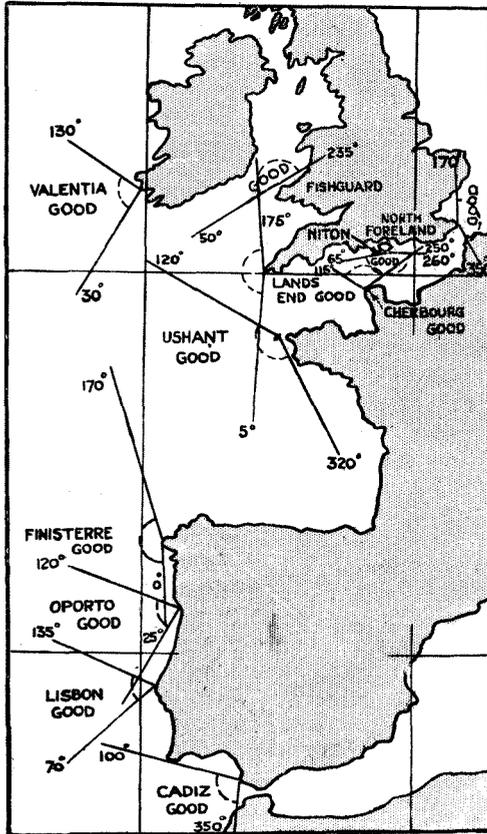


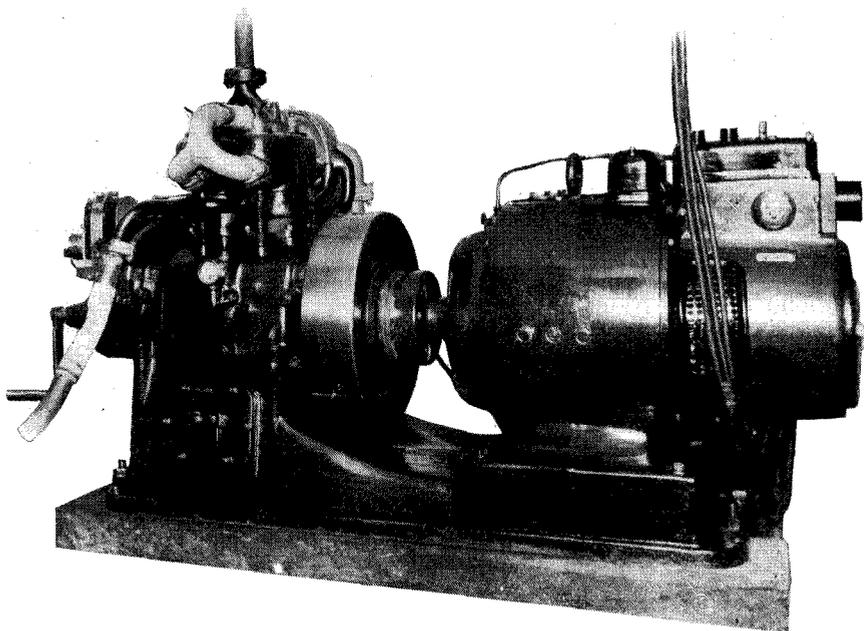
Fig. 3. Arcs of good bearings.

just described can be achieved by running the machines at different speeds. This will impart quite distinct notes to the various signals, and will greatly facilitate the task of picking out the signals of one beacon from those of another. If beacons are worked on this system, there is nothing to be gained by attempting accurate timing.

It would, of course, be of advantage if neighbouring beacons could make use of distinctly different waves, but it is clear from the above that the service can be carried out with one wave, and the congestion

as to be economically impossible. The necessity for beacon stations is not always due to fog alone. A prolonged spell of cloudy weather may have deprived shipping of astronomical observations for some days before approaching the land, and in such cases one or more direction finder bearings are of the greatest use in making a landfall.

The apparatus required to produce an emission of 35 metre-amps is quite simple. The power that must be supplied to the aerial is not likely to exceed 100 watts even



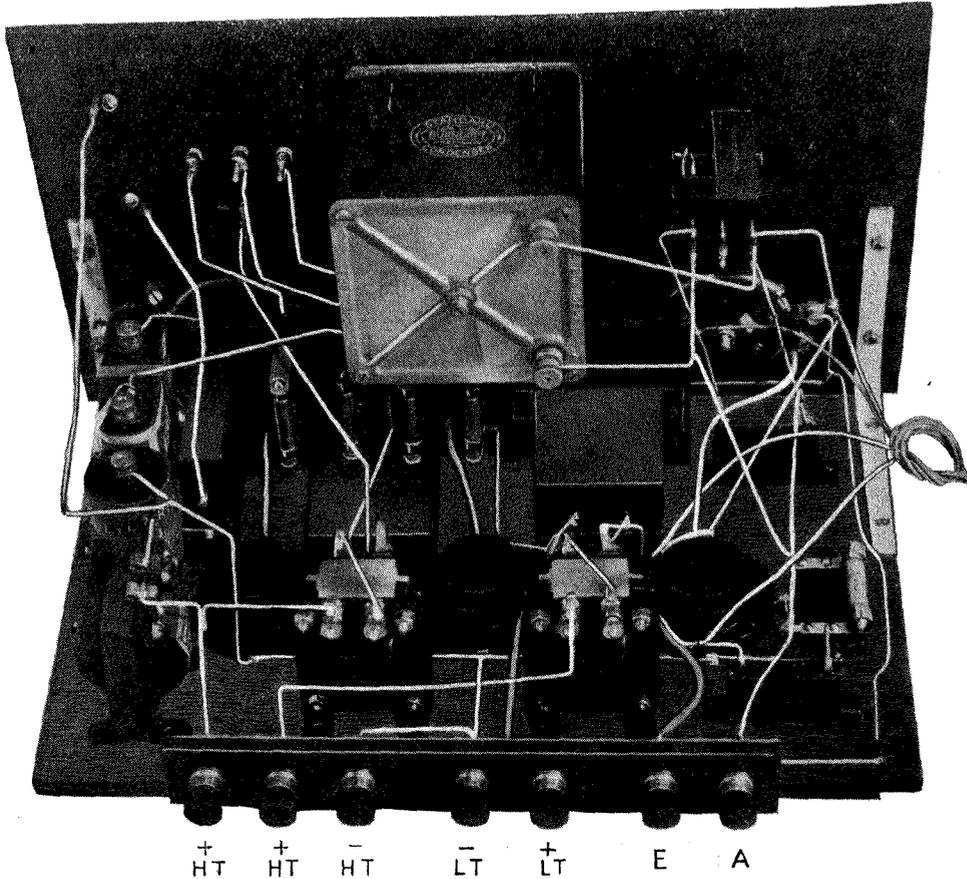
*Fig. 4. The Austin automatic power plant.*

of modern wireless traffic makes it much easier to allot one wave for this purpose than to find two.

As the typical beacon station can be expected to have a working range of 50 miles, and as it is impossible for a man in charge of a beacon to know what the weather is like 50 miles to seaward, the only practicable plan is to keep the beacons always working. A satisfactory system of communication whereby ships requiring the use of beacons could ask for them to be started implies the use of so large a staff

under most adverse conditions, and the direct current power required for all purposes should not exceed 400 watts when the beacon is transmitting, and about half this amount during the periods of silence.

The photographs show the prime mover, transmitters and aerial, employed during experiments just concluded at the lighthouse at Nash Point, in the Bristol Channel, which has been made available by Trinity House for the long series of experiments which have been necessary to clear up the various points explained in this article.



*A back view of the receiver showing the arrangement of the components.*

## IDEAL RECEIVERS—I.

### A THREE-VALVE RECEIVER

With Valve Detector and Two Stages of Choke Coupled L.F. Amplification.

By W. JAMES.

*(Concluded from December 3rd issue).*

IN the first portion of this article we pointed out that it is desirable to employ valves having a high amplification factor and chokes of large inductance in order that the largest possible voltages shall be applied to the grid of the last valve. If the inductances connected in the anode circuits have too low a value, there will be distortion, and the voltage amplification

will be less than it need be. The minimum value for the inductances depends on the lowest frequency in the signal to be amplified and the impedance of the valves. With valves of the D.E.5B. type, chokes having an inductance of about 100 henries are suitable.

It is as well to mention again that the last valve must be of the power type. The last valve supplies the current which

operates the loud speaker. Therefore it must be one which has ample emission, and a low impedance. The valve recommended is one of the D.E.5 class.

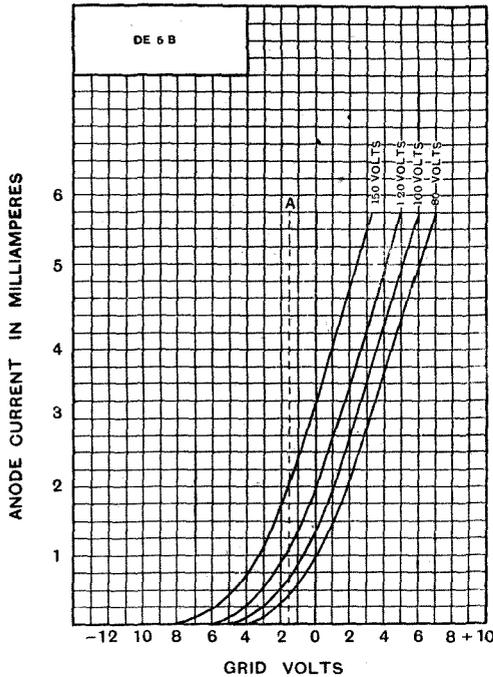


Fig. 1. Characteristic curves of D.E. 5 B valve.

There is one other very important thing which we feel should be emphasised, and that is the grid bias. If grid current flows in amplifier circuits there is sure to be distortion. We suggested that a signal of 5 (peak value) volts, or a total grid voltage swing of 10 volts applied to the grid of the last valve would be ample for the usual household loud speaker. Therefore the grid of the last valve is given a bias of about negative 6 volts, obtained from 4 dry cells. As we expect the second valve to amplify the signal 18 times, the grid bias of the second valve need only be small. A single dry cell is used.

We have now ensured that there will be no grid current distortion, provided the signal voltage applied to the last valve does not exceed 5 volts, and we know that because the valves and couplings are matched, they will not introduce distortion.

We have still to determine the anode voltages. From the curves of a D.E.5B.

valve, Fig. 1, we see that when the grid is 1½ volts negative, an anode voltage of about 120 is suitable. The normal anode current is about 1 milliampere. To this voltage should be added the voltage drop due to the resistance of the choke which, however, is so small as to be negligible.

For the last valve, a D.E.5, we find from the characteristic curves of Fig. 2 that with a grid bias of 6 volts an anode voltage of 120 volts is suitable, and that the normal anode current is about 6 milliamperes. The second and third valves are therefore given the same value of H.T., and a common terminal is employed in the receiver. For the detector valve a separate H.T. terminal is provided, as it is desirable to adjust the anode voltage of this valve to secure best detector action and smooth reaction effects.

The receiver was designed on the assumption that a signal voltage of 5 volts would

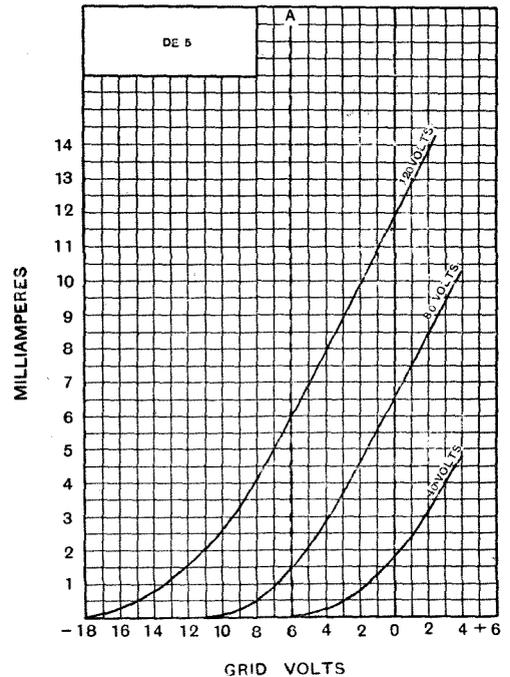


Fig. 2. Characteristic curves of D.E. 5 valve.

produce a satisfactory volume of sound from the loud speaker. When a large type of loud speaker is used, a signal voltage up to 8-10 volts may be required for the grid of the last valve. It would then be necessary to use a grid bias of about 10-12 volts, and

if a D.E.5 valve is used, a higher anode voltage. We do not recommend employing an anode voltage of over about 120 volts with valves of this type, as they are designed for a maximum anode voltage of 120.

**THE CONSTRUCTION OF THE RECEIVER.**

The accompanying drawings and photographs show the position of the parts and the wiring. It will be seen that a front ebonite panel measuring 14 ins. by 8 ins. by  $\frac{1}{4}$  in. carries a 0.001  $\mu$ F tuning condenser,

To the bottom of the panel is secured by means of a pair of 4 in. brackets a base of wood, measuring  $13\frac{1}{4}$  ins. by  $8\frac{1}{2}$  ins. by  $\frac{3}{8}$  ins. This base carries the valve holders, chokes, (two transformers are employed as chokes by connecting their windings in series), fixed condensers  $C_1$ ,  $C_3$  and  $C_4$ , and the grid battery which comprises a  $4\frac{1}{2}$  volt unit and a single cell.

The coupling condensers  $C_5$  and  $C_6$ , the filter condenser  $C_7$ , the H.T. condenser  $C_8$ , and the grid leaks  $R_2$ ,  $R_3$ ,  $R_4$  and  $R_5$  are

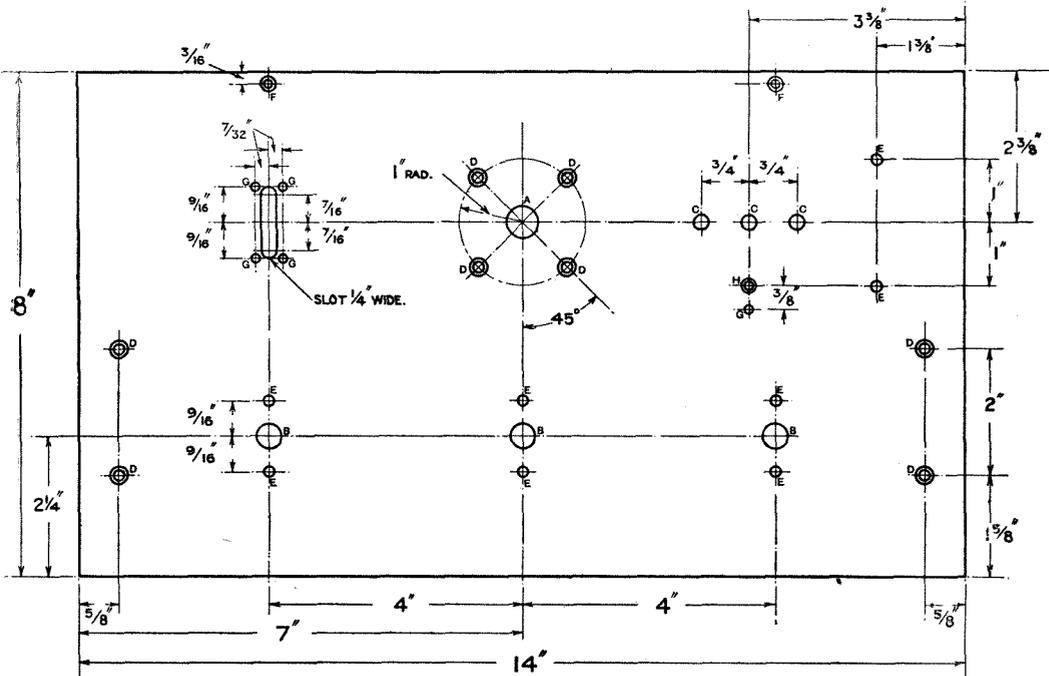


Fig. 3. Showing the position of the parts on the front panel. Drilling details are as follows—

- A = Drill  $\frac{1}{2}$  in. diameter.
- B = Drill,  $\frac{3}{8}$  in. diameter.
- C = Drill,  $\frac{7}{32}$  in. diameter.
- D = Drill  $\frac{5}{32}$  in. diameter, and countersink on top side.
- E = Drill  $\frac{5}{32}$  in. diameter.
- F = Drill  $\frac{1}{8}$  in. diameter, and countersink on top side for No. 4 wood screws.
- G = Drill  $\frac{1}{8}$  in. diameter.
- H = Drill  $\frac{1}{8}$  in. diameter, and countersink for No. 6 B.A. wood screws.

a series-parallel switch (double pole two-position), three *Clix* sockets and one plug, three filament resistances, and two terminals for the loud speaker. As the *Clix* sockets are connected to a grid circuit, special care should be taken that the ebonite is of good quality. The skin should be carefully removed. A two-coil holder is secured to the side of the containing box, as may be seen from the illustration at the head of the first portion of this article. The position of these parts is clearly shown in Fig. 3.

mounted on a piece of ebonite measuring 8 ins. by  $3\frac{1}{8}$  ins. by  $\frac{1}{4}$  in., which is screwed to the base on the side nearest the panel. The arrangement of the parts on the base is given in Fig. 4, and Fig. 5A gives the details of the small ebonite strip.

The values of the parts are given below the wiring diagram, Fig. 6.

On the back edge of the base is fitted a strip of ebonite measuring 9 ins. by  $1\frac{1}{2}$  ins. by  $\frac{1}{4}$  in., which carries terminals for the aerial, earth, L.T. and H.T. batteries. The position

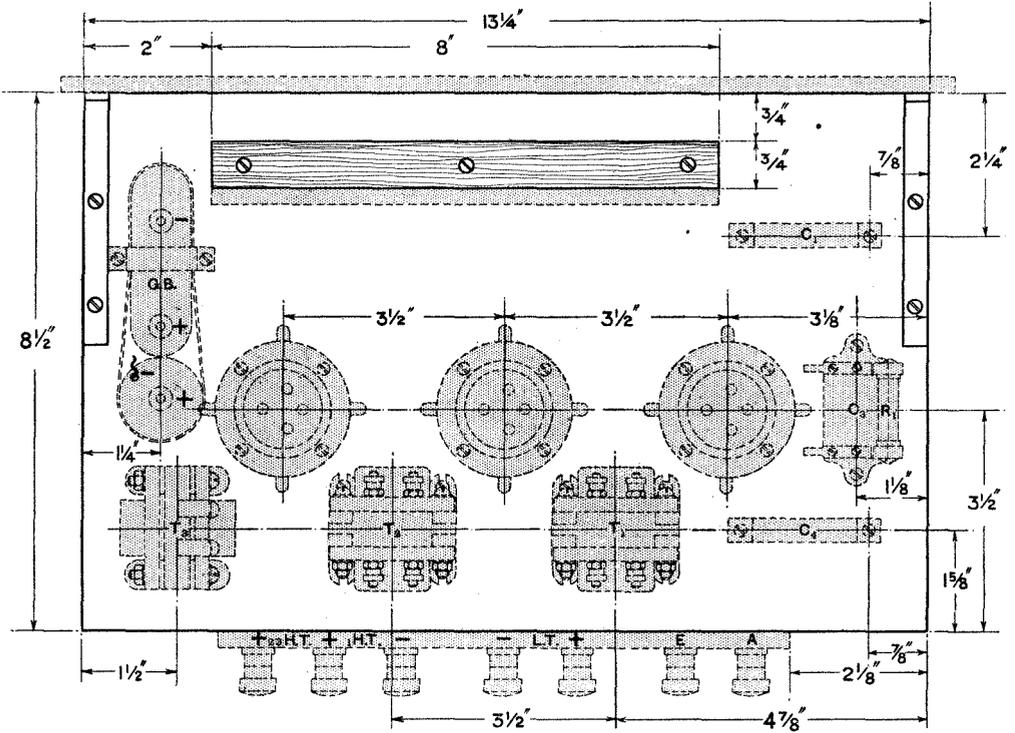


Fig. 4. Layout of components on base.

of the terminals is indicated in Fig. 5B. Having assembled the components according to the particulars given on the figures, examine the wiring diagram of Fig. 6. Notice that the wires connecting the filament resistances to the valves pass through holes in the small panel carrying the coupling condensers and grid leaks, and that this panel must be removed before the filament resistances can be wired. It is also convenient to remove the chokes.

Before commencing the wiring, clean and tin each part that is to be soldered. Commence the work by wiring the filament resistances, and the aerial circuit, using No. 16 tinned copper wire. Then wire the filament connections of the valves and the grid condenser (C<sub>3</sub>).

The *Clix* plug is connected by a flexible wire to the No. 6 B:A. screw fixed below the sockets.

Now replace the panel carrying the coupling condensers and the grid leaks, and wire them according to the diagram.

Finally, replace and wire the chokes. The wires connecting to the + H.T. terminals are covered with sistoflex.

It will be found that if the work is carried

out carefully and without haste, the connecting wires are short and easily arranged.

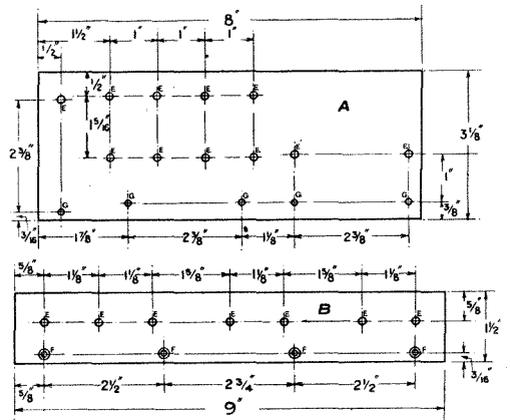


Fig. 5.

A = Details of ebonite strip carrying coupling condensers and grid leaks.

B = Details of ebonite strip carrying terminals for aerial, earth, L.T. and H.T. batteries.  
Drilling Details.

E =  $\frac{3}{32}$  in. diameter.

F =  $\frac{1}{8}$  in. diameter, and countersunk for No. 4 wood screws.

G =  $\frac{1}{8}$  in. diameter.

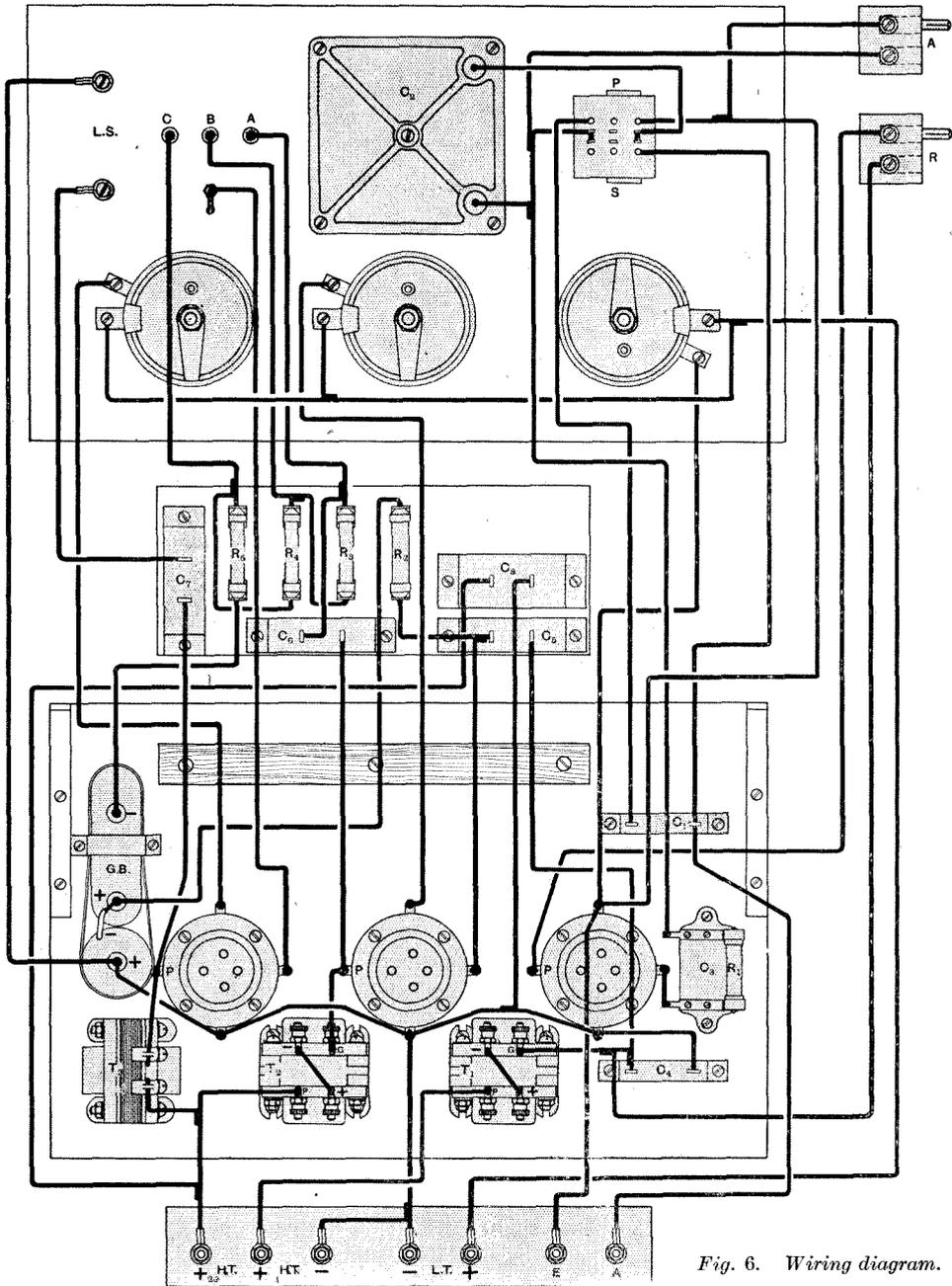
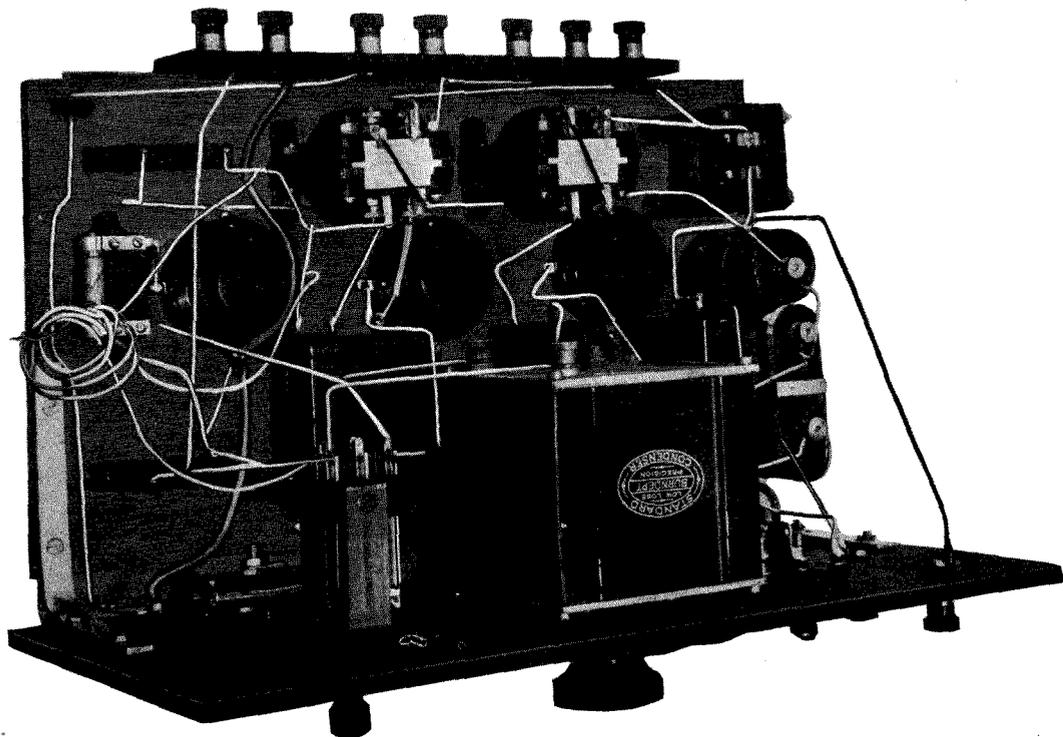


Fig. 6. Wiring diagram.

- A = Aerial coil.
- C<sub>1</sub> = Fixed condenser, capacity 0.0002 microfarad.
- C<sub>2</sub> = Aerial tuning condenser, capacity 0.001 microfarad.
- C<sub>3</sub> = Grid condenser, capacity 0.00025 microfarad.
- C<sub>4</sub> = Fixed condenser, capacity 0.0002 microfarad.
- C<sub>5</sub> C<sub>6</sub> = Fixed condenser, capacity 0.125 microfarad (Mansbridge type).
- C<sub>7</sub> = Fixed condenser, capacity 0.5 microfarad (Mansbridge type).
- C<sub>8</sub> = Fixed condenser, capacity 2 microfarads (Mansbridge type).

- R = Reaction coil.
- R<sub>1</sub> = Grid leak, 2 megohms.
- R<sub>2</sub> = Grid leak, 0.3 megohms.
- R<sub>3</sub>, R<sub>4</sub>, R<sub>5</sub> = Grid leak 0.1 megohms.
- T<sub>1</sub> T<sub>2</sub> = Burndept low ratio transformer with windings connected in series.
- T<sub>3</sub> = Burndept 20 henry choke.

The series-parallel switch is a Burndept double-pole change-over key switch (the one used in the instrument described has an extra set of contacts which are not required).



*A view of the receiver showing the arrangement of components on the baseboard.*

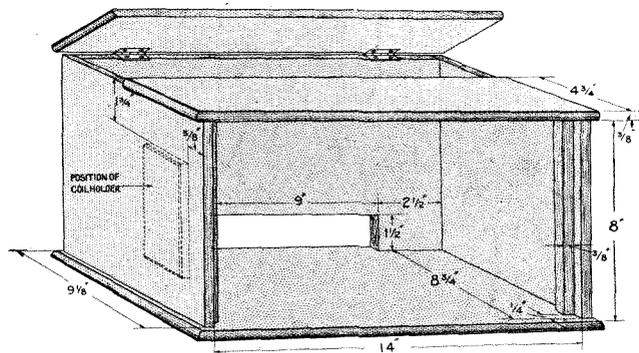
Four rubber-covered flexible wires are connected for the aerial and reaction coils. Their ends are passed through holes in the side of the containing case, and joined to the terminals on the two-coil holder. The correct connections are given in the wiring diagram, where A is the aerial coil and R the reaction coil.

A view of the containing box, with its dimensions appears as Fig. 7. The wood used is  $\frac{3}{8}$  in. thick. The position of the two-coil holder on the side of the box is clearly shown. It will be observed that a piece is cut out of the back of the box to allow the connection strip to fit.

#### OPERATION.

To receive the short wavelength broadcast transmissions fit a No. 35 or 50 coil in the aerial plug of the two-coil holder and a No. 35 coil in the reaction plug. Put the series-parallel switch in the parallel position. For the 1,600 metres station a No. 150 coil may be used in the aerial circuit and a No. 75 in the reaction.

When the signals are of good strength it will probably be found that best results are



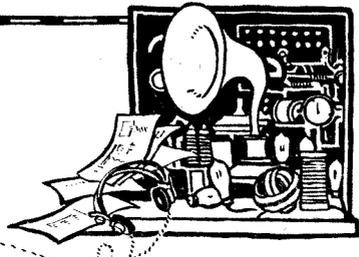
*Fig. 7. The box.*

obtained by fitting the plug in the centre *Clix* socket. The volume will then be about two-thirds of the maximum.

It might be found that the signals are weakened by bringing the reaction and aerial coils nearer together. The connections to either the reaction or aerial coils should then be reversed.

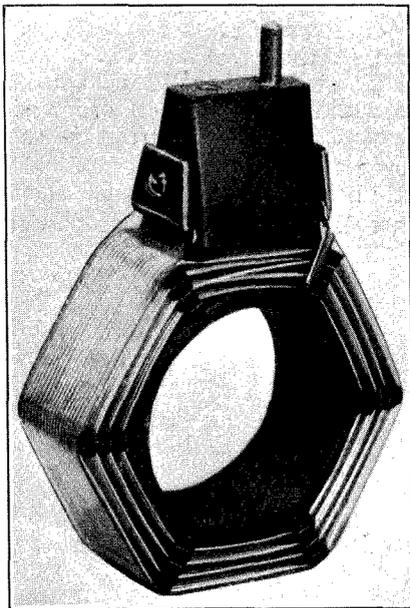
It is essential to employ an anode voltage of the value given if distortion is to be avoided. The voltage applied to the detector should be varied until best results are obtained. We found a voltage of about 90 volts satisfactory.

# NEW APPLIANCES.



## The New "Airmax" Inductance Coil.

One aim in inductance coil design is of course to bring the self-capacity of the winding down to as low a value as possible and the merit of a coil can to some extent be



*The new "Airmax" interchangeable inductance coil.*

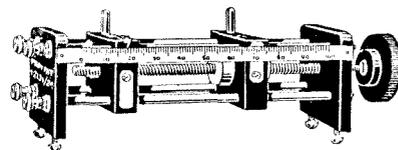
judged by the relationship of the value of self-capacity to the inductance. The self-capacity of a coil may be reduced by arranging the turns to be as far as possible air spaced, which brings with it the additional advantage of using air as a dielectric between the turns because of the very low dielectric loss which is produced. It is not a difficult matter to design coils with air spaced turns and possessing extremely low self-capacity, but difficulties arise when it is a requirement of the design that the inductance coils shall

be interchangeable. Interchangeability is an ordinary feature as it renders the tuner operative over the entire band of wavelengths. The accompanying illustration shows a type of coil recently introduced which is secured to the customary two-pin mount. A piece of ebonite tube is used as a central former and six small pieces of insulating material are arranged to space the turns away from its surface. The coil is wound with bare wire and the necessary insulation between the turns is produced by spacing. Successive layers are separated by small pieces of insulating material, while the finishing end is terminated by soldering across on to a previous turn.

Sharpness of tuning is a property which may be observed and a coil having low self-capacity gives sharper tuning than one in which appreciable capacity exists between the turns when shunted with a valve grid filament circuit used as a detector. The low capacity coil also gives greater signal strength. Such a simple test may be applied to this coil and the experimenter will see for himself the advantages to be gained by adopting coils wound in this manner.

## Two-Coil Holder

A critical degree of coupling is obtained when two inductances are made to slide one away from the other, and at the same time



remain parallel. A useful form of two-coil holder is shown in Fig. 3, in which the coil mounts are carried on a spindle having differential screw threads. Thus as the spindle is revolved the two holders are propelled one away from the other. An ivory scale and pointer indicates the setting.

# THE "SQUARE LAW" CONDENSER.

In this article the author explains why condensers of the "square law" type have vanes which are different in shape to those of the ordinary tuning condenser. He also gives a method of setting out one type of square-law vane, and shows how to find its area for the purpose of estimating the capacity.

By J. AISBITT, B.Sc.

**T**HIS note is an attempt to explain the object of the square law condenser and the peculiar shape of its vanes. The reader probably knows that the wavelength to which his set is tuned is proportional to the square root of the product of the inductance and the capacity in the tuned circuit, or, briefly,

$$\lambda = 1885 \sqrt{LC}.$$

It follows that if he turns the condenser dial—using the semicircular vanes—he makes a definite increase in wavelength for the first 10°, but on turning it from 0° to 20° he does not produce twice this increase. To effect this he must give a rotation four times as great; *i.e.*, from 0° to 40°, while thrice the increase requires nine times the rotation; *i.e.*, to 90°.

readings is impossible, without a vernier condenser, but how can this be remedied?

If that part of the moving vane which first enters between the fixed vanes is cut away somewhat, then a larger turn of the dial is needed to produce a given change in capacity.

It can be seen on examining Fig. 1, which represents an improved vane, that a turn of 10° makes at first only a small change in the area inserted between the fixed plates, but that the next 10° makes a larger difference, while each successive 10° produces a still larger increase in capacity.

Now let us see how we can decide more exactly how to produce this new shape.

Since the wavelength is proportional to the square root of the capacity, to double

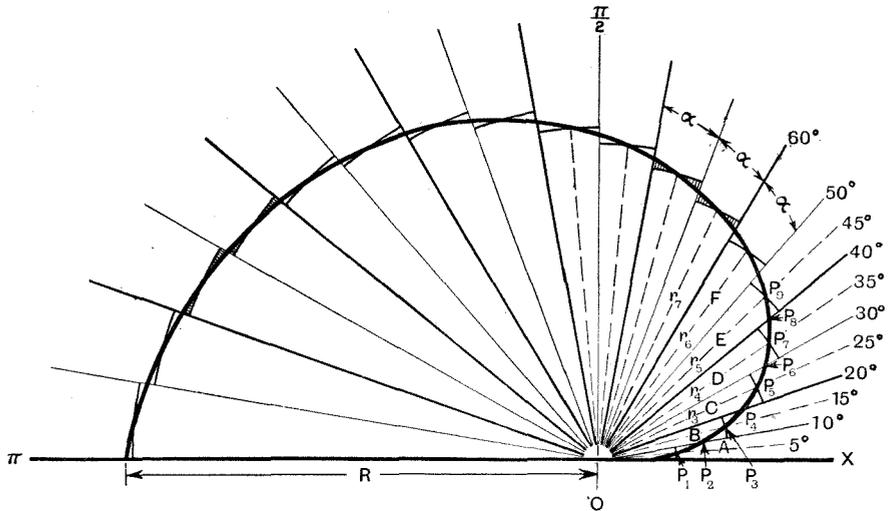


Fig. 1. Explaining the unusual shape of one type of "square law" condenser vane.

This explains why, in the ordinary variable condenser, the settings for stations on the lower part of the scale are crowded together while on the higher readings they are widely spaced.

Obviously, fine tuning on the lower

change in wavelength we must quadruple the change in capacity, while to treble the change in wavelength we must effect a capacity change nine times as great as that produced by the first rotation of 10°, and so on.

This means that if the area of the first sector, *A* (Fig. 1), including 10°, is represented by 1, then the area of the sector (*A+B*), including 20°, must be 4, while the area of sector (*A+B+C*) is 9, and so on.

That is, the areas of the sectors—

*A, B, C, D, E, F* —————  
must be in the ratio—

1, 3, 5, 7, 9, 11 —————

But since the area of a sector of a circle is proportional to the square on its radius, then the squares—

$r_1^2, r_2^2, r_3^2, r_4^2, r_5^2, r_6^2$  —————  
must be in the ratio—

1, 3, 5, 7, 9, 11, —————  
while the radii are in the ratio—

$\sqrt{1}, \sqrt{3}, \sqrt{5}, \sqrt{7}, \sqrt{9}, \sqrt{11},$  —————

Now in Fig. 1 are shown sectors of circles, each sector including 10° at the centre, with

20°, 30°, etc.,  $OP = 0, OP_2 = \sqrt{2}, OP_4 = \sqrt{4}, OP_6 = \sqrt{6},$  etc., so the final method of construction arrived at is to draw radiating lines at any suitable angle—not necessarily 5°, and along them to set off lengths equal to 0,  $\sqrt{1}, \sqrt{2}, \sqrt{3}, \sqrt{4}, \sqrt{6}, \sqrt{7},$  etc., etc., and joining them by a curve, as indicated in Fig. 2.

CALCULATION OF CAPACITY.

Since, in calculating the capacity of a variable condenser one must know the area of the plates, we must now find out how to calculate the area of this “square law” vane.

First of all, remember that the area of a circle is given by  $\pi r^2$ , while the angle at its centre is 360° or  $2\pi$  radians. That of a semi-

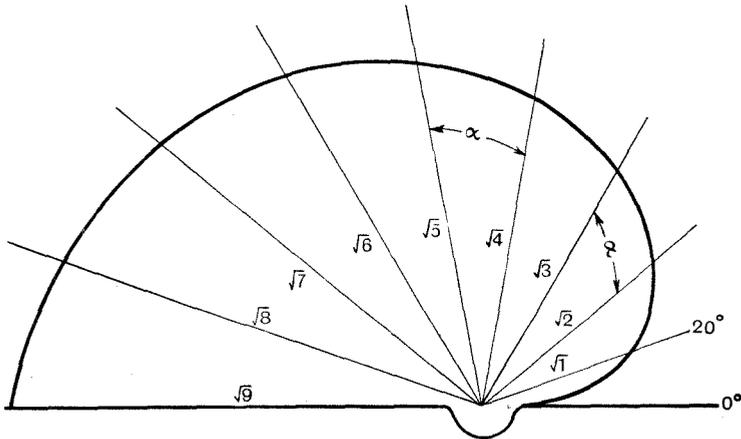


Fig. 2. The method of setting out a “square law” vane.

radii in this ratio, and it is apparent that if they were made exceedingly thin, to include 1°, say, instead of 10°, then their areas would merge into the resultant curve known as the “square law” curve.

One method of obtaining the required shape is to draw lines radiating from a point *O* and inclined to a line *OX* at 5°, 15°, 25°, 35°, 45°, etc., since these are the angles at which the radii are given in Fig. 1.

Then mark off  $OP_1 = \sqrt{1}$  cms. or ins.,  $OP_3 = \sqrt{3}, OP_5 = \sqrt{5}, OP_7 = \sqrt{7}$  and so on.

On joining these points to form a curve, it will be found that at the angles 0°, 10°, 20°, 30°, etc.,

circle, whose angle is  $\pi$  radians, is  $\frac{\pi}{2} r^2$ .

Similarly, the area of a sector of a circle including an angle of  $\alpha$  radians must be

$\frac{\alpha}{2} r^2$ . That is to say, we multiply the square

on the radius by half the angle in radian measure\*

Now we have seen that the vane may be considered as being made up of a large number of tiny sectors whose radii are in

\* A radian is the angle subtended at the centre of a circle by an arc equal in length to the radius, and is approximately 57.3°.

the ratio 0,  $\sqrt{1}$ ,  $\sqrt{2}$ ,  $\sqrt{3}$ ,  $\sqrt{4}$ ,  $\sqrt{5}$  — — —  $R$ , where  $R$  is the largest radius of the vane.

Suppose there are “ $n$ ” sectors, each including  $\alpha$  radians. Then their areas are in the ratio —

$$\frac{\alpha}{2} \times 0, \frac{\alpha}{2} \times 1, \frac{\alpha}{2} \times 2, \frac{\alpha}{2} \times 3, \dots$$

$$\frac{\alpha}{2} \times R^2.$$

But since these areas are proportional to

(It should be noted that the author assumes that the stray capacity of the circuit in which the condenser is connected is zero.—E.D.)

$r^2$ , which itself increases uniformly from 0 to  $R^2$ , the average value being  $\frac{R^2}{2}$ , the average value for the area of a sector is—

$$\frac{\alpha R^2}{2 \cdot 2} = \frac{\alpha R^2}{4}.$$

But there are “ $n$ ” sectors.

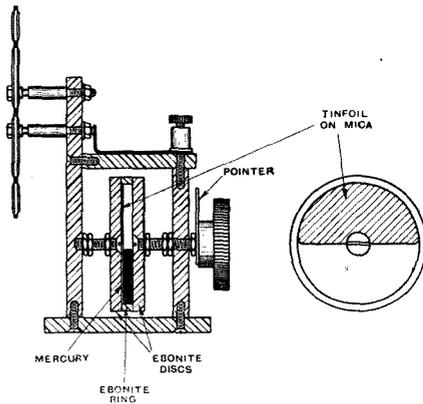
$$\therefore \text{the area of the vane} = \frac{n \alpha R^2}{4} = \frac{\pi R^2}{4}.$$

## READERS' PRACTICAL IDEAS

This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

### A Novel Tuned Circuit.

THE accompanying drawing shows a simple method of mounting a plug-in coil on two valve pins which are connected



A tuned circuit comprising a plug-in basket coil and a novel variable condenser.

with the receiving set through a pair of valve sockets. The ebonite supports are used to carry also a novel type of variable condenser which consists of two discs spaced apart by an ebonite ring. The ring must be held securely in position by small brass pins. A piece of zinc or tin foil is mounted to the face of one of the discs as shown, whilst a quantity of mercury exactly half fills the space between the two discs. The face of the metal foil is covered with a piece of mica. It will be seen that the capacity of the

piece of foil and the mercury changes as the apparatus is revolved.

The reader is reminded that mercury has a very corrosive action upon aluminium and for this reason the finished instrument should not be mounted too near to a variable condenser built up with aluminium plates.

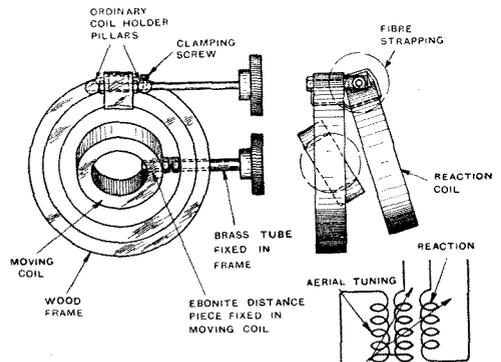
W. S.

### Variometer with Reaction.

MANY single valve sets have variometer tuning in the aerial circuit and the difficulty arises as to a suitable method of producing a variable reaction coupling with the windings of the variometer.

A specially designed variometer must, of course, be employed and the necessary practical details for mounting the reaction coil are shown in the figure.

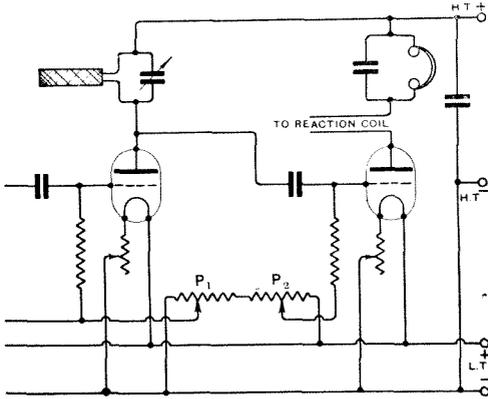
R. W. C.



A variometer having an additional coil for reaction.

**Potentiometer Grid Control.**

THE accompanying diagram shows a useful method of using two potentiometers (P1 and P2) for controlling the grid potential of the H.F. and detector valves.



*An arrangement of two potentiometers for giving fine control of grid voltages.*

It will be seen that the windings of the two potentiometers are connected in series across the L.T. battery. The slider of P1 supplies a potential from zero to maximum negative suitable for controlling the H.F. amplifying valve, while P2 applies a potential from zero to maximum positive such as is usually needed when a valve is used as a rectifier in conjunction with the usual grid condenser and leak.

Thus it will be seen that half the voltage of the L.T. battery can be tapped off along either potentiometer, and this range is usually all that is required.

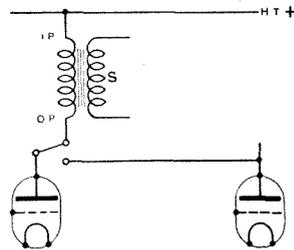
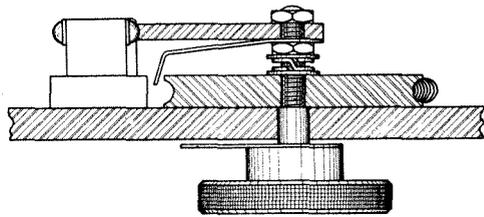
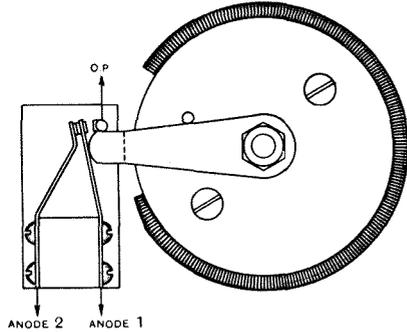
By connecting up in this manner it will be seen that the current taken by the potentiometer circuit is halved, but more important than this is that for a given movement of the slider a much more critical control of potential is obtained as the voltage of the battery is in effect dropped across a potentiometer of twice the normal dimensions.

R. S.

**L.F. Switching Device.**

NOTE magnifiers can be thrown out of circuit without the use of specially provided switches by causing the arm of the filament resistance to operate a spring contact. The drawing shows the actual form of construction, and from which it will be noticed that an additional ebonite arm is locked on the rheostat spindle. When

the sliding contact of the resistance is in the "off" position it will press against a spring blade, pushing it over and producing the necessary circuit change to take the intervalve transformer out of circuit.



*Automatic switching device.*

This will be found a particularly useful method, as it is only necessary to turn off the filaments of valves not required.

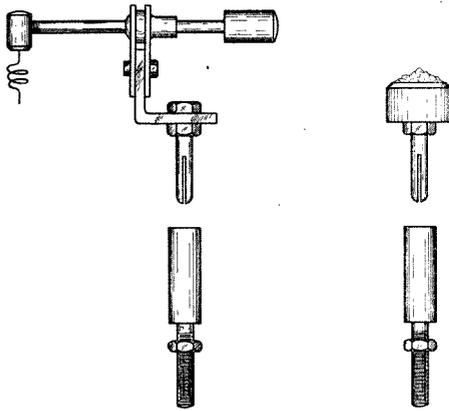
J. E. N.

**Interchangeable Crystal Detector.**

BY assembling the crystal contacts to plug and socket mountings it becomes possible to interchange various types of crystals and in addition to reverse the direction of the potential applied to the detector. As well as providing interchangeability both crystal and contact can be rotated and if the plugs make a good tight

fit in the sockets, the relative height of the two contacts can be critically adjusted.

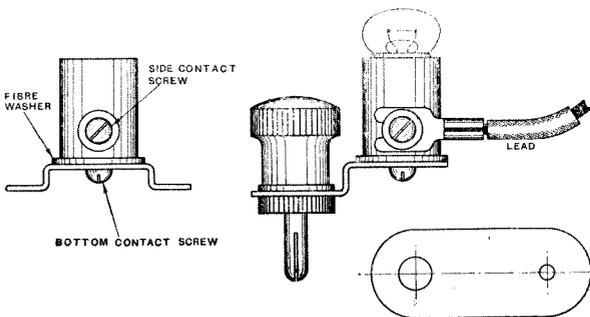
A. E. D.



An arrangement of crystal detector and contact.

### Combined H.T. Battery Fuse and Switch.

THE use of a small lamp to protect the H.T. battery against short circuit is in general use. A convenient form of mounting is shown in the accompanying drawing and the screw holder is a standard one such as can be readily purchased. By means of a small brass bracket, details of which are shown, it can be attached to a wander plug so that the lamp is located close to the point of H.T. distribution. Thus a contact between the flexible leads themselves will cause a breaking of the battery circuit. The use of a protecting fuse of this sort is strongly recommended, for not only does it guard against damage to the battery but



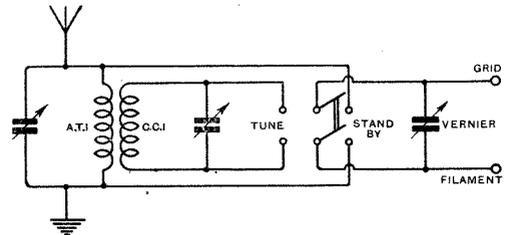
An H.T. battery fuse.

also protects the valve filaments should a valve be incorrectly inserted. The lamp selected should be of very low rated candle power and preferably of the 1/2-watt type so that it will burn out with a very small current.

F. C. H.

### The Position of a Vernier Condenser in a Receiving Circuit.

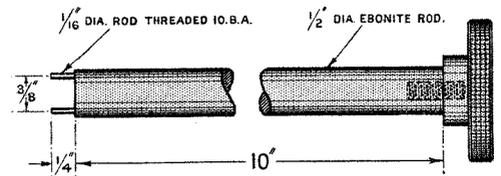
THERE is no need as a rule to provide a vernier condenser in both the aerial and closed circuits, though if a tune-stand-by switch is fitted, vernier control must be



Connections of a vernier tuning condenser.

available in whichever position the switch may be thrown. The vernier condenser should therefore be fitted across the centre contacts of the switch and thus vernier control is always available.

F. S. R.



Simple anti-capacity handle.

### Anti-Capacity Handle.

WHEN receiving on short wavelengths it becomes essential in many receiving sets for the hand to be well removed from the components while tuning.

This anti-capacity handle is constructed from 3/8 in. ebonite rod and is fitted with two small brass pins either threaded 10 B.A. or merely driven a tight fit into the end of the rod. These pins engage in holes made in the centre of the instrument knobs.

C. L.

# VALVE TESTS.

## THE BRITISH THOMSON-HOUSTON CO.'S B.6 VALVE.

WE have recently conducted a series of tests on the new B.T.H. valve, the B 6, and the results obtained are summarised below. Purchased in the ordinary way across the counter at a well-known dealer, the valves tested may be considered as typical of their type, and the results obtained are those which may be expected by any user. The B 6 may be classed as a low consumption power valve. The filament normally operates on 3 volts, taking a current of 0.12 ampere, and is therefore within the range of dry cell working should necessity so demand.

When operating as an amplifier potentials up to 120 may be applied to the plate, a grid bias of -3 volts with 80 volts on the plate, and -4.5 with 120 being suggested by the makers.

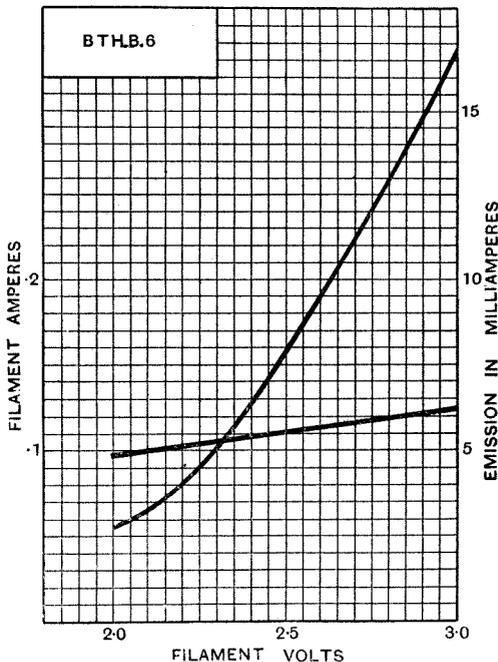


Fig. 1. Curves showing the relationship of emission and filament current to filament volts.

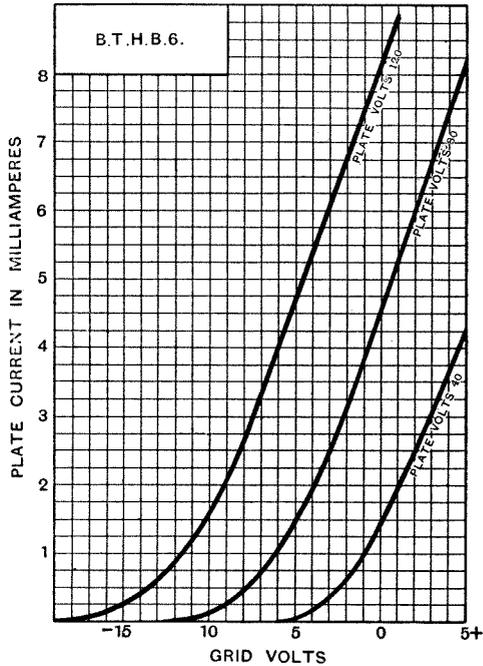


Fig. 2. Plate current-grid volts characteristic.

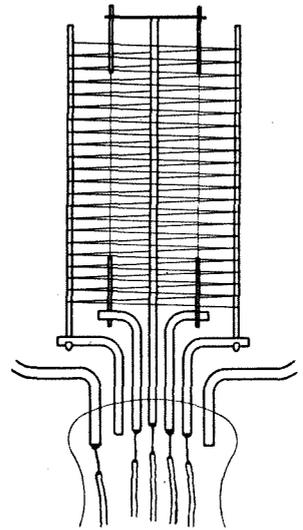
The filament system of the B 6 is rather out of the ordinary and merits description. Two straight filaments are used and are connected in parallel, the central support being a common lead. Since the two filaments are in parallel, and together take 120 milliamperes (0.12 ampere) each single wire takes 60 milliamperes (0.06 ampere), and the system thus consists of two 60 milliamper filament connected in parallel across the filament supply. In Fig. 1 we show the usual filament characteristics, the current and emission at normal volts being 0.125 ampere and 16.5 milliamperes respectively. The efficiency is therefore of the usual order with filaments of this type.

Plate-current grid-volts characteristics are given in Fig. 2, and indicate good L.F. performance at plate potentials of 80 and over, according to the input. The curves,

moreover, suggest a grid bias of about  $-3$  to  $-5$  volts, as the plate voltage is raised from 80 to 100, which is in very close agreement with the makers' figures. The magnification and resistance curves are shown in Fig. 3. The former factor is around 7.75, and the impedance varies between 20,000 and 10,000, according as the plate voltage is increased from 40 to 100. At the higher values the ratio of magnification to impedance is good, a result due, at least in part, to the modern electrode design, which, it should be mentioned, is being adopted by several valve manufacturers just now.

On circuit, and used in the second stage of a low frequency amplifier, we obtained excellent results with this valve, the output from a medium size loud speaker being clean and free from distortion. We operated the valve under the following conditions: 3 volts across the filament, plate potential 120, grid bias negative 6.

Although the B 6 is not put forward as a general purpose valve, we tried it out both as a H.F. amplifier and detector. About 50 volts H.T. gave the best results in both cases, but very critical adjustment seemed unnecessary, in addition to which the



Showing the peculiar arrangement of the filament of a B.T.H. B 6 valve.

filament could be dimmed quite considerably before noticeable reduction in signal strength occurred.

### TWO INTERNATIONAL RADIO CONVENTIONS.

The International Committee on Wireless Telephony, which was founded in 1923, is planning to hold an international conference in Paris from April 16th to 20th, 1925. Twenty-seven nations are represented in this organisation, which is in close touch with the League of Nations, the International Chamber of Commerce, the International Law Association, and many other influential bodies.

Items on the agenda of the conference include—(1) The allocation of wavelengths and State control; (2) International broadcasting regulations; (3) Authors' rights, and publicity matters.

The International Conference of Radio Amateurs will probably meet at the same time, and among the questions which the amateurs will discuss will be—(1) The founding of an international union of radio amateurs; (2) the methodical organisation of amateur tests; (3) the wavelength problem; (4) wireless in education; and (5) an auxiliary international language. The address of the Secretary of the Amateur Conference is 2 Rue de l'Echaude-Saint-Germain, Paris.

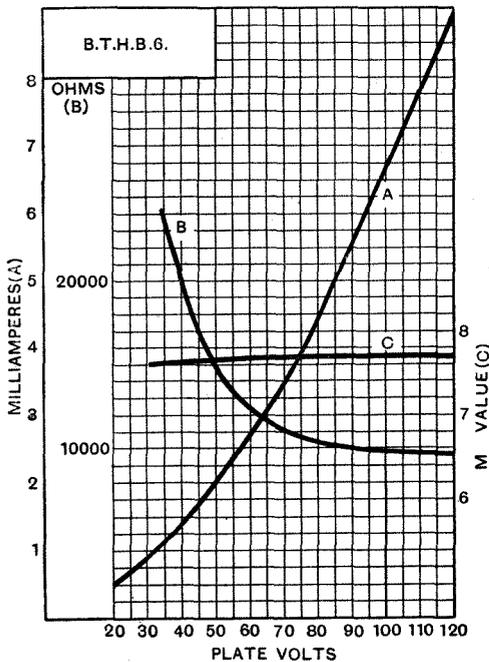


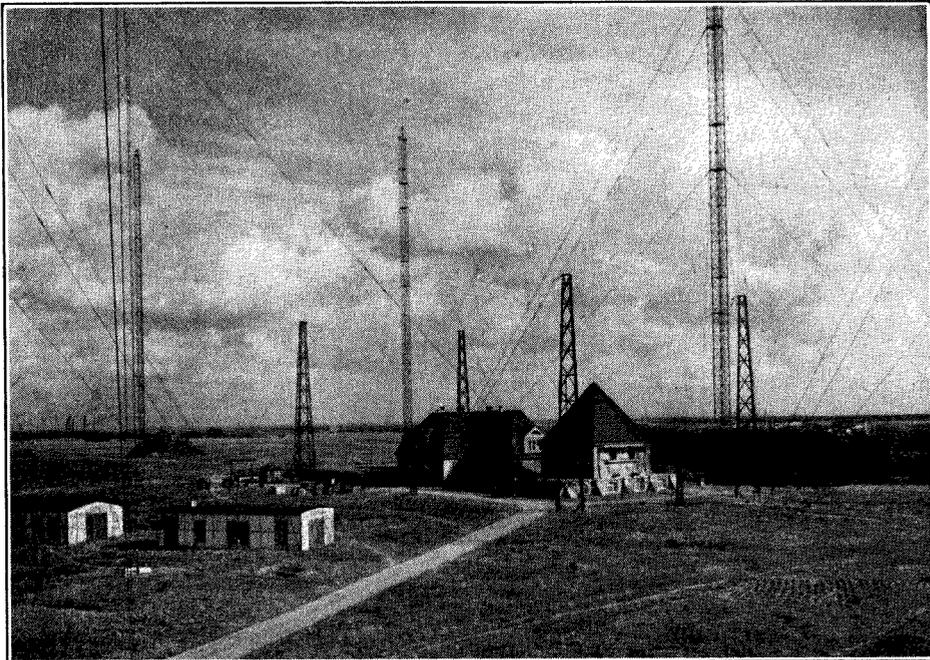
Fig. 3. Curves showing the plate current (A), impedance (B), and amplification factor (C) for various plate voltages.

## INTERNATIONAL RADIO WEEK.

**R**EPORTS of reception, during the recent tests, of the American stations on this side continue to come in, and it is easy to see that the two predominating stations are **WGY** and **KDKA**, whilst a number of others appear to have been successful, though it is necessary to wait for details of their programmes before it is possible to confirm reception in every case.

We take this opportunity of thanking those who have so kindly sent in their reports

position to check up each reception with the actual programmes transmitted at the stations. Cables received from Mr. Lynch indicate that on his side he is inundated with reports of the reception of the British and Continental stations, and as these reports run into very many thousands, the task before him of sorting them up is a very big one, particularly in view of the fact that he has cabled over on more than one occasion to the effect that he is receiving from some listeners in America, claims that they have



*The transmitter building of the Koenigs Wusterhausen station which participated in the transmissions to America.*

of reception, and whilst there must be some delay before these can all be sorted up, it is hoped to acknowledge receipt of each communication individually in due course.

We should welcome further reports from others who have not yet sent them in, as every contribution is of value in assisting to identify stations, particularly where call signs have not been heard distinctly. After acknowledgment here all reports will be sent to Mr. Arthur Lynch, the Editor of *Radio Broadcast*, who organised the tests on the American side, so that he will be in a

heard individual European stations at times when these stations were not transmitting! The imagination of some American listeners must add considerably to the task of sorting out the reports there.

It will be necessary to wait until a sufficient time has elapsed for the American reports to be gone through before a complete account of the results of the transmissions from this side can be published in *The Wireless World* so that there is not likely to be any further information of interest to give to our readers until this account is available.

## THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

### A Quick Method of Finding the Amplification Factor of a Valve.

**W**E have explained\* two methods of finding the amplification factor from the grid volts— anode current static characteristic curves of the valve. It is not necessary, however, to go to the trouble of plotting these curves if one desires to know the approximate amplification factor of the valve. We may proceed as follows.

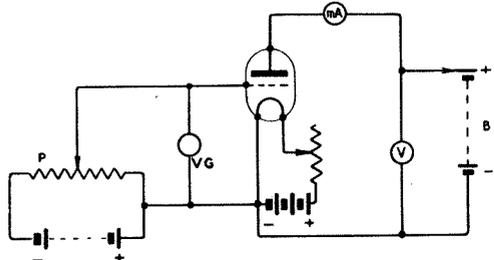


Fig. 1. One circuit arrangement employed when finding the amplification factor.

Connect a milliammeter (mA, Fig. 1) which need not be accurately calibrated, in the anode circuit with the normal anode battery B, and join the grid through a potentiometer P to the negative side of the filament. The voltmeter VG will read the voltage of the grid with respect of the filament, and V the voltage of the anode.

Note the readings of the milliammeter and the grid and anode voltmeters. They might read, for instance, 4 milliamperes, -3 volts and 60 volts respectively. Now increase the anode voltage by, say, 9 volts (which is roughly the voltage of 6 dry cells). The anode voltage is now 69 volts, and of course the anode current, as shown by the milliammeter, has increased—say to 5 milliamperes. Then the effect of adding 9 volts to the anode voltage is to increase the anode current by 1 milliampere.

Now reduce the anode current to the value it had before (namely 4 milliamperes)

by making the grid more negative—that is by moving the sliding contact of the potentiometer P in the grid circuit to the left. Let us assume that now the grid voltmeter reads -4 volts. The effect of making the grid 1 volt more negative is therefore to reduce the anode current by 1 milliampere. Hence the effect on the anode current of increasing the anode voltage by 9 volts has been counteracted by adding 1 volt to the negative potential of the grid. That is to say, a voltage applied to the grid is nine times more effective than a similar voltage applied to the anode; the amplification factor of the valve under the conditions of the test is therefore 9.

### Another Method.

One may dispense with the voltmeters employed in the last method when only a rough idea of the amplification factor (which is all that is needed in many instances) is required. Thus, suppose we wish to get an idea of the amplification factor of a valve employed in the last stage of an amplifier, Fig. 2. The secondary winding of a transformer PS is connected to the grid and to the

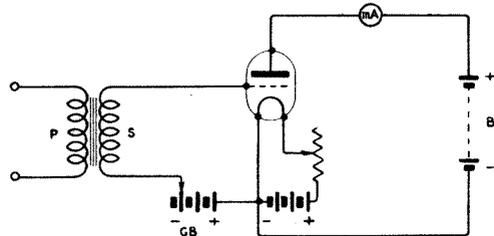


Fig. 2. Explaining another method of finding the amplification factor of a valve.

filament through the usual grid battery. Connect a milliammeter in the anode circuit (an instrument of any type which will give a readable deflection and has a fairly low resistance will do), and the normal anode battery. Note the reading of the milliammeter. Now connect one more cell in the grid circuit, which makes the grid about 1.5 volts more negative. This has the effect

\* In the last number of this journal (December 3rd, 1924).

of reducing the anode current. To bring the anode current back to its normal value add cells, one at a time, to the anode circuit. If the anode current is restored to its original value by adding 9 cells to the anode circuit, we may take the amplification factor as being 9. The assumption made here, of course, is that the cells have identical voltages, which is not always true, even though the cells are new ones. The simplicity of the method should, however, appeal to the man who does not possess accurate measuring instruments.

**The Anode Impedance.**

By the anode (or internal) impedance of a valve is meant the effective resistance of the anode-filament path through the valve to varying or alternating currents. The anode impedance depends on the construction of the valve and the operating conditions. It depends, for instance, on the distance between the anode and filament, the area of the anode, and the construction and position of the grid. The impedance is roughly inversely proportional to the area

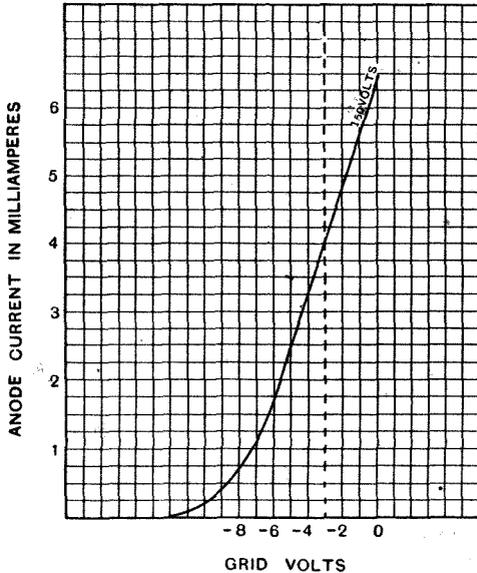


Fig. 3. A characteristic curve.

of the anode. If the area is increased, the impedance is reduced. By increasing the distance between the anode and the filament the impedance is increased.

The anode impedance does not remain constant for all values of filament current, grid and plate volts. For instance, if the filament current and grid volts are fixed at

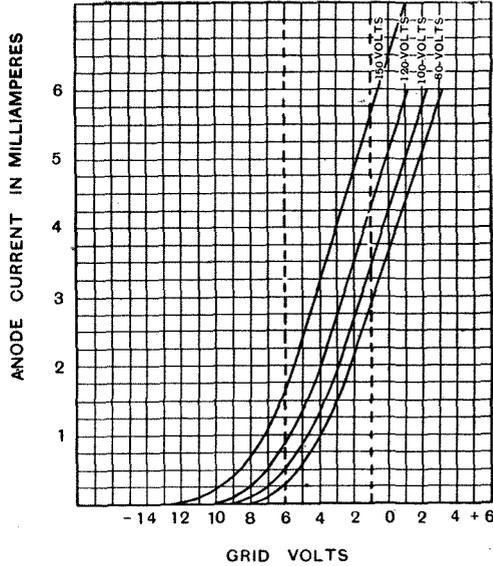


Fig. 4. A group of characteristic curves.

normal values, the anode impedance falls rapidly as the anode voltage is increased from a small value. For higher anode voltages the impedance does not fall so rapidly. If the anode volts and filament current are fixed at normal values, the anode impedance may increase or decrease, depending on the value of the grid volts.

The ordinary direct current resistance of a valve is, of course, found from the formula :

$$\text{Resistance (ohms)} = \frac{\text{Voltage (volts)}}{\text{Current (amperes)}}$$

The value of resistance found from this simple formula is not the anode impedance. For instance, the direct current resistance of the valve having the characteristic curve of Fig. 3, when the grid voltage is - 3 (shown by the dotted line) is  $\frac{150}{0.004} = 37,500$  ohms.

The anode impedance is equal to the ratio of the change in anode volts to the change in anode current for a given grid voltage. It may be found from the characteristic curves† which were used when finding the amplification factor.

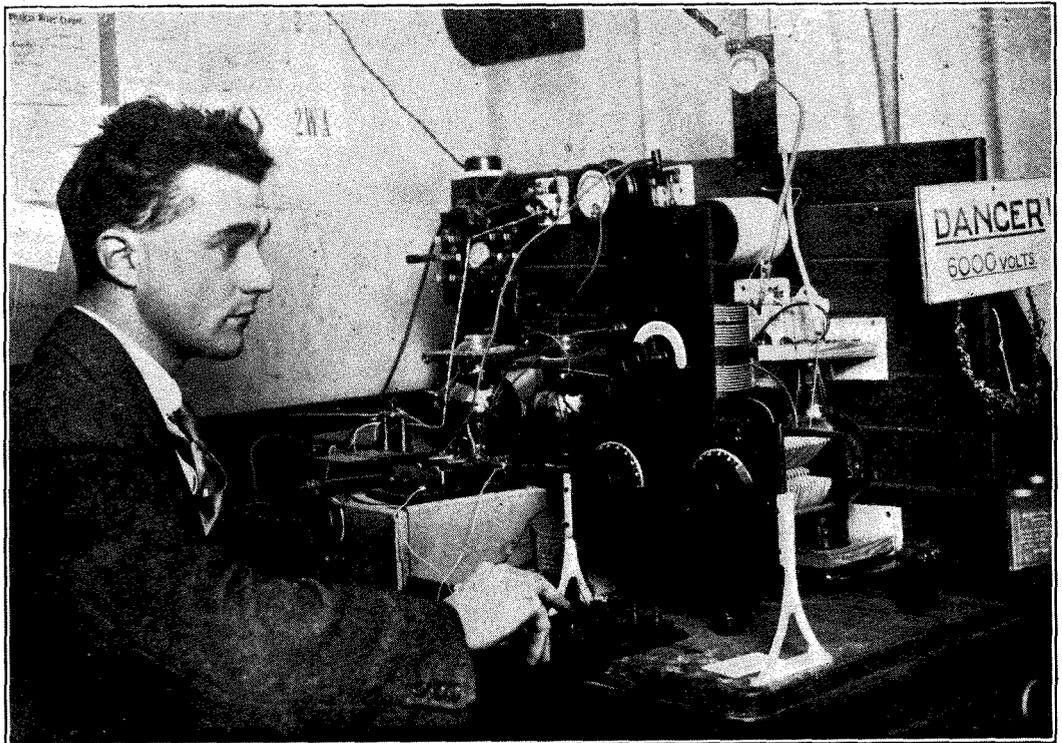
† The method of finding the characteristic curves of valves was described in the last number—page 320.

Thus, referring to the characteristic curves of Fig. 4, we see that when the grid has a voltage of  $-1$  volt, and the anode a voltage of 120, the current is 4.25 milliamperes. If the anode voltage is increased to 150 volts the anode current increases to 5.7 milliamperes. That is, a change in anode volts of 30 produces a change in anode current of 1.45 milliamperes. The anode impedance is therefore  $\frac{30}{0.00145}$  or 20,600 ohms.

When the grid has a potential of  $-6$  volts and the anode a voltage of 120 the anode current is 0.9 milliamperes, which

increases to 1.6 milliamperes if the anode voltage is increased by 30 volts. The impedance under these conditions is therefore  $\frac{30}{0.0007}$  or 43,000 ohms. This is a considerably larger value than when the grid bias was  $-1$  volt. The reason may be seen by carefully examining the curves. They are not parallel. The distance between the curves decreases as the negative grid voltage is increased. One may therefore find by an examination of the curves whether the impedance varies with the anode and grid voltages.

## AN EFFICIENT AMATEUR TRANSMITTER.



*Mr. J. H. Ridley (5NN), the South Norwood transmitter who has recently worked with three of the New Zealand amateurs, besides a number of U.S. and Canadian stations. On November 25th he picked up signals from the Mexican amateurs DZ and BX.*

# PHOTOGRAPHS BY WIRELESS

## SUCCESSFUL TRANSMISSIONS ACROSS THE ATLANTIC

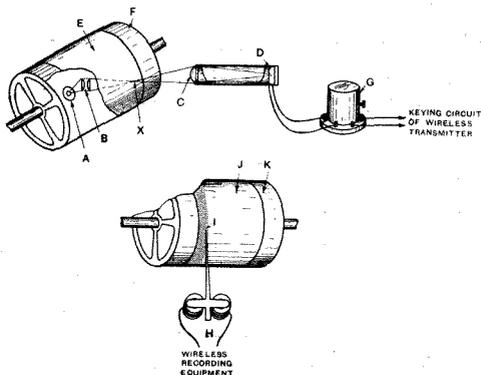
**T**HE problem of the transmission of pictures by telegraphic means is one which has exercised the ingenuity of inventors for some time past. More recently, as some successful results have been obtained, the possibility of wireless transmission of photographs has been considered. In this connection very interesting experiments were carried out on the afternoon of November 30th between Radio House in London, and New York. The apparatus used is described as the invention of Mr. R. H. Ranger, developed by the Radio Corporation of America. This company, as is well known, acts in association with Marconi's Wireless Telegraph Co., in England. At the time of conducting the tests transmitting equipment only had been set up in England, receiving apparatus having not yet been supplied from America. It is expected that in the near future this system, which, although not altogether novel in principle, has been developed to a high degree of efficiency, will at an early date be available for commercial application. The



A photograph of President Coolidge transmitted by the system described.

sketches reproduced here are intended to show the general principle of operation of the apparatus, but do not, of course, give any details of the arrangements.

At the transmitting end is a glass cylinder F, round which a photographic film E to be transmitted is fixed. Inside the cylinder is a powerful source of illumination A. A lens converges illumination on to a point on the film, and the beam of light is then focussed on to a photoelectric cell D located at some distance from the cylinder. In order to transmit a picture the glass cylinder bearing the film is rotated, and as darkened or opaque patches of the film move by they control the amount of illumination which reaches the photoelectric cell. In the course of transmission the cylinder is gradually moved on and reverses its direction of rotation each time it reaches the edge of the picture. Variations of illumination on the photoelectric cell produce variations of current in the circuit in which the cell is included owing to the changes in the resistance of the cell so produced. These changes in current flow can be utilised to control a wireless transmitter, or, for the



Explanatory sketch showing the general principle of the apparatus. A, "pointolite" lamp; B, condensing lens; C, focussing lens; D, sensitive photo-electric cell in adjustable mounting; E, transparent image; F, rotating cylinder; G, relay; H, electromagnet controlling stylus; I, self-inking stylus; J, rotating paper; K, revolving drum.

purpose of illustration, we may imagine that they control directly an electro magnet H, which in turn controls the mechanical movement of a pen acting upon another cylinder K carrying a sheet of paper J. As the cylinder is rotated back and forth in synchronism with the cylinder of the transmitter, so dots or blank patches will appear on the paper coinciding with the opaque or dark patches of the film. In the transmitted

20 minutes. According to reports, the demonstration of reception in America was extremely satisfactory. It was unfortunate that it was not possible to demonstrate reception in this country owing to the absence of receiving apparatus, but no doubt it will be possible to witness reception also at a later date, when arrangements will be made for the complete experiment to be carried out. The transmissions from Radio

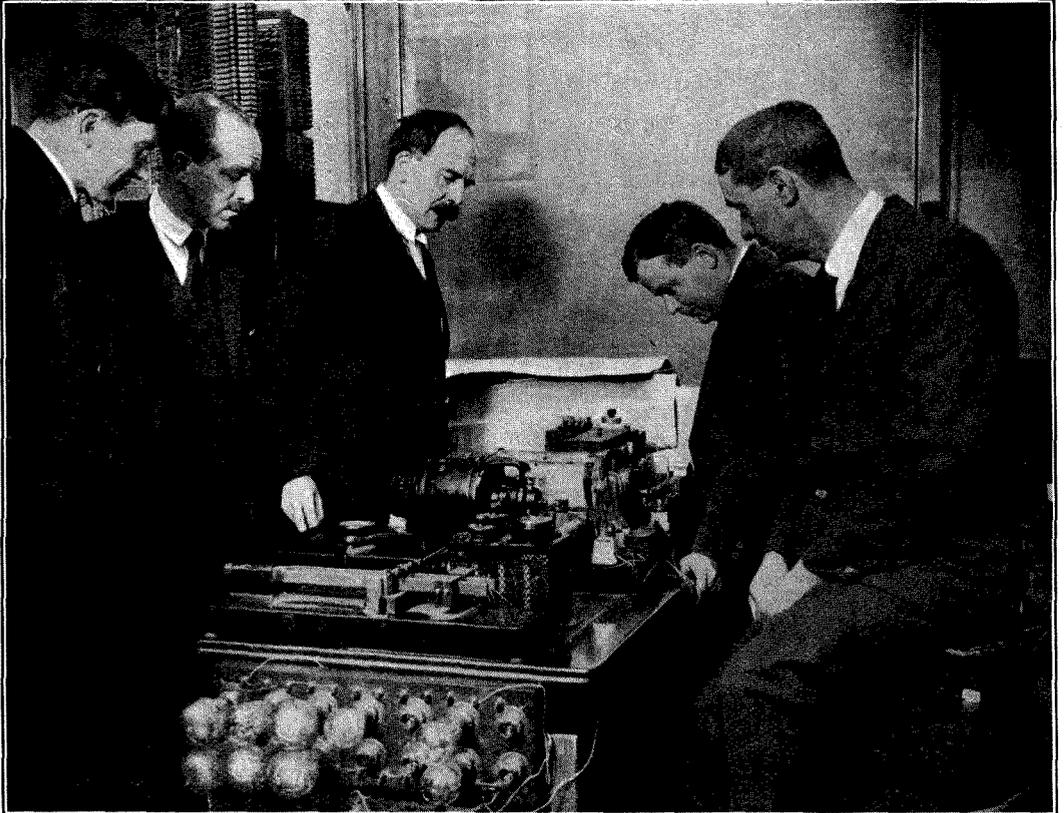


Photo: Daily Sketch

*The transmitting apparatus installed at Radio House. The tuning fork<sup>1</sup> shown in the front serves to synchronise the motor with the motor at the receiver controlled by a similar tuning fork.*

picture of President Coolidge, which we illustrate here, the points made by the pen can be distinctly seen, and it may be mentioned that in this instance the spacing between the successive rows of dots is  $\frac{1}{64}$  in. In the transmissions made from New York the movement was  $\frac{1}{128}$  in. for each revolution, so that finer detail was obtained in the finished picture, although more time was required to effect the transmission, which, for a half-plate film, occupied approximately

House were witnessed by a considerable gathering of press representatives, and amongst the photographs sent to America were portraits of the Queen, Queen Alexandra and Mr. Baldwin.

The photograph which we reproduce on this page shows the apparatus installed at Radio House with Mr. G. S. Whitmore, Chief Communication Engineer of the Marconi Company, standing in the centre, watching the operations.

# PATENTS AND ABSTRACTS



## Low Frequency Amplifiers.

In the issue of this journal of June 4th, 1924, was described an amplifier using the push-pull system of amplification, in which

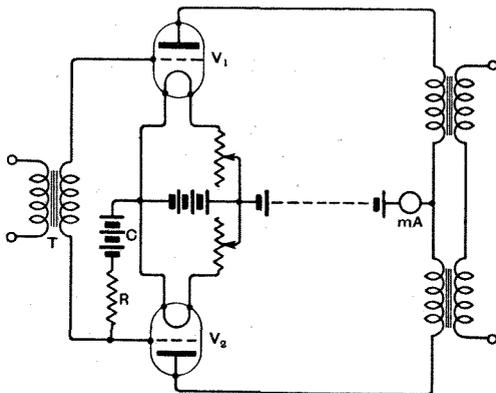


Fig. 1. A special amplifying system.

the secondary winding of the input transformer and the primary winding of the output transformer have a centre tap. According to Patent No. 222,981, it is possible to dispense with the special input transformer,

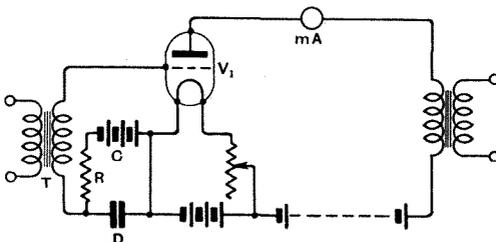


Fig. 2. A modification of the circuit of Fig. 1, but using one valve.

and to employ an ordinary transformer as indicated in Fig. 1. The secondary terminals

of the input transformer T are connected to the grids of the valves  $V_1$  and  $V_2$ , and a high impedance R is connected between one grid and the filaments, preferably through cells C, to act as a return path for the grid.

If the voltage to be amplified is not so great that the valves have to be used differentially, only one valve (Fig. 2) need be used. A condenser D should be connected in place of the grid-filament path of the unused valve.

## A Vernier Adjustment.

A convenient vernier adjustment is sketched in Fig. 3, where 1 is the spindle of a tuning condenser or variometer, 2 the panel, 3 the knob of the instrument, 4 the vernier adjusting knob, and 5 a support for the spindle of 4.

In the construction shown in the figure (described in Patent No. 224,973), a toothed

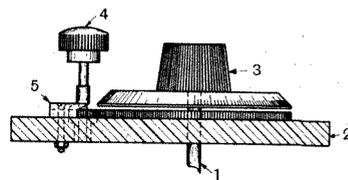
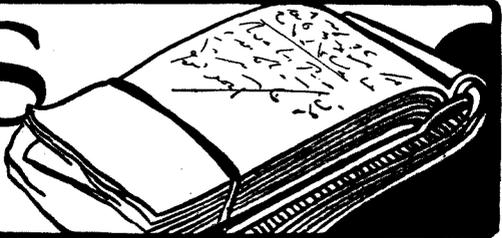


Fig. 3. A vernier device.

wheel is mounted on the spindle between the panel and the dial of the knob, and a smaller wheel is mounted on the spindle of the vernier control.

Instead of employing separate gear wheels, teeth may be moulded on the lower side of the dial, or it may be found more convenient to mount the gears below the panel.

# NOTES & NEWS



At the recent wireless conference in Johannesburg it was announced that the Post Office would collect broadcasting fees next year, and would prosecute unlicensed listeners.

\* \* \*

In consequence of the unexpected demand for the list of New Zealand amateur transmitters referred to in these columns last week, we have decided to publish the list in our next issue.

\* \* \*

The Lyons Fair for 1925, which will be held from March 2nd to 15th, is expected to contain exhibits from twenty different countries. The radio industry should be well represented.

\* \* \*

A performance of the opera, "Prince Igor," at the Brussels Opera House, on December 15th, will be relayed by wireless from the Brussels station and broadcast from 5 XX.

\* \* \*

An experiment in the open-air reception of broadcasting was recently carried out with success in Bombay, when a musical programme was reproduced on loud speakers to a large audience.

\* \* \*

A new transmitters' society has been formed by transmitting amateurs in Bristol and the surrounding districts. The Hon. Secretary is Mr. W. A. Porter, 2 AKG.

\* \* \*

## 128 AMERICANS AT A SITTING.

Mr. S. K. Lewer (6 LJ) of West Hampstead, reports that on Sunday morning, November 23rd, he logged 128 American amateurs, using only a single valve.

## AUSTRALIA WITH 'PHONES ON BENCH.

At 6.55 p.m. on Friday, November 26th, Mr. E. J. Simmonds (2 OD) of Gerrard's Cross, added to his laurels by receiving the Australian 3 BQ at "phones-on-the-table" strength. Two test messages had been passed prior to this, and at 6.40 the Australian's signals had gradually increased until they reached their maximum strength at the time mentioned. The signals were also received comfortably on a single detector valve.

Successful two-way working with the Australian 3 BQ was accomplished by Mr. J. A. Partridge (2 KF) of Merton Park, on Sunday, November 30th. Communication was maintained for about five minutes at 7 p.m. and the Australian reported good signals from both 2 KF and 2 NM (Mr. Gerald Marcuse).

## M. DELOY HEARD IN THE TRANSVAAL.

According to our Paris correspondent, signals transmitted by M. Leon Deloy, of Nice, were heard clearly at Johannesburg, on October 19th,

at 3.35 a.m. by Mr. S. C. Pleass. The distance covered is about 5,000 miles, mostly overland.

## IMPROVED U.S. NAVAL WIRELESS.

Amateurs on the American coasts are rejoicing at the installation of new high power transmitting apparatus on twenty-one first line U.S. battleships. This is a great step towards the abolition of the constant interruption from the old spark and arc transmitters of the navy, which has continually interfered with broadcast reception in the past. The new apparatus, designed by the Western Electric Company, has greatly increased the range of communication, and the "Colorado" has been able to communicate from Gibraltar to Chatham, Mass. Water-cooled valves are employed and power is supplied from the same generator as formerly fed the spark transmitter.

## CONGRATULATIONS FOR G 2NM.

Mr. Gerald Marcuse (2 NM) has received a card from Argentine DA 8 (ex CB 8), reporting his signals as steady and of good strength on October 30th, when calling New Zealand and congratulating him on being the first British amateur to be received in the Argentine.

## BELGIAN CALL SIGNS.

M. Henrotay, President of the Radio Club Belge de l'Est, wishes to remove the widespread impression that amateur call signs commencing with "4" are of German origin. They are in fact Belgian stations, the only exceptions being two or three stations in the occupied Rhine area. Belgian transmitters have been asked to prefix their call signs with the letter "B."

## HEAVISIDE LAYER AND AMATEUR COMMUNICATION.

The possible influence of the Heaviside layer on the success of amateur communication between this country and New Zealand was discussed by Mr. Gerald Marcuse in the course of his talk from 2 LO on Thursday, November 27th.

"In order to get data on this subject," said Mr. Marcuse, "special tests were arranged whereby American stations along the route which the waves were supposed to traverse, would keep watch and give reports of the signal strength as they received it, but their reports were contrary to expectation inasmuch as they reported weak signals, whereas New Zealand amateurs reported that the same signals were very strong. This lends favour to a suggestion that signals travelling to New Zealand jump the U.S.A., by which I mean

that, when radiated from a given point, they travel towards the Heaviside layer or as it is sometimes called the 'ceiling,' and on reaching it are deflected. Another fact which supports this theory is that there are certain areas in the United States with which British amateurs have never yet succeeded in establishing communication, despite the fact that power equal to that used for communicating with New Zealand has been used. Another point which is not altogether out of the question, although many people will not listen to it, is that signals travel through the earth. Whether a satisfactory explanation of these points will eventually be produced in a matter upon which I will not express an opinion, but in any case, the success of these experiments should open up the way to further researches on interesting scientific phenomena."

**BROADCASTING RUMOURS IN EGYPT.**

The recent discontinuance of the issue of wireless licences in Egypt, states the American Trade Commissioner, has led to the rumour that the Government is contemplating the grant of a monopoly to an Egyptian wireless company. The general feeling is that this step would enable such a company to compel would-be listeners to buy its own products while paying a licence fee to the Government.

**ACCUMULATOR SERVICE IN BRISTOL.**

Bristol readers may be interested to learn that Messrs. Fuller's United Electric Works, Ltd., have

taken new premises in connection with their Bristol depot at 22 Temple Street (Phone: Bristol 2531).

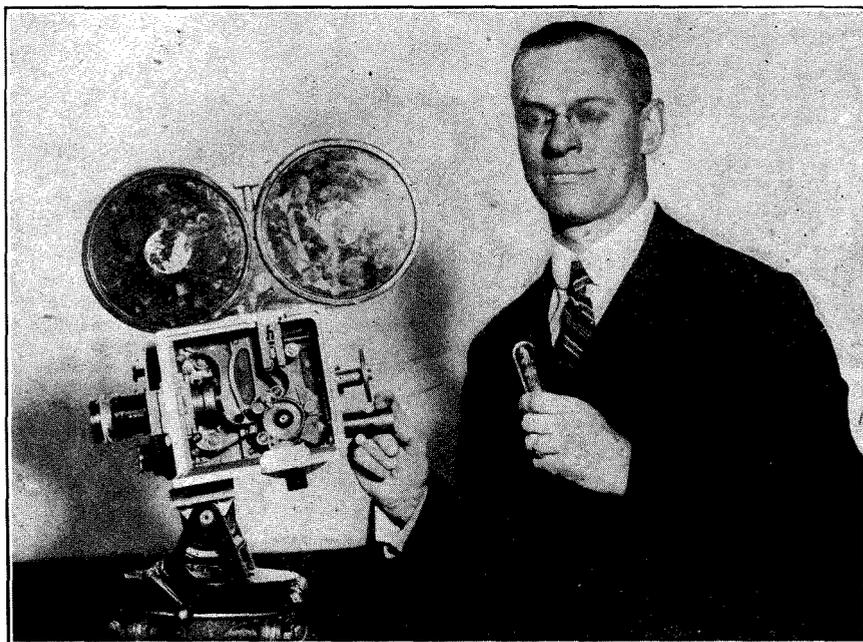
**EIFFEL TOWER TRANSMISSIONS.**

The following is the latest schedule of transmissions from the Eiffel Tower on a wavelength of 115 metres:—

- 4.0 to 5.0 a.m. (G.M.T.) Repetition of "Le Verrier" and "Maury" weather report for America.
- 9.40 to 9.45 a.m. America Weather Report.
- 2.20 to 2.55 p.m. (a) France, Belgium, Switzerland and Holland Weather Report.  
(b) "Le Verrier" Weather Report for America.
- 5.0 to 5.30 p.m. Observations of 1 p.m. from Europe and North Africa Stations and from ships in the Atlantic.
- 11.0 to 11.30 "Maury" weather report for America.

**NEW TURKISH HIGH POWER STATION.**

The establishment of a new high power radio station at Angora is the latest project of the Turkish Government. The two existing high power stations at Constantinople, which have not been in use since the departure of the Allied Armies, will be abandoned.



Mr. C. F. Elwell, photographed with his recent invention which photographs sounds whilst taking cinematograph pictures. The invention is made possible by the use of a valve amplifier in conjunction with an extremely sensitive microphone and a photoelectric cell. Mr. Elwell will lecture on "Photo-Electrics" before the Radio Society of Great Britain, on Wednesday, December 17th.

## NEW GREENWICH CLOCK.

After claiming to have broken all the world's records for accuracy of time measurement at the Edinburgh Observatory, the Synchronome Free Pendulum has now been installed at Greenwich Observatory. The erection of the Greenwich clock coincides with the election of its inventor, Mr. Hope-Jones, as a Fellow of the Royal Astronomical Society, and to the office of Chairman of the British Horological Institute.

## SOUTH AMERICAN BROADCASTING.

Listeners in Buenos Aires can enjoy music almost continuously from 10 a.m. until 1 a.m., according to a letter which has been received by Mr. Kenyon Secretan (5LF) of Barnes, from a friend in South America. The station LOR commences its programme at ten o'clock in the morning and thereafter until the early hours of the next day, LOR, LOX, LOY, LOE and LOZ, all contribute concerts, news bulletins and market reports. The last-named station occasionally re-broadcasts the transmissions from KDKA.

Throughout South America there is a noticeable absence of British wireless apparatus, most of the sets being of American manufacture.

## G 2 AWD.

If G 2 AWD will kindly communicate his address to Mr. W. D. Keiller (6HR) c/o the offices of this Journal, he will receive a souvenir card relating to his reception of 1HT's signals during the latter's recent voyage to the Argentine.

## SWEDISH AMATEUR CALIBRATION WAVES

A useful series of calibration waves is to be sent out by the three well-known Swedish amateurs, SMZS, SMZQ, and SMYY from December 15th until December 20th. The exact schedule of transmissions which will take place daily at 6 a.m. (G.M.T.), is as follows:—

December 15th	..	..	50 metres
" 16th	..	..	80 "
" 17th	..	..	110 "
" 18th	..	..	140 "
" 19th	..	..	170 "
" 20th	..	..	200 "

The transmissions in Morse will begin with a CQ call, followed by: "QRH... metres. Pse QSL to Radio-Bladet, Stockholm," continuing for ten minutes.

## STANDARDISATION OF EBONITE.

Some important facts about ebonite of value to every home constructor, were given by Mr. J. H. Reeves in the course of his broadcast talk from 2 LO on Thursday, December 4th.

Mr. Reeves stated that he was indebted to the Hon. Secretary of the Ebonite Manufacturers' Association for the following information concerning composition of ebonite as bought by the ordinary amateur.

The materials used are very varied. The best ebonite is composed of about 67 per cent. rubber and 33 per cent. sulphur, but the proportion of rubber is often less than this 67 per cent., perhaps only 40 per cent. or even less, and the quality of the finished product diminishes or increases in

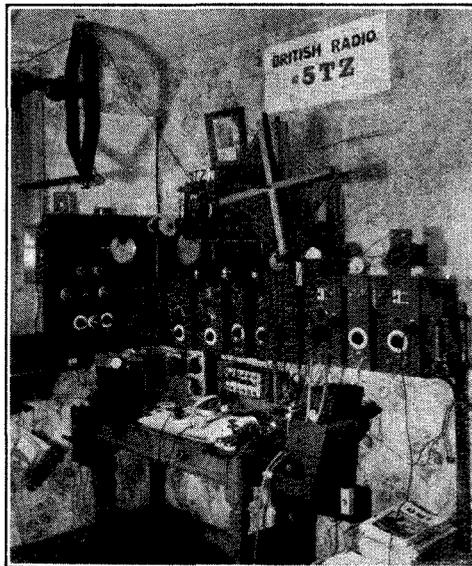
proportion to the amount of rubber used. In the finished product there is little, if any difference in appearance, whatever be the proportion of rubber used, and the difference in quality can only be detected by tests which, although fairly easy to apply in a well equipped laboratory or ebonite works, are beyond the power of the ordinary purchaser.

The various ebonite manufacturers have their own idea as to the minimum quality, electrically and mechanically, which they think good enough for wireless purposes, and with a view to securing uniformity in this respect the Radio Society of Great Britain, in consultation with the Ebonite Manufacturers' Association, sent a joint letter to the British Engineering Standards Association requesting them to set up a Committee to determine a standard of ebonite for wireless purposes. This Association, generally known by its initials

B.E.S.A. has consented to do so.

We believe that the B.E.S.A.'s procedure will be somewhat as follows: this Committee will be thoroughly representative of all the interests concerned, and will include in addition to certain of its own highly experienced staff, representatives of ebonite manufacturers, of builders of wireless sets, of technical bodies which have carried out research in insulating materials, and of the Radio Societies.

The proposals of this Committee will be put before the industry as a whole, and it is hoped that there will finally be published a specification as British Standard. Very soon after the specification is issued we may expect to find sheets and panels, and possibly small ebonite components, all bearing



*This station, owned by Mr. Walter G. Sherratt, of Cowes, I.O.W., has been designed exclusively for short wave work. It has been heard in many European countries, and efforts are being made to reach the U.S.A., using 50 watts.*

the B.E.S.A. mark in addition to that of the individual manufacturer. When this happens everyone who wishes to buy standard material will be able to assure himself that he will be getting what he demands.



Walton-on-Thames, Surrey. (October 5th, 12th and 31st).  
 All American, on 80 metres: 1 AH, 1 MX, 1 FD, 1 AU, 1 ZZ, 1 XZ, 1 BQ, 1 BG, 1 SF, 1 YO, 1 SW, 1 MY, 1 KC, 1 ER, 1 RT, 1 ML, 1 GY, 1 CG, 1 IL, 1 XW, 1 AAL, 1 BMT, 1 BQL, 1 AHT, 1 BDT, 1 AAC, 1 CMP, 1 ICP, 1 CCQ, 1 BIP, 1 ADN, 1 AHI, 1 AOM, 1 CGR, 1 CAK, 1 BSD, 1 BFN, 1 AOU, 1 BGG, 1 BKQ, 1 AUN, 1 BIE, 1 AAU, 2 GK, 2 QW, 2 KU, 2 PD, 2 BE, 2 EM, 2 BRD, 2 APY, 2 MU, 2 ANA, 2 BRC, 2 CVS, 2 BGG, 2 ADJ, 2 CYW, 3 GK, 3 HH, 3 WB, 3 OG, 3 MB, 3 KD, 3 ZD, 3 AU, 3 BTA, 3 BSB, 3 CDG, 3 BDO, 3 ARL, 3 VW, 3 AUV, 3 BFE, 3 GC, 3 BOF, 3 BWT, 3 AJD, 3 ADG, 3 BCO, 4 IO, 4 ZD, 4 FS, 4 XX, 4 OA, 4 TJ, 4 RR, 4 KE, 4 EV, 5 KQ, 5 ZAS, 7 FR, 8 XC, 8 CYI, 8 BFE, 8 CLN, 8 UP, 8 DFW, 8 PL, 8 GHW, 8 CM, 8 BF, 9 EM, 9 LD, 9 DXN. (o—v—u) F. Walker.

(October 26th to November 2nd).  
 British: 2 AM, 2 BA, 2 CA, 2 FP, 2 HS, 2 JA, 2 JL, 2 KF, 2 KT, 2 NM, 2 ON, 2 PB, 2 PX, 2 QO, 2 QQ, 2 QS, 2 TA, 2 TY, 2 VD, 2 VS, 2 XR, 2 YM, 5 AG, 5 AS, 5 CQ, 5 CX, 5 DT, 5 FL, 5 LF, 5 LP, 5 MA, 5 NN, 5 OX, 5 PS, 5 RN, 5 RV, 5 RW, 5 SZ, 5 SQ, 5 UO, 5 WN, 5 XN, 6 AL, 6 HD, 6 JB, 6 TT, 6 DH, 6 GH, 6 LJ. French: 8 AB, 8 AL, 8 BH, 8 BN, 8 BC, 8 BR, 8 CA, 8 CN, 8 CO, 8 DD, 8 DF, 8 DG, 8 FL, 8 GL, 8 JBV, 8 MN, 8 PE, 8 PD, 8 PP, 8 SR, 8 SSH, 8 SSC, 8 UV. Belgian: 4 YL, 4 YR, 4 RS. Finnish: 8 FNINB. Danish: 7 EC. Unknown: OXL, OMS, OZZ, 1 AO, QRA. L. S. Crutch (2 AWH).

London, N.I. (During October, 1924).  
 British: 2 ABJ, 2 CC, 2 DR, 2 DX, 2 FK, 2 FM, 2 FP, 2 JF, 2 JU, 2 KD, 2 KF, 2 KG, 2 KW, 2 KY, 2 LH, 2 NM, 2 OM, 2 PX, 2 PY, 2 QQ, 2 QS, 2 UC, 2 UV, 2 VS, 2 WJ, 2 WY, 2 ZA, 2 XO, 2 XZ, 5 BH, 5 BV, 5 CF, 5 FL, 5 GF, 5 LP, 5 MO, 5 OX, 5 PD, 5 RZ, 5 SI, 5 SU, 5 SZ, 5 UL, 5 UO, 5 WG, 5 WN, 6 AL, 6 BBC, 6 BO, 6 DO, 6 DW, 6 FG, 6 GH, 6 GM, 6 HC, 6 HG, 6 KJ, 6 LB, 6 LJ, 6 NF, 6 PD, 6 PX, 6 QT, 6 TD, 6 TM, 6 UD, 6 UT. Foreign: French: 8 AL, 8 BF, 8 BN, 8 CA, 8 CN, 8 CO, 8 EN, 8 EU, 8 FL, 8 GL, 8 GO, 8 ML, 8 MU, 8 PA, 8 PD, 8 QG, 8 RW, 8 SZ, 8 ZF. Italian: IDO, IHT. Danish: 7 EC. Dutch: OBA. Finnish: 3 NB. Unknown: 3 ZZ, 4 QS, 4 UU, 4 YZ, 8 UMZ, PICR. (r—v—o, and o—v—o.) C. S. Bradley.

Stratton-on-the-Fosse, Nr. Bath.  
 Between October 30th and November 11th; below 200 metres.  
 British: 2 AG, 2 ARB, 2 FB, 2 FNG, 2 JF, 2 MP, 2 MN, 2 KC, 2 ZG, 5 HA, 5 IP, 5 LF, 5 QP, 5 QJ, 5 RY, 5 SV, 5 SZ, 5 UG, 5 UQ, 5 WL, 6 XJ. French: 8 AG, 8 AL, 8 AP, 8 AQ, 8 BC, 8 BE, 8 CK, 8 CO, 8 CPP, 8 CM, 8 CS, 8 DF, 8 DP, 8 EC, 8 EM, 8 EV, 8 FG, 8 FS, 8 GH, 8 GM, 8 HSM, 8 IL, 8 IP, 8 JDL, 8 MN, 8 PB, 8 RC, 8 RS, 8 RL, 8 SM, 8 TM, 8 WAL, 8 XH, 8 ZM. Swedish: SMXY, SMZV, SMZY, SMZZ. Dutch: 8 AD, 0 II, 0 MS. Belgian: 5 UU, B7. Italian: 1 FP. Danish: 7 ZM. Miscellaneous: 3 AF, 3 CM, 9 AD. (o—v—o: Reinartz).  
 Downside School Wireless Society. (2 KM).

MISUSE OF CALL SIGN, 2 XD.

Mr. H. R. Gladwell (2 XD), of Romford, Essex, has reason to believe that his call sign is being used by a powerful station working on 100 metres. Many reports of such a station have been received from the West of England. Mr. Gladwell has never transmitted below 150 metres.

CATALOGUES RECEIVED.

- Burdnapt, Ltd. (Aldine House, Bedford Street, London, W.C.2). 1924-25 Catalogue of Wireless Apparatus, Section V: Transmitting apparatus. - A 16-page booklet of particular interest to transmitters. Publication No. 247, containing full illustrated descriptions of the Burdnapt range of receiving apparatus and accessories. Price 1s.
- L. McMichael, Ltd. (Hastings House, Norfolk Street, W.C.2). Illustrated Catalogue of McMichael Broadcast Sets, Home Assembly Sets, Components and accessories.
- Carfax Company, Ltd. (312 Deansgate, Manchester). Price List of Carfax Wireless Sets and Accessories, and of the "Kodel" portable set.
- Fuller's United Electric Works, Ltd. (Woodland Works, Chadwell Heath, Essex). List 315b, describing and illustrating Sparta Radio Accessories.

Radio Society of Great Britain.

RADIO SOCIETY OF GREAT BRITAIN.

The Eleventh Annual General Meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2., at 6 p.m., on Wednesday the 17th December, when a lecture on "Photo-Electrics," will be given by Mr. C. F. Elwell, M.I.E.E., Fellow I.R.E. Tea at 5.30 p.m.

T. & R. NOTES.

The principal events of the week are the continued activities of the Australian amateurs who come in very well during the evening from 6 to 7.15 p.m. after which they fade away, doubtless owing to sunrise in Australia. The Australians most frequently logged in this country are 3 BQ, 2 CM, and 2 DS, and the first-named has been worked by several. I would, however, specially ask our friends across the Channel to keep above 85 metres, as on Saturday and Sunday, November 29th and 30th, when 3 BQ was calling me, considerable interference was caused by a transmitter using raw A.C.

Mr. Jack Orbell reports good reception of 3 BQ and states that on November 30th he heard good signals from this station on his loud speaker, using two valves.

GERALD MARCUSE,

(Hon. Secretary Transmitter and Relay Section, Radio Society of Great Britain).

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 10th.

- Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Talk on "Supersonic Heterodyne." By Mr. W. K. Alford.
- Streatham Radio Society. At 35 Streatham High Road, S.W. Lecture: "Amplification." By Mr. H. A. Thomas, M.Sc.
- Radio Research Society, Peckham. At 44 Talfourd Road. Lecture: "Dynamos and Motors." Discussion: "Switching of Valve and Crystal Receivers."
- Bristol and District Radio Society. Wireless Lecture No. 7. By Mr. W. A. Andrews, B.Sc.
- Edinburgh and District Radio Society. At 8 p.m. At 117 George Street. Film: "An Englishman's Home." Kindly lent by the General Electric Co., Ltd.
- North Middlesex Wireless Club. Members' Loud Speaker Competition.
- Sutton and District Wireless Society. At 8 p.m. At the Sutton Adult School, Benhill Avenue. Free demonstration and lecture arranged by Messrs. S. G. Brown, Ltd.

THURSDAY, DECEMBER 11th.

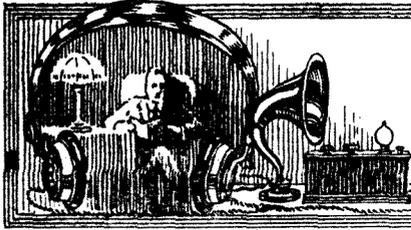
- Royal Society of Arts. At 8 p.m. At John Street, Adelphi, W.C.2. Inaugural address of the 171st Session: "Radio Communications." By Senatore Guglielmo Marconi, G.C.V.O., LL.D., D.Sc., Chairman of the Council and a Vice-President of the Society.
- Bournemouth and District Radio and Experimental Society. At 7 p.m. At Canford Hall, St. Peter's Road. Dutch sale of Members' Surplus Apparatus.
- Luton Wireless Society. At 8 p.m. At Hitchin Road Boys' School. Experiments and Demonstration for Beginners.
- West London Wireless and Experimental Association. At Belmont Road Schools. Lecture: "Measurement of Wireless Quantities." Part III. By Mr. F. E. Studt.

FRIDAY, DECEMBER 12th.

- Bristol and District Radio Society. Annual General Meeting.
- MONDAY, DECEMBER 15th.
- Dorking and District Radio Society. At 7.45 p.m. At 65 South Street. Members' Evening with Apparatus.

TUESDAY, DECEMBER 16th.

- Radio Association of Ireland. At 8 p.m. In the University College, Dublin. Lecture: "The Useful Valve." By Professor J. J. Dowling, M.A., F.Inst.P.



## AMONG THE SOCIETIES.

The Woolwich Radio Society have produced another issue of their entertaining little magazine, "The Oscillograph." In perusing its columns the impression is gained that the Society is in a very active state, and the preparation of such a journal might well be considered by other societies.

\* \* \* \*

A lecture on electrical measuring instruments was given on November 19th before the Clapham Park Wireless and Scientific Society by Mr. E. F. Anderson, of the Cambridge Instrument Company. The many instruments dealt with included a moving coil tuner, galvanometers, ammeters and voltmeters, thermo-electric pyrometers, and many other devices specially designed for experimental work.

\* \* \* \*

On November 21st the Radio Experimental Society of Manchester held an instructive discussion on the neutrodyne method of H.F. amplification, the opener being Mr. J. Hudson. A lively discussion took place, and interesting demonstrations were made on a neutrodyne receiver, which proved the selectivity and ease of operation of which the circuit is capable.

\* \* \* \*

High and low frequency amplification were interestingly dealt with by Mr. John A. Sang, lecturing before the City of Belfast Y.M.C.A. Radio Club recently. The lecturer gave some useful information concerning the advantages and disadvantages of various methods of intervalve coupling.

\* \* \* \*

L.F. transformers were described by Mr. H. F. N. Riddle before the Croydon Wireless and Physical Society on November 11th. Of particular value was the lecturer's description of his method of winding transformers.

\* \* \* \*

Valve rectification was dealt with very thoroughly by Mr. B. A. Matthews in a recent lecture before the Birmingham Wireless Club. The value of the lecture was considerably enhanced by practical demonstrations carried out on the Club's detector panel.

\* \* \* \*

An informal lecture on "Esperanto" was delivered before the Tottenham Wireless Society on November 12th by Mr. Montagu C. Butler, Secretary of the British Esperanto Association. After outlining the difficulties of compiling

a common language, the lecturer dealt with the reasons why a non-international language such as Esperanto is the best solution of the problem. He urged the advantages of its use in wireless communication.

At the following meeting of the society, Mr. F. J. A. Hall provided some interesting tests with a three-valve straight circuit, by means of which he demonstrated the value of adjusting the L.T. and H.T. voltages to suit different requirements.

\* \* \* \*

Members of the Glasgow and District Radio Society were entertained and instructed for over an hour on November 19th, when Captain P. P. Eckersley delivered a lecture on the work of the British Broadcasting Company. After dealing with the growth of the Company's system and the genesis of relay stations, Captain Eckersley spoke on the mysteries of fading. Some interesting and simple mechanical analogies were given and Captain Eckersley concluded with a tribute to the energies of Mr. J. C. W. Reith, Managing Director of the B.B.C.

\* \* \* \*

We note with regret the suspension of the Wandsworth Wireless Society, which was agreed to on November 21st. We trust that this is only a temporary measure and that the amateurs of such an important district as Wandsworth will again be represented in the near future.



Members of the Hounslow Wireless Society photographed on a recent field day with their portable transmitter.

# READERS PROBLEMS

*Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.*

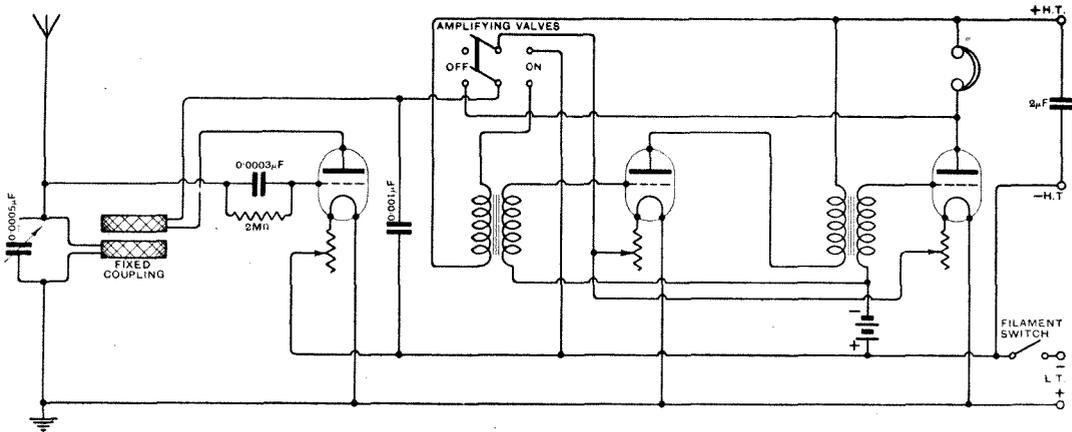
## A "ONE KNOB" RECEIVER FOR BROADCASTING.

THE receiver given in the circuit diagram is controlled by a single tuning dial—that of the aerial tuning condenser. A detector valve provided with limited reaction is followed by two stages of low frequency amplification. Plug-in coils should be employed for the aerial and reaction circuits, with a fixed coupling between the coils. Two single coil holders may be screwed to the baseboard of the instrument parallel to one another, and about  $\frac{1}{2}$  in. or 1 in. apart. A suitable degree of

## ANODE RECTIFICATION.

IN a wireless text-book a reader has noticed a circuit diagram in which no grid condenser and leak is used in the grid circuit of the detector valve. Instead, a variable negative grid bias is applied, either by means of grid cells, or grid cells in conjunction with a potentiometer. He asks in what manner rectification takes place, and whether this method is a desirable feature in a receiver designed purely for telephony.

The method of rectification referred to is generally known as "anode rectification," and depends for



A "one knob" loud speaker receiver.

reaction will then be obtained by carefully choosing the size of the reaction coil. This coil should be of such a size that the set does not oscillate at any point on the condenser scale. If pairs of coils are chosen in this way for different wavelength ranges, the use and adjustment of the set may be left to unskilled hands. A switch is provided to control the filament supply from the L.T. batteries, and a D.P.D.T. switch cuts out the last two valves when not required. Telephones or a loud speaker can therefore be connected across the output terminals according to the strength of signals required.

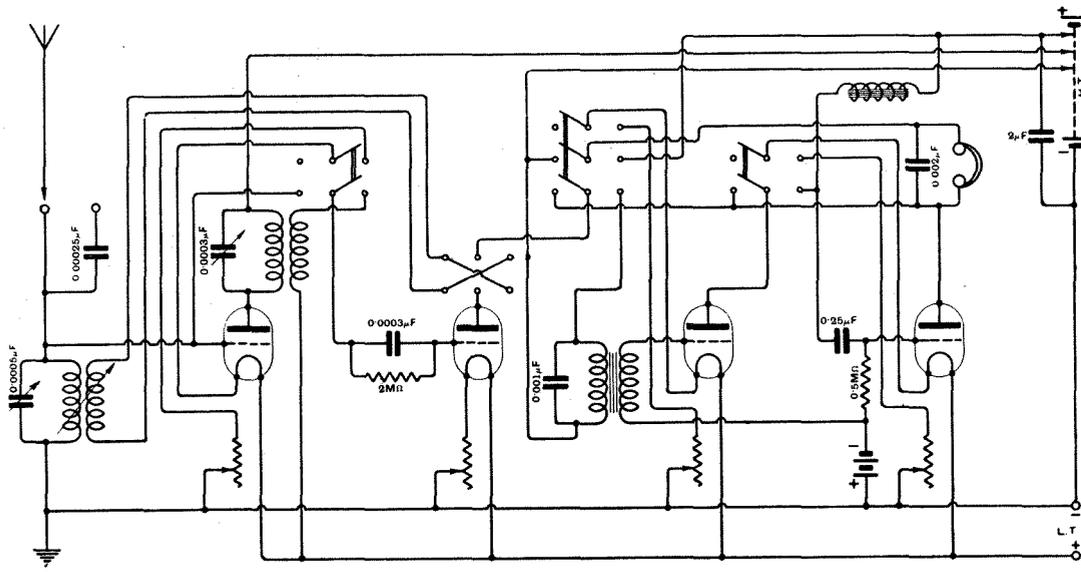
its action on the curvature of the lower end of the grid voltage—anode current characteristic of the valve. The method is inefficient for weak signals, but gives greater freedom from distortion than the grid condenser and leak method for telephony signals of large amplitude.

In special valves of the Q and QX type, the lower bend of the characteristic curve has been made to approach closer to the zero grid voltage line, and attempts have been made to increase the sharpness of the bend in the characteristic, with the object of improving rectification. In

general, anode rectification should only be employed when several stages of H.F. amplification precede the detector valve, or when the receiver is situated very close to a broadcasting station.

#### CONNECTIONS OF A FOUR-VALVE RECEIVER.

**T**HE diagram given below shows the connections of a four-valve receiver with one stage of H.F. amplification and two note magnifiers. The H.F. valve is transformer coupled, and the first and second stages of L.F. amplification are transformer and choke coupled respectively. Switches are provided to control the number of valves in use, and separate H.T. voltages are applied to the H.F., detector and L.F. valves.



*A four-valve receiver with choke coupled power stage.*

#### H.T. SUPPLY.

**A** READER who has a supply of current available from a 16-volt D.C. house lighting set wishes to raise the voltage to 120 volts for the H.T. supply, and asks if this could be done by means of a step-up transformer.

Before the transformer could be used, it would be necessary to interrupt the direct current by some mechanical means, and then to rectify and smooth the output from the transformer before it could be applied to the receiving apparatus. The necessary apparatus would be very costly and difficult to maintain, and considerable losses would be introduced. It would be much cheaper to purchase a small motor generator for the purpose, in view of the fact that dry batteries cannot be used, owing to the climatic conditions. Motor generators of this type, such as the M.L. Magneto Converter, have been designed specially for use in conjunction with receiving apparatus. They are extremely reliable, and will give very long service without attention.

#### RESONANCE IN A RESISTANCE COUPLED AMPLIFIER.

**A** READER who has recently constructed a resistance coupled low frequency amplifier observes that a very marked resonance peak is present in the lower frequencies.

One of the first things to be noticed in using a resistance coupled L.F. amplifier for the first time is the increased amplification given to the lower frequencies. It is possible that our correspondent has mistaken this quality for a resonance effect. Assuming, however, that this is not the case, and that true resonance is present, the most likely causes are to be found in the values of the grid coupling condenser and leak, and in the characteristics of the loud speaker itself. The latter is by far the most likely cause, and the possibility of resonance due to the time constant of the grid condenser and leak can be detected by changing one or other of the values, and observing whether any change is thereby brought about in the frequency of resonance.



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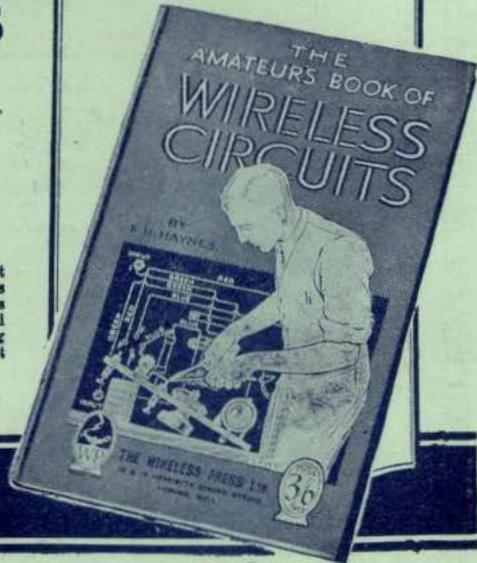
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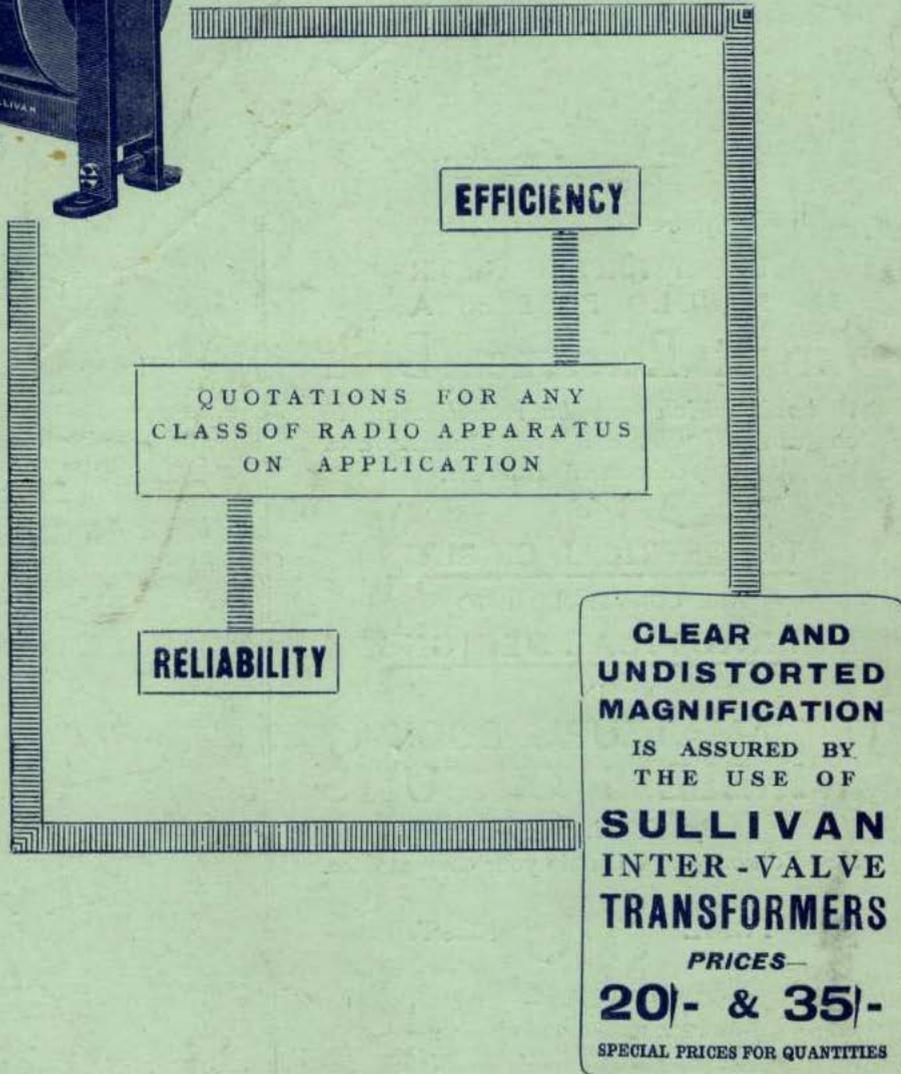
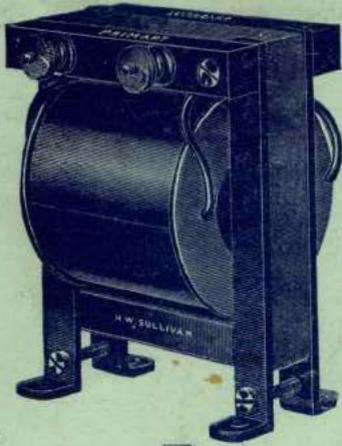


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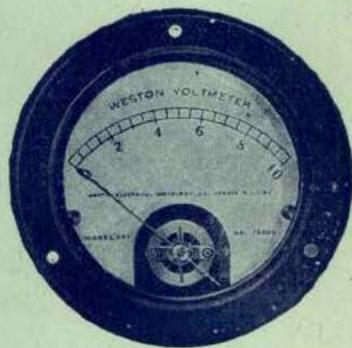
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# THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

No. 279. (No. 12 Vol. XV.) DECEMBER 17th, 1924.

WEEKLY.

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(B.Sc., F.Inst. P., A.M.I.E.E.)**

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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.



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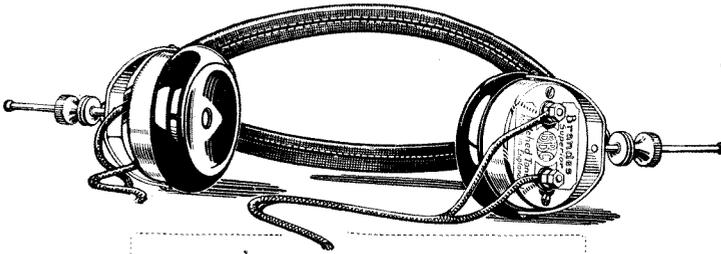
# Tune the Table-Talker with the "Matched Tone" Headphones



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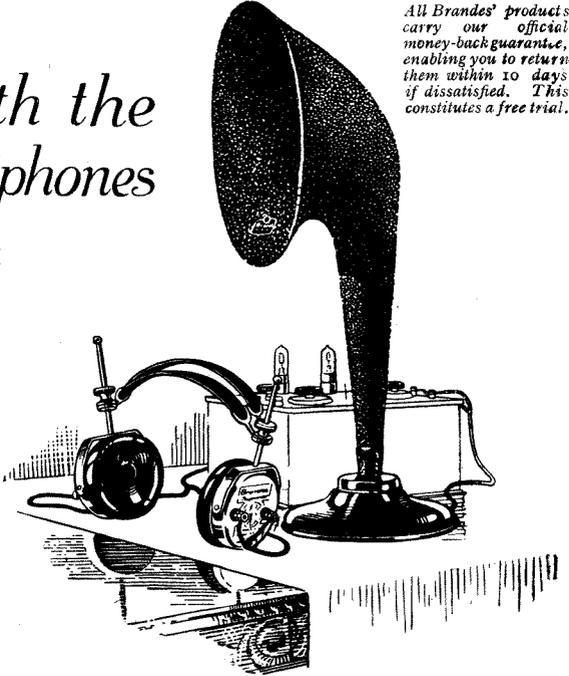
BABY, with his earnest supplication to Father Christmas for a profusion of gifts to swell the traditional stocking, certainly thinks that all such demands should be addressed to the *Table-Talker*. He thinks that's where all the really nice people are. He is able to catch the kindly inflexion in the deep friendly voices which talk gently and most naturally to him of all the good things in store. And he is most anxious, in his baby fashion, that his very youthful cronies should at least have a pair of Brandes' "Matched Tone" Headphones for Christmas. They bring every intriguing detail of the Bedtime Stories so clearly, and he hates to think that his friends are missing it.

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Crown Farm House,  
Walton-on-Thames, Surrey.

Dear Sirs, November 19th, 1924  
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Yours faithfully, (Sgd.) F. Walker.



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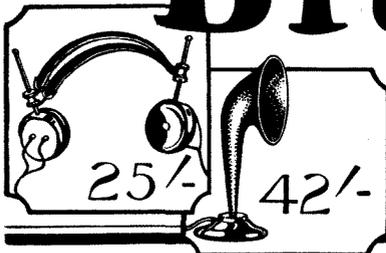
The *Table-Talker* is a Brandes quality product at a moderate price. The non-resonant, specially constructed horn is matched to the unit so that the air resistance produced will exactly balance the mechanical power of the diaphragm. This means beautiful sound-balance and remarkable tone qualities. It is twenty-one inches high, and is finished a shade of neutral brown **42/-**

**For Christmas!** An excellent family gift to the family—Club together and get yourselves Brandes Products for the receiver. They provide good fun during Christmas festivities and all the year round.

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Result of  
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Experience

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# The WIRELESS WORLD — AND RADIO — REVIEW



## RADIO TOPICS.

### AMERICAN NATIONAL CONFERENCE REPORT.

BY THE EDITOR.

**A** REPORT on the recommendations for the regulation of radio adopted by the Third National Radio Conference has just been issued. This Conference has for the past three years been called by the Secretary of Commerce of the United States of America and the present report is a document of vital interest to everyone associated with wireless, and in particular the amateur.

In reading through the publication we have been struck by the large amount of attention which has been paid to the requirements of amateurs as users of wireless and the very generous consideration which has been given to their needs. The Secretary of Commerce, opening the Conference, in referring to those present, stated, "You who represent the radio fans, broadcasting stations, engineers and manufacturers, have come at my request to again consider the situation from a national point of view and to determine what steps can be taken to advance the art and improve its service." Whether by accident or design, it is of interest to note that the amateurs or radio fans are addressed first in the classification of wireless interests, and the same consideration is noticeable throughout the recommendations of the Conference. In dealing specifically with the interests of the amateur, the Secretary of Commerce went on to state:

"Nor have we overlooked in these previous conferences the voice or interest of the amateur, embracing as he does that most beloved party in the United States—the American boy. He is represented at this conference, and we must have a peculiar affection for his rights and interests. I know nothing that has contributed more to sane joy and definite instruction than has radio.

Through it the American boy to-day knows more about electricity and its usefulness than all of the grown-ups of the last generation. I have during the past year somewhat extended this wave band. I hope that this conference may dismiss the objections that have been raised to this action."

In the final recommendations under the heading of "Amateurs," the wording is as follows:

"The Conference has allocated to amateurs substantially the same frequency bands that are now in use, with some minor changes in their location. The temporary allocation of frequencies above 2,000 kilocycles (below 150 metres) made by the department to the amateurs some months ago is given definite approval with some slight changes in the bands. The net result of this is to give to amateurs an increase over what they had at the end of the Conference a year ago, and to allow them a much greater area for operation."

This expression of opinion made by the United States Secretary of Commerce and the final recommendation of the Conference shows clearly how completely the work of the amateur is recognised and valued by the American public as represented by all wireless interests. As indicating the consideration which is given to the amateur, a further quotation may be taken from the speech of the Chairman. In dealing with the subject of interference he states:

"Our amateurs, who make up by far the largest element in the radio family outside of the listeners as a whole, are particular sufferers, since the harmonics from many stations have an especial tendency to invade the amateur band. Accurate and sharp transmission must be insisted upon."

Various sub-committees were appointed to report to the Conference, and No. 5 of these was detailed to consider amateur problems. The following is a copy of their report to the Conference: "Sub-committee No. 5, amateur problems, has met, and, being advised of the allocation of frequencies for amateur use by sub-committee No. 1, has considered amateur problems involving subdivision of types of transmitting apparatus and also various amateur technical problems. We have found that most of the problems confronting the amateur are disciplinary in character, and can best be handled within the amateur organisation with the assistance of the chief supervisor of radio. The committee has voted unanimously to recommend to the Conference the following:

1. That the use of receivers capable of radiating be discouraged for use on the short wave relay broadcast bands.

2. Except in the case of transmitters using coil antennas or loops, the use of circuits loosely coupled to the radiating system, or devices producing an equivalent effect, shall be required in all amateur transmitters.

3. All of the amateur bands shall be open to telegraphic communication effected by means of tube transmitters or devices producing an equivalent effect, excepting those using outright forms of I.C.W. by mechanically interrupting one of the radio-frequency circuits.

4. A band of 1,670 to 1,760 kilocycles (170 to 180 metres) shall be assigned non-exclusively to amateur radiotelephones and I.C.W. stations which employ apparatus in which one of the radio-frequency circuits is mechanically interrupted.

5. The question of issuing one amateur station licence which will permit of the use of all amateur wavebands is to be left to the discretion of the chief supervisor of radio.

6. The international intermediates that have been in use by the amateurs of the various nations in their international amateur radio communications, and which were established unofficially by the American Radio Relay League should be continued, and it is requested that this matter be taken up by the Department of Commerce with the International Bureau at Berne to the end that they may be brought to the attention of the next International Radiotelegraphic Convention for official confirmation."

The tendency in the past has been for most radio-telegraphic regulations, where

they apply to individual countries, to be based on decisions arrived at at international conferences. It is therefore not unreasonable to expect that regulations framed by the United States for the control of wireless in that country are likely to be followed by many other nations.

Unfortunately there are still some countries in Europe where amateur transmissions are unauthorised. Notably we may refer to Denmark, where we understand that the regulations are so stringent that an unfortunate amateur who passed to *The Wireless World*, for publication, some particulars of his transmissions, has been traced, and his apparatus confiscated by the authorities as a sequel. Happily, in this country we are for the moment less subject to oppression and individual rights of citizens are still respected. There are, however, rumours of trouble to come, and we must expect that attempts will be made in the near future to divest the amateur of facilities for experimental work as a right, and he will be placed in the position of having to plead for facilities, and be at the mercy of individuals whose task it is to administer the law in relation to the granting of experimental licenses. Amateurs in this country must wake up, and the public too will have to be educated to appreciate the value of the amateur until the same consideration is given as the recent Conference indicates, is granted in the United States. When we consider that this Conference in America relates only to problems of transmitting stations, one realises even more how unsatisfactory are the conditions under which the amateur operates in this country. In America the necessity does not exist for any licence for reception. Our readers are equally as familiar as we ourselves with the position here of those who desire to conduct experiments in transmission, and they can draw for themselves the comparison between the attitude of the authorities here and in America. It is up to every amateur to do what he can to bring the public, and particularly those individuals who may have influence with the Government, to understand something of the value of the work of the amateur, and acquaint them with the fact that in this country, where our boast has always been the Freedom of the Subject, we are far behind our more progressive friends in the United States.



## LOUD SPEAKERS

In the issue of November 26th Captain Round described the microphone and associated amplifiers now in extensive use for broadcasting and reproduction of band music, speech, etc. In the present article the author gives details of his loud speaker and associated equipment which may be regarded as a companion to the microphone system.

By CAPTAIN H. J. ROUND, M.I.E.E.

Chief of Research Department of the Marconi Company.

A standard power amplifier using 8 open mesh L.S.5 A valves is shown in Fig. 1, and this is connected directly to the "B" amplifier shown in the previous article.

Fig. 2 is the diagram of connections for this instrument.

Two commercial sizes of large loud speakers have been designed to work with this amplifier, but the principle employed in the loud speaker lends itself to practically unlimited increase in size and power if necessary.

The basic idea in the loud speaker is that invented by Sir Oliver Lodge and consists of a suspended cylindrical coil immersed in a strong magnetic field. The field is energised with direct current and the speech current traverses the coil. This principle is well known in the Magnavox but unlike that instrument a normal type diaphragm is not used.

A cylindrical coil C Fig. 3 is rigidly connected to a narrow annular strip which is made of such a width that it moves only as a whole. The edges of the strip both

**T**HE Marconi Microphone Amplifier system described in a recent issue (see issue of Nov. 26, 1924), pages 260-265, lent itself to a rather elaborate but very high quality public speech amplifier and general amplifier for bands and other types of music.

The only additions necessary were some form of power amplifier and a loud speaker capable of handling music and speech. The practical development of these details was started about a year ago and a considerable number of sets have been in common use for some months.

The power amplifiers were built up by using parallel valves with very open grid mesh so as to enable considerable power to be developed with comparatively low plate voltage. In this way storage batteries could be used for the source of power.

inside and outside are connected with the general body of the magneto system and an elastic membrane, MM.

The coil C is immersed in a magnetic field produced by a magnetic system, X.

The whole system can be given any one natura period, which I have found it preferable to have between 150 and 250 per sec. for practical reasons.

tone of music although it will be quite satisfactory for speech.

A diagrammatic section through the magnetic system of one of the loud speakers is shown in Fig. 3. It is possible to use this type of instrument without horns but for general public work the horn has many advantages. The smaller commercial type of instrument is shown in section with its

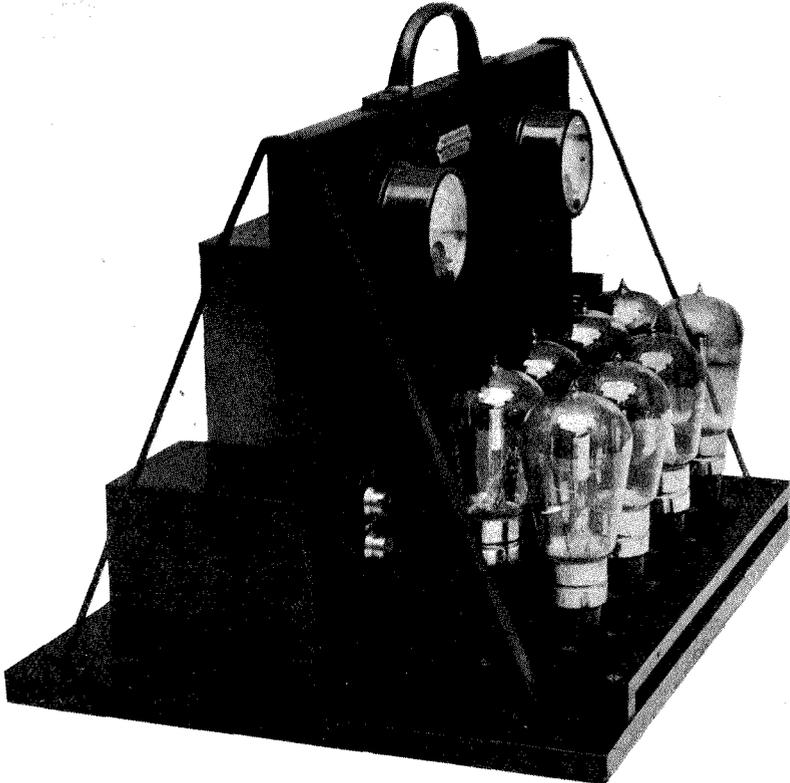


Fig. 1. The "C" Amplifier with eight L.S.5A valves in parallel.

Too low a period permits serious rattling of the diaphragm on the pole pieces. Too high a period tends to reduce the lower

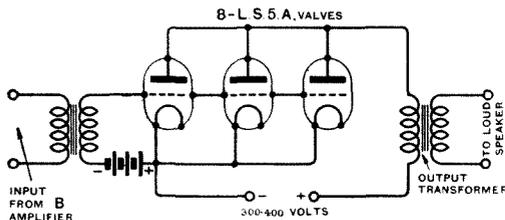


Fig. 2. Schematic circuit of the "C" Amplifier.

horn, Fig. 4, and a photograph of the base parts in Fig. 5.

Fig. 6 is a photograph of the base parts of the large loud speaker showing the magnetic system, the diaphragm, the central core for the air chamber and the base of the horn.

The large loud speaker on its stand is shown on the previous page.

The magnetic system in the larger type consumes 4 amperes at 6 volts and a field of 9,000 lines per square centimetre is produced across the gap.

The moving coil has a resistance of 9 ohms—and will carry for some considerable time

± 2 millimetres, and consequently the moving coil system has to be constructed very strongly. In the design work the longest time was taken in making a satisfactory diaphragm.

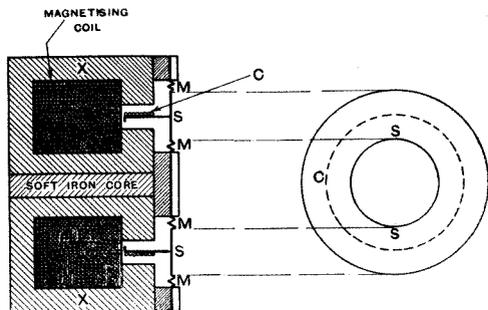


Fig. 3. A diagrammatic section through one of the loud speakers (not to scale).

The connections to the winding gave a great deal of trouble on account of the continual bending, but all these difficulties have now been completely overcome.

The output transformer of the amplifier is arranged with tappings to permit of several loud speakers being connected if necessary, in each arrangement with the correct terminal condition. It is now usual to have a transformer with each loud speaker to permit of a high impedance line being used with it, so

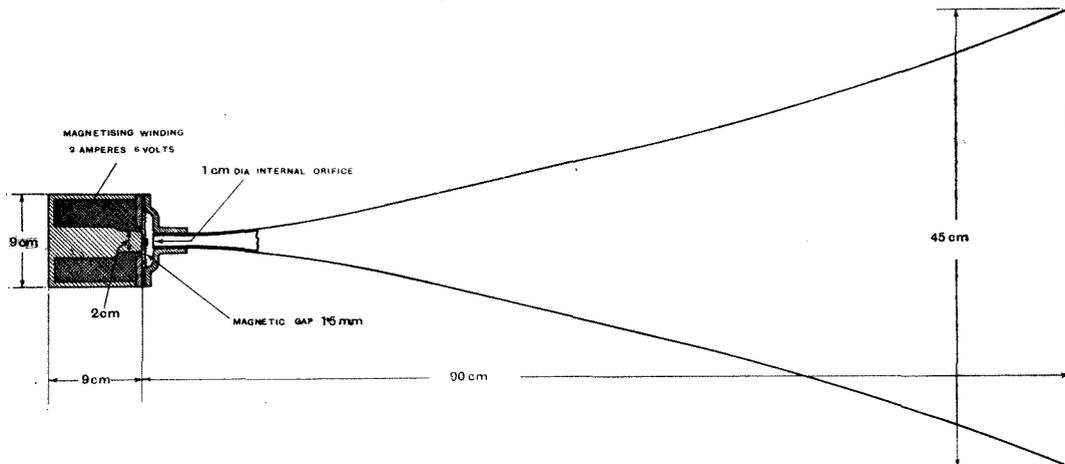


Fig. 4. A dimensional sketch of the small type commercial loud speaker.

one ampere of alternating current—about 10 watts.

that long leads up to a mile or so may be employed if necessary.

The amplitude of movement of the diaphragm system can be as much as

The large system described above is suitable for very big demonstrations and is

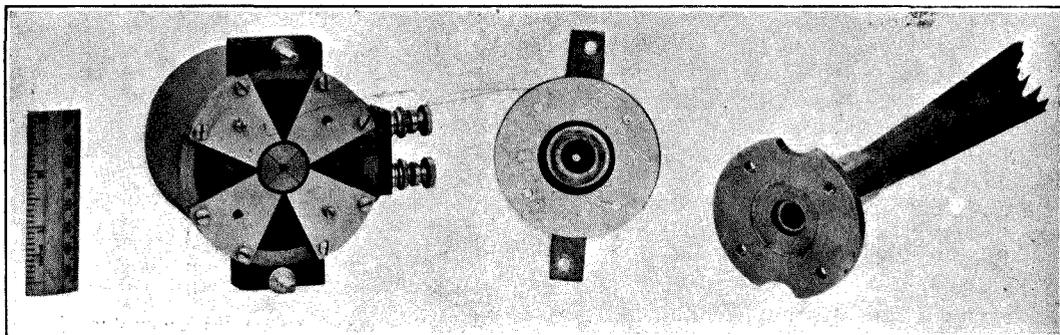


Fig. 5. Detailed photograph of the base parts of the smaller loud speaker, showing the magnetic system, the diaphragm and the horn base.

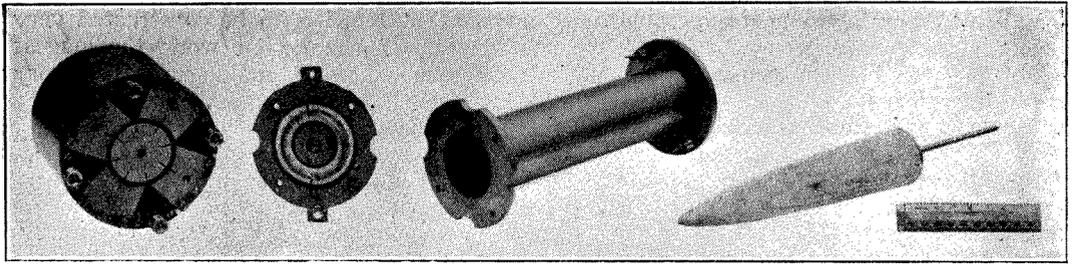


Fig. 6. Base parts of the large loud speaker showing the magnetic system, diaphragm, outer tube of horn base, and inner cone.

necessarily expensive both initially and to maintain. A smaller system has been produced which will be described in these pages shortly. In this system both the initial

The difficulty of all public speech work when the microphone is near the loud speaker system is reaction—that is the sound from the loud speaker gets back to the microphone and eventually at some magnification the whole system howls.

It is easy to see that this effect will be worse in a hall with echo. The actual strength from the loud speaker which can be produced is inversely as the distance of the original sound from the microphone.

Now with an orchestra it is very difficult to get near every instrument with one microphone and a number will have to be

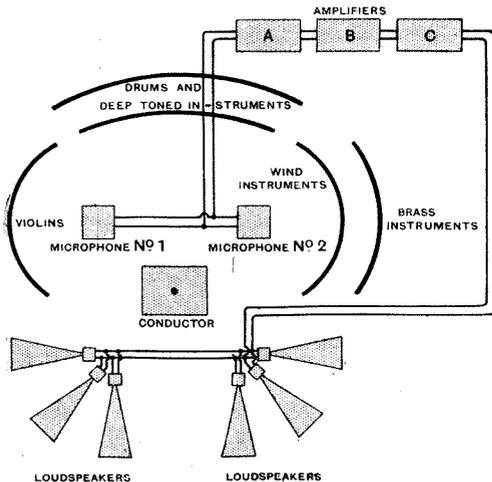


Fig. 7. A plan to indicate the best distribution of microphones and band instruments.

expense and the maintenance costs have been greatly reduced at the expense of some loss of quality and strength.

I will now give one or two examples of the use of the complete apparatus. On the election night a demonstration was given at the Albert Hall for the *Daily Mail*, at which the announcing of election result alternated with amplified gramophone records and the magnification of the Piccadilly Orchestra and various singers.

The announcements were made from another room and this problem exhibited no difficulties, but to amplify an orchestra was not quite so easy.

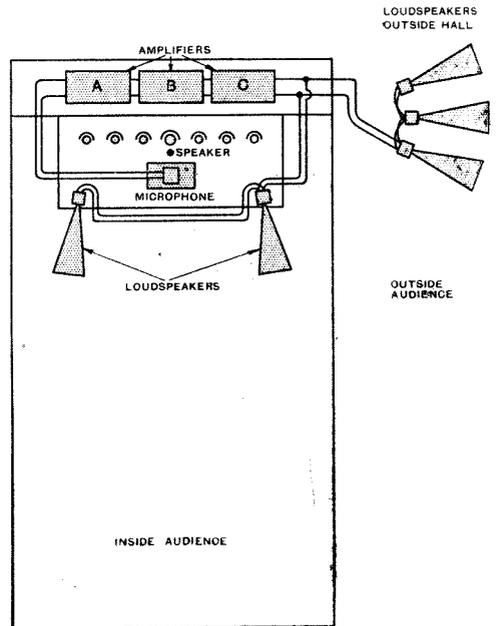


Fig. 8. Plan showing how the apparatus should be arranged so that a speaker in a hall may address two audiences at once.

used to give the right effect. The actual arrangement used is shown in Fig. 7, where there are two microphones, one for the violins, one for the wind instruments and brass instruments, whilst the other big instruments take care of themselves. By adjusting the magnetising currents of each microphone a correct balance is obtained and a very large amplification of the band is produced without any serious disturbance of the normal distribution of the orchestra.

It will be noted that the microphones are always put at the back of the loud speakers. The horn of the loud speaker tends to give a marked shadow at the back, thus reducing the tendency to reaction.

Another condition which occurred frequently during election time was the amplification of the speaker's voice in a hall and the transmission of the voice to overflow audiences outside. The arrangement employed is illustrated in Fig. 8. Actually the

outside loud speaker can be used at full strength as there is little tendency to reaction, since they are shielded from the microphone, but the inside loud speakers shunted on to these outside ones are controlled with a series rheostat and brought up to the strength the system will stand, *i.e.*, nearly up to the howling point. Occasionally, in certain halls, under these conditions, when packed with people, no reaction trouble was shown, but in this case another curious trouble was experienced. As the microphone and speaker were both in a strong sound shadow, the speaker did not instinctively realise how powerful his voice was against interruption, and so did not use that power to the full.

A technical solution of the difficulty is to give the speaker headphones shunted on to the loud speaker, but the practical solution is to instruct the speaker to go ahead and find out by the effect of his speech on the audience how strong his voice is.

### A GERMAN BROADCASTING PLANT.

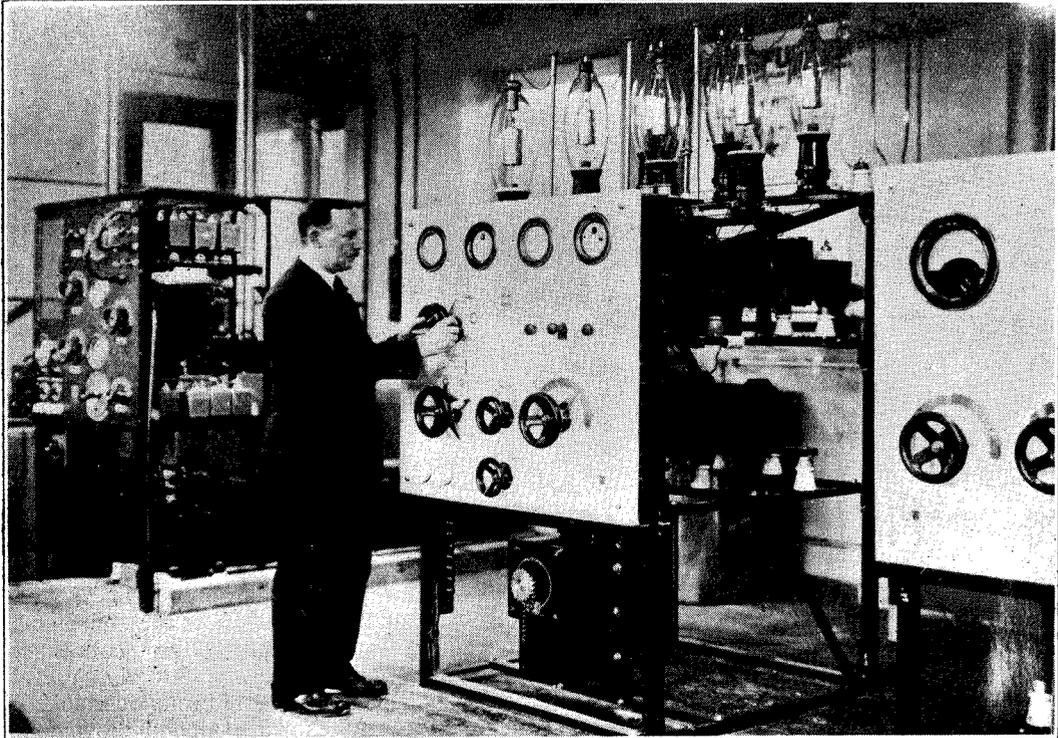
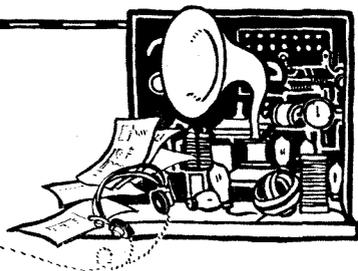


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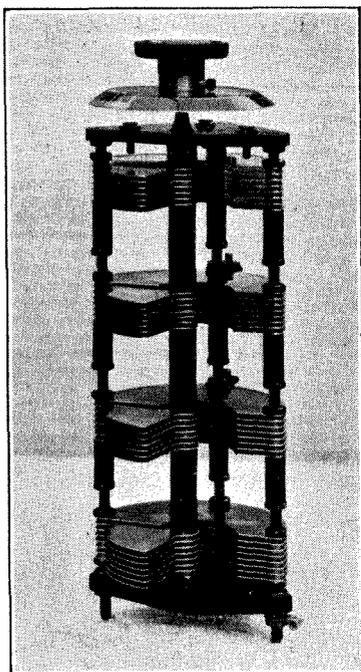
*A view in the transmitting room of broadcasting station installed at the recent Berlin Wireless Exhibition. The station may remain in permanent use.*

## NEW APPLIANCES.



### The Bowyer-Lowe Quadruple Condenser.

Multiple condensers consisting of sections controlled by the movement of a single knob and dial have many applications. When the sections are exactly equal in capacity value throughout the entire range such condensers are occasionally employed

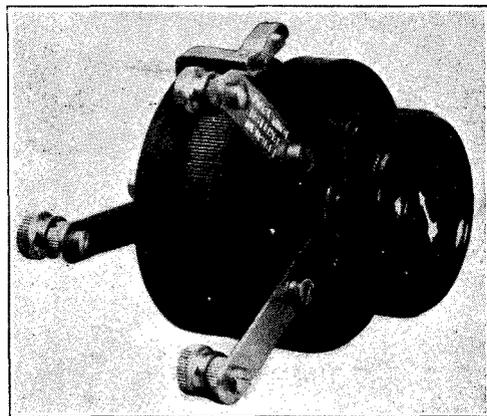


*The four-section condenser, a product of Bowyer-Lowe.*

for simultaneously tuning a number of oscillatory circuits, whilst sometimes this arrangement is adopted for uniformly controlling self-oscillation. The somewhat unique condenser shown here may be found to have many useful applications in experimental work.

### The Ediswan Potentiometer.

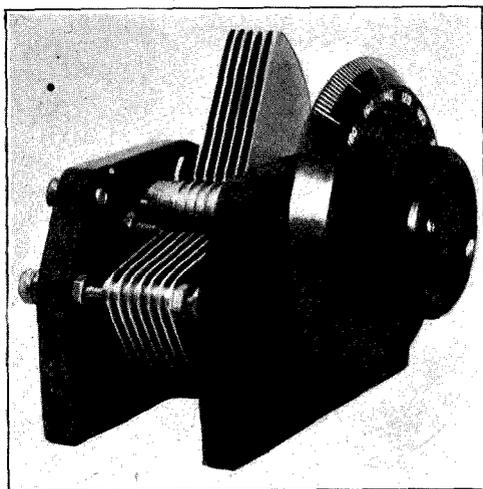
The resistance wire, which has a value of approximately 300 ohms, is wound on a fibre strip held firmly in position between two circular end pieces. Reliable contact with the resistance wire is made by means of a brush attached to the end of the rotating arm and owing to its special shape has a particularly smooth action.



*The Edison Swan Electric Co.'s potentiometer.*

### A New Square Law Condenser.

The Edison Swan Electric Co., Ltd., have recently introduced a condenser of the square law type. It is robust in construction, having its plates made of hard brass and nickel plated. The end pieces are made of thick insulating material of sufficient strength to overcome any chance of bending. Tapped holes are made at the sides of the end plates to allow for mounting the condenser on a baseboard, a particularly useful feature which has not been overlooked. The condenser has quite a good movement and it is with some satisfaction we observe

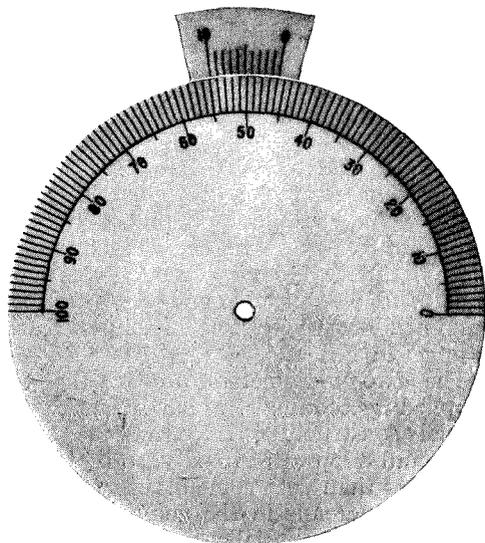


*Ediswan's new square law condenser.*

that the spindle makes a good fit in the bushes carried by the end plates. It is made up in three sizes, having capacities of 0.0003, 0.0005 and 0.001 microfarads.

**A Vernier Scale.**

To facilitate accurate reading of variable condenser settings a vernier dial has been introduced by Messrs. N. V. Webber. The dial itself is of good stiff ivoryine and is divided into a hundred sections. The fine

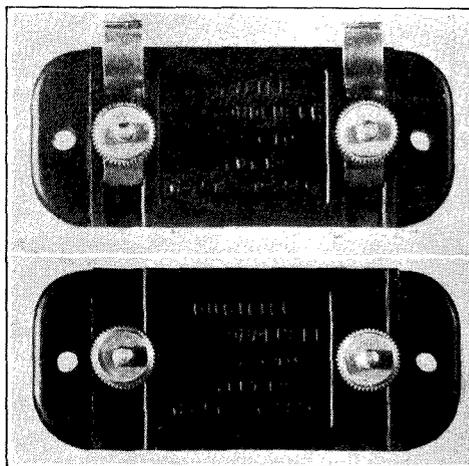


*A vernier dial made in ivoryine. Used on a wave-meter it provides easy reading to the 1/10 of a scale division.*

reading attachment has a suitably curved edge so that it fits well against the edge of the dial and by means of its use tenths of a division can be rapidly read off. This dial should prove exceedingly useful if fitted to a wavemeter when it is necessary to read to fractions of a scale division.

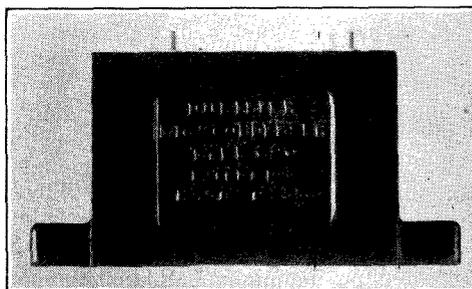
**The New Dubilier Fixed Condensers.**

The Dubilier Condenser Co. are now marketing small fixed condensers suitable as grid and blocking condensers, having a



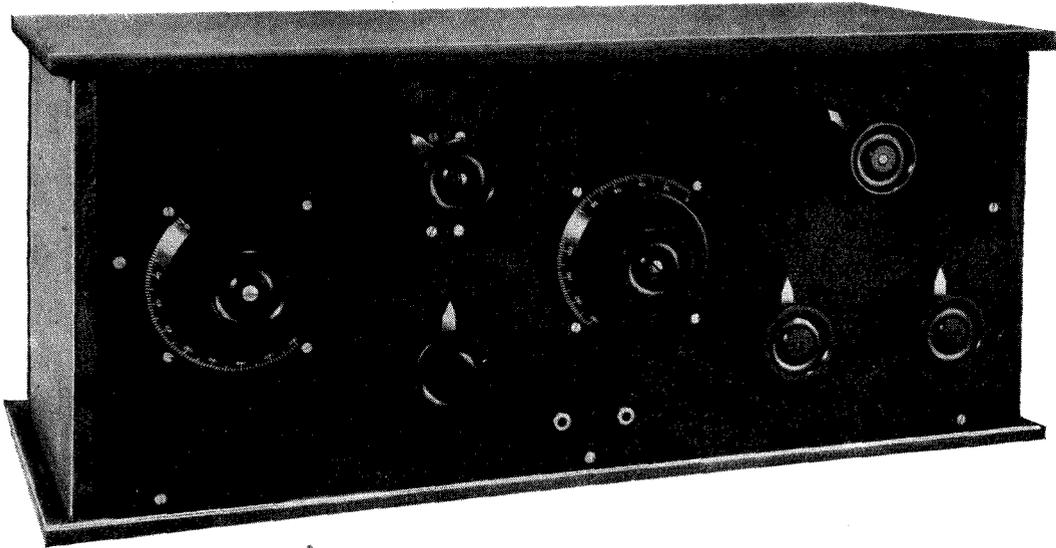
*The new Dubilier Type 610 condenser with detachable clips.*

somewhat different finish to the well-known 600 and 600A types. These condensers are a little larger in dimensions, whilst a new moulding material is used having a particularly clean appearance. The type intended



*Another new product of the Dubilier Co. Condenser Type 620.*

for use as a grid condenser is fitted with milled terminals and clips can be fitted if required so that the leak can be mounted across it.



## A TWO-KNOB THREE VALVE RECEIVER TUNING FROM 250—2,800 METRES.

The set described in this article has been designed for extremely simple tuning over all broadcasting wavelengths. Only two tuning controls are provided and the settings of these are made to correspond so nearly that ease in tuning is assured.

By HUGH S. POCOCK.

**T**HE three-valve receiver to be described in this article may conveniently be referred to as a "two-knob set," not because there are only two knobs, for the photograph shows that there are seven, but because all the tuning can be done by means of the two knobs which carry dials. The range in wavelengths of the set is approximately from 250 to 2,800 metres, so that all the broadcasting stations of the British Broadcasting Company, as well as the Continental broadcasting stations, are included.

Those who are interested in the reception of broadcasting stations and who customarily use the very popular types of receivers where plug-in coils are employed, find that it is very tiresome to have to change several coils in order to go over from the local station to 5 XX or *vice versa*, and the two independent programmes now being transmitted make it still more desirable to be able to change over rapidly from one wavelength to another. This was the principal consideration in the design of this receiver.

It is possible to receive the local station or 5 XX at will, and to change over from one to the other almost instantaneously without any other adjustments except the movement of the switch between the two dials and the readjustment of these two for the new wavelength.

The two dials are fitted to the spindle of two variometers, one in the aerial circuit and one in the plate circuit of the high frequency valve. The set consists of one high frequency stage (anode variometer tuned), detector, and one stage of L.F. amplification. The circuit in simplified form is given in Fig. 1.

The two variometers are of the type supplied by Sterling's, which, owing to their special construction, have a wide tuning range and a low self-capacity, so that tuning is sharper than with some other types. The first variometer is in the aerial circuit, and therefore has the aerial capacity permanently in parallel with it. In order that the setting of the two dials may be approximately the same, for the sake of ease of adjustment, a

fixed condenser is arranged to be in circuit in parallel with the anode variometer on all wavelengths, and the value for this is chosen as  $0.0002 \mu\text{F}$ , which is assumed to be the capacity of the average aerial when a  $0.0005 \mu\text{F}$  condenser is in series with the aerial.

The next consideration was to arrange for obtaining the requisite tuning range without complicated switching or wiring.

LONG WAVES.

For the longer waves the windings of the variometers remain as for the medium range, but two fixed condensers each of  $0.0005 \mu\text{F}$  are inserted in parallel with the windings of each variometer. The aerial capacity compensating condenser is also left in parallel with the anode variometer, whilst the  $0.0005 \mu\text{F}$  condenser across the aerial variometer is that which in the other positions

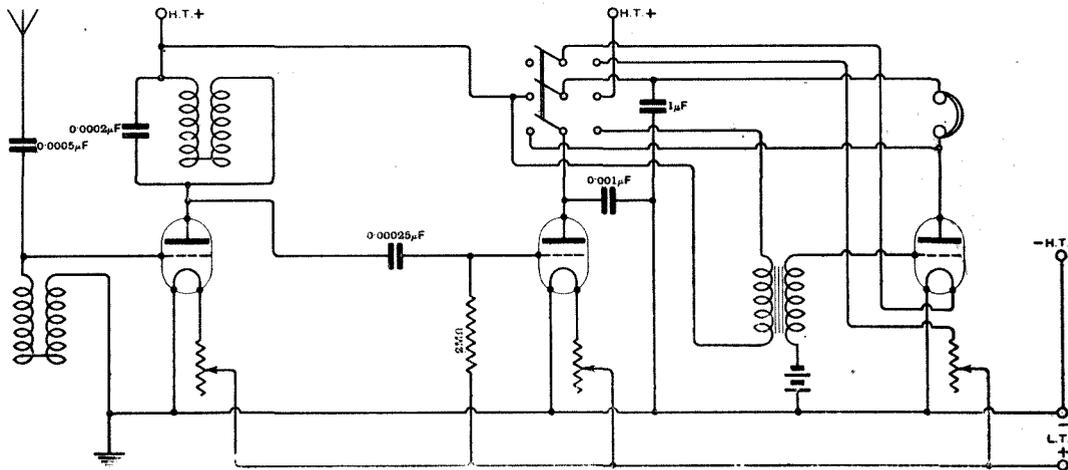


Fig. 1. Diagram of the circuit employed.

SHORT WAVELENGTHS.

For the short wavelengths the windings of each variometer are required to be in parallel, so reducing the inductance values. The aerial compensating condenser is included across the anode variometer, and a fixed condenser of value  $0.0005 \mu\text{F}$  is inserted in series with the aerial lead (Fig. 2 position 1). In this way one is starting the tuning range at the minimum of the variometer, which is approximately 250 metres.

MEDIUM RANGE.

For the medium wavelengths the inductance of the variometers is increased by arranging the windings of the stators and rotors in series, and the tuning ranges as indicated by the two dial settings are brought to approximately the same by introducing again the aerial compensating condenser referred to above across the anode variometer, and leaving the series fixed condenser in the aerial circuit (see Fig. 2, position 2).

was in series with the aerial (see Fig. 2, position 3).

It might at first appear that in order to obtain these various conditions for three different ranges the switching arrangements would be exceedingly complicated. This, however, is not the case, and although considerable thought had to be given to working out how it could be done in the first instance there is no great difficulty to be encountered in arranging the switching when it is set out as in the accompanying illustrations. All the necessary circuit arrangements can be done on one barrel switch, and for this receiver a five-contact barrel switch of Sterling type has been chosen. The three ranges of wavelength (Fig. 2) are made with three positions of the switch, and since the connections to the switch are the only real difficulties in constructing the set these are explained in considerable detail in the drawings. First of all the barrel of the switch, which is of ebonite, will be found to be supplied with a number of round-headed

screws, and these have to be screwed out in places and inserted in other holes provided, as is clearly indicated in Fig. 3. These screw heads have no connections to them, but

screws in the correct position as indicated in Fig. 3, the next step should be to solder all the strap connections of the switch, as shown in Fig. 4, because whilst it is easy to do

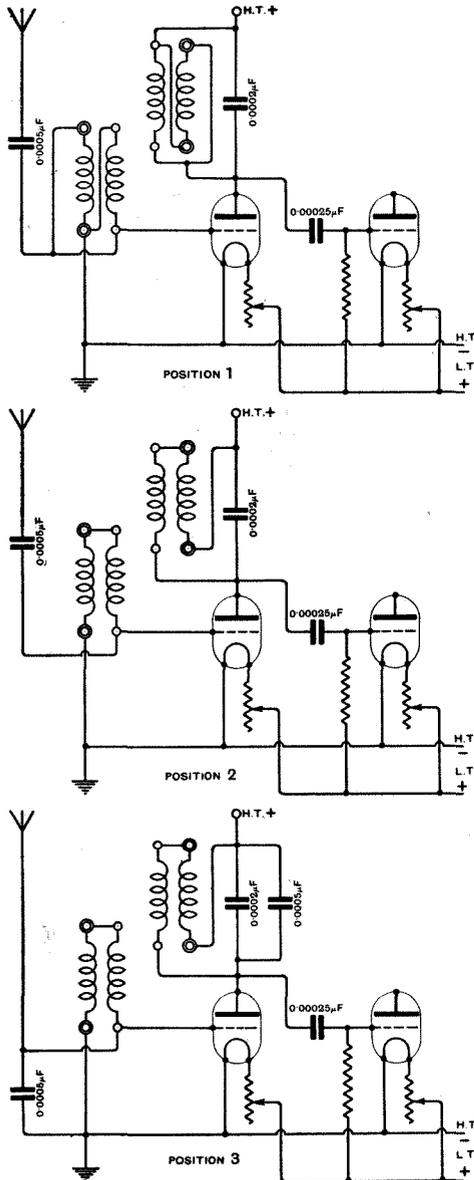
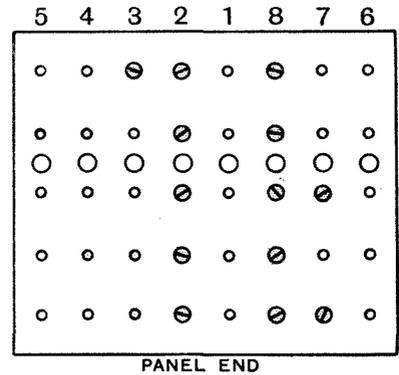


Fig. 2. Showing the circuit arrangement in the three positions of the barrel switch.

merely serve to bring together the contact blades of the switch where connection is required to be made. Having arranged the



PANEL END

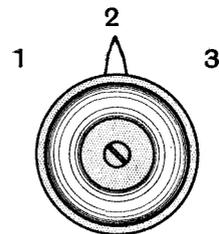


Fig. 3. Showing where the screws should be inserted in the barrel.

this when the switch can be handled freely, it would be an extremely difficult job to undertake after the switch had been fitted to the panel. My own view is that it is always more convenient when working from a definite and dimensioned design to

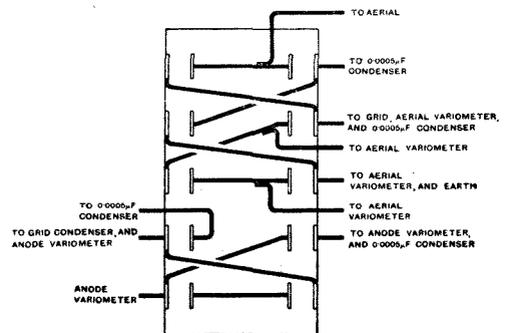


Fig. 4. Strap connections of the barrel switch which should be made before the switch is mounted on the panel.

do as much as possible of the soldering of connections before the components are mounted, because, in proportion to the number of components fitted to the panel, so the inaccessibility of different points to be soldered becomes greater. Next, as many of the remaining leads from the switch

very carefully checked over, because to find after all the wiring had been done that a wrong connection on the switch had been made would be more than exasperating, because of the difficulty of getting at the connections afterwards.

It may be thought that it is rather out of

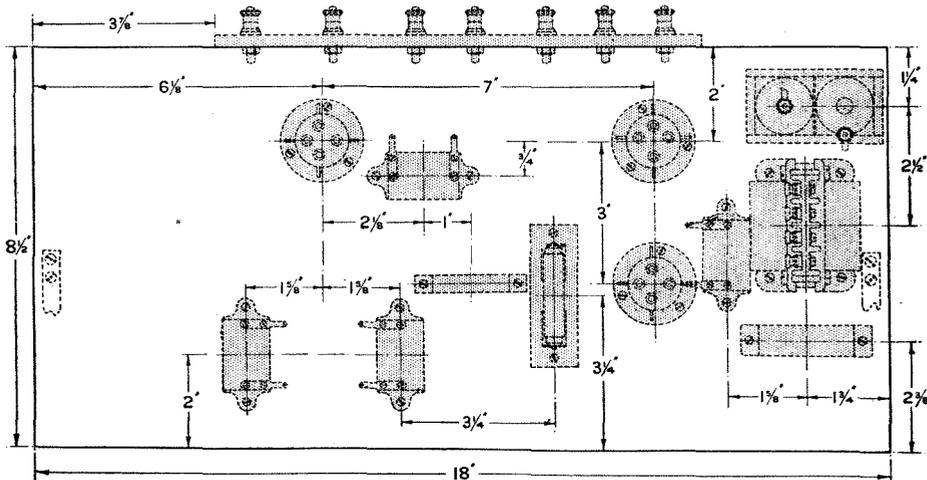


Fig. 5. The lay-out of components on the base.

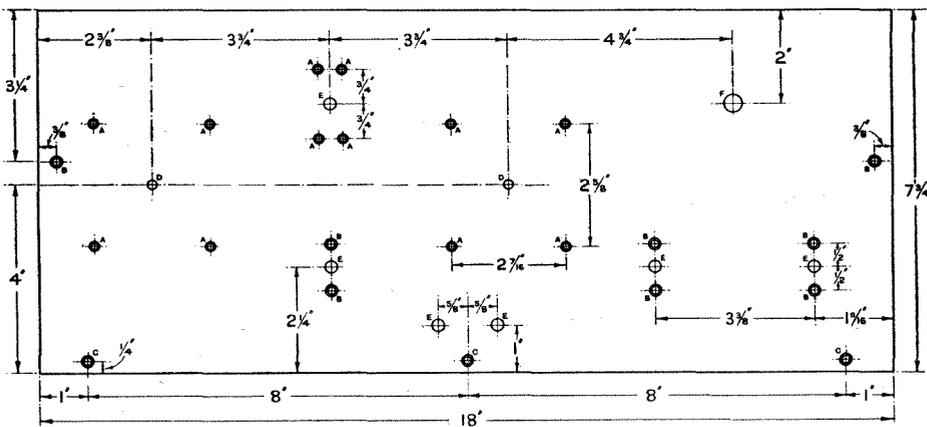
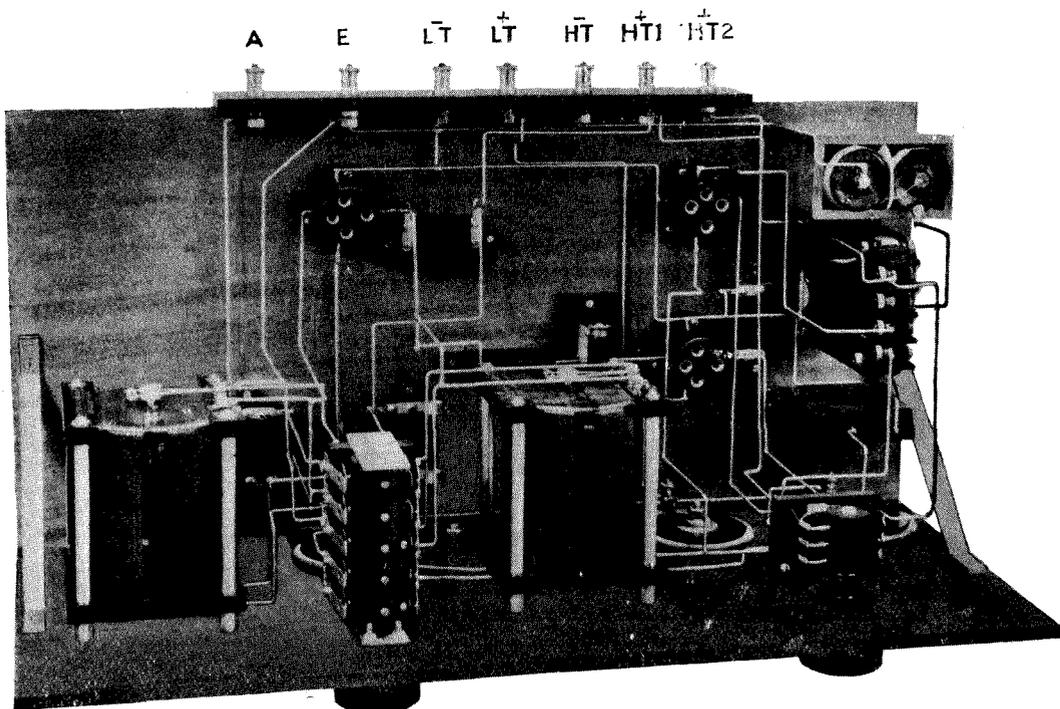


Fig. 6. Diagram for panel drilling. Dimensions for holes are as follows:—A,  $\frac{1}{8}$ " dia. countersunk for No. 6. B.A. screws. B,  $\frac{5}{32}$ " dia. countersunk for No. 4. B.A. screws. C,  $\frac{1}{8}$ " dia. countersunk for No. 4 wood screws. D,  $\frac{7}{32}$ " dia. E,  $\frac{1}{4}$ " F,  $\frac{3}{8}$ " dia.

as possible may be soldered, giving consideration to the requisite length and direction of the various leads to the points of attachment to other apparatus. The utmost care must be taken to see that all the switch connections are correctly made, and this part of the work should be

order to discuss the wiring of a component before dealing with other parts of the set, but the reason the switch is taken first is because, as stated above, it comprises the hardest part of the construction, and once that has been understood correctly the rest is "plain sailing."



*A photograph showing details of the layout and wiring of the components.*

It will be noticed from the layout of the base (Fig. 5), that the spacing of the components had been rather on the generous side. This is partly because, in my opinion, it is seldom worth while to cramp components and thereby add considerably to the work of construction, and especially wiring with only a small gain in appearance; but the principal reason is that it was necessary to provide reasonable spacing between the variometers in order to avoid coupling between them. If they were brought closer together they would couple in some positions of the rotors, and not in others, resulting in very unsatisfactory operation of the receiver, and screening would have to be resorted to as a compromise remedy.

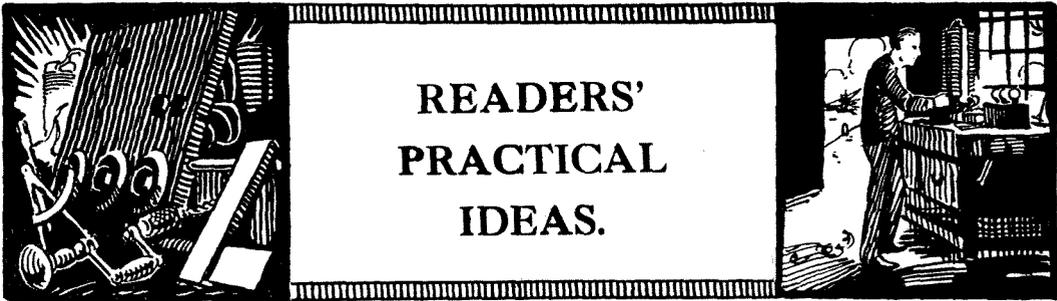
In Fig. 6 is given the dimensions of the ebonite panel, with positions and dimensions of holes to be drilled to accommodate the components used in the receiver.

If any other components are made use of as alternatives the reader must ascertain the

correct holes and positions for them. A complete list of the parts used in this set is as follows:—

- Ebonite panel, 18 ins. by  $7\frac{3}{4}$  ins.
- 2 Sterling variometers.
- 1 Sterling barrel switch, type R 2837.
- 1 Igranic L.F. transformer, ratio 3 to 1.
- 3 Ormond filament resistances.
- 3 Burndept valve holders.
- 1 „ grid leak, 2 megohms.
- Dubilier fixed condensers of the following values: 0.00025, 0.0002, 0.001 and two of 0.0005.
- 1 Fixed condenser, 1 microfarad.
- 1 Utility three-pole two-way switch
- 1 Two-cell grid bias battery.
- 7 Terminals.
- 2 Plugs and sockets for telephones.
- 1 Wood base, size 18 ins. by  $8\frac{1}{2}$  ins. by  $\frac{3}{8}$  ins.
- 2 Brass brackets.

*(To be concluded.)*

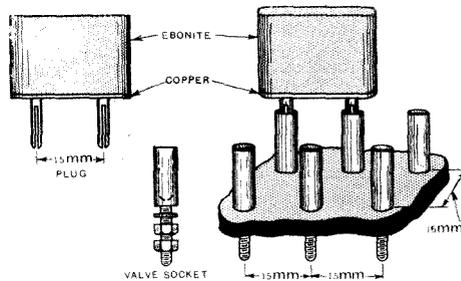


This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

**A Simple Switch for Valve Amplifying Stages.**

THE use of pin and socket connectors for switching purposes is often adopted by amateurs in the design of their sets and the circuit layout shown here has been developed so that valves may be thrown in and out of circuit efficiently and without the use of expensive multi-contact switches. Bridging connectors are made up from pieces of ebonite and pairs of valve pins. Five of these are inserted in a set of five and another set of six valve sockets. The method of connecting these sockets in the circuit is shown and for simplicity the filament leads are omitted. The following connections provide for using any arrangement of valves from one to five. With sockets 4 and 5 and 6 and 8 bridged the set is a single valve detector, 4 and 5, 6 and 7, and 8 and 10 bridged gives detector valve with one note magnifier. With 4 to 5, 6 to 7, 8 to 9, and 10 to 11 gives detector valve with two note magnifiers; 2 to 4, and 6 to 8, gives

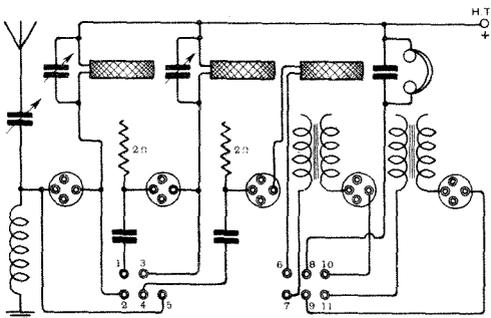
one high frequency amplifier with valve detector; 2 to 4, 6 to 7 and 8 to 10 gives one H.F., detector and one L.F.; 2 to 4, 6 to 7, 8 to 9 and 10 to 11 gives one H.F., detector



Details of the bridging pieces.

and two L.F.; 1 to 2, 3 to 4, and 6 to 8 gives two H.F. and valve detector; 1 to 2, 3 to 4, 6 to 7 and 8 to 10 gives two H.F., detector and one L.F.; 1 to 2, 3 to 4, 6 to 7, 8 to 9, 10 to 11 gives two H.F., detector and 2 L.F.

L. V.



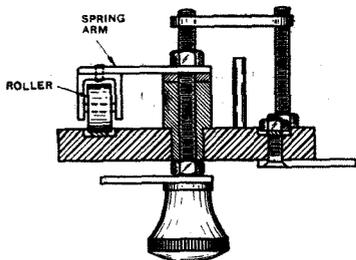
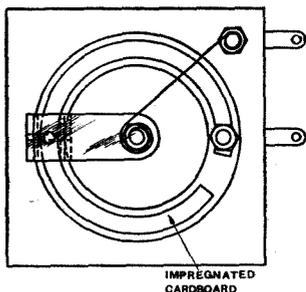
Circuit connections of sockets numbered 1 to 11, into which bridging pieces are inserted for changing the number of valves in circuit. The diagram has been simplified by omitting the L.T. battery leads.

**Another Variable Grid Leak.**

ONE disadvantage possessed by many of the types of variable grid leak available is that they are not fitted with an indicator showing to some extent the value of the resistance in circuit.

The variable grid leak illustrated is arranged to give maximum and minimum values in slightly less than one revolution and can be fitted with a scale calibrated to known values which will remain reasonably constant. The ebonite plate is about 2 ins. square by about 1/4 in. in thickness and has a circular groove 1/4 in. wide by 1/16 in.

deep. A metal bush is fixed in the centre for carrying a rotating arm and spindle. A ring is made  $\frac{1}{32}$  in. thick of good quality cardboard  $1\frac{1}{2}$  ins. outside diameter by  $\frac{1}{8}$  in. wide and with a small segment cut away. This is soaked in drawing ink for several hours until it is thoroughly impregnated, after which it is removed, dried and fastened with gum to the bottom of the groove. Connection is made with the end in the manner shown. The contact roller is of brass and should have a highly polished surface. It is mounted by means of a small carrier on an arm constructed of springy brass. Connection between the arm and one of the tags is made by means of a spiral of phosphor bronze strip. Suitable sizes for



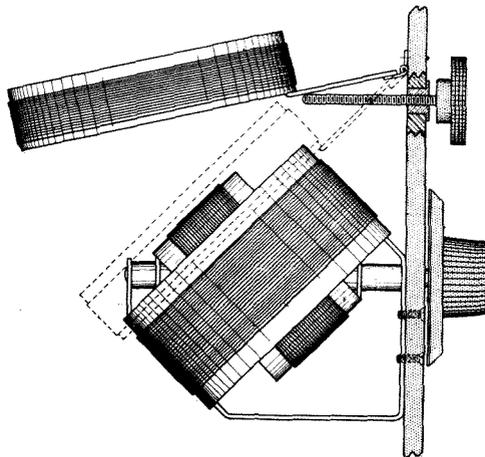
*Variable grid leak construction with pointer passing over a scale to indicate value of resistance in circuit.*

the roller are  $\frac{3}{8}$  in. diameter  $\frac{3}{16}$  in. wide, and with a  $\frac{1}{32}$  in. hole for pivoting. This instrument when completed was found to have a maximum resistance value of about 4 megohms and a calibrated scale was made giving values of  $\frac{1}{4}$ , 1, 2, 3, and 4 megohms.

A. E. S.

### Reacting on to a Variometer.

WHEN a variometer is used for tuning aerial or anode circuits, reaction is usually needed to bring about an increase



*Reaction coupling with a 180 degree variometer.*

of signal strength and selectivity. The arrangement of the coils of a variometer renders the setting up of reaction coupling rather difficult and a suggested method is shown here, of suitably adjusting the position of the reaction coil as applied to the 180 deg. type of variometer. The reaction former is wound upon an ebonite or cardboard cylinder and attached to the panel by means of a short piece of brass soldered to a small hinge. It is propelled away from one of the variometer coils by means of a No. 0 B.A. screw passing through a threaded bush.

J. T.

### A Simple Way of Matting Ebonite.

A quick and easy way of producing a good matt surface is to mix water with a little Vim, producing a thin paste. Place some of the paste on a small hard brush and well scrub the surface of the ebonite, being careful to scrub always in the same direction. When the matting is finished wash the surface of the panel in water and dry thoroughly. This method of matting leaves a soft and velvet-like finish.

J. C. L.

# THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

## Anode Resistances.

It is generally agreed by experimenters who have studied the resistance-capacity method of speech-frequency amplification that for good results it is essential to employ *wire-wound* resistances. The results obtained from a resistance-capacity coupled amplifier employing anode resistances of the grid leak type are usually unsatisfactory and disappointing. There is generally a background of noise—not a very violent crackling noise to be sure, but a buzzing noise which is sometimes of sufficient intensity completely to spoil the quality of the reproduction. That the noise is due to the anode resistances may be found by replacing them with wire-wound resistances of similar value.

As the anode resistances only have to carry a small current, of the order of 1-5 milliamperes, a very fine gauge of resistance wire may be employed. The table below gives the properties of several Eureka\* wires from which the reader will be able to estimate the amount required for anode resistances of any value. The most suitable value depends, among other things, on the type of valve employed. Usual values are 40,000 to 80,000 ohms.

EUREKA RESISTANCE WIRE.

Gauge S.W.G.	Resistance ohms per 1000 yds.	Turns per inch of D.S.C. wire.
47	214,284	238
46	148,764	217
45	108,648	200
44	83,664	192
43	66,136	179
42	53,564	167
41	44,268	150
40	37,184	142

The anode resistances should preferably be wound non-inductively and to have a minimum value of self-capacity in order

\*London Electric Wire Co.

that the impedance of the units shall not appreciably vary with frequency. However, there is usually no need to go to great trouble to make them absolutely non-inductive or to wind them in a special manner to have a very low value of self-capacity.

A convenient former consists of a piece of ebonite rod having a number of grooves after the style of some types of tapped high-frequency transformers and anode reactances. Such a former is sketched in Fig. 1, and might, for instance, consist of a piece of ebonite rod two inches in diameter and 3 inches long with eight grooves 0.1 ins. wide and 0.2-0.3 ins. deep.

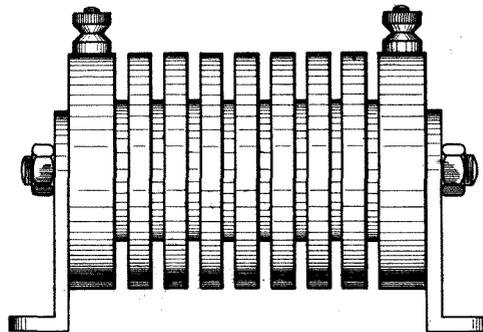


Fig. 1. A suitable former for a wire-wound anode resistance.

To make the winding practically non-inductive, wind, say, 25 turns in the first slot and then wind 25 turns in the second slot in the same direction. Now wind 25 turns each in the first and then the second slots in the opposite direction. Continue the work by putting as many turns as required in the first and second slots; then pass to the second pair of slots and so on until the resistance has the desired value.

For anode resistances No. 45-47 gauge wire, with a double silk covering is usually employed.

Those who do not want to make their own wire-wound resistances will find that Zenite rods, supplied by the Zenith Manufacturing Company, are very satisfactory.

### Resistances for Use in Transmitters.

The grid leaks employed in valve transmitters usually have a value of 6,000-15,000 ohms. Sometimes it is an advantage to have them variable in steps up to 30,000 ohms.

They may carry considerably larger currents than anode resistances: hence a heavier wire, such as No. 40 Eureka should be employed.

The grid leaks may be wound as described above, but it should be borne in mind that they may get hot or burn out if too many wires are wound in a single groove. It is better to provide a number of shallow grooves in the ebonite former.

A satisfactory grid leak may consist of strips of micanite wound with wire and slightly spaced. The strips may be supported below the surface of a panel of ebonite, and the tappings made to sockets or terminals mounted on the panel.

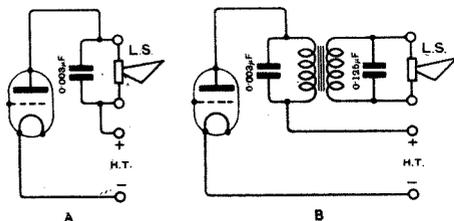


Fig. 2. The tone of music or speech may be improved in some instances by the use of fixed condensers.

### Improving the Quality of Reproduction from Telephones.

It appears that no matter how good the wireless receiver itself may be it is possible to improve the quality of the reproduction from head telephones or loud speakers by the use of chokes and condensers. It is, of course, well-known that certain manufacturers recommend users of their products to connect a fixed condenser of rather large capacity across the telephones (or loud speaker). For instance one manufacturer recommends the values given in Fig. 2. Many experimenters, however, find that the results may considerably be improved by employing a condenser of one capacity for music, and a condenser of another capacity for speech.

The necessity for the use of correcting apparatus will more readily be appreciated when it is realised that the sound amplitude

produced by signals of a given electrical strength for different frequencies varies, in the case of head telephones, something after the manner shown in Fig. 3. From this curve we see that even though the amplifier may give perfectly undistorted amplification, the

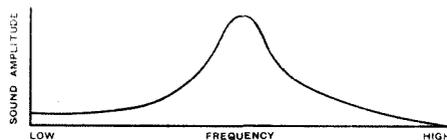


Fig. 3. Approximate characteristic curve for head-telephones.

amplitude of the notes will be very different to what they should be, because the head telephones respond very well to notes of intermediate frequency, and not so well to lower or higher notes.

The effect of the telephones in giving more sound for notes of middle frequency may be practically eliminated by connecting a rejector circuit in series, as indicated in Fig. 4.

The low frequency choke coil L and condenser C have values such that they offer a higher impedance to the currents of middle frequency. Thus this circuit, in series with the telephones, tends to make the characteristic of Fig. 3 a straight line.

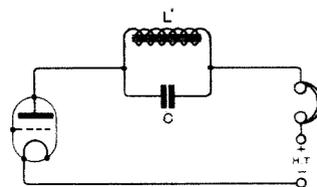


Fig. 4. A parallel circuit consisting of capacity and inductance employed to improve the quality.

Those who wish to make experiments will find that the primary winding of some types of low frequency transformer serve very well for the coil L. The value of the condenser C should be varied up to about 0.006 microfarads.

This method is not so suitable for improving the quality from loud speakers, because loud speakers in general have a curve which is very different to that of Fig. 3.

# WAVEMETERS.\*

By L. B. TURNER, M.A., M.I.E.E.

*Section 1.*—Introduction. *Section 2.*—Absolute Measurements. (a) Natural frequency of L, C, R circuit. (b) Oscillograph. (c) H.F. Alternator. (d) Lecher Wires. (e) Multi-vibrateur. *Section 3.*—Comparison of frequencies, and forms of calibrated instruments. *Section 4.*—Heterodyne wavemeters. *Section 5.*—Wavelength standards. *Section 6.*—Points in the design of an every-day wavemeter.

## (1) INTRODUCTION.

SOME seventy years ago Lord Kelvin proved theoretically that the discharge of a Leyden jar might be oscillatory—a fact with which every one of us now is very familiar, but which had been first suspected by the experimentalist, Joseph Henry, in 1842. Forty odd years have elapsed since Hertz, taking advantage of this fact, first said “Let there be electric waves,” and, behold, wireless telegraphy was created. During this brief period, and especially during the last quarter of it, the wireless science and art together have so progressed that to-day you and I, and a tenth of the population of the country, personally utilise and control these electric waves; we quote their length, and we measure the frequency of the associated currents—the rate of those alternations discovered by Joseph Henry, whose name we use whenever we specify the inductance through which these currents flow.

The intention of my paper is to sketch out the methods which may be used in measuring the frequencies met with in wireless; to describe very briefly some of the circuits and apparatus; and to consider the design of a wavemeter, which, in some form or other, is part of the necessary equipment of every experimentalist.

In case the relationship between wavelength and frequency, as these terms are used in the wireless jargon, is not perfectly clear to all, let me preface the following explanation.

Clerk Maxwell showed that every disturbance in free space (æther) propagates itself with the same velocity, say  $c$ ; and

\*A paper read before the Radio Society of Great Britain on Wednesday, November 26th, at the Institution of Electrical Engineers.

since light is an æther disturbance,  $c$  is often referred to as the velocity of light. It is found to be very nearly  $3 \times 10^{10}$  cm./sec. If the disturbance is periodic in time—if, for example, it is set up by an alternating current of frequency  $n$  p.p.s. in a wireless aerial—the disturbance takes the form of a wave, like the wave motion on the surface of a pond into which a stone has been cast; and if  $\lambda$  stands for the length of the wave (*i.e.*, the distance between crest and crest at any instant), we have the necessary relation

$$c = n\lambda$$

In cms. and secs.

$$n = \frac{3 \times 10^{10}}{\lambda}$$

$$\text{or } n \text{ (p.p.s.)} = \frac{3 \times 10^8}{\lambda \text{ (m)}}$$

Actually we more often observe  $n$ , the frequency of the alternating current in a circuit, than  $\lambda$ , the wavelength of the radiation; but since there is this fixed relation, it does not matter which we measure or specify; and the instrument which is really a frequency meter may be—and generally is—called a wavemeter, and be calibrated as such.

## (2) ABSOLUTE MEASUREMENTS.

### (a) Natural Frequency of L, C, R Circuit.

If the L, C, R circuit in Fig. 1 is disturbed, then left alone, it will oscillate (as we say) with a damped alternating current of frequency

$$n_0 = \frac{1}{\left(2\pi\sqrt{LC - \frac{R^2}{4L^2}}\right)}$$

$$= \frac{1}{(2\pi\sqrt{LC})} \text{ very nearly in lowly}$$

damped circuits.

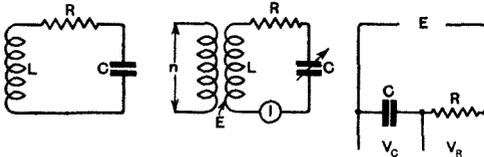
If, therefore, we can measure  $C$ ,  $L$  (and  $R$ ), we can calculate the frequency of the current produced. Alternatively, if we have available an alternating current of frequency  $n$ , we can excite the circuit therefrom by inducing in it an e.m.f.  $E$  of frequency  $n$ , as in Fig. 2. The current  $I$  then produced has the magnitude

$$I = \frac{E}{\sqrt{R^2 + \left(2\pi nL - \frac{I}{2\pi nC}\right)^2}}$$

and if we vary  $C$  or  $L$  until  $I$  becomes a maximum (viz.,  $\frac{E}{R}$ ), we have

$$2\pi nL = \frac{I}{2\pi nC}$$

$$i.e., n = \frac{I}{(2\pi \sqrt{LC})}$$



Figs. 1, 2 and 3.

Again, we can deduce  $n$  if we know  $L$  and  $C$ .

The difficulty is that we cannot measure  $L$  and  $C$  very accurately for such high frequency currents; especially are the stray capacities of the coil  $L$  and the leads very difficult to ascertain with accuracy. The latter difficulty could be eliminated by omitting  $L$ , as in Fig. 3, and adjusting  $C$  or  $R$  until the two P.D.'s  $V_c$ ,  $V_r$  were equal. Then

$$\frac{I}{2\pi nC} = R$$

$$i.e., n = 2\pi CR$$

But we should then be faced by the stray capacity across  $R$ , and the necessity of having an e.m.f.  $E$  of pure  $n$  frequency.

For such reasons it is not practicable to determine the high frequencies met with in wireless with great accuracy from measurements of  $C$ ,  $L$  and  $R$ .

(b) *Oscillograph.*

I remember that when I first became connected with wireless telegraphy we had in the Post Office a grant of (I think) £200 to be expended on attempts at the N.P.L.

to photograph the sparks across a gap in an  $L, C$  circuit. By actually counting the sparks shown in the photograph as occurring in a known fraction of a second the frequency of the current would be determined. This method has the virtue of extreme directness, requiring measurement only of time and number; but it is very cumbersome and difficult, and the presence of the spark gap is objectionable. More recent oscillographic developments of this same method are a great advance in practical detail. They are, I imagine, capable of giving accurate determinations, but are necessarily difficult and costly.

(c) *H.F. Alternator.*

When an alternating current is produced by an ordinary electro-mechanical machine, the frequency is easily found by the use of a watch and a revolution counter. A high-frequency alternator would thus constitute an ideal means for absolute determination of frequency and wavelength. Unfortunately for the high frequencies of wireless—at any rate those corresponding with the shorter wavelengths—such machines are impracticable, even as instruments for laboratory measurements.

(d) *Lecher Wires.*

Let a pair of long straight parallel thin wires be supported so as to be far from the ground and other conductors in comparison with their separation from each other. It can be shown that an electrical disturbance propagates itself along the pair with a speed given by an expression which, in practical cases, is sensibly equal to the velocity of propagation in free space, i.e., the "velocity of light." Hence frequency and wavelength of oscillations excited on these "Lecher wires" (as they are called) bear the relation already referred to. If, therefore, we excite such a pair with standing waves by coupling to a triode oscillator, as in Fig. 4, maxima of current will be developed at the spots  $I_1, I_2, I_3 \dots$ , and maxima of P.D. at  $V_1, V_2, V_3 \dots$ . On observing the positions of successive maxima or minima, by means of a Neon tube or otherwise, the wavelength is found as

$$\lambda = 2 (V_1 V_2) = 2 (V_2 V_3).$$

This, unlike all the other methods considered, is a direct determination of wavelength; we deduce  $n$  from an observed  $\lambda$ ,

instead of  $\lambda$  from a more or less directly observed  $n$ . The method was originally used with spark oscillators, the shock excitation of which introduces awkward complications, and it is obviously impracticable for long waves; but with C.W. oscillators it appears to be quite a feasible method, and has recently been used for wavemeter calibration by Townsend and Morrell.\* Their oscillator, whose wavelength was

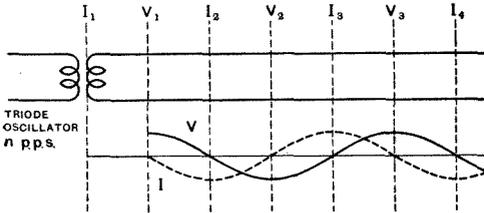


Fig. 4.

measured on the Lecher wires, had a frequency of some  $60 \times 10^5$  p.p.s. ( $\lambda=5m$ ), and was used to check a longer wave oscillator by the method of harmonics, of which more hereafter.

(e) *Multivibrateur.*

It is well known that any periodic quantity of frequency  $n = \frac{p}{2\pi}$  —i.e., repeating itself

every  $\frac{1}{n}$  secs.—can be analysed into the

sum of a series of harmonic terms of frequencies  $n, 2n, 3n \dots$ . More precisely, if  $i$  is any periodically varying current,  $i$  may be represented by the Fourier series,  $i = I_1 \sin (pt + \theta_1) + I_2 \sin (2pt + \theta_2) + I_3 \sin (3pt + \theta_3) + \dots$

provided that the amplitudes  $I_1, I_2 \dots$  and the phase angles  $\theta_1, \theta_2 \dots$  are suitably chosen.

We are not here concerned with the phase angles, but only with the amplitudes of the several harmonic terms. If  $i$  is itself a nearly pure sine current, as in most ordinary A.C. circuits, the harmonics  $I_2, I_3, I_4 \dots$  are small compared with the fundamental  $I_1$ ; but if  $i$  is of a suitably jerky character, the harmonics even far along in the series may be quite appreciable.

This fact was very elegantly utilised by Abraham and Bloch† in 1917. They devised a method of interconnecting two triodes with resistances and condensers, by which extremely sudden reversals of current could be effected at regular intervals, such, for example, as 1/1000 sec. This current is representable by the Fourier series already quoted, where now  $p = 2\pi \times 1000$ ; and owing to the very pronounced jerkiness of the current, the amplitudes  $I_2, I_3 \dots$  to beyond  $I_{100}$  are quite well marked.

Suppose we pass this current through a coil coupled lightly to a wavemeter circuit as in Fig. 2. Instead of the single frequency  $n$  in the coil on the left, we now have currents of frequencies  $n$  and  $2n$  and  $3n$  and  $\dots$   $100n$  and  $\dots$ ; and there will consequently be a maximum of current  $I$  whenever the wavemeter resonates to one of these frequencies. Supposing, for example, we turn the condenser handle over the part of the scale corresponding to wavelengths about 3,000 metres, there will be a current maximum at :

$\frac{n}{(p.p.s.)}$	$\dots$	99,000	100,000	101,000	$\dots$
$\frac{\lambda}{(m)}$	$\dots$	3,030	3,000	2,970	$\dots$

If the wavemeter circuit is sufficiently lowly damped—if its decrement

$$\delta = \pi \sqrt{\frac{C}{L}} R$$

is not greater than (say) about 0.02—these peaks will be distinguishable; and we can thus determine the frequency to which the wavemeter is resonant with precisely the same percentage accuracy as the fundamental frequency is known. It is quite easy to measure acoustic frequencies of the order of 1,000 p.p.s. by noting the beats with a tuning fork or other source of sound of nearly the same pitch; so that the wireless frequency of, say,  $h \times n$  is found as  $h$  times the fork frequency  $n$ , where  $h$  is known to be exactly 100 or 99 or 101 or whatever harmonic is chosen.

The triode arrangement used by Abraham and Bloch was designated by them a "Multivibrateur." But a clever man—or even a dull man now that clever men have shown us the way—can do almost anything with a triode or two, some time, and a little

\*Phil. Mag. XLII., p. 265 (1921).

†Ann. de Physique, 9e série, XII, p. 237 (1921).

money; and a variety of substitutes for the Multivibrateur can be employed. In particular, almost any ordinary triode oscillator thrown together in the laboratory will give currents fairly rich in harmonics; and if we are satisfied to pass from the acoustic frequency of 1,000 p.p.s. to the wireless frequency of 100,000 p.p.s. in two stages instead of one, we can fairly easily use an acoustic oscillator of 1,000 p.p.s. adjusted from a tuning fork, take its tenth harmonic to calibrate another oscillator of 10,000 p.p.s., and use its tenth harmonic to give us the frequency of 100,000 p.p.s. corresponding with the wavelength of 3,000 metres.

In the Multivibrateur method, and its variations, we have a very beautiful and quite practical means of making absolute measurements of high frequencies with all the precision of the time measurement involved in counting the periods per second of the fundamental frequency. But such absolute determinations most of us prefer to delegate to experts at the National Physical Laboratory or elsewhere, for establishing the standard signals transmitted for our service, or for calibrating instruments which we ourselves handle as substandards. These are our ordinary wavemeters; their scale indications we accept, and we use them for setting other instruments to equal wavelength. Accordingly, I pass now to—

(3) COMPARISON OF FREQUENCIES AND FORMS OF CALIBRATED INSTRUMENTS.

In theory, perhaps, the simplest arrangement which might be calibrated as a wavemeter is something of the sort shown in Fig. 5. With a variable condenser  $C$  or a variable resistance  $R$ , we can calibrate  $C$  against  $R$  to give equal currents  $I_C, I_R$ . There are three practical objections to such an arrangement:

- (i) Two current readings are needed.
- (ii) We can set  $C$  or  $R$  only to the same accuracy as we can read  $I$ .
- (iii) Large power is required because of the heat loss in  $R$ .

Objection (iii) is avoided on substituting an inductance  $L$  (with, let us suppose, negligible resistance) for the resistance  $R$  (Fig. 6). Objections (i) and (ii), however, remain.

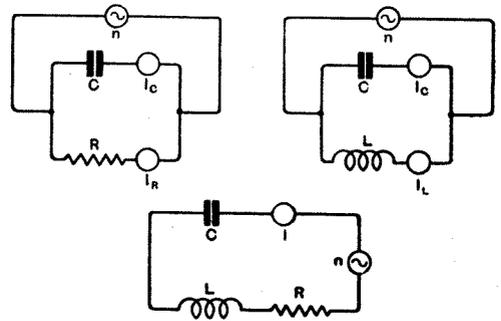
We avoid (i) and (ii) also if we impress the e.m.f., whose frequency we are observing, in series with  $C$  and  $L$  (Fig. 7) instead of

across them both. If  $E$  is that e.m.f. of frequency  $n$ , we now have, as we saw in Section 2, a maximum current  $I$  when  $C$  and/or  $L$  are adjusted to make

$$\frac{I}{2\pi nC} = 2\pi nL$$

i.e.,  $n = \frac{I}{(2\pi \sqrt{CL})}$

We have to make only a single observation of current, and we do not need to note its value, but merely to bring it to a maximum.



Figs. 5, 6 and 7.

That we do not know the true values of  $C$  and  $L$ , as explained in Section 2, does not matter when once the wavemeter has been calibrated in terms of frequency or wavelength.

Assuming that the scale of our wavemeter is correctly calibrated, how closely can we measure with it? This depends on:

- (a) How small is the change of  $I$  we can detect.
- (b) How low is the damping of the circuit?

If we plot a curve showing the values of  $I$  as  $n$  is varied, we get the familiar "resonance curve" of Fig. 8. The shape, the "peakiness," of this curve depends only on the "decrement"  $\delta$  of the circuit, where

$$\delta = \pi \sqrt{\frac{C}{L}} R.$$

Fig. 8 is drawn to scale for

the cases of  $\delta = 0.01$  and  $\delta = 0.1$ . It is easy to calculate that the current falls (say) 1 per cent. below its peak value on distuning the frequency by  $\frac{\delta}{\sqrt{2}\pi}$  of the resonance frequency. Taking the sharper curve, therefore, and assuming we could detect 1 per cent. drop of current, we could set our

wavemeter with an uncertainty not exceeding  $\frac{0.01}{\sqrt{2}\pi} \doteq 0.2$  per cent. ; and with the blunter curve similarly 2 per cent.

Thus, the lower the decrement of the wavemeter circuit, the better the wavemeter ; but for most purposes a very fair accuracy can be got even though the decrement is rather high. I may mention that an oscillatory circuit can be built with a decrement of 0.02 or 0.03 without great difficulty.

An ordinary wavemeter always takes the form of an oscillatory circuit, of the lowest decrement that considerations of size and cost will permit, provided with a scaled variation of either  $C$  or  $L$  or both. The outstanding features of design are the means by which it is coupled to the circuit

triode so that the whole generates steady oscillation at the frequency mainly determined by, and controllable by, the product  $LC$ . Such a wavemeter is usually called a heterodyne wavemeter, because it can be used to give the heterodyne effect with incoming C.W. signals or with another heterodyne wavemeter. By the heterodyne method two frequencies ( $n_1$  and  $n_2$ ) can quite easily be adjusted to equality within 100 or less periods per second. Suppose these frequencies correspond with wavelengths of about 300 metres ( $n = 10^6$  p.p.s.).

Then the ratio  $\frac{n_1}{n_2}$  or  $\frac{\lambda_2}{\lambda_1}$  is known to within 100 in a million, *i.e.*, to within 0.01 per cent. Observe that this very close comparison does not depend upon the provision of lowly damped circuits.

Another feature of the heterodyne wavemeter of great practical value is that it can be used as transmitter or as receiver without any changes in its circuits whatsoever. A pair of telephones is put in the H.T. battery circuit and left there whether the wavemeter is acting as transmitter or receiver.

Further, there are the harmonics of the triode oscillator. Sometimes these are a nuisance, and must be reduced in intensity as much as possible ; more usually they are of great utility, as extending the range of the instrument in the manner described in Section I (e). To generate a current rich in harmonics, the triode retroaction should be much greater than the critical amount causing oscillation to set in. If the even harmonics are wanted—and it is difficult to keep them out—the oscillation should be made strongly asymmetric by putting the mean grid potential well above or well below the value which makes the non-oscillating anode current equal to half the saturation current.

When two heterodyne wavemeters, both rich in harmonics, are used together, it is sometimes very difficult to ascertain which pair of frequencies are combining to give any particular heterodyne scream. Unless the scales of both instruments have been calibrated so as to be tolerably closely accordant already, it is desirable to reduce as much as possible the harmonics in one of the oscillators (A, Fig. 9), and to place the telephone in the other oscillator (B).

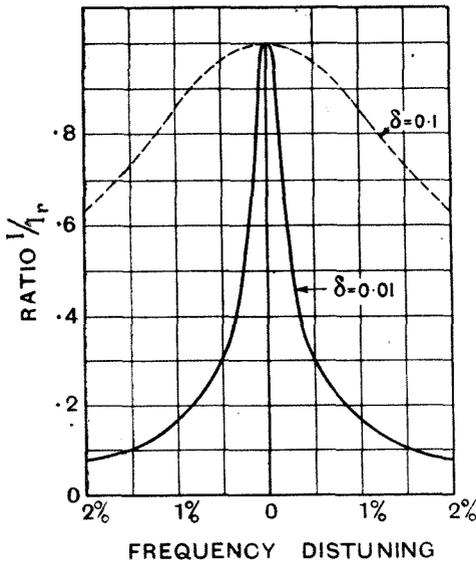


Fig. 8.

or source of e.m.f. under observation ; the means for detecting the amplitude of oscillation evoked when it is responding to an impressed e.m.f. (*i.e.*, acting as a receiver) ; and the means by which it is itself excited when it is required to act as a transmitter. I will touch on these points in Sections 4 and 6.

(4) HETERODYNE WAVEMETERS.

There is no need nowadays to emphasise the advantages of C.W. as opposed to damped train technique. An obvious way to excite our wavemeter circuit is to connect it to a

Heterodyne screams associated with harmonics of *A* are then more easily distinguishable (if heard at all) from screams got with the fundamental of *A* by the relative weakness of the former.

But even when one of the oscillators, *A*, is sensibly free from harmonics, doubts often arise as to which of the harmonics of *B* is causing a certain scream. A decision is come to most simply as follows. Suppose *B* is our standard wavemeter, and we wish to calibrate *A* from *B*'s harmonics, *A*'s indications at present being only roughly interpretable in terms of wavelength  $\lambda$ , capacity *C* or inductance *L*.

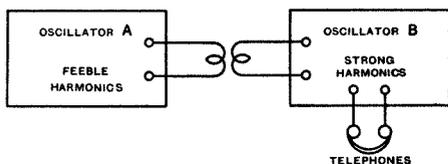


Fig. 9.

Set *B* to a known wavelength  $\lambda_B$ . Then we know that *B* is emitting currents of  $\lambda_B, \frac{1}{2}\lambda_B, \frac{1}{3}\lambda_B, \frac{1}{4}\lambda_B$ , etc. Turn *A* until a scream is heard, and let its middle be at  $\lambda, C$  or *L*, as roughly given by *A*'s scale. We then know that the accurate value of

$\lambda$  is  $\frac{\lambda_B}{h}$  where *h* is either 1, 2, 3, . . . , but

which of these integers we know not. Now decrease *A* until the next scream occurs, at  $\lambda^1, C^1$  or  $L^1$  (say). Then the value of *h* is given from the approximately observed

ratio  $\frac{\lambda}{\lambda^1} \left( \frac{C}{C^1} \text{ or } \frac{L}{L^1} \right)$  by Table 1, which is self-explanatory.

TABLE 1.

Standard Wavemeter	$\lambda_B$	$\frac{1}{2}\lambda_B$	$\frac{1}{3}\lambda_B$	$\frac{1}{4}\lambda_B$	$\frac{1}{5}\lambda_B$	$\frac{1}{6}\lambda_B$	$\frac{1}{7}\lambda_B$	—
<i>h</i>	1	2	3	4	5	6	7	—
$\lambda/\lambda^1$	2	1.50	1.33	1.25	1.20	1.17	1.17	—
$C/C^1$ or $L/L^1$	4	2.25	1.78	1.56	1.44	1.36	—	—

A single example will make this clear—an example taken from an actual calibration of Range 1 (100-200 metres) of the wavemeter described in Section 6.  $\lambda_B$  was 400 metres. Successive screams occurred at 44 degs. and 18 degs. on the scale. Rough calibration of the wavemeter on another range had shown

44 degs. meant 468 metres,  
18 degs. meant 357 metres, approximately.

Hence  $\frac{\lambda}{\lambda^1} = \frac{468}{357} = 1.31$  approximately.

Reference to the table shows that the harmonics were the third and fourth; and we have found that

44 degs. means  $\frac{400}{3} = 133.3$  m.

18 degs. means  $\frac{400}{4} = 100.0$  m.

precisely. Later on, the position 18 degs. was found again with the fifth harmonic of  $\lambda_B = 500$  m.

The harmonics procedure enables one to calibrate over any range of wavelengths by the use of a few known wavelengths. Thus suppose we have only a wavemeter whose calibration from 300 metres to 600 metres is reliable. An oscillator may be adjusted by use of this wavemeter to yield the frequencies, say, shown in the first row of Table 2.

TABLE 2.

Millions of periods per second.

.5	.6	.7	.8	.9	1
1	1.2	1.4	1.6	1.8	2
1.5	1.8	2.1	2.4	2.7	3
2	2.4	2.8	3.2	3.6	4
2.5	3	3.5	4	4.5	5

while the frequencies of the second, third, fourth and fifth rows are given by the second, third, fourth and fifth harmonics. Ignoring the small-figure terms (which are, however, useful as checks), a series of well-distributed points of known wavelength are obtained covering the whole range 600 metres—60 metres.

(To be continued).

# PATENTS AND ABSTRACTS



## An Automatic Filament Safety Switch.

In valve receivers which have a filament on-and-off switch, it is possible that although the filament controlling resistances have been left in the positions which have been found to give good results, when the filament switch is closed to bring the receiver into use again, the filaments of the valves may

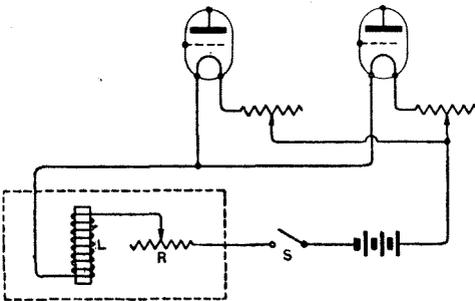


Fig. 1. A filament protecting switch.

be fractured owing to the voltage of the battery having increased. This is particularly likely to occur with dull-emitter valves heated by dry cells, but may also occur with ordinary valves which are heated from an accumulator. Apart from the fact that the voltage of the battery may have increased during the time that the receiver is not in use, it is well known that a filament is liable to break if the current is suddenly applied.

It has been proposed (Patent No. 221,027) to employ an arrangement connected as in Fig. 1, where L is an electro-magnet and R a resistance. So long as the switch S is closed, the arm of the resistance, R, is held in position by the current flowing through the electro-magnet. When the switch is put in the "off" position, the arm of the resistance is released, and moves to the point where the maximum value of resistance is in circuit. Hence, when the

circuit is closed by operating the switch, the full value of the resistance R is in circuit, and the current flowing through the valves is limited. The value of the current may then be increased by adjusting the main resistance R.

## Adjustable Resistances.

Adjustable resistances of the carbon pile type employed as grid leaks or filament rheostats usually consist of discs or pellets of carbon or of fibrous material impregnated with carbon. It has been proposed to make the discs of resilient material, also to press them together by means of a spring. In this type of adjustable resistance, however, the discs or pellets sometimes stick together, so that when the compression pressure is relieved somewhat there is not obtained the resistance variation which should accompany such relief of pressure.

It has been proposed to remove this disadvantage (Patent No. 224,061) by employing springs between the discs of the pile as sketched in Fig. 2. A tube A has its ends closed by plugs B and C and a compression screw E, and the discs H of the pile are

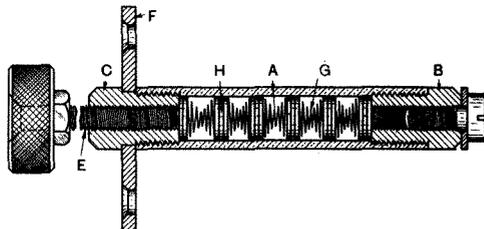


Fig. 2. An adjustable "carbon pile" type resistance.

separated by springs G. The flange F is for attaching the unit to a panel. Every disc may be separated from its neighbour by a spring as indicated in the sketch, or fewer springs may be employed.

# THE SUPER-HETERODYNE RECEIVER

## A DESCRIPTION OF THE RADIOLA (SECOND HARMONIC) RECEIVER

By JOHN R. WORTLEY-TALBOT.

**T**HROUGH the courtesy of the Editor of *The Wireless World and Radio Review*, I am enabled to give readers a short account of this wonderful receiver, which I have had in use for some time.

The complete cabinet contains the super-heterodyne equipment of condensers, transformers, oscillator coils, also the low tension, high tension and grid bias batteries, which are all of the dry type, six U.V.199 Radiotrons, and its own loop aerial. The valves are of the dull emitter type, each taking 0.06 of an ampere at a pressure of 3 volts. A plate voltage of 90 is employed. The receiver will tune from 220 to 550 metres, with the loop provided, but a larger

external loop may be used, provision being made in the receiver to do this if required. An earth lead may be used, or a short length of wire under the carpet or round the picture moulding, which is not connected to earth.

The cabinet itself is beautifully made and finished in mahogany, and on the front are the following controls. The left-hand dial is called the station selector No. 1, and is the variable condenser tuning the loop. The dial on the right-hand side (looking from the front) is the condenser controlling the frequency of the oscillator. Of the two knobs in the centre the one on the left is the master rheostat, the one on the right being a potentiometer, controlling the volume. The condensers are vernier, operated by universal joints to metal plates at the back of the condenser, giving a very easy and fine control.

The three small knobs at the bottom are as follows: the right-hand one is for a plug, for loud speaker or 'phones, as required; the centre knob switches on *all* the valves and the H.T. When the left-hand knob is pulled out it cuts out valves 4 and 5, and permits one to receive on four valves only, the telephony on four valves and a 3 ft. loop being beautifully clear and strong, especially from Madrid.

The tuning is remarkably simple. One just needs to plug in a pair of 'phones, pull out the centre bottom switch, put the rheostat to about No. 40 on its dial (with new batteries), turn the condenser, and increase the volume control until the signal is as strong as one desires. If too loud, pull out the left-hand bottom switch, and you are receiving then on four valves.

As a matter of fact, although this receiver will operate the loud speaker direct on its own aerial and six valves, still I much prefer to couple four valves of the super heterodyne to either of two power amplifiers—a Western Electric power amplifier equipment, which will give exceptional volume, or a resistance

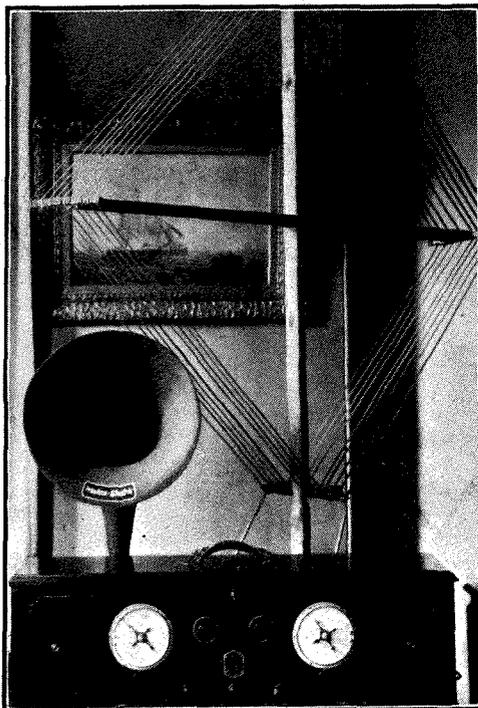


Fig. 1. A front view of the receiver showing the controls, the loud speaker and the frame aerial.

coupled power amplifier, using Dubilier resistances and three Western Electric 216 A type power valves. The complete amplifier has its own low and high tension batteries. This gives most wonderfully natural reproduction, due to the fact that no iron core transformers are used in either circuit. It would be quite deafening to use the full six valves of the super heterodyne and the power amplifier together; although, curiously enough, there would be no howling, but altogether too much volume.

I have received great numbers of stations on the loud speaker, both with and without the amplifier, which I could not recognise; German, French, two Spanish (of which I

receiving any station within a thousand miles that may be transmitting on fair power between 220 and 550 metres. No skill is required to work this set. One cannot go wrong. Only one item—if *you have not enough* filament emission you will get distorted telephony; if you have too much there will be a continuous hiss in the loud speaker. There is no whistle in tuning. The telephony just comes in weak or loud, according to the volume control setting, and anyone can get these results without any previous knowledge of a super heterodyne. The set is as selective as one could desire, although I have no opportunity of giving the set a crucial test, as the nearest

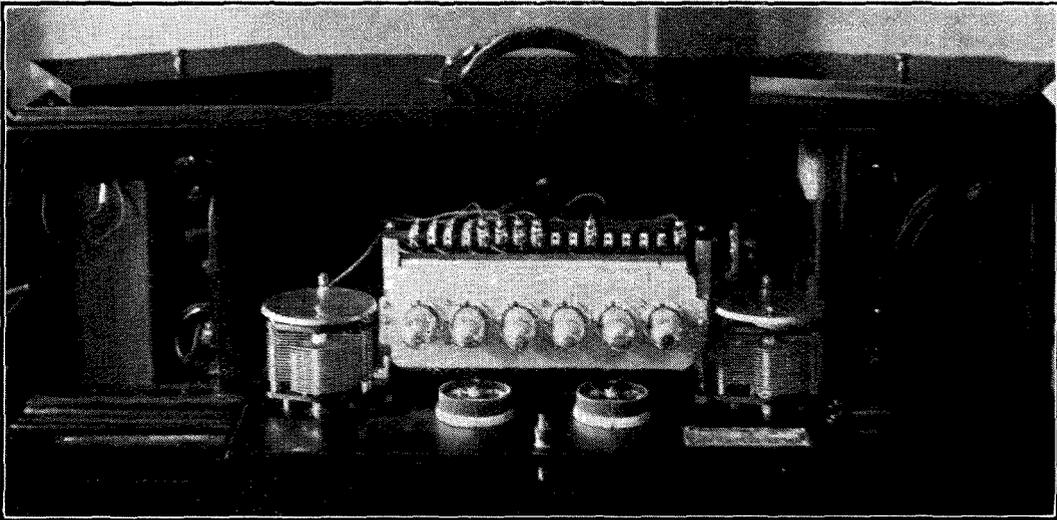


Fig. 2 A view of the super-heterodyne receiver, showing the tuning condensers, filament resistance and potentiometer.

know Radio Iberica), and all the British stations including Belfast.

I tried the earth lead for reception, but, although tremendously sensitive, it brought in so many ships that I returned to the 3 ft. loop. This loop consists of nine turns (1 in. apart, 3 ft. square)  $\frac{1}{4}$  in. by  $\frac{1}{64}$  in. silicon bronze strip, and is remarkably effective.

I may say that it will be found in using a power amplifier with this set that the volume control knob can be turned back very much towards "soft," with a corresponding increase in purity and absence of noise. Static appears to be the one bar to

$1\frac{1}{2}$  kW. station is about 100 miles away from here. The valves, batteries, etc., have never given a moment's trouble, and the set works on an average two hours daily. It is well worth its cost, as it gives exceptional results.

The range of this set can be very much increased by tuning an ordinary 50-turn Igranac coil by a variable condenser connected in series with the usual type of outdoor aerial. When the coil is tuned and the outdoor aerial and the super heterodyne loop are in resonance, and are tuned to the same wavelength, there is a marked increase in signal strength.

# NOTES & NEWS



According to a Reuter message, an amateur wireless station at Dartmouth, Nova Scotia, has established two-way communication with New Zealand.

\* \* \* \*

The Moscow broadcasting station, operating on 3,200 metres, transmits a complete programme in Esperanto on the last day of each month.

\* \* \* \*

Wireless telephonic communication has been established between the Crosby lightship and the Mersey Dock Board offices. The Bar and Formby lightships are in similar communication with the mainland.

\* \* \* \*

M. Menars, the well-known French amateur, reports the reception of a Tokio amateur on a wavelength of 90 metres. Confirmation of this feat will be awaited with interest.

\* \* \* \*

The Irish Free State Posts and Telegraphs Department announces an examination for the granting of certificates of proficiency to wireless operators. Particulars may be obtained from the Secretary of the Department, Dublin Castle.

\* \* \* \*

## ARGENTINE DA 8 BUSY.

Good reception of Argentine **DA 8** (ex **CB 8**) is reported by Mr. C. W. Goyder (**2 SZ**), the well-known Mill Hill transmitter. On Sunday, November 30th, from 6.45 until 7.40 a.m. (G.M.T.) the Argentine station was heard working frequently with **U 7GW** and **U 6GG**, both of which are situated on the Pacific Coast of America. **DA 8**'s signals were of fair strength, with a steady D.C. note, and his wavelength was 95 metres.

It will be remembered that Mr. Carlos Braggio (**DA 8**) is transmitting daily from 4.30 to 5.30 G.M.T., on a wavelength of 120 metres. Amateurs who succeed in hearing these signals are requested to report direct to Mr. Braggio, at Alsina 412, Buenos Aires, Argentine.

Mr. Goyder also reports faint reception of Mexican **BX** on the morning of December 1st. These signals were on a wavelength of 92 metres, with rectified A.C. note.

## NEW SWISS BROADCASTING STATION.

A new broadcasting station, states our Continental correspondent, has been established at Dubendorf, near Zurich, operating on a wavelength of 1,980 metres; it employs the call sign **HBK**.

## U.S.—CHILI TWO-WAY WORKING.

A "genuine Chilean hat" is to be presented by a prominent and delighted Chilean experimenter to Mr. Glen A. Litten, of Orange, California, for being the first American amateur to work a Chilean station. In all four Americans have carried out two-way communication with Chili during the Pan-American tests, and these men are credited with having made the best South American records since DX work was established with the Argentine. In addition to Mr. Litten, they are Mr. Maurice E. McCreery, of Los Angeles, Mr. William L. Williams, of Pomona, California, and Mr. Robert W. Kennedy, of Riverside, California.

## BELGIAN AMATEUR TRANSATLANTIC TESTS.

Low power communication tests with America are being carried out by a number of Belgian amateurs, who propose to use powers of from 6 to 15 watts. These transmissions will take place on the following dates: December 21st, 22nd, 25th, 26th, 28th, 29th; January 1st, 2nd, 4th, 5th, 11th, 12th, 18th, 25th, 26th; February 1st and 2nd.

The wavelengths will be from about 100 to 120 metres, plate supply being 50 cycles unrectified A.C. The times of these transmissions on each of the above dates are as follows: 0400 to 0415, 0430 to 0445, 0500 to 0515, 0530 to 0545 G.M.T.

## NEW CLOCK AT GREENWICH.

We regret that owing to a misunderstanding the new free-pendulum clock reported in our last issue as having been installed at Greenwich was referred to as being the invention of Mr. F. Hope-Jones; whereas the instrument is only being manufactured by the Synchronome Co., of which Mr. Hope Jones is the managing director. The clock is the third of the series of "Clocks Shortt," which have been specially designed by Mr. W. H. Shortt, M.Inst.C.E., and embody inventions covered by his own patents, as assigned to the Synchronome Co., Ltd.

## HUNGARIAN AMATEURS OFFICIALLY HONOURED.

An association of Hungarian wireless amateurs has just been formed under the Presidency of Herr Josef Hollos, Professor in the State Technical High School. A seat on the Committee is stated to have been taken by Herr Franz Kohl, who is Under-Secretary of the Government Postal Service.

**SWEDISH SMZN ASKS FOR REPORTS.**

Owned by Mr. George Holmlund, of Rosenlundsgat, 3 Gothenburg, Sweden, **SMZN** transmits generally on Wednesdays, Saturdays and Sundays from 10 p.m. onwards (G.M.T.) on wavelengths between 100 and 120 metres. Reports are always welcome.

**A VALUABLE VALVE BOOK.**

One of the most useful of reference books to the amateur experimenter has just been issued by Messrs. Marconi's Wireless Telegraph, Co. Ltd., under the title, "Marconi Valves made at the Osram Works." This publication covers an extensive range of the Osram valves now in use, classified under Transmitting, Rectifying and Receiving Valves.

A photograph of each valve is included, together with its characteristic curve and full working data. The book (Pamphlet No. 233) can be obtained from the Company, Marconi House, Strand London, W.C.2. Price, 5s. net.

**WEST OF ENGLAND TRANSMITTERS' SECTION.**

Further details of the new Society of transmitting amateurs in the West of England, founded on November 27th at Bristol, may be of interest.

The inaugural meeting was held at the Merchant Venturers College, Bristol University, and after discussion it was unanimously agreed that the interests of transmitters would be best served by their banding themselves together for mutual protection and research work. The Chairman of the new organisation is Mr. W. A. Andrews, **5 FS**, and the Hon. Secretary, Mr. U. A. Porter, **2 AKG**.

Permission is to be asked to install transmitting gear for the use of the Society, and arrangements have been made whereby one subject of research will be undertaken by members each month. Another useful feature will be the instruction of closed licence holders in the handling of transmitting gear, with a view to their being granted a full open licence. Between 25 and 30 transmitters have already joined the Section.

**SORBONNE LECTURES FROM PTT.**

So great was the public appreciation last winter of the broadcasting of educational courses from the Sorbonne, Paris, that the scheme is being extended this winter. Four complete courses will be given covering subjects of historical and literary appeal. As hitherto, the transmissions will be conducted from **PTT**, on 450 metres, and will take place on Monday, Wednesday and Thursday afternoons.

**SENATORE MARCONI ON BEAM TRANSMISSION.**

Senatore Marconi, in the course of his inaugural address as Chairman of the Council of the Royal Society of Arts, on Thursday, December 11th, emphasised the changes which long distance wireless communication was now undergoing as a result of the recent discoveries in short wave transmission.

The primary value of the very short wavelengths lay in their suitability for directional work and the lower powers which could consequently be employed. For broadcasting purposes the longer wavelengths were more desirable.

Summarising his work in the matter of short waves, Senatore Marconi expressed the opinion that they opened up what he believed would prove a most fertile field for the investigator and an entirely new horizon to our view.

**BROADCAST RECEPTION IN INDIA.**

The first experiment in open air broadcasting in Bombay was recently carried out with success, a musical programme being reproduced on loud speakers to a large audience specially invited by the Municipal Commissioner.

A correspondent informs us that listeners in Bombay have recently been very successful in picking up British broadcast programmes.

The successful reception of **2 LO** in Calcutta was reported last year.

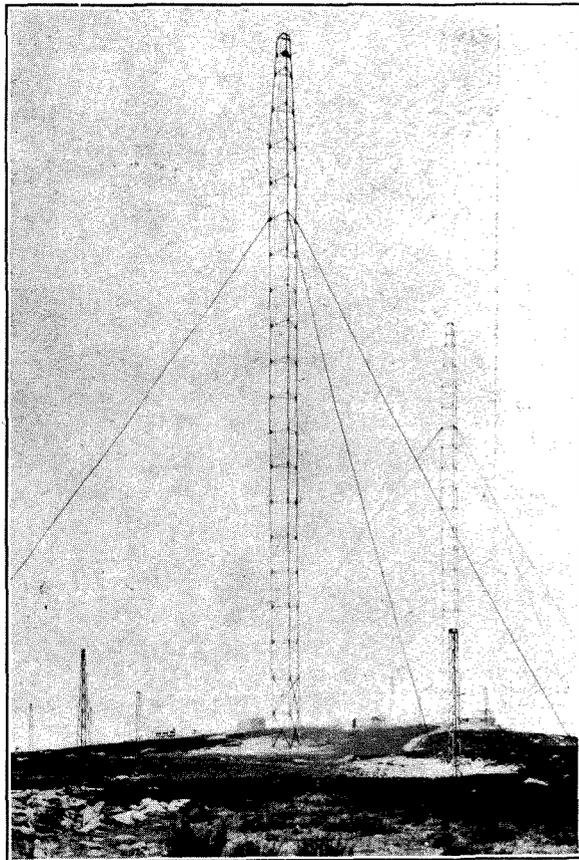


Photo: Marconi's Wireless Telegraph Co., Ltd.

*Two of the new 400-ft. single-stayed lattice masts at the Carnarvon Marconi station.*

# Calls Heard

Birkdale, Lancs. (Heard on November 22nd).

American: 1 ABF, 1 AFN, 1 ANH, 1 ARE, 1 ARY, 1 AWW, 1 BAL, 1 BDB, 1 BY, 1 CTJ, 1 CZV, 1 GA, 1 GOA, 1 PL, 1 SF, 1 SW, 1 XL, 1 XZ, 1 YZ, 2 BG, 2 BGO, 2 BLU, 2 BN, 2 BO, 2 BRB, 2 CGO, 2 CVU, 2 DGO, 2 DN, 2 KGG, 2 QH, 2 UD, 2 UM, 2 XQ, 3 ALX, 3 AN, 3 BDO, 3 BHU, 3 BTF, 3 CFC, 3 CHG, 3 CD, 3 EH, 3 JW, 3 KML, 3 NHF, 3 SF, 4 IO, 4 SI, 4 SO, 5 LF, 6 BJJ, 6 CGO, 6 CHL, 6 OF, 6 UF, 6 VC, 7 AFO, 7 ACY, 8 AMR, 8 AWJ, 8 CVI, 8 JQ, 8 OMJ, 8 SEV, 8 XB, 9 BCJ, 9 BDU, 9 BFN, 9 EIB, 9 XI.  
Canadian: 1 AR, 1 CG, 1 DQ. Mexican: BX. Various: JFWA, FN1, RR8. (o—v—o). A. H. Fielding (2 AU).

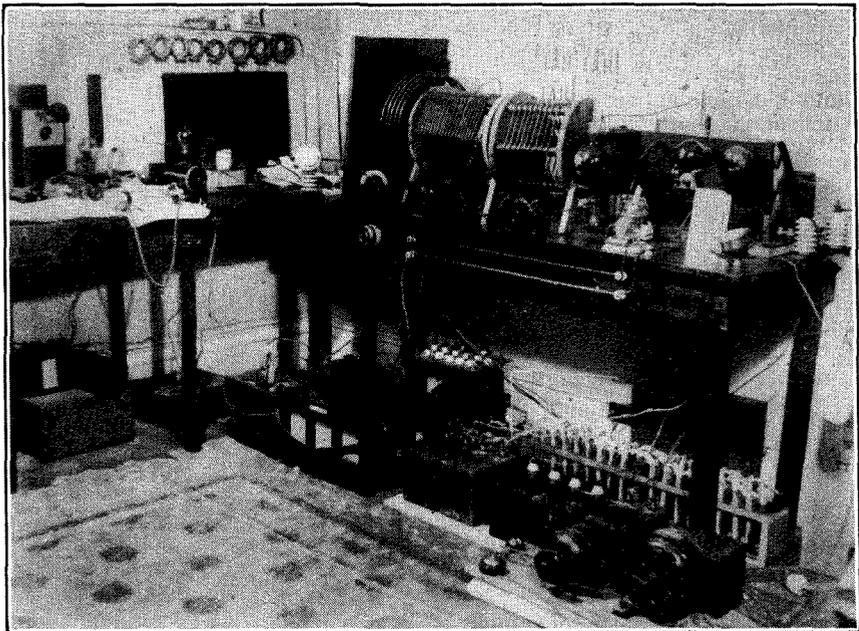
Tralleborg, Sweden.

British: 2 CC, 2 TR, 5 CC, 5 CX, 5 MA, 5 MO, 5 OX, 5 XN, 6 GH. French: 8 BM, 8 BP, 8 CPP, 8 EM, 8 EU, 8 FI, 8 GM, 8 GO, 8 GP. Dutch: OX, ONF. Danish: 7 EC. Finnish: 3 NB, 2 NCA, 2 NM. Italian: 1 CN, IDO. Miscellaneous: 7 AB, EST. B. Agren and E. Sjostrom (5MYR).

8 CC, 8 CM, 8 CN, 8 DP, 8 DU, 8 EI, 8 EM, 8 EU, 8 FC, 8 FK, 8 FQ, 8 GK, 8 GO, 8 GP, 8 HSG, 8 HSM, 8 LLO, 8 MG, 8 MN, 8 NS, 8 PA, 8 SM, 8 SR, 8 XR, 8 ZM, 8 ZZ, IOKZ. Belgian: 4 AU, 4 AX, 4 RS, 4 SS. Dutch: 0 MS, 0 RE, 0 XF, 0 ZZ. Finnish: 2 NCA, 2 NM, 3 NB. Miscellaneous: LOAA, 3 CM, 3 AF, 1 ER, 9 AD, ACD, 7 EC, FN1, B7, SMYY, WGH. (November 8th to 23rd). American: (All between 2.45-8.30 G.M.T., November 23rd): 1 AJA, 1 ANA, 1 BCG, 1 CAB, 1 CK, 1 CMP, 1 DQ, 1 GV, 1 KC, 1 PC, 1 PL, 1 FY, 1 SF, 2 AWF, 2 EG, 2 ER, 2 BSC, 3 AJD, 3 BC, 3 BOP, 3 BSS, 3 CH, 3 HQ, 3 SUF, 4 IO, 4 KU, 4 TJ, 5 SI, 8 ACL, 8 DRW, 8 GZ, 8 XK, 9 AC. (o—v—2.) Stanley F. Evans.

Lichfield, Staffs. (Below 120 metres.) Since September 7th.

British: 2 JF, 2 JF, 2 KF, 2 KW, 2 NM, 2 OD, 2 SZ, 2 TF, 2 VW, 2 WD, 5 GF, 5 GS, 5 IG, 5 LF, 5 NN, 5 SI, 5 UQ, 6 BEC, 6 UD. French: 8 AB, 8 AQ, 8 AU, 8 EF, 8 EM, 8 EN, 8 EP, 8 FS, 8 LO, 8 DP, 8 FM, 8 EV, 8 GO, 8 HM, 8 MN, 8 FA, 8 SF, 8 SU, 8 WAL, 8 WZ, UFT2. American: 1 AHI, 1 ER, 1 GV, 1 SW,



The transmitting apparatus at G2 WJ, owned and operated by Mr. R. L. Royle, of Palmer's Green, London. 2 WJ works frequently with U.S. amateurs.

Mosul, Mesopotamia. (November 8th, 1924): 3 CM, SMYY. (November 10th, 1924): 2 XA, 2 NC, F8B (working JFWA). All R 7 on single detector valve. R. F. Durrant.

Gt. Shelford, Cambs.

(November 2nd, 1924): 5 RW, 0 BMA, 8 CM, 0 RE, 8 GM, 8 IM. (November 7th, 1924): 6 KK, 6 GH, 5 UL. (November 9th, 1924): 2 NB. (November 8th, 1924): FNI, 4 AL, 8 NG, 4 CA. (November 14th, 1924): 8 SSC. (November 15th, 1924): 8 UU, 7 MR, NOGC, 27 Q, 0 RE, SS4, 2 DE, 6 XG, 8 GI, 4 AX, 8 DU, CMSE. (November 16th, 1924): 8 SG, 4 YZ, 5 SU, 2 SQ, 6 GM, 2 MX, 1 JXK. (November 10th, 1924): 8 GK, 8 SM, 2 WJ, 2 BBK, 6 TM, 2 MD, 2 AC, 5 NH, 2 NZ. (November 21st, 1924): 6 NF, 2 VW, 8 BF, 2 AG, LP 8, 2 OD, 6 AF, 1 GV, 1 II, 2 CG. (o—v—2.) Gerald A. Jeapes (2 AUL).

Whitley Bay, Northumberland (Below 120 metres.)

British: 2 CC, 2 EK, 2 KF, 2 NM, 2 OD, 5 GS, 5 NN, 5 OT, 5 UQ, 6 AB, 6 FG, 6 NF, 6 XG, 6 XJ. French: 8 AB, 8 AM, 8 BF,

1 XAV, 2 BRB, 2 CRP, 2 PD, 3 AJD, 3 AYA, 3 BDO, 4 IJ, 8 BGN. Swedish: SMYY, SMZY, SMZZ. Dutch: 0 AA, 0 RD, 0 ZZ. Danish: 7 ZM, 7 EB. Finnish: 2 NM. Various: 3 LG, 3 AF, 3 CM, WGH, AGA. G. S. Sanways (6 OH).

## UNKNOWN CALLS.

The following unidentified calls have been heard by readers. Information leading to their identification would be welcomed. YW 4 (heard in Alexandria); W1 BHN (heard at Verviers, Belgium); AIN (heard at Lymm, Cheshire); G 6GH, G5 PP.

## Reports Wanted.

Reports on his signals are welcomed by Mr. E. Brady (6 IG), of 6 Cottsgate Hill, Ripon. 6 IG transmits on 150 metres, C.W.

2 SP.

Mr. Lawrence Mansfield (2 SP) wishes it to be announced that he has changed his address to 34 Bath Street, Southport.

# NEW ZEALAND AMATEUR TRANSMITTERS.

The following list of call signs and addresses of amateur transmitters in New Zealand is published in response to the large number of requests we have received from readers.

- 1 AA C. N. Edwards, 42 Pollen Street, Grey Lynn, Auckland, N.Z.
- 1 AB Penny, 11 Peary Road, Mt. Eden, Auckland, N.Z.
- 1 AC L. S. Spackman, 10 Ardmore Road, Ponsonby, Auckland.
- 1 AH Hartle and Gray, Hall Commerce, High Street, Auckland, N.Z.
- 1 AI Charles Sievier Goodwill, Hamilton.
- 1 AK Claxton, William Harry, Parawai Road, Thames.
- 1 AM Hamilton Amateur Radio Club, Hamilton.
- 1 AO Russell Garland White, 125 Grafton Road, Auckland, N.Z.
- 1 AQ Aymer Alexander Sommerville, Thames.
- 1 AR Frank Beesley Hobbs, 44 Le Arota Street, Claudelands, Hamilton, N.Z.
- 1 AS Ralph Eric Grainger, 88 Clarence Street, Ponsonby, Auckland, N.Z.
- 1 AU Rolf Ernest Lempriere Aubin, Auckland.
- 1 AV Rolf Ernest Lempriere Aubin, "The Oaks," Parnell, Auckland, N.Z.
- 1 AW Robert Maxted, Queen Street, Thames, N.Z.
- 1 AZ James Reginald Therson, 17 Te Aroha Street, Claudelands, Hamilton.
- 1 FC Robert Fred Douglas Burrell, Auckland.
- 1 FF Vincent John Williams, 45 Valley Road, Mt. Eden, Auckland.
- 1 FH James Steel, Auckland.
- 1 FI Herbert W. Batty, 22 York Street, Parnell, Auckland.
- 1 FJ George Henry Choules, Waiuku.
- 1 LA Auckland Radio Service Ltd., Scots' Hall, Symonds Street, Auckland.
- 1 YB Mr. C. H. Pearson, La Gloria Gramophones Ltd., 157 Karangahape Road, Auckland.
- 2 AB Dan Wilkinson, Motueka, N.Z.
- 2 AC Ivan Henry O'Meara, 209 Harris Street, Gisborne.
- 2 AD Percy Ronald Stevens, Gisborne.
- 2 AE Robert James, Gisborne.
- 2 AF William John Sinclair, c/o W. Sinclair & Co., electrical engineers, P.O. Box 227, Gisborne.
- 2 AH Wanganui Amateur Radio Club, Gordon S. Bissett, Hon. Sec., P.O. Box 423, Wanganui, N.Z. Station: Y.M.C.A. Buildings.
- 2 AI Walter Leslie Harrison, 47 Austin Street, Wellington, N.Z.
- 2 AJ Henry Brangrove, Broadway, Stratford.
- 2 AK Leslie Rowson, 99 Victoria Street, Hawera.
- 2 AL A. C. Cooper, 3 Cecil Street, Ashfeld.
- 2 AM Dr. William Fred Buist, Hawera.
- 2 AO Gordon Albert John Brunette, Club Hotel, Opunake.
- 2 AP Percy Charles Collier, 17 Taft Street, Brooklyn, Wellington.
- 2 AQ Morton Wm. Coutts, Box 26, Taihape.
- 2 AR Thomas R. Clarkson, 304 Nelson Street, Hastings.
- 2 AS Albert Edward Simpson, Wellington.
- 2 AU Ian J. Innes, Radio Road, Nelson.
- 2 AW Cecil Roy Clarke, 60 Edinburgh Terrace, Wellington.
- 2 BC Eric William Beale, Hastings.
- 2 BF The Wilkins and Field Hardware Co., Ltd., Nelson.
- 2 BH Paul Bareham, 213 Nelson Street, Hastings.
- 2 BI Harry Neville Shrimpton, Brookside, Nelson.
- 2 BJ Allan Evans, Wellington.
- 2 BL Wellington College Radio Club, Wellington.
- 2 BO Ercel Mervyn Goffe, Gisborne.
- 2 BQ Edmund Dolbel Edmundson, Napier.
- 2 BR Kenneth Arundel Lambert, Wanganui.
- 2 XB Physics Dept., Victoria University College, Wellington.
- 2 YM Gisborne Radio Co., Gisborne.
- 3 AA Reginald John Orbell, Christchurch.
- 3 AB Francis Vincent, Christchurch.
- 3 AC Radio Society of Christchurch, 158 Manchester Street, Christchurch.
- 3 AD Blake, R. G. F., Blaketown, Greymouth.
- 3 AF Leonard Francis Ball, 90 Nursery Road, Linwood, Christchurch.
- 3 AH Henry B. Courtis, 69 Grey Road, Timaru.
- 3 AK Ernest Reynolds, Ashburton.
- 3 AL Wilfred Milne Dawson, 263 Wills Street, Ashburton.
- 3 AM Bernard Tyndall Withers, Christchurch.
- 3 AQ James Ingram Small, 188 Hereford Street and 263 High Street, Christchurch, N.Z.
- 3 AR David Wm. Buchanan, 74 Wills Street, Ashburton.
- 3 AS Ian James McLean Paterson, Timaru.
- 3 CA H. W. Lavallin-Puxley, Farghleigh, Ealing.
- 3 CB Clyde Romer Hughes Taylor, 45 Weston Road, St. Albans, Christchurch.
- 3 CF Albert E. H. Simpson, 99 Amberley Road, Christchurch.
- 3 CG Harold Phillip Vincent Brown, Christchurch.
- 4 AA Frank D. Bell, Palmerston South.
- 4 AB Otago Radio Association Incorp., P.O. Box 660, Dunedin.
- 4 AC Robert Edward Robinson, Dunedin.
- 4 AD Arthur Edward Jordan, 17 Biggar Street, Invercargill.
- 4 AG Ralph Slade, 15 Harbour Terrace, Dunedin.
- 4 AH Ian Sinclair Macdonald, 45 Royal Terrace, Dunedin.
- 4 AJ Claude Norman Douglas McGregor, 131 Engleton Road, Mornington, Dunedin.
- 4 AK William L. Shile, Post Office Box 519, Dunedin.
- 4 AL Arnold Henry McLeod Crubb, 53 Sligo Terrace, Roslyn, Dunedin.
- 4 AM William McGill, Crockett, Palmerston.
- 4 AO Thomas Edward Scott, Dunedin.
- 4 AP Invercargill Amateur Radio Club, Hallenstein's Buildings Invercargill.
- 4 AR W. Grey Wilkinson, 21 Melrose Street, Rosedin.
- 4 XO Professor Robert Jack (for University of Otago), Dunedin
- 4 YA British Electrical & Engineering Co., Dunedin
- 4 YO Radio Supply Co., Dunedin.

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LA PRESSE is the National French Canadian Newspaper and the largest circulated daily newspaper published in Canada.

The well-known Montreal broadcasting station issues acknowledgement cards to listeners who report reception. The above is a reproduction of a card received by Mr. A. H. Brackensley, of Finchley, London.

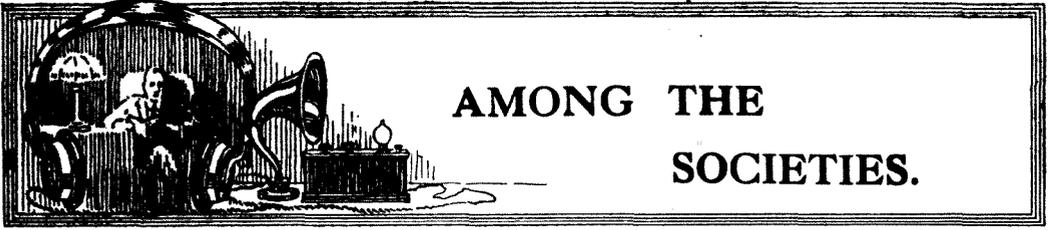
## A. J. S. RECEIVERS.

Messrs. A. J. Stevens & Co. (1914), Ltd., of Wolverhampton, the well-known wireless manufacturers, apologise to their many customers for the delays which have recently occurred in the execution of orders. These have been due to the recent builders' strike, which has retarded the erection of additions to their wireless factory. The Company is now in a position to guarantee immediate deliveries.

## BOOKS RECEIVED.

"Wireless."—By P. J. Risdon, F.R.S.A. With an introduction by J. A. Fleming, M.A., D.Sc., F.R.S. Containing many diagrams and illustrations. (London: Ward, Lock & Co., Ltd., pp. 384. Price 6s. net.)

The Book of the Wireless Valve. pp. 71 and xi. With many plates and diagrams. (London: Arks Publicity, Ltd., for the Mullard Radio Valve Co., Ltd. Price, 1s. 6d.)



### Radio Society of Great Britain.

The possibilities of amateur wireless recording were dealt with by Mr. Maurice Child in his talk before the Transmitter and Relay Section on Tuesday, December 2nd, and he expressed the

In pointing out the comparative simplicity of recording experiments, Mr. Child alluded to the significant fact that all the early wireless apparatus was of the recording type, and he exhibited the actual Lodge-Muirhead detector used in reception twenty-four years ago. It still worked!

\* \* \* \*

A demonstration of a five-valve neutrodyne receiver was given recently by Mr. Lyon at a meeting of the Southampton and District Radio Society. British and continental stations were received at considerable strength on the loud speaker, and the efficiency of the instrument impressed all present.

\* \* \* \*

A useful service was rendered by the Wireless Section of the Morley College Scientific Society, on Wednesday, December 10th, when H.R.H. The Prince of Wales opened the new college building at 61 Westminster Bridge Road. By means of amplifiers members of the wireless section broadcast the speech to different parts of the building. The official opening was followed by an exhibition of wireless apparatus made by members.



A group of members of the Hampstead and St. Pancras Radio Society, photographed at a recent meeting.

opinion that an opportunity existed for the amateur to evolve cheaper and less complicated methods than those at present in commercial use.

Of the two practicable methods of recording, viz., the phonograph cylinder and the tape printer, Mr. Child placed greater reliance in the latter, and outlined the various instruments operating on this principle. In all systems of recording, said Mr. Child, the use of an efficient relay was of the utmost importance and for amateur requirements the ideal instrument should be capable of working at speeds up to 25 words per minute. Such an instrument would work on the plate of a thermionic valve, and it was in the application of the valve to this purpose that the speaker emphasised the opportunity for amateur experiment.

Mr. Child then described an interesting theoretical design of his own, in which use was made of a Turner relay in conjunction with three-electrode valves.

## FORTHCOMING EVENTS.

### WEDNESDAY, DECEMBER 17th.

- Radio Society of Great Britain.** Eleventh Annual General Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Photo-Electrics." By Mr. C. F. Elwell.
- Institution of Electrical Engineers (North-Eastern Centre).** At 7.15 p.m. At Armstrong College, Newcastle-on-Tyne. Faraday Lecture: "World Wide Radio Telegraphy." By Prof. G. W. O. Howe, D.Sc.
- Radio Research Society, Peckham.** At 44 Talfourd Road. Lecture: "L.F. Transformers." Discussion: "Insulators."
- Bristol and District Radio Society.** Wireless Lecture No. 8. By Mr. W. A. Andrews, B.Sc.
- Edinburgh and District Radio Society.** At 8 p.m. At 117 George Street. Seventh General Meeting of Series.
- Tottenham Wireless Society.** Discussion: "Elementary Magnetism and Electricity."

### THURSDAY, DECEMBER 18th.

- Luton Wireless Society.** At 8 p.m. At the Hitchin Road Boys' School. Exchange of Apparatus.
- Beckenham and District Radio Society.** At 8.20 p.m. Club Wireless Mart of Miscellaneous Gear.
- West London Wireless and Experimental Association.** At Belmont Road Schools. Lecture: "Use of Esperanto for Radio," by Mr. H. W. Smith, of the Chiswick Esperanto Society.

### FRIDAY, DECEMBER 19th.

- Bristol and District Radio Society.** Lecture: "Provision of Power for Wireless Work." By Mr. H. R. Bessant, A.M.I.E.E.



## READERS PROBLEMS



*Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.*

### THREE-COIL TUNERS.

A READER has noticed that in some diagrams given in this journal the secondary tuning coil is placed between the aerial and the anode coils, while in other diagrams the aerial coil is made the central coil in the holder. He asks if there is any difference between the two methods, and if so, which is correct.

Best results are obtained when the secondary tuning coil is mounted between the aerial and reaction coil, but when a "tune-stand by" switch is connected in the circuit, the aerial coil must be placed in the centre, in order that reaction may be coupled directly to this coil in the "stand-by" position. When no "tune-stand by" switch is used, we always show the secondary coil mounted between the other coils.

A method of obtaining the "tune" and "stand-by" connections without the use of a switch was described in this section of the journal for September 2nd, 1924. Terminals are provided so that the aerial and earth may be removed from the A.T.I. and connected across the end of the secondary coil, in order to give the "stand-by" connections. The reaction coil then becomes directly coupled to the aerial coil, and the only other alteration necessary is the substitution of the A.T.I. for the closed circuit coil.

### MILLIAMMETERS FOR ANODE CURRENT.

INCREASING use is being made of measuring instruments in receiving sets. Voltmeters are being used to a greater extent to measure the filament voltage, as this voltage is more critical in the case of dull emitter valves. Milliammeters are also being included in the H.T. circuits, and many useful conclusions regarding the operation of the receiver can be drawn from the readings indicated. Some amateurs connect their milliammeters between the minus side of the H.T. battery and - L.T. This is quite wrong, unless the receiver happens to be a single-valve receiver. In a multi-valve receiver the best method would be to arrange switches, so that the meter could be connected in the plate circuit of any of the valves. In the H.F. and detector valves the value of the anode current will serve as an indication of the average grid voltage, if the H.T. voltage and the characteristic of the valve are known. In the low frequency amplifying valves, an additional

purpose is served by the milliammeter. When signals are being received there should be no appreciable movement of the pointer. If the anode current changes from its normal value distortion is taking place through rectification. The trouble may be cured by readjusting the grid bias, but if this measure is unsuccessful, a higher value of H.T. or the use of a valve of larger capacity is indicated.

### "SPADE" TUNING.

A METHOD of tuning which is becoming increasingly popular on account of its simplicity depends for its action upon the eddy currents set up in a metal conductor placed in the field surrounding the tuning coil. When a disc of high conductivity metal, such as copper, is placed at the side of a duolateral or basket-type coil, the eddy currents produced in the copper also produce a high frequency magnetic field in opposition to the field surrounding the coil. A reduction in the number of lines of force threading the coil is thereby brought about, and its inductance and the wavelength received are correspondingly reduced.

In designing tuning coils for spade tuning, the total number of turns in the coil must be arranged to give the maximum wavelength required, instead of the minimum wavelength, as in the case of tuning by means of a variable condenser. Thus, for the B.B.C. band of wavelengths between 300 and 500 metres, a No. 75 coil would have to be used in the aerial circuit, assuming that the aerial has an effective capacity of 0.0003  $\mu$ F. The amount by which the wavelength is reduced will depend, of course, upon the position, area, and thickness of the copper tuning plates. The closer the tuning plates are coupled to the coil, the greater will be the reduction of wavelength.

### A DISTORTIONLESS LOUD SPEAKER RECEIVER.

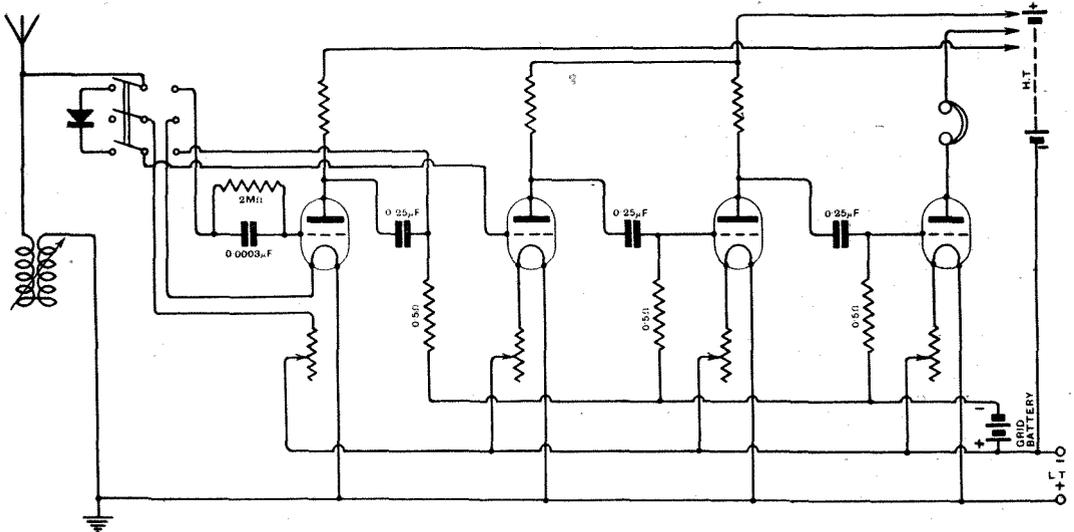
A CORRESPONDENT living within a few miles of a main B.B.C. station in a position where he obtains excellent 'phone signals on his home-made crystal set has written to ask for a circuit that will give him really distortionless loud speaker results on his local station. He has tried an ordinary two-valve amplifier, using "R" type valves, purchased

locally, and is extremely dissatisfied with the quality, and asks if it is possible to design a set to give him the results he desires, and not to give results "reminiscent of a 1905 gramophone."

A well-designed amplifier used in conjunction with correctly designed valves and transformers, and with correct adjustment of filament temperature, H.T. voltage and grid bias will give excellent results, and if they are passed to a loud speaker of good make, will give results far clearer and more natural than the best gramophone yet produced. It is, of course, essential that the amplifier receives

low ratio transformers on the market have a high impedance. Thirdly, the incorrect use of H.T. voltage and grid bias; it is important to remember that H.T. voltage and grid bias are correlative, it being equally incorrect to use too much grid bias with a given H.T. voltage, as it is to use too little.

It is quite possible to obtain distortionless amplification without resistance coupling, with its attendant high anode voltage and low amplification value, by first choosing the correct valves and then choosing transformers to work in harmony with them.



*A distortionless loud speaker receiver.*

the signals from the detector valve in an undistorted state. Signals received from distant stations are unfortunately liable to be spoilt by extraneous noises such as "mush" from high powered arc stations, atmospherics, and other noises picked up, owing to the sensitive state in which it is necessary to bring the receiver, in order to obtain good signal strength from the distant station. If extreme purity is desired, therefore, it is advisable to confine one's attentions to the local station, and thus the use of excessive reaction, with its accompanying distortion effects is avoided. If sufficiently near, a valve detector with no reaction whatsoever can be employed, or even a crystal detector, which will eliminate the slight distortion due to the usual grid condenser and leak method of rectification.

The chief causes of distortion are threefold. First, the use of "R" valves for amplification; distortion being caused by the fact that they have not a sufficient straight line length of grid volts—anode current curve, strong signals causing them to work partially on the bend of the curve, with disastrous results to purity. Secondly, the use of transformers not having a sufficiently high impedance primary winding, especially after the detector valve. A high impedance transformer usually has, owing to necessities of mechanical design, a low ratio, but unfortunately it does not follow that all

It must not be thought that resistance coupling is a panacea for all distortion. Unless the correct values of resistance, coupling condenser and leak are chosen, distortion will still occur. Speaking generally, it is first necessary to choose the value of anode resistance according to the valve used, and then to use a large value coupling condenser and a low value leak.

As our correspondent is very emphatic on the point of purity, we illustrate above a suitable resistance-coupled amplifier employing either a valve or crystal detector as required. No reaction is used. Suggested condenser and leak values are marked. It is recommended that type D.E. 5B valves be used, as these valves are specially designed for the purpose, and since they possess a high amplification factor, not so much loss of amplification will be experienced. It is essential, however, that the final valve be of the D.E. 5 type, and not D.E. 5B. There is, however, no harm in employing a D.E. 5B as detector valve if desired, provided that the anode voltage is suitably adjusted. Separate H.T. tapings are provided. With regard to loud speakers, there are many excellent types on the market. If the "megaphone" effect of a horn is objected to, there are excellent hornless loud speakers that can now be obtained in this country.



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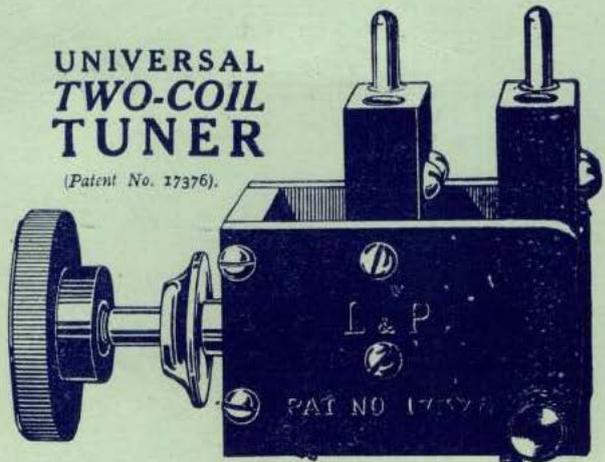
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# THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

No. 280. (No. 13, Vol. XV.) DECEMBER 24th, 1924.

WEEKLY.

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EDITOR:

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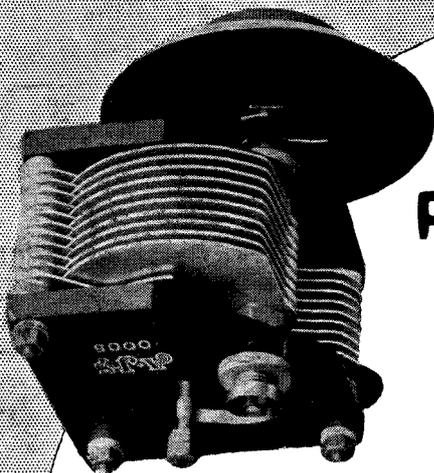
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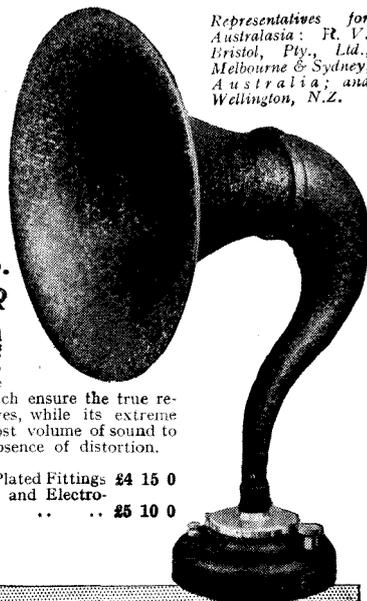
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# The WIRELESS WORLD AND RADIO — REVIEW



## RADIO TOPICS.

By THE EDITOR.

### THE SHORTAGE OF APPARATUS.

**I**N a recent editorial note we referred to the responsibility of the manufacturers in connection with the poor quality and defects in some apparatus which might produce symptoms in completed sets difficult to diagnose by any but experienced amateurs. There is a further responsibility of the manufacturers, more than ever in evidence at the present time, which, through lack of foresight or from some other contributing cause, many manufacturers have failed to meet.

During past months there has been a steadily increasing shortage of a large proportion of the essential components of receivers which in the past the public have depended upon manufacturers to supply for their requirements. Perhaps it is on account of the Christmas season that an abnormal demand has been created, but this seems a poor excuse when one takes into consideration the fact that the manufacturers, and particularly some of those who are responsible for the greatest shortages of apparatus, have already had the experience of several Christmas seasons, and the present shortage in supply has been steadily increasing over many months. In addition to past experience the manufacturers have had access to a very definite indication of the increase in demand if they had cared to study the figures for licences issued. What is, perhaps, the most regrettable point about the situation which has arisen is that the public has found that it is impossible, without a very long delay, to obtain components by the best manufacturers, whereas the supply of inferior materials is in many cases kept up on an

adequate scale by less experienced and unreliable manufacturers. This only tends to result in disappointment amongst the public at the results which they afterwards obtain from sets so constructed. In desperation they cannot turn to complete sets even if their pockets can afford these, for the position is almost as serious with regard to the supply of complete sets, and it surely is not satisfactory to a prospective customer to be informed early in December that the set he wishes to buy as a Christmas gift can be delivered to him somewhere towards the end of January if he places his order at once.

It is no wonder that manufacturers of valves have thought fit to maintain their prices up till now, because we cannot imagine what would happen in the rush for sets and components if a substantial reduction in the price of valves were suddenly introduced. We are quite prepared to admit that a certain amount of caution in manufacturing commitments is desirable, but we believe that British manufacturers have adopted a policy of caution which is beyond all reason, and we fear that unless some radical change is brought about in order to increase the supply in proportion to the demand, that competition from abroad will soon rob the home industry of a large proportion of the business which has been heaped up on the doorsteps of British manufacturers.

### THE RADIO SOCIETY OF GREAT BRITAIN.

**T**HE announcement of the acceptance by Sir Oliver Lodge of the Presidency of the Radio Society of Great Britain is a matter on which

the Society may well congratulate itself. The name of Sir Oliver Lodge ranks with the highest names associated with the development of wireless telegraphy and his contributions to the science are of such importance that the name Lodge must always remain inseparable from that of wireless.

The Society has in the past set itself a high standard in its choice of leaders and all those whose names have been associated with the Society as Presidents in the past must feel gratified that the continuance of their work has been undertaken by so illustrious a successor.

It would not be fitting on this occasion to omit a reference to the inestimable services rendered to the Society and to the entire amateur community by the retiring President, Dr. W. H. Eccles, whose task is relinquished, after two years of office, in deference to the rules of the Society in the framing of which, under the new constitution, he has played so important a part.

The development of wireless and its extended application to broadcasting brought about the necessity for a radical reorganisation of the Society's affairs and an extension of its activities. After broadcasting started the Society grew out of its older and less flexible constitution. It was under the Presidency of Dr. Eccles that the urgent need for action was recognised and as the leader of the amateur community he lost no time in setting in motion the wheels which have for two years been busy in bringing about the necessary changes to enable the Society to cope with the altered situation. Dr. Eccles can now feel that

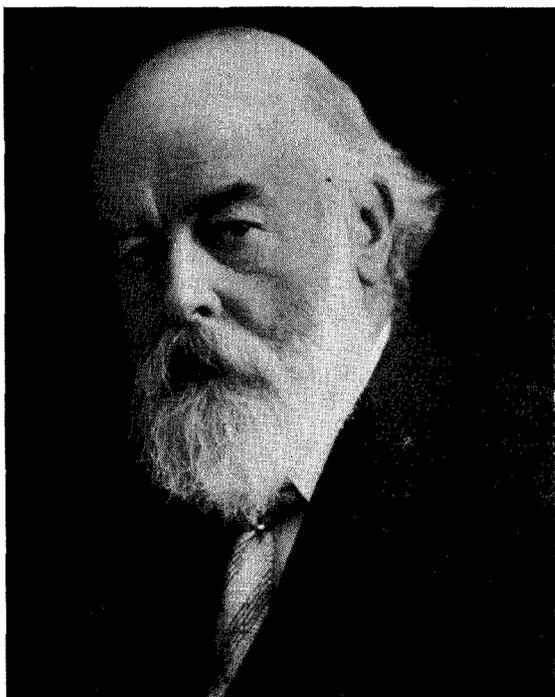
most of his task is completed yet at the same time the Society will not readily part with his services and it is to be hoped that, as the retiring President, his seat on the Committee reserved for him as the immediate past President will seldom be vacant at the deliberations of the Council.

There is no doubt that important events of interest to the amateur will transpire during the coming year, and much work lies ahead for the Radio Society. With the growing interest displayed by commercial companies, the Government and the Services, in the short wavelengths, it will not be easy for the amateur to retain his claim to the use of a short wavelength band for transmissions unless a good case is made out on his behalf.

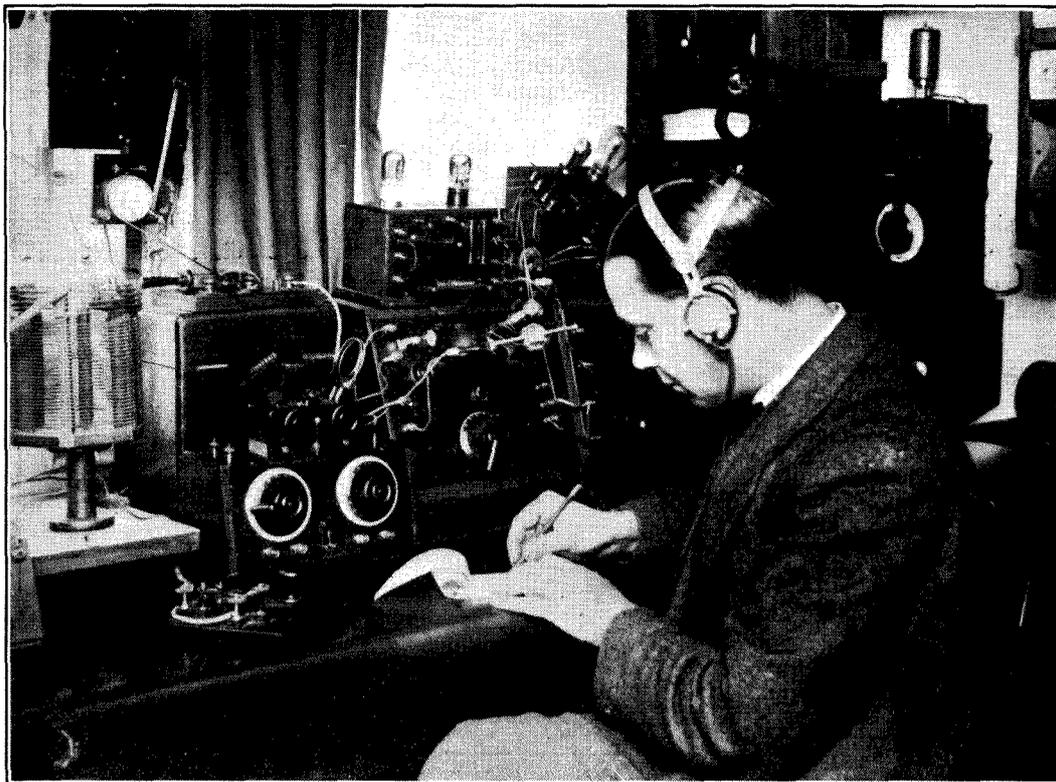
A few days ago the Postmaster-General made the disclosure in the House of Commons that a Bill has been drafted and will shortly come before the House which will modify the terms of the "Wireless Telegraphy Act of 1904," and it seems more than probable that the purpose of

the Bill will be to give greater powers to the Postmaster-General in the matter of the granting of amateur and experimental licences, especially for purposes of transmission.

Every amateur should take steps to inform himself of the exact situation so that he may be in a position to give accurate and sound advice to those with whom he comes in contact. It is only by educating the public that a fair consideration of the amateurs' case can be assured. The Radio Society must receive the fullest support from the amateur community in their efforts to maintain the rights of the experimenter.



*Sir Oliver Lodge, F.R.S., who has accepted the Presidency of the Radio Society of Great Britain for the coming year.*



*Mr. Simmonds operating at 2 OD*

## BRITISH 2 OD

### A DESCRIPTION OF THE STATION OF MR. E. J. SIMMONDS.

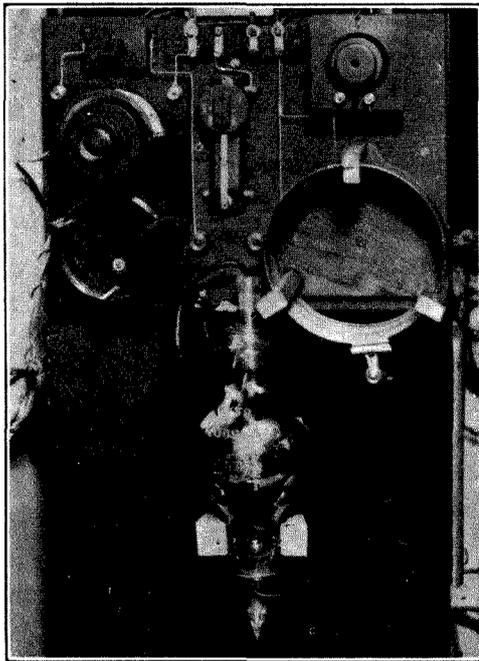
Among the English amateur stations conducting communication tests with the Antipodes, 2 OD, situated at Gerrard's Cross and operated by Mr. E. J. Simmonds, probably holds the foremost position. His achievements are of such outstanding interest that every reader is by now thoroughly acquainted with the work that has been done and it may even be said that it is the duty of every amateur to watch the progress made not only because of its scientific interest, but to assist in laying stress on an event which endorses the rights of the amateur to full facilities for conducting experimental work with transmitting equipment.

**A**NY commercial company would be proud of the results which the amateur workers have obtained and it is not without some surprise when one learns that efforts should ever have been made to bridge such a vast distance. It is safe to say that all world amateur records have been broken by the British successes

in these long distance tests and it is probable that it will be a long time before a new record can be set up. The distance is over 11,000 miles and the greatest span on the earth's face cannot exceed more than about 12,500 miles, so that unless stations can be selected of exact location to half encircle the world the present records must remain unbroken.



the insulating material which forms a dielectric between the turns is of ebonite, whilst for the plate coil, where appreciable dielectric loss may occur due to the use of supports constructed from unsuitable insulating material, teak is used, having had a liberal treatment with paraffin wax. These coils will be found simple to construct and possess good rigidity, whilst a minimum of dielectric material is introduced into the electrostatic field and entirely avoiding the use of screws or other metal parts in the neighbourhood of the turns.



*Fig. 2. The master oscillator; on the left is the grid coil and tuning condenser; on the right, the anode coil and tuning condenser.*

The amplifying valve, as will be seen from the photograph in Fig. 3, is a O 250C and is operated very much below its normal output. Owing to the particularly good layout, the components here again can be readily identified. The milliammeter in the feed circuit is on the left, whilst the lead trailing across it is from a tapping point on the tuned plate circuit of the drive oscillator. The H.F. choke coil in the plate lead of the amplifying valve is immediately behind a Zenite rod, which is used to support the small condenser connected between the

master oscillator and the grid of the oscillation amplifier. The meter immediately beneath the valve indicates the filament current, whilst the filament resistance is just below it. The two condensers just above the meter bridge the secondary of the filament heating transformer to provide a point on which to terminate the grid leak and oscillating circuit leads. The inductance in the plate circuit is to the right of the valve and its equipment, and consists of a winding of bare copper wire supported on a hexagonal frame. This winding is extended to the coil immediately above it, so that a few turns are linked in with the aerial inductance through the fixed coupling. A series condenser tunes the aerial and is seen in Fig. 3 immediately above the aerial ammeter.

The filament of the amplifying valve is heated by means of a step-down transformer, operating from the public supply mains. The supply is at a frequency of 50 cycles and is also made use of for providing a high tension current for the plate circuits of both oscillator and oscillation amplifier. A very simple arrangement is used for providing a high potential plate current and consists of a step-up transformer fed to a commutator rectifier revolving on the shaft of a synchronous A.C. motor (Fig. 4) with a simple filter circuit. The success of this method of deriving the H.T. supply is best judged by listening to 2 OD's transmission, when it will be observed that there is an entire absence of hum due to a rippling H.T. supply.

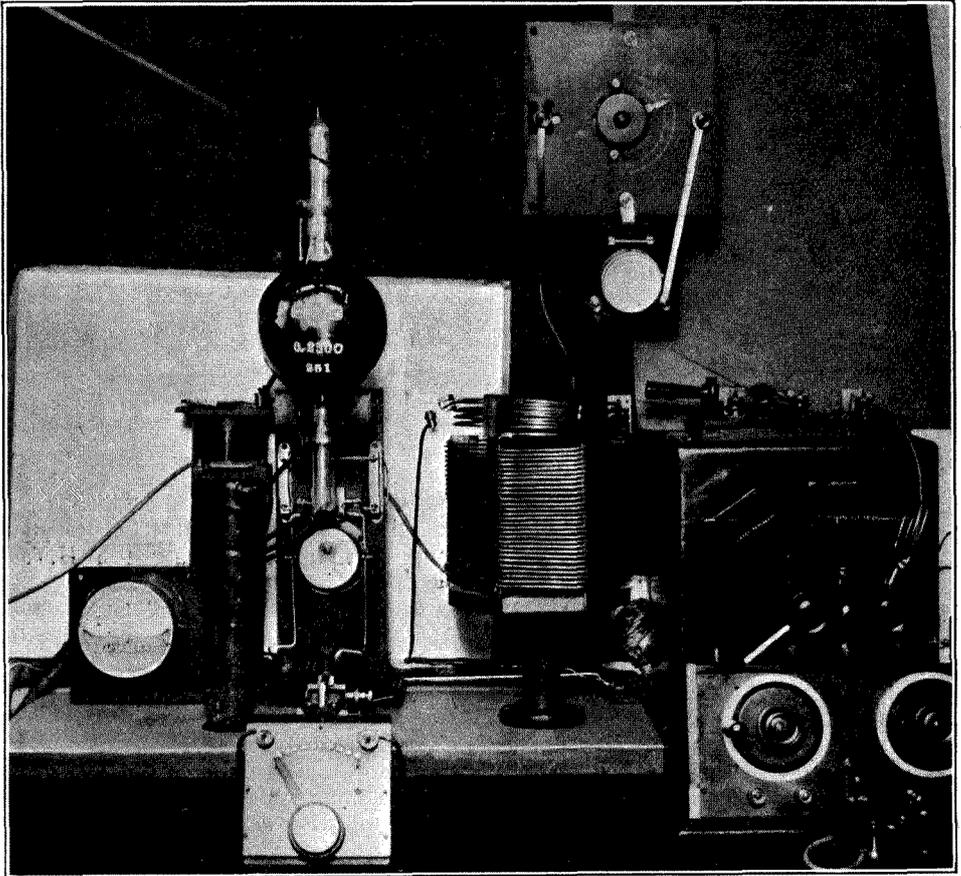
The send and receive change-over switch is on the right-hand side in Fig. 3 and immediately below it is the receiving tuner. Coils of high efficiency are employed here of the same type as those already described. They are almost self-supporting coils wound with enamel wire and carried upon drilled ebonite strips.

Most experimenters must have met the difficulty of making up an efficient tuner which will operate over a wide band of wavelengths. A single inductance does not tune over a very wide band and thus it becomes necessary to either adopt some system of plug and socket connector so that inductances can be interchanged or to make use of tapped coils. Mr. Simmonds prefers the former arrangement though he does not use the

standard plug and socket coil mount. His pin connectors are widely spaced and it is interesting to observe that this coil holder is of a unique design. Its side plates are of ebonite, rigidly spaced apart by means of an ebonite spacing piece, whilst the plug and socket connectors for any one coil holder are mounted on small pieces of wood and separated by an air space. The use of air spacing has been extended as far as

consist of only one or two turns, is in the aerial circuit and variable coupling is provided with a tuned closed circuit. The reaction coil is in the left-hand holder.

This tuner precedes a "QX" valve used as the detector in front of a supersonic heterodyne receiver. The receiver follows orthodox lines excepting that a novel method has been introduced of controlling self-oscillation. The intermediate stages



*Fig. 3. The power amplifier and aerial tuning equipment. The receiving tuner and send and receive switch can be seen on right.*

possible in all the apparatus employed at the station as is evidenced if one closely examines the lead-in terminal of the aerial tuning condenser in Fig. 3. It will be seen that holes have been made around the terminal to render it as far as possible "air supported." The right-hand coil in the three-coil holder, which will be seen to

operating on the long wavelength are all carefully tuned by means of condensers though the second stage is controlled by a tuning condenser which can be operated from the front of the instrument. When this second amplifying stage is thrown into step with the other intermediate circuits, self-oscillation is set up in the long wave

amplifier and by critically adjusting this tuning condenser oscillation may be controlled to a fine degree.

After the detector valve of the supersonic heterodyne receiver, two stages of low frequency amplification are available and are introduced by the operation of a switch. It is interesting to observe that these two L.F. stages are resistance coupled, the object being to entirely eliminate "transformer noise." A feature of the entire receiving apparatus is that it is perfectly silent in operation. There is an absence of background noise so that the weakest of signals can be easily read. Listening on the telephone receivers a condition of entire silence exists until a signal is tuned in and however weak that signal may be, no great difficulty is experienced in reading it, as there are no interfering sounds. To further eliminate any chance of interfering noises arising in the receiver, H.T. accumulators are employed for supplying anode potential to the receiving valves and these are charged from the A.C. supply by means of "S" tube rectifiers. The filament heating and other low voltage accumulators are also

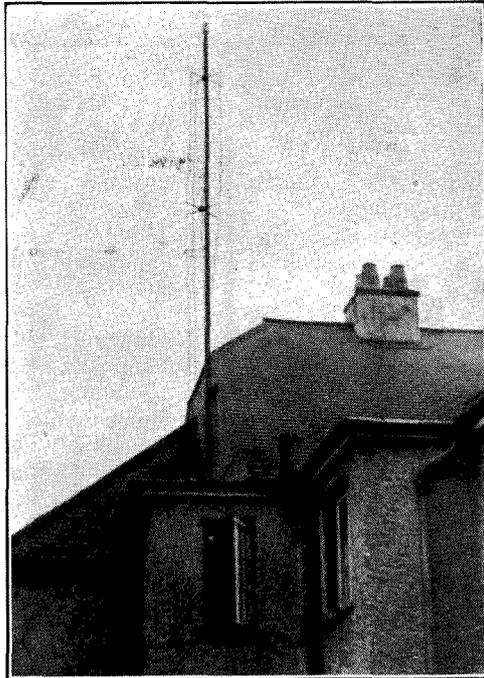


Fig. 5. The short mast to elevate the aerial at the leading-in end.

charged from the A.C. mains by means of a home constructed vibrator rectifier.

On examining the aerial system one is a little surprised to learn that such enormous distances can be covered with an aerial of such modest dimensions. A mast, Fig. 5, is attached to the house to a height of only 10 ft. above the roof and carries a small cage aerial. The far end is supported in a tree a short distance away, while the foliage reaches to a height greater than that of the aerial. The earth screen consists of six wires spread out in fan formation about 7 ft. above the surface of the ground.

To summarise the successful working of 2 OD we might mention that Mr. Dillon Bell, operator at 4 AA in New Zealand, states that 2 OD's signals are easier to read than those of any other British station, while other New Zealanders worked include 4 AG and 2 AC.

Australian stations with whom reliable communication has been established are 3 BQ, 2 DS and 2 CM. Two-way working has also been carried out with the American station 5 UK which is the only American 5th district station that has established two-way communication with England.

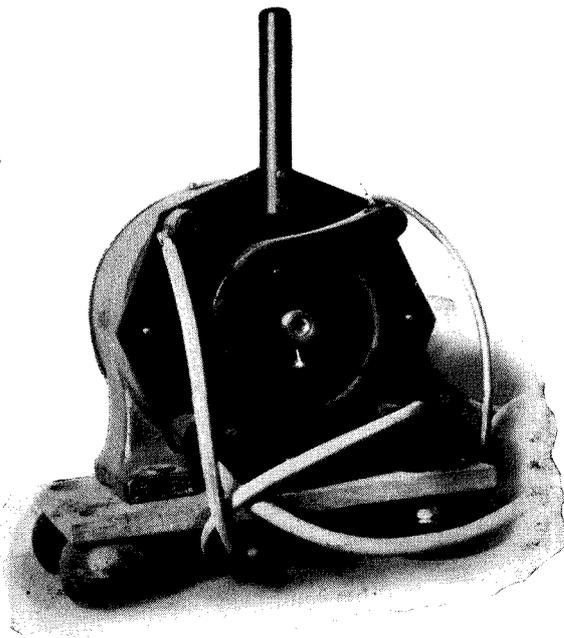
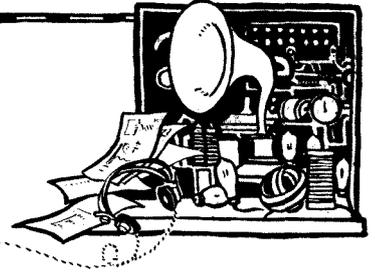


Fig. 4. The mechanical rectifier consisting of a commutator mounted on the shaft of a synchronous motor. It is supported on balls of "Sorbo" india-rubber to eliminate vibration.

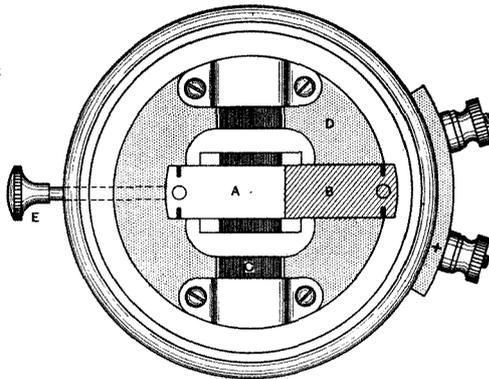
## NEW APPLIANCES.



### Novel Features in Loud Speaker Design.

Two new types of loud speakers have been introduced by the Ediswan Company.

One is of particular interest inasmuch as an entirely new device has been added to the magnetic system. It consists of a sliding metal piece composed half of brass and half of



The "Televox" loud speaker. A and B are the pieces of soft iron and brass which may be moved between the poles C of the magnet D by knob E.

soft iron. Its movement is controlled by a knob on the side of the instrument and the iron piece can be made to move between the poles of the magnet. The manufacturers claim that this device, which they describe as a modulator, has the property of removing the "tinniness," "rattle" or "blasting" so often present in loud speaker reproduction. According to the makers' instructions the diaphragm, which is adjustable and is mounted in a ring, is brought down to almost make contact with the pole pieces, after which, by bringing the piece of soft iron into position across the pole pieces, the pull on the diaphragm is released and an adjustment obtained where distortion is reproduced to a minimum.

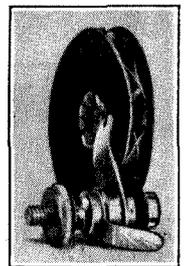
The movable piece of iron, which may be termed a "keeper," closes the entire magnetic circuit and thus controls the amount of sound emitted by the instrument. This loud speaker appears under the name of the "Televox" and is particularly beautiful in its appearance, being given a black and gilt finish.

The other loud speaker which is marketed under the name of the "Dulcivox," is of the more usual pattern and has its diaphragm fixed in position, while the pole pieces are adjustable by means of a milled screw. This instrument also has a particularly attractive finish.

The standard winding for both instruments is to a resistance of 2,000 ohms.

### Useful Adjustable Resistance for Dull Emitters.

The difficulty with regard to the use of both bright and dull emitter valves in a receiving set has been overcome by the introduction of a little device sold under the name of the Lissenstat "Resistor." It consists of a winding of insulated resistance wire in basket coil formation and fitted with protecting covers on back and front. A hole in the centre provides for easy mounting. The winding has a total resistance of about 35 ohms and is variable by means of an arm which moves smoothly over the turns. When inserted in series with the usual filament resistance used with bright emitter valves it is easily brought into operation by moving the arm across the turns so that suitable resistance values can be obtained to suit almost any type of dull emitter.



The Lissenstat "Resistor."

## PROGRESS IN RECEIVER DESIGN

A review of the developments of the past few years shows that many advancements have been made, some of which under the test of time no longer assume the importance with which they were heralded, while others have proved to become standard practice.

It is the purpose of this article to sum up those developments and incorporate the best of them in a receiver designed entirely to give as perfect reception of broadcast as modern circuits and apparatus can provide.

By F. H. HAYNES.

**T**HE thinking amateur hesitates when drawing up a design for a set which he hopes will be the last word in receiver construction because he appreciates that so much of his component apparatus is by no means perfect. His less experienced confrère, also, is in very much the same position, having gained his knowledge by a perusal of articles on the subject in which the one object of their authors may not have been to guide him on the smoothest path but to centre attention on some device which to the beginner would appear to have not been hitherto described. We stop to think in these times, when developments seem to follow one another so rapidly, before locking up costly equipment in any particular design, yet the writer, in no way wishing to convey that receiver design has come to a halt, feels that at the present stage an instrument can be built so nearing perfection that it will remain standard for some time to come.

The circuit arrangement is here discussed under headings so that a careful analysis can be made.

### THE AERIAL TUNING SYSTEM.

In setting up the aerial circuit a choice must be made from among a number of tuning arrangements, bearing in mind that the efficient tuning range should be from 200 to 3,000 metres.

For the shorter wavelengths up to 600 metres and employing an aerial of the usual amateur dimensions the series tuned circuit with inductance and variable condenser recommends itself. This is extensively used for reception on the short wave broadcast band but suffers from the defect that as the capacity of the aerial system may be brought down to a low value,

self-oscillation may be brought about in a manner rather difficult to control. The series condenser gives comparatively sharp tuning which is not always an advantage if a tuned high frequency stage has to be simultaneously adjusted.

As an alternative the parallel resonance circuit with the condenser connected across the ends of the inductance is often seen, yet this has the disadvantage of dropping the potential across the ends of the coil. A series parallel switch makes optional the two arrangements, but here again neither is quite suitable and there is a tuning gap when switching over.

From these considerations the use of both series and parallel condensers can be made to give sharpness of tuning, develop a maximum potential across the inductance and at the same time hold the set reasonably stable against self-oscillation.

A condenser has appeared on the market admirably suited for the purpose although designed really to give simultaneous tuning of two high frequency circuits. It consists of two condensers operated on a common spindle and this can be connected with one section in series and the other in parallel with the inductance. It gives good tuning up to wavelengths of 800 metres, when each section has a maximum capacity of about 0.0002 mfd.

The use of a condenser of this type brings with it another advantage inasmuch as the series condenser can be taken out of circuit when on the longer wavelengths, oscillation frequency may be appreciable, and thrown in parallel with the already parallel connected condenser, so increasing its maximum. The two circuits are shown in Fig. 1 at A and B, whilst the switching is given in the complete circuit diagram.

One must not overlook when contemplating this arrangement that aerial tuning is still effected by a single dial. Condensers with cut-away plates to produce a "square-law" effect are recommended owing to the opening out of the tuning scale near the minimum.

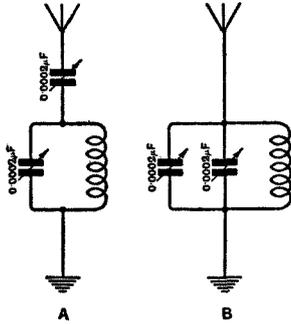


Fig. 1. Two condensers operating on a common spindle used for tuning on wavelengths up to 800 (A), after which they are connected in parallel (B).

The consideration arises as to whether it is advisable to introduce loose coupling with the aerial and although the writer favours such an arrangement, as it provides good selectivity and possibly improved signal strength as well as giving smooth oscillation control by varying the radiation load on the closed circuit, it adds a complication in tuning which immediately takes the operation of the set out of the hands of the inexperienced user. In discarding it, the simultaneous series parallel aerial tuning is a good substitute.

Turning to the question of the aerial inductance and as one who has gained his schooling before the introduction of plug-in coils, the writer rather favours a specially constructed single layer coil for wavelengths up to 1,000 metres, followed by a banked or basket winding for the longer wavelengths. Such coils, although possessing good efficiency, immediately limit the wave range, while they are not always easy to construct and considerable difficulty arises when it comes to devising a suitable variable coupling with other coils in the set.

It is undoubtedly the extreme utility of the plug-in coil and the three-coil holder which accounts for their extensive use. It is interesting to note that this type of coil has never become very popular in America. As to the special type selected and its adaptation, details will be given in a description of the actual set to be given later.

#### HIGH FREQUENCY AMPLIFICATION.

The provision of high frequency amplification is essential if the set is to be capable of receiving any other than local transmission. An oscillating high frequency amplifier may enormously increase the range of reception, though it is not always favoured, as it produces a peculiar form of distortion. The H.F. amplifier adjusted to be on the point of oscillation is "triggered" by incoming wave trains and received oscillations may be prolonged. As a result, the varying amplitude of the wave train is not accurately reproduced at the grid of the detector valve.

The tuned anode method of high frequency amplification is universally adopted and where rectification is to be brought about with a general purpose valve by means of a grid condenser and leak, a tuned anode amplifier is to be recommended.

A tuned intervalve transformer is employed when it is desired to pick up a potential possessing the necessary phase reversal for feeding back to cancel out self-oscillation. Another reason for employing transformer coupling is when anode rectification using a grid potentiometer is adopted. Again the difficulty arises with regard to constructing the transformer having fixed coupling with coils of the plug-in type. This is overcome by mounting an additional coil holder in a fixed position on the side of one of the adjustable coil holders, as shown in Fig. 2. When a suitable detector valve is employed, it is probable that better quality is maintained than when grid condenser and leak rectification is made use of.

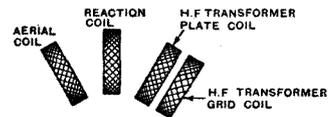


Fig. 2. Mounting of the tuning coils to provide reaction coupling with the aerial and H.F. transformer inductances.

In tuning to the wide wave range, the maximum capacity of the tuning condenser should be increased on the longer wavelengths. A large capacity tuning condenser does not give the necessary sharpness of tuning on the shorter wavelengths and for this reason a two-section condenser is again used. When the aerial switch is moved

over to the long wave position the two sections are thrown in parallel so that a single dial provides an extensive tuning range (Fig. 4).

**REACTION.**

Self-oscillation can be set up by inductively linking together the aerial inductance and the high frequency transformer, but a separate reaction coil in the plate circuit of the detector valve stimulates the desirable condition of oscillation in the detector valve plate circuit and at the same time provides for separately controlling oscillation in the aerial and H.F. amplifying circuits.

seen that the secondary can be loosely coupled to the aerial and the receiver becomes a loose coupled set with tuned primary and secondary, giving a very high degree of selectivity. The reaction coil winding may be connected across with a short-circuiting plug.

The fitting of a reversing switch in the leads to the reaction coil is recommended.

**LOW FREQUENCY AMPLIFICATION.**

So much has been written concerning the relative merits of the three methods of low frequency interval coupling that little more

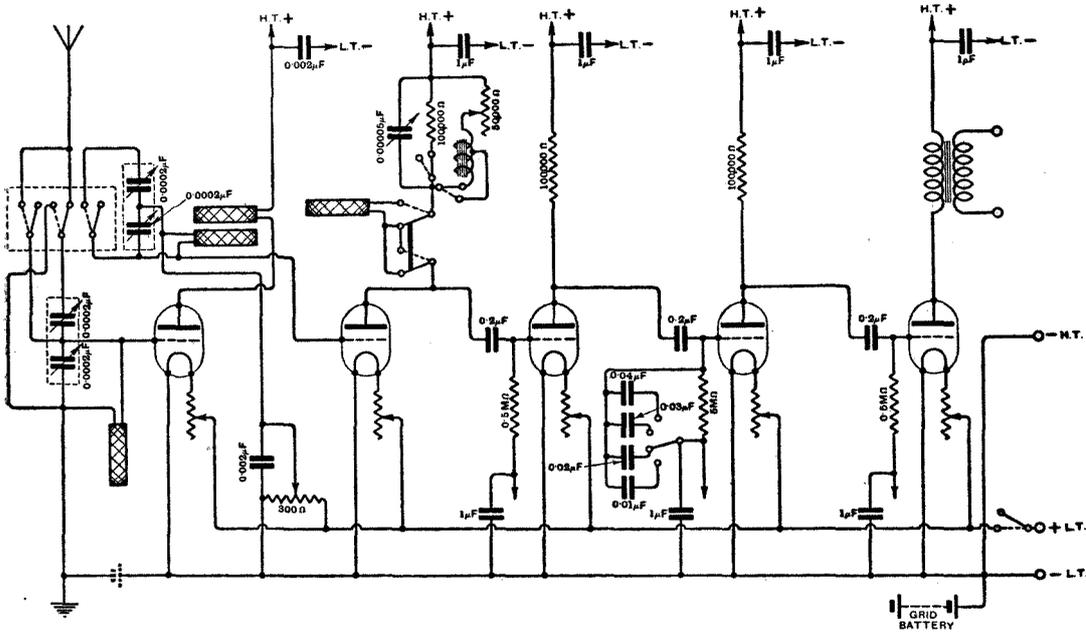


Fig. 3. The aerial and anode tuning makes use of plug-in inductances and a switch changing the wave range. The low frequency stages are essentially resistance coupled and include tone selecting devices.

Using the three-coil holder with the reaction coil mounted in the centre, some degree of self-oscillation can be stimulated in the aerial circuit where damping normally occurs, whilst the connections to the high frequency transformer may be arranged to stop oscillation as the transformer windings approach the reaction coil, for it is readily realised that the inter-electrode capacity of the H.F. valve brings about a condition of self-oscillation in the high frequency circuit. The arrangement of the coils is shown in Fig. 2 and this permits of taking the H.F. amplifier out of circuit by merely removing the transformer plate coil. It will then be

is left to be said that each method has reached a high degree of perfection and each has its own application. Where it is desired to preserve the speech wave form and introduce a minimum degree of distortion, then it is necessary to use resistance interval coupling, though it is well known that an additional amplifying stage must be employed. An attempt has been made in the circuit (Fig. 3) to use resistance coupling between the detector valve and the first L.F. stage. Several difficulties arise here. In the first place the initial degree of amplification at this point is low and in consequence the output after the subsequent stages is limited, while again

in order to make the reaction coil operative, a capacity shunt must bridge the resistance. However, the arrangement gives satisfactory results, though choke coupling as an alternative is available. The iron core choke coil serves a double purpose. In order to give even amplification it is wound to possess exceedingly high inductance value, whilst a tapping point is taken where the inductance value is only of the order of 4 or 5 henries. With such a low value inductance the higher note frequencies will develop a greater potential across its ends than the lower frequencies and in consequence, as the 50,000 ohm series resistance is taken out of circuit in stages, it becomes more operative in this respect, and has the result of giving greater amplification to those frequencies representing the higher pitched speech components. By means of a two-pole switch the entire inductance, which may be of the order of 120 henries, is brought into circuit, while the lead to the 100,000 ohm anode resistance is broken so that the intervalve coupling becomes the straightforward choke arrangement.

The subsequent stages are resistance coupled by means of 100,000 ohm non-

inductive wire-wound spools possessing low capacity across their ends.

A condenser shunt circuit is fitted across the input of the second low frequency amplifying stage, variable in steps between 0.01 and 0.04 mfd. These shunt condensers offer comparatively low impedance to currents at the higher speech frequencies and as a result provide a selective control

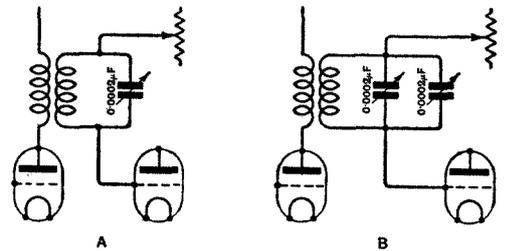
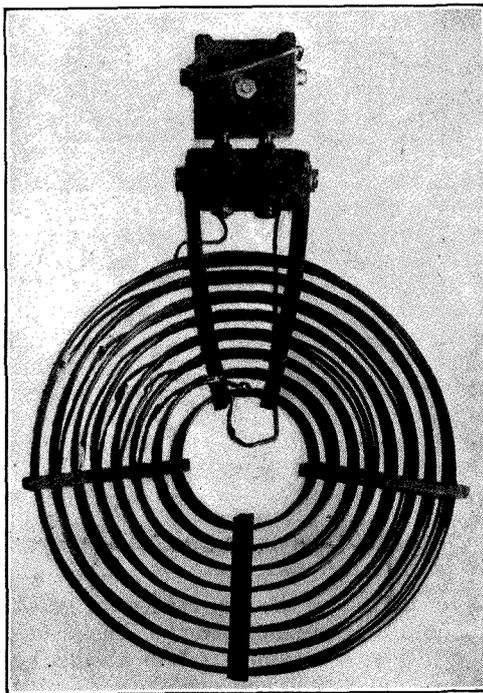


Fig. 4. The wave range switch in the aerial circuit throws the two sections of a double condenser in parallel across the H.F. transformer secondary.

over amplification at the varying frequencies. Thus, this condenser shunt circuit permits of accentuating, if necessary, the lower notes, whilst the iron core inductance in the detector valve plate can be used to boost up the higher frequency components.

The output of the last valve is fed to the loud speaker by a suitable ratio transformer and this arrangement is preferred as it separates the loud speaking equipment from a direct conductivity contact with the receiver and its amplifier.

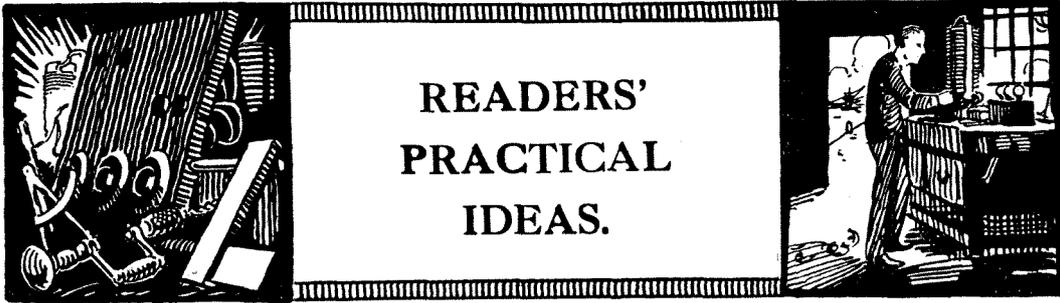
*A description will appear in an early issue of a receiver built to the circuit principle outlined here.*



#### LOW LOSS PLUG-IN COIL.

A photograph, reproduced here, of a coil constructed by Mr. Sydney Burns to the details given in a recent article.\* He has developed the design to make use of a greater number of layers than was shown in the original article.

\* *Wireless World and Radio Review*, July 2nd, 1924, page 393.

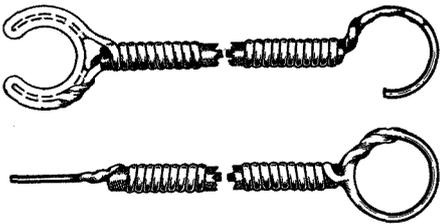


This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

**Terminating Flexible Wires.**

FOUR different methods of providing connectors for the ends of flexible leads are shown. From the illustration it will be seen that in one method the end of the flex is tightly bound, using No. 20 tinned copper wire. Connection is made by leaving a piece of the wire projecting and soldering the flexible to it. As an alternative it can terminate as a ring or as a hook for inserting under terminals. A very rigid tag connector can be made by bending the wire back to form a double loop which, when filled in with solder, produces quite a strong connector.

S. H.

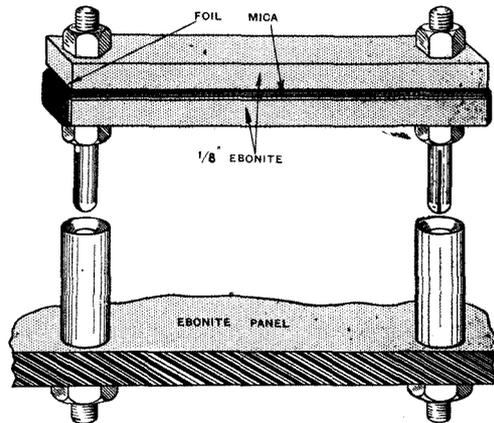


*Terminating tags for flexible wires.*

**Interchangeable Condensers.**

WITH the usual pattern of fixed value condenser it is not always a simple process when interchanging for the purpose of producing various capacity values. A condenser made up as shown here, in which it will be seen that the plates are clamped between two pieces of ebonite held together by valve stems, provides for easy interchanging. The constructional details can be seen in the drawing and for the guidance of the beginner it might be explained that

when using mica having a thickness of about 2/1000 in., that an overlap with two pieces of copper of 3/4 in. by 1/2 in. produces a capacity



*An easily constructed interchangeable type condenser.*

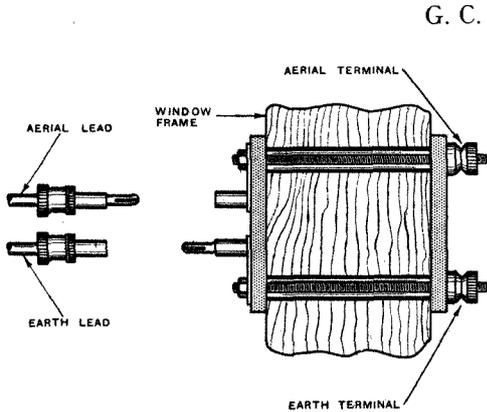
of approximately 0.0002  $\mu$ F, providing the plates are clamped up so securely as to practically exclude air.

A. E. D.

**Aerial and Earth Connections.**

THREADED rods, holding ebonite plates, can be used for aerial and earth lead-in, passing through clearance holes in the window frame. Both aerial and earth leads may be terminated on plug and socket connectors which permits of easy disconnection, whilst the aerial plug can be inserted into the earth socket giving effective earthing and entirely disconnecting the receiving apparatus. This arrangement may, if

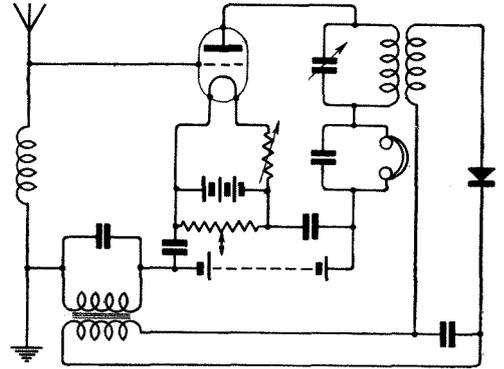
desired, be reversed so that the aerial and earth wires are connected by suitable tags to the terminals shown on the right in the diagram whilst the leads to the instrument terminate on plugs and sockets. The receiver can thus be disconnected from the aerial system and a short-circuiting plug used to connect the aerial to earth.



*Simple construction of aerial and earth lead-in. The aerial is earthed by withdrawing the plug and socket and linking them together.*

**Grid Bias.**

**A** SAVING in weight, space and expense will often be secured by employing the method here shown of utilising the potential of the H.T. battery for the purpose of providing suitable grid bias potential. Both positive and negative potentials can be stepped off, while in the case of reflex circuits where it is desired to use a potentiometer in conjunction with a grid battery giving fine



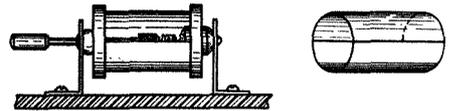
*H.T. potential and grid bias from a single battery.*

control over the grid voltage this method can be made use of as in the arrangement shown in the single valve circuit.

C. V. S.

**A Crystal Detector Hint.**

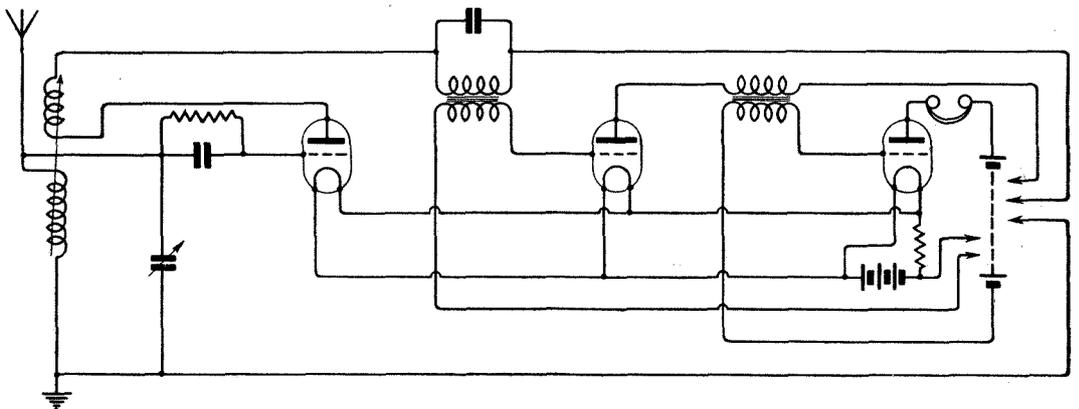
**W**HEN it is found difficult to see the point of contact in a crystal detector owing to the blackness of the ebonite panel



*A piece of white paper in the lower half of the tube illuminates the detector contact.*

beneath it, it is a good plan to insert a piece of white paper in the lower half of the glass tube, so as to throw up the outline of the contact against a white background.

A. H.



*The use of one dry cell battery for providing H.T. and grid biasing potentials.*

## VALVE TESTS.

### MESSRS. RADIONS' LTD. "G.P." VALVE.

**M**ESSRS. Radions, Ltd., have recently submitted for test samples of a new valve which they have developed, and which is known as the Radion "G.P."

This has been designed for general purpose use, and is quite distinct from the earlier products of this Company, the D.4 and the A.2. The electrodes are mounted vertically in a spherical bulb, which has the ruby tint peculiar to Radion valves.

The valve is rated by the makers as follows: Filament voltage 3.6-4.0; normal filament current 0.48 ampere; plate voltage 30-80.

The results of tests on the filament are shown in Fig. 1. At normal filament current a voltage of 4.25 is required, giving an emission of 4.4 milliamperes. This gives an efficiency of 2.2 milliamperes per watt,

but the voltage is outside the range of a 4-volt accumulator, and a 6-volt battery and a resistance should be used.

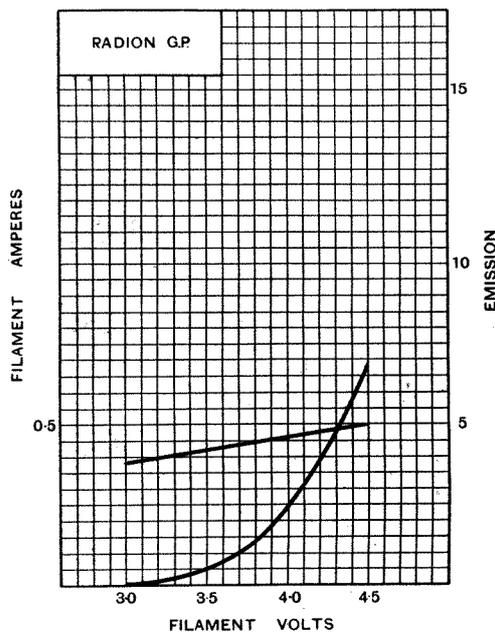


Fig. 1. Showing the filament current and emission for various filament voltages.

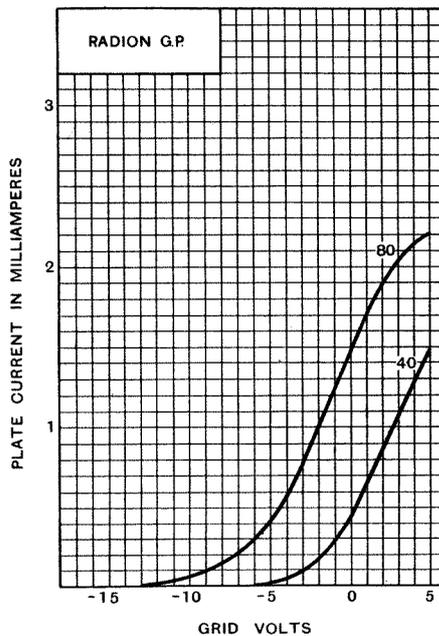


Fig. 2. Plate current-grid voltage curves.

At the maximum rated filament voltage (4) the emission is 2.5 milliamperes, which is on the low side. The filament efficiency now works out at 1.4 milliamperes per watt.

Plate current—grid volts curves are shown in Fig. 2, and the small emission is reflected in the early bend of the curve at the higher voltage. The characteristic at 80 volts, although restricted in length, has a good slope and, provided the input is small, should give good low frequency amplification. The amplification factor is of the order of 9, while the impedance varies between 50,000 and 40,000 ohms according to plate potential. The impedance is also somewhat high, and

it was thought to be due, to a great extent, to the small emission. The truth of this assumption was proved by testing again for impedance at a higher filament voltage, when a much lower value was obtained. The filament was, of course, over-run for this test, and such an expedient is therefore not to be recommended, for the gain in efficiency is obtained at the cost of valve life.

The next test was carried out on our standard receiving arrangement, first on the high frequency side, then as a detector, and finally in the first stage of a low frequency amplifier.

The valve gives quite good results when used as a detector or high frequency amplifier, and a too careful adjustment of anode potential is not necessary, something round 40 volts being suitable. As a low frequency amplifier the high plate impedance and low emission tell against it, but even so, provided the input is small, quite satisfactory results will be obtained if this valve is used in the first stage.

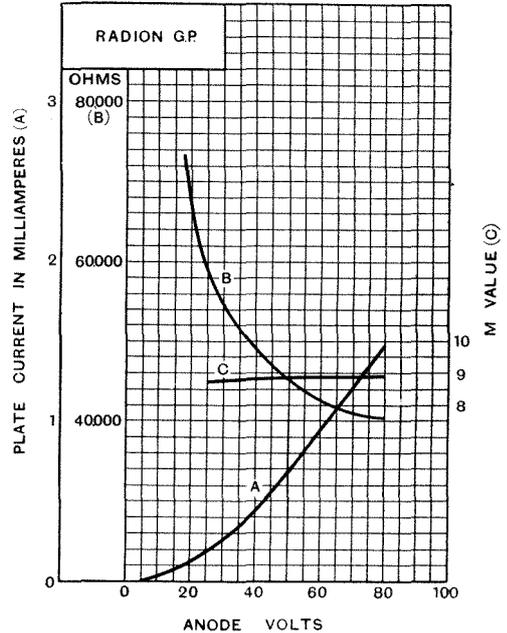
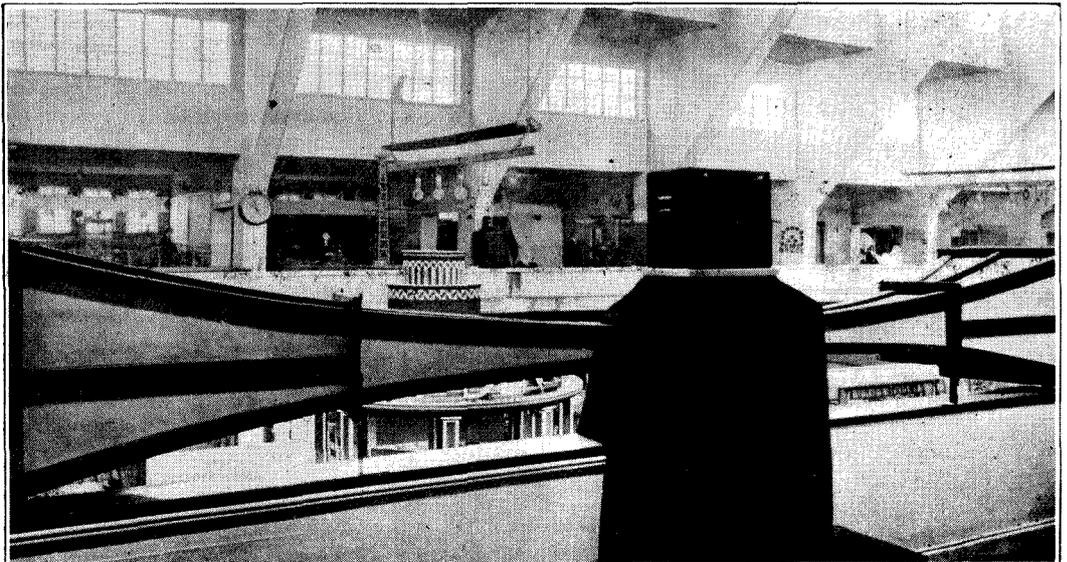


Fig. 3. Curves showing the plate current (A), impedance (B), and amplification factor (C).

### A GIANT LOUD SPEAKER.



A giant loud speaker by Siemens and Halske, installed at the first German Wireless Exhibition in Berlin.

# THE EXPERIMENTER'S NOTE BOOK

By W. JAMES.

## Reading Valve Curves.

WHEN studying valve curves it is useful to remember that a small change in the grid voltage is quite as effective in producing an increase (or decrease) of anode

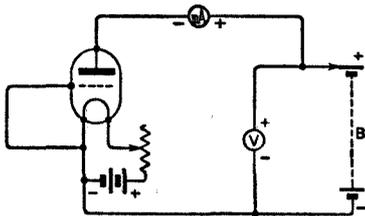


Fig. 1. Connections of the valve for finding the anode characteristic.

current as a much larger change in the anode voltage. With one valve, for instance, the anode current may be increased by the

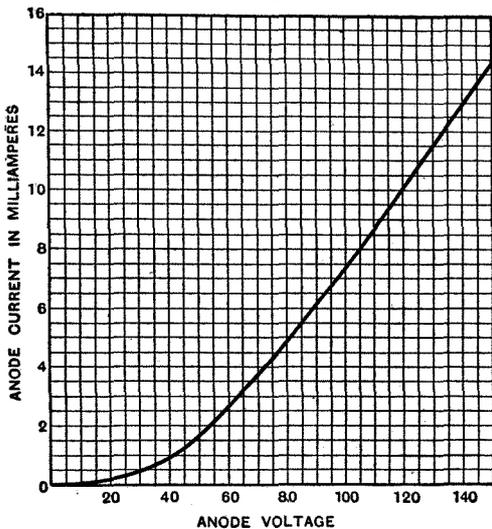


Fig. 2. The curve shows the relationship of anode current to anode volts with a fixed grid potential.

same amount by adding 1 volt (positive) to the grid as by adding 10 volts to the anode circuit. With another valve the grid may be twenty times as effective in changing the anode current, or it may, perhaps, be only five times as effective. Thus the anode current depends on the anode *and* the grid volts.

To show this more clearly let us draw two curves—one showing the relationship of anode current to anode volts with the grid at zero voltage, and the second showing the relationship of anode current to grid volts with the anode at a fixed voltage.

To obtain the information for the first curve connect to the valve, as shown in Fig. 1, the usual filament heating battery, a high tension battery B which can be tapped, and a

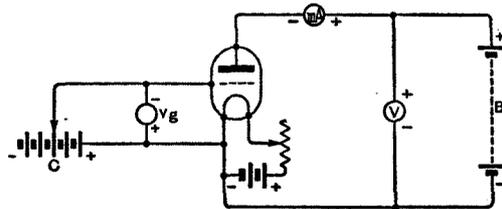


Fig. 3. Connections of the valve for finding the grid volts-anode current characteristic.

milliammeter. The milliammeter may be one reading 0-15 milliamperes, and the voltmeter across the anode battery, 0-150 volts. Connect the grid to the negative side of the filament.

With the filament heated to its normal temperature, take readings of anode current for various anode voltages. Make a note of the anode current at 10, 20, 30—up to say 150 volts. Then plot the values on squared paper, and so obtain a curve such as that of Fig. 2. This curve then shows us how the anode current varies when the anode voltage is changed, the grid being connected to the negative side of the filament.

To secure the information for the second curve, connect the valve as shown in Fig. 3. A high tension battery B, of say 100 volts, as measured by the voltmeter V, is connected with a milliammeter mA in the anode circuit. In the grid circuit connect a low-reading voltmeter Vg and a battery of single cells C, in order that the grid may be given as negative a voltage as desired. With the filament heated to normal, and the anode voltage fixed, make a note of the anode current for various grid voltages, and plot a curve such as that of Fig. 4.

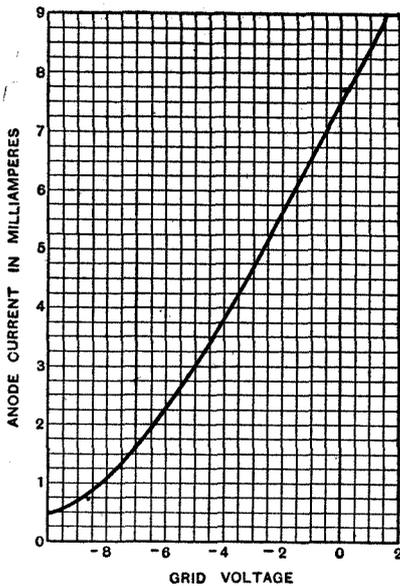


Fig. 4. Curve showing the relationship of anode current to grid volts with a fixed anode voltage.

### The Effect of Grid Bias.

Let us now examine these two curves. We notice at once that the anode current, with zero grid volts, Fig. 4, has the same value (7.4 mA) as when the anode voltage, Fig. 2, is 100. This is easily understood, because of the points considered; the anode voltage is 100 and the grid voltage zero in both instances.

However, to prevent grid current distortion, it is usual to give the grids of valves employed in low frequency amplifiers a negative voltage. Suppose then that the grid is given a negative bias of 1.5 volts. What effect has this on the anode current? Referring to Fig. 4, we see that when the

grid is 1.5 volts negative, the anode current is 6.1 mA. The anode current is reduced by making the grid more negative. When the anode current of Fig. 2 is 6.1 mA, however, the anode voltage is only 90. The effect of making the grid 1.5 volts negative, therefore, is to reduce the anode current to a value which it would have if the grid voltage were zero and the anode voltage reduced from 100 to 90. In other words, the voltage on the grid has seven times as much effect on the plate current as a similar change in anode volts. The amplification factor of the valve is therefore 7.

But this is not the point which we wish to emphasise here. The important point is that from the curves of Figs. 2 and 4 we can see that a given anode current can be set up by a combination of grid and anode voltages. Thus, 100 volts on the anode and -2 grid volts gives an anode current of 5.6 mA (Fig. 4); Fig. 2 shows that this anode current may be obtained by connecting 86 volts to the anode and the grid to the filament.

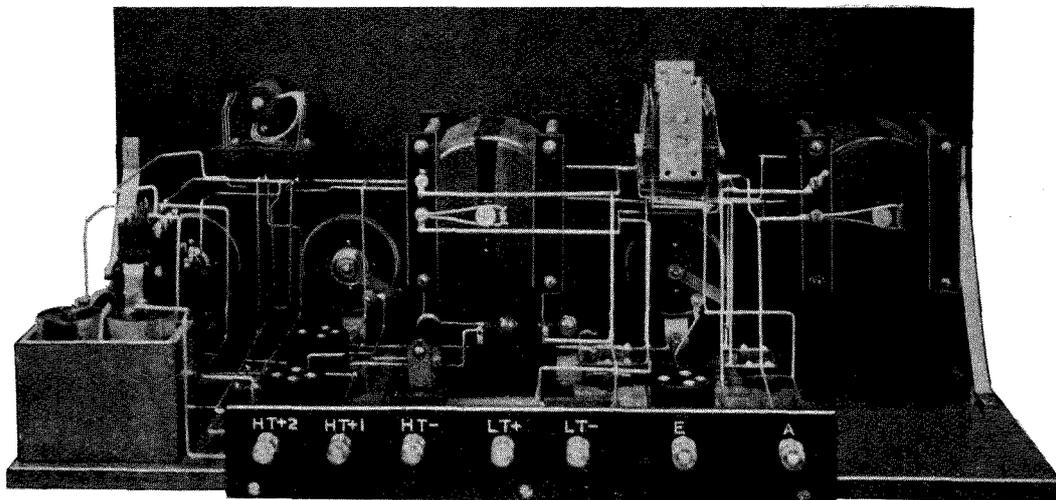
If the grid bias is -6 volts, the anode current is 2.25 mA, which is equivalent to connecting 58 volts to the anode and the grid to the filament.

The effect then of making the grid more negative is to reduce the anode current as though the anode voltage was reduced by an amount depending on the amplification factor of the valve multiplied by the grid voltage. This may be expressed as follows:—

The anode current,  $I_A$ , is proportional to  $K(E_A + ME_G + e)$ , where  
 $E_A$  is the anode voltage  
 $M$  is the amplification factor  
 $E_G$  is the voltage of the grid battery  
 $K$  and  $e$  are constants.

The effective voltage causing anode current is the sum of the anode voltage and the product of the amplification factor and grid voltage. A voltage applied to the grid ( $E_G$ ) affects the anode current in the same way as a voltage  $ME_G$  added to the anode voltage. Put in a simpler way, the effective voltage =  $E_A + ME_G$ .

Thus referring to the above examples we see that when the grid bias is -6, the effective anode voltage is  $100 - (6 \times 7)$  or 58 volts and the current is 2.25 mA. When the grid is 2 volts negative, the effective anode voltage is  $100 - (2 \times 7)$  or 86 volts, and the anode current 5.6 mA.



*A back view of the assembled receiver.*

## A TWO-KNOB THREE VALVE RECEIVER.

TUNING FROM 250—2,800 METRES.

This concluding instalment gives the details for wiring and completing the assembly of the receiver dealt with in the last issue. Particulars for the construction of the cabinet are also given.

By HUGH S. POCOCK.

*(Concluded from page 376 of previous issue.)*

**T**HE first step in the assembling of the set should be to obtain the wooden baseboard and the panel. Unless the panel is purchased ready prepared and squared up, this must be done first, but it is much better to buy the panel ready for use squared up and rubbed down. Radion panels are so prepared to the dimensions advertised. After the necessary holes have been drilled in the panel in accordance with the diagram, Fig. 5, given in the last issue, the panel should next be attached to the baseboard. This is done by means of screws through the bottom edge of the panel, and the fixing is strengthened and held rigid by means of two brass brackets. These may either be bought ready or may be made from strip brass. The fixing screw holes for the brackets should not be drilled in the panel until the brackets are ready. If they are

made up by the constructor great care must be taken in bending the brass to the required angle. It cannot, of course, be bent sharply, or it will crack. The strip should be held in a vice at the point where it is desired to bend it, and should be gently and gradually bent over by tapping with a hammer. Having made or obtained the brackets the position on the panel for the fixing screws should be marked and the holes drilled in case they differ from the positions given in the diagram.

Next the wiring to the Utility switch, which switches the L.F. valve, may be treated in the same way as the barrel switch, making as many as possible of the connections before the switch is fixed to the panel. For this it will be necessary to follow the wiring diagram Fig. 7, and after this has been done attention can be directed to the variometers. It will be observed that two connections

have to be made at each end of the variometers, and therefore two of these on each instrument are fixed between the variometer and the panel. To put these connections on

All wires, which should be No. 16 tinned bare copper, should be stretched in convenient lengths, and the bends should, for the sake of appearance of the finished set,

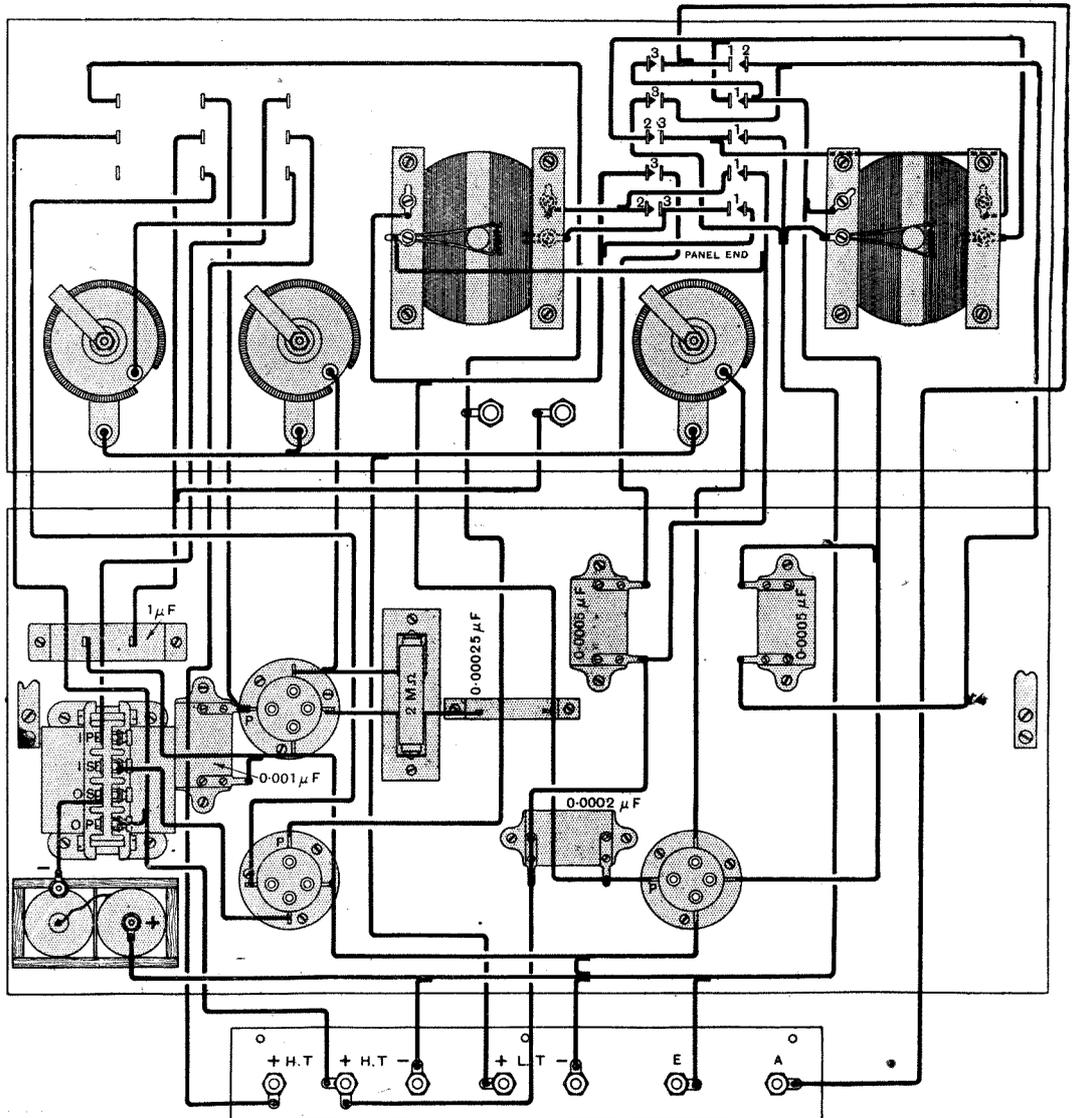


Fig. 7. Complete wiring diagram.

neatly it is again almost imperative to solder them before the variometer is fixed in place on the panel, so that again those wires must be carefully measured to the next points of attachment and bent to the correct direction.

be made at right angles as far as possible, but I do not suggest that all wiring used be so arranged if convenience or the possibility of using shorter leads may dictate otherwise.

Fig. 8 gives the dimensions and drilling

sizes for the terminal strip, which is screwed in place at the back edge of the wooden base so that when the box is constructed, the ebonite is flush with the back of the box, leaving the terminals projecting. It will be seen that two H.T. positive terminals are provided, so that additional potential can be applied to the plate of the L.F. valve.

The wiring to be done after the components are assembled on the panel and baseboard is comparatively simple, and by following the diagram Fig. 7, no difficulties are likely to be met with. It will be observed that two cells are used to provide a negative potential to the grid of the L.F. valve, and this valve may be a B.T.H., B 4, or an L.S.2, or a valve of similar type. The R 5 v type valves may conveniently be used with these for H.F. and detector stages, when a six-volt battery will be required for filament heating.

No stipulations are made as to the wood used for this cabinet as this is left to individual discretion. If a very good-looking set is required, the wood can be mahogany and polished, or it can be plain white wood, stained after the box is completed, if its purpose is simply to keep the set free from dust and to protect it from damage.

When the receiver has been completely finished, it should be tried out for any possible faults which may occur, perhaps not so much through accidents in wiring as through failure by one of the switches to make a good contact. The barrel switch should be checked over carefully to see that proper contact is being made at all the points where the blades should come together in the three positions. It will very likely be found that in the process of fitting to the panel and soldering the connections

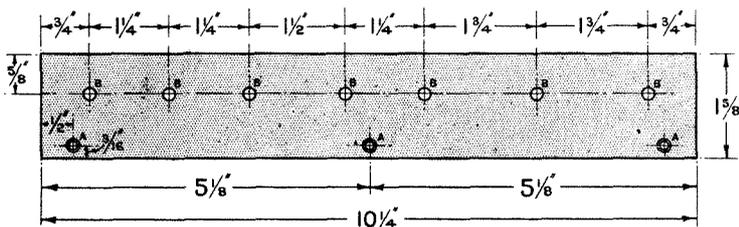


Fig. 8. Details for the terminal strip ; A, drill 1/8" dia. countersunk for No. 4 wood screws ; B, drill 3/8" dia.

All the information necessary for the construction of the set should now be at the disposal of the reader, and therefore we can pass on to some notes on the operation of the receiver and instructions for making a cabinet for housing the set if this is required.

The dimensions and other details of the box to contain the receiver are given in the illustration, Fig. 9, and the photograph of the complete set (see page 372 of previous issue) shows the appearance when the receiver is completed. It is necessary that the lid of the box should be hinged as shown, in order to facilitate the interchange of valves or to get at any connections easily if necessary. By adopting the method of construction indicated, it will be seen that the receiver itself is independent of the box and is self-contained, so that by simply sliding out the ebonite panel, the complete receiver is removed with it, leaving the empty box, as shown in Fig. 9.

that a blade may become slightly bent, so that when the under blade is pressed towards it, it just fails to make contact. A very slight bending inwards of the outer blade from close to its base will make the necessary correction and it must be noted that this bending will have to be very slight, otherwise the two blades make permanent contact and do not separate where they should. After the present set was assembled, two of the blades were found to require adjustment in this way, and the failure to make contact was a fault at first rather difficult to trace. The set shown in the photograph does not indicate any engraving on the front panel, but if it is desired, this can be done by sending away the panel after drilling with the positions and lettering for engraving marked. With the arrangements of the leads of this set it is possible to remove the panel from the set even after the wiring has been done without interfering

greatly with the connections, and no soldered joints need be undone, as the only points where leads actually go to components on the panel are where terminal tags can be employed.

In trying out the receiver it will be found that the tuning is distinctly sharp and the settings of the two dials run approximately together so that when once the scale settings of the anode variometer have been ascertained for various stations on the three ranges, there should be no difficulty in picking up these stations as required, because the setting of the aerial variometer will be within a few degrees of the same reading as the anode variometer.

with longer wavelength range, it is nevertheless possible in practice to get sufficient reaction to receive continuous wave stations and to stimulate amplification by the inclusion of a fixed condenser between the anode and grid leads of the first valve. As I have mentioned already, the necessity for this capacity coupling to produce reaction effects will depend on the arrangement of the wiring to a certain extent and therefore it is well to have some means of introducing this capacity which can be conveniently increased until the requisite value is obtained. The simplest method of doing this is to take two pieces of well insulated copper wire about 4 ins. long and solder

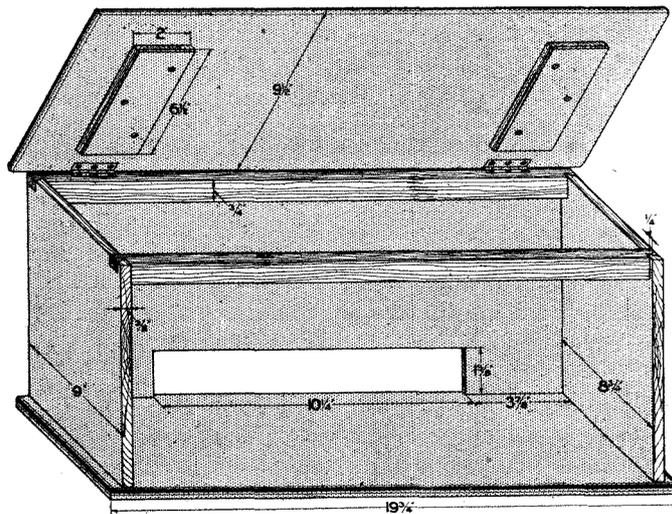


Fig. 9. Dimensions for building the cabinet.

It will probably be found when testing out the set, that whilst spark and telephony stations come in well, the set does not quite oscillate even when the two variometers are in tune. Whether it will oscillate slightly or not depends largely on how the individual constructor has arranged the wiring and this is why it has been left until now to make the final adjustment which will give comparatively uniform oscillation if required over the wavelength range. Although the tendency to oscillate will naturally decrease

one each to the leads coming from the plate and grid of the valve holder of the first valve. Then take the two leads and twist them together, when the capacity between the leads will provide the condenser required. The ends will, of course, be left free and the two leads will be wound up until it is found by experiment that the set oscillates sufficiently to receive C.W. stations on all three ranges. Once found, no further alteration need be made and this condenser value can be left permanently.

## WAVEMETERS

By L. B. TURNER, M.A., M.I.E.E.

(Continued from page 386 of previous issue.)

### (5) WAVELENGTH STANDARDS.

WE have seen in the last section that the triode oscillator offers facilities which render it an indispensable instrument for wavelength measurements. Is it, then, feasible to construct triode oscillators accurately calibrated for wavelength so that they can be kept as standards? As far as ordinary convenient practice is concerned, I think the answer can only be no. The calibration is so liable to be upset by replacement of the triode, or change of battery voltage, that it is most undesirable to rely on such an oscillator as an accurate standard. The proper course is to provide a series of wavelength standards from which the oscillator can be checked or connected at any time when it is required for use as an accurate wavemeter. We have seen that, thanks to the available harmonics, the standards need not cover a wide range.

The most obvious form of such a standard is a robust invariable inductance coil of low resistance joined by leads of constant or negligible inductance and capacity to an invariable condenser. The latter is preferably a good mica condenser, sealed solid into a box with wax; and, where the wavelength is very short, it is a good plan to seal the whole—condenser, coil and connections—in a block of wax. Constancy is then assured, even if the instrument is subject to the ravages of the inquisitive fiend with a screwdriver. An example of this construction is shown in Fig. 10. Two wavelengths, nominally 50 and 45 metres, were by this instrument fixed for the factory adjustment of the circuits of a fixed-tune portable military telephone outfit. At that time the official standard wavemeter was undergoing corrections, at these short waves, about once a week, and it was necessary to take a firm line and say that, as far as the British Army and this telephone

set are concerned, this is "50 metres" and ever more shall be so.

It is clearly best in principle that the standard  $LC$  circuit should have no exciting or detecting apparatus attached to it. In the example shown a crystal detector was provided as part of the standard, but care was taken to employ such a large  $C$  and a small  $L$  that the detector could produce no appreciable effect on the wavelength.

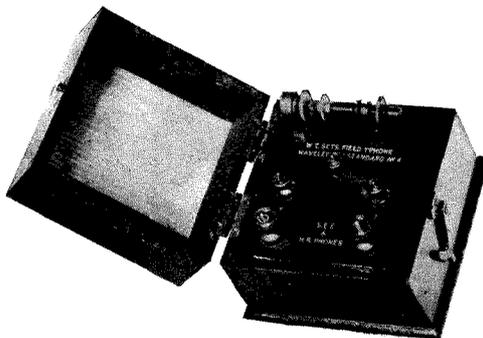


Fig. 10.

Superior to a crystal detector with telephone or galvanometer is that beneficent instrument, a Moullin H.F. voltmeter\*; but by using the well-known click phenomenon, resonance between oscillator and standard may be observed by a telephone connected to the oscillator without any conductive connection to the standard at all.

### (6) POINTS IN THE DESIGN OF AN EVERY-DAY WAVEMETER.

For many purposes a simple wavemeter, with a crystal detector for use with telephone or galvanometer when receiving, and with buzzer excitation for transmitting, is a great convenience. It may not be very precise, but it can be constant; it has no harmonics (which are a nuisance once calibration is

\* *Journal I.E.E.*, February, 1923.

done), and it uses no H.T. or filament battery.

Apart from obviously necessary qualities in a measuring instrument, such as mechanical soundness in the moving parts (condenser or coil), a satisfactory design may take various shapes, provided always that the following conditions are met :

- (a) The buzzer must not be unsteady, for this drives the user mad.
- (b) The buzzer must not show any trace of spark at the contact, for this leads to (a), and spoils the H.F. oscillation.
- (c) The buzzer current must not pass through the coupling coil, for this shocks the circuit under test into its own natural oscillation, whatever the wavemeter setting.
- (d) The coupling must not change with change of wavelength setting, for we wish to impress or receive an e.m.f. constant in magnitude while variable in frequency.
- (e) The calibration must not be subject to upset from capacity effects from the hands, or from adjustments of the crystal detector.
- (f) There should be good overlap between successive ranges.
- (g) The decrements should be fairly low at all wavelengths.
- (h) A sensitive indicator (telephone) should be provided for, even if other indicators, such as the ingenious Townsend lamp, are also available.
- (i) Preferably, the buzzer should be accessible, and not very noisy, and its battery should be easily replaced.

Most of these conditions, and the manners of meeting them, will be fairly obvious to you, but I may enlarge a little on two of them. I assume that the buzzer is used in the usual way after the manner of Fig. 11. The buzzer opens when a current  $I$  is flowing in  $L$ ; and if the break is sudden and complete an oscillation of initial energy  $\frac{1}{2} LI^2$  is set up in  $LC$ . The buzzer magnet must obviously be adequately shunted with resistance or condenser  $S$  to delay the fall of magnet current when the break occurs; and clearly the smaller the part of  $I$  which flows round the magnet, and the larger the part in  $S$ , the better.

But control of the P.D. across the magnet winding is not sufficient to prevent sparking. Even when, as in Fig. 11, the buzzer

inductance is completely shunted by the condenser, the quantity  $I \sqrt{\frac{L}{C}}$  must not be too great; otherwise sparking is bound to occur. In wavemeters where a single variable condenser  $C$  is used with several values of  $L$  for the several ranges, this trouble is often met at the longer waves. This is one point in favour of variable  $L$  and fixed  $C$ .

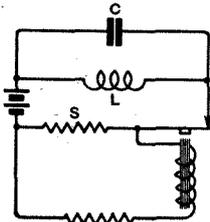


Fig. 11.

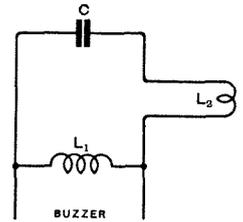


Fig. 12.

In Fig. 11 condition (c) is violated, for coupling can be made only to the coil carrying the buzzer current. If, however, we change to Fig. 12, sparkless working becomes an impossibility. Sudden buzzer break would require sudden growth of current in  $L_2$ , and an indefinitely large P.D. would be produced across  $L_1$ . There are two alternatives, shown in Figs. 13 and 14. Each of these is theoretically sound; but

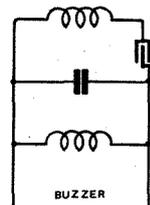


Fig. 13.

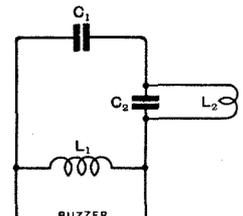


Fig. 14.

Fig. 13 is inconvenient if a fixed condenser is used, and in Fig. 14 two frequencies occur. Provided, however, that  $C_2 L_2 \ll C_1 (L_1 + L_2)$ , the oscillation of the higher frequency will be so much higher and so feeble as to be inappreciable. Such considerations are no merely academic question, as is shown by the fact that visible sparking may be observed when a buzzer breaks a current of 0.2 ampere or so through an

unshunted inductance of only some 20 microhenries. And as long as the buzzer contacts remain bridged by the arc, any oscillation in the LC circuit is desperately damped by the resistance shunt thereby provided across L.

Fig. 14 is an attractive arrangement, with C<sub>1</sub> a series of fixed mica condensers, L<sub>1</sub> a variable inductance of the variometer type,

range. Hence if J is the initial value of the oscillatory current, and if we neglect the change of resistance as L<sub>1</sub> is varied in tuning,

$$J \propto \sqrt{L_1}$$

$$\propto \frac{I}{n} \text{ if } L_2 \ll L_1$$

Hence the e.m.f. impressed in the circuit

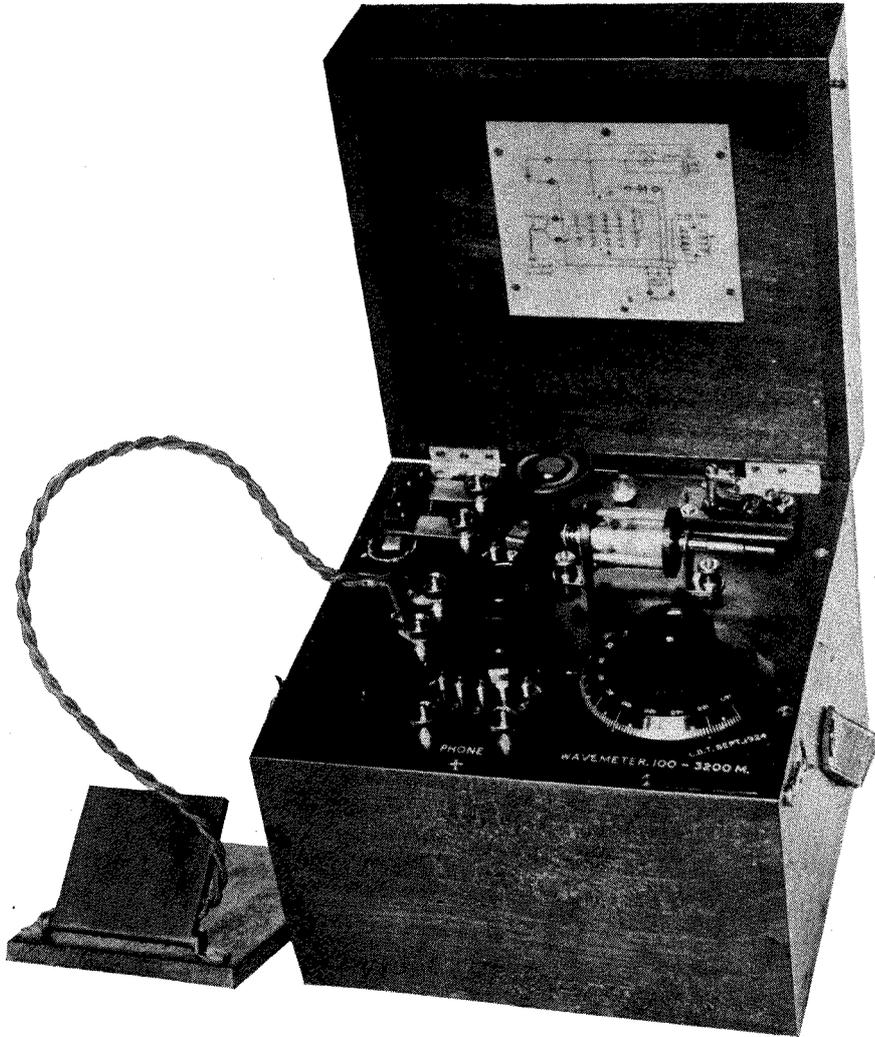


Fig. 15.

L<sub>2</sub> a small movable coupling coil, and C<sub>2</sub> a small capacity, such as that between the conductors of a short piece of flexible cord leading to L<sub>2</sub>. The buzzer excites the same coil, with energy  $\frac{1}{2} L_1 I^2$  per break, on every

under test coupled with L<sub>2</sub>, being proportional to n I, is constant as L<sub>1</sub> is varied. This is the correct condition for detecting resonance by the occurrence of maximum current; it does not obtain in wavemeters where L is

fixed and  $C$  varied—an error which, however, becomes serious only if the decrement is high.

I have here (Fig. 15) a wavemeter constructed on these lines. I do not proffer it as an instrument of any outstanding virtue, but as an example to stimulate discussion and criticism. It has five ranges covering wavelengths of 100—3,200 metres, and its electrical dimensions are given in Fig. 16 and Table 3. For reception a carborundum rectifier is fitted. This does not appreciably increase the decrement of the circuit; although when silicon was used the decrement was greatly increased. For sending there is a buzzer, whose shunt is a small lamp. The two coils of the variable inductance—an "Igranic" variometer—are connected in parallel; and, being wound in opposite directions, give a minimum self-capacity at the position of minimum inductance. The wavelength-degree curves with this ball-form of variometer are fairly straight over the whole scale. The measurements quoted in Table 3 have been made at 20 degs., 90 degs. and 160 degs. on the scale.

TABLE 3.

	Range.				
	1	2	3	4	5
$\lambda$ at 20° ..	102	185	363	725	1,470
$\lambda$ at 160° ..	257	455	900	1,720	3,550
Receiving decrement at 20°	.08	.08	.09	.07	.11
Receiving decrement at 160°	.03	.05	.04	.035	[.05 at 90°]
Sending decrement at 90°	.6	.34	.15	.12	.09

I am particularly interested in—and, I may add, disappointed by—the sending decrements. I have not seen other measurements of the decrements of buzzer-excited oscillations, and should be glad to hear of any in the discussion. The rise of decrement due to the buzzer is very marked at the shorter waves. I do not think it is due to sparking at the buzzer contact; firstly because none is visible; and secondly because, in a test on range 2, replacement of the 10  $\Omega$  lamp shunt across the buzzer magnet by a 40  $\Omega$

shunt made no perceptible change in the decrement. I think the rise must indicate that there is an appreciable epoch of poor conductance across the junction after mechanical separation has begun, but is incomplete. We must bear in mind that with short waves the oscillation is all over in an extremely short time—say in about 4 micro-seconds in Range 1 and 500 micro-seconds in Range 5. Any, even very brief, transition epoch of poor conductance intervening between sensibly perfect short circuit and complete break is therefore to be feared.

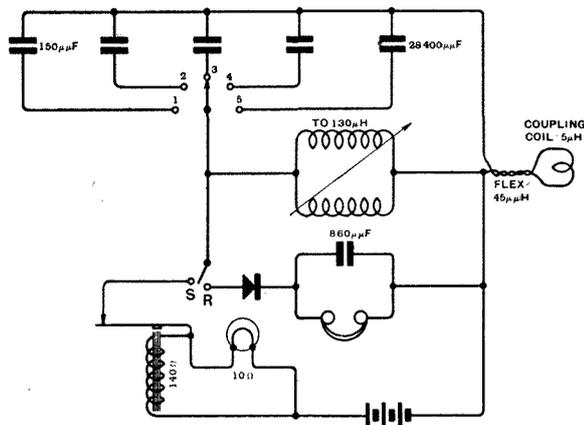


Fig. 16.

In conclusion, I feel that a word almost of apology is called for. I have been wearying you with talk which, you may have felt, would have suited your grandfathers—talk of buzzers and crystals. In my own mind recollections have been awakened of the time when the buzzer was a necessary and exasperating instrument for laboratory measurements; recollections

“Of old unhappy far-off things,

And battles long ago,”

which I had supposed abolished from my life by the happy triode of to-day. But I do think that in the domestic wavemeter there is still a field for the buzzer and the crystal; and I thank you for patiently hearing me speak of them at the end of a rather lengthy paper.

(The ensuing discussion will be included in a subsequent issue.)

# PATENTS AND ABSTRACTS



### A Method of Winding Multi-Layer Coils.

The method of winding a multi-layer tuning coil described in Patent No. 216,084 may be gathered from Fig. 1.

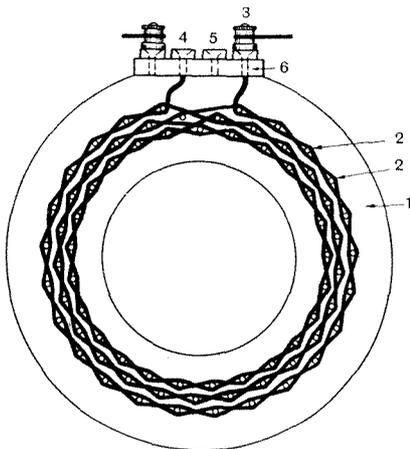


Fig. 1. A multi-layer coil.

A former consisting of a disc of wood (1) has an odd number of pins (2) arranged on its surface, the pins in one row being opposite the spaces of the pins in the next row. The number of pins, their length, and the distances between them will vary according to the thickness of the layers to be wound.

In forming a flat coil, the first layer of wire starts from one terminal (3), and is laid round in a zig-zag path between the pegs, and terminates at contact 4. A second layer may start from contact 5, following the path of the first layer, and ending at another contact, mounted on a strip of insulating material (6). A number of layers, according to the number of rows of pegs employed, may be wound. When the winding is completed, the pegs may be withdrawn.

To support the winding a disc of insulating material, such as treated cardboard, may be

placed on each side of the coil, and the winding secured to the discs by thread.

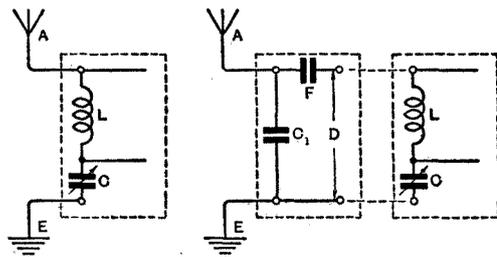
Various combinations of the coils may be employed, and it is not necessary that the wire of the coil be laid regularly along the pegs in the manner illustrated in the figure.

### A Filter Circuit.

When interference due to atmospheric, spark signals, etc., is experienced, considerable relief may usually be obtained by connecting a suitably arranged filter circuit (or "wave-trap") in the aerial or other tuned circuit.

The filter circuit usually comprises a condenser and inductance, the condenser generally being of the adjustable type. Patent No. 217,601 discloses a simple scheme for reducing interference, which consists in connecting between the aerial and earth an arrangement of condensers.

The connections of Fig. 2 are those of an ordinary receiver, having an aerial A, tuning coil L, condenser C, and earth E.

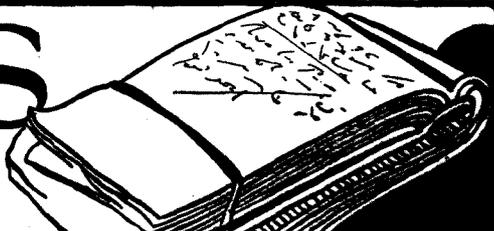


Figs. 2 and 3. Showing a simple filter circuit connected to a receiver.

Fig. 3 shows the invention. Between the aerial and earth a condenser  $C_1$  is connected, which preferably has a capacity of two or more times that of the aerial, and a condenser F is connected in one of the wires, D, connected to the receiver.

The condensers may, of course, be built in the receiver, or form a separate attachment.

# NOTES & NEWS



Bradford Corporation proposes to issue licences for wireless aeriels across streets at a charge of 2s. 6d. each.

\* \* \* \*

Arguing that wireless listeners have not contributed their financial share to the support of the game, Mr. Tex Rickard has decided to forbid the broadcasting of boxing matches promoted by him.

\* \* \* \*

A radio society has, we understand, been formed at Southall, Middlesex.

\* \* \* \*

A microphone has been installed on the White Star liner "Cedric" for broadcasting the ship's orchestral concerts to the third-class quarters.

\* \* \* \*

A report of a banquet to Mr. Owen Young in New York on December 11th, was published in the *Johannesburg Star* on the following day. The speeches were broadcast and picked up in Johannesburg.

\* \* \* \*

## GOOD WORK WITH A T.V.T. UNIT.

Mr. D. B. Knock (6 XG) reports that, using an ex-Government T.V.T. unit for H.T. supply with a Phillips 5-watt valve, he is able to maintain reliable communication over a distance of 1,000 kilometres. Among the stations recently worked under the above conditions are Finnish 3 NB (at 7.30 a.m., in daylight); Italian 1 ETR, owned by Countess Elena Thaon di Revel Florence, and at the time of communication operated by Signor Giulio Salom; also Danish 7 ZM, and Swedish SMZV and SMZN. In each case 6 XG's signal strength was given as comfortably readable. Mr. Knock would be glad to know whether any other readers have effected greater distances with a T.V.T. unit.

## CHRISTIANIA EXPERIMENTAL BROADCASTING STATION.

The installation of a temporary broadcasting station at Christiania is reported to us by an English reader in Norway. The power of the station is understood to be at present  $\frac{1}{2}$  kW., and the wavelength varies between 440 and 500 metres. Experimental transmissions take place daily from 7.30 until about 10 p.m. (G.M.T.).

From the same source we learn that a Norwegian broadcasting company is in course of formation, modelled on the lines of the B.B.C., but with a maximum capital of 350,000 kroner. As soon as

arrangements are complete, a Marconi "Q" transmitter will be erected in Christiania.

## RADIO AND U.S. BUDGET ALLOWANCE.

An idea of the growth of wireless activity in the United States can be gained from the general belief that Secretary Hoover, in presenting next year's Budget before Congress, will ask for a larger appropriation for the Radio Section of the Department of Commerce. The prospective allowance of 215,238 dollars, which is an increase of 10,000 dollars over the present year, is deemed insufficient for the work of the Section.

## TETRAZZINI'S CHRISTMAS PROGRAMME.

The Italian agent of Burndept, Ltd., calls attention to a very interesting programme which will be broadcast from the Rome station on Christmas Day.

Madame Luisa Tetrizzini, the famous prima donna, assisted by Signor Ugo Donarelli, will sing the Mad Scene, from "Othello" (Verdi), and "La Ci Darem La Mano," from "Don Giovanni" (Mozart).

For the benefit of British listeners, Madame Tetrizzini will sing certain items in English, including "The Last Rose of Summer" and "Somewhere a Voice is Calling."

Owners of efficient receivers should certainly try to pick up this concert, which will commence at 8.30 p.m. (G.M.T.). The wavelength of the station is 425 metres.

## NEW ZEALAND BROADCASTING.

An unfortunate occurrence marred the inaugural transmission from the new broadcasting station at Wellington, N.Z., at the end of October, writes Mr. H. Ninnis. A locally constructed transmitter was used, with a power of 500 watts, and after broadcasting had been carried on for ten minutes the filter circuit blew out, putting an end to the performance for that day.

The present transmissions are stated to be good, but it is felt that improvements would be effected with the use of a more suitable microphone.

The amateur regulations at present in force in New Zealand forbid the use of reaction on the aerial circuit, but in spite of this, "howling" is very prevalent and the broadcast programmes are considerably interfered with.

## AERIALS AND BIRD CASUALTIES.

Pigeon societies and organisations for the preservation of bird life have made an appeal to the Postmaster-General for legislation to enforce the use

of corks on aerials. It is stated that, despite their keenness of vision, birds frequently cannot see the wires until too late, and are either killed or badly injured. A naturalist expresses the opinion that a cork placed every two yards along an aerial is quite sufficient.

It is unlikely that legislation of this kind would be introduced by the Post Office in the immediate future, in view of the fact that the same reproach can be levelled at that department in respect of open telegraph wires. As these wires, besides being more plentiful than aerials, are stretched to a far greater tautness, their toll of bird life must be correspondingly heavier.

**TELEPHONY TESTS FROM ss. "LEVIATHAN."**

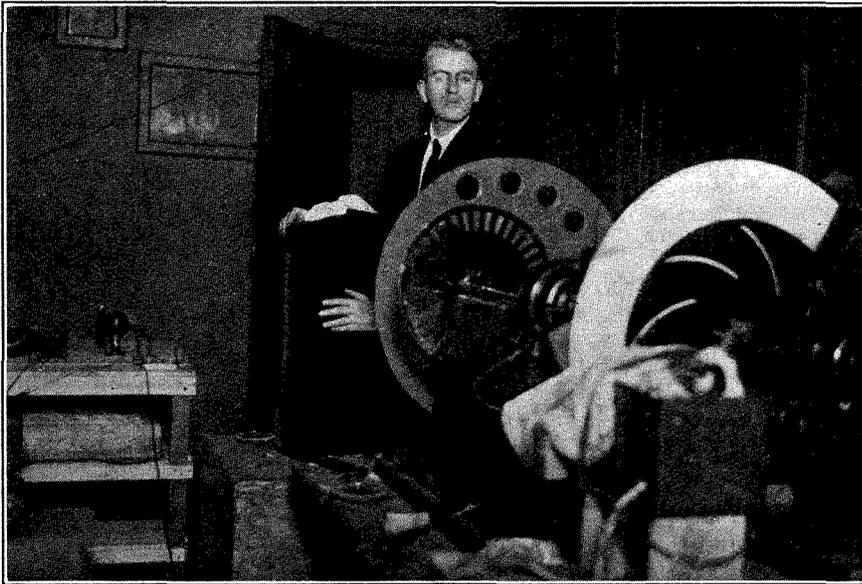
Apropos of the note in our issue of December 3rd regarding Mr. E. A. Richardson's reception of telephony from ss. "Leviathan," Mr. F. H. Lindsay,

Comstock, of East Hartford. The Danish transmitter sent the following message: "Greetings from the first Danish amateur across." Mr. Hiram Percy Maxim, President of the A.R.R.L., replied, through Mr. Comstock, "Sincere congratulations. Hope that we communicate often."

**BURNDEPT CHAIRMAN'S GIFT.**

Readers may be interested to learn that Mr. Geoffrey E. Duveen, whose gift of £50,000 to the University College Hospital recently roused considerable public attention, is the chairman, and one of the founders, of Messrs. Burndept, Ltd., the well-known wireless firm.

This munificent gift is for the purpose of rebuilding the Ear Hospital, a scheme which the donor is carrying out in memory of his father, the late Mr. Henry J. Duveen.



*Mr. J. L. Baird, the inventor of a very promising system of television, photographed with his apparatus. An earlier form of the device was described in "The Wireless World and Radio Review" of May 7th, 1924.*

of Belfast, suggests that the vessel was not at the time in the neighbourhood of Cuba as stated. The "Leviathan" left Southampton for New York on November 25th (five days later), and could not possibly have come from the Gulf of Mexico in that time.

Mr. Lindsay states that he picked up telephony from the vessel at 12.30 a.m. on November 26th, when her position was given as 750 miles off Cherbourg, westward bound.

Letters of corroboration have also reached us from Mr. S. T. Clark, of West Hartlepool, and Captain Fletcher, of Godalming.

**DENMARK-AMERICA TWO-WAY COMMUNICATION.**

The American Radio Relay League reports that a Danish amateur was recently worked by Mr. D. C. S.

**ANNUAL EXHIBITION OF PHYSICAL AND OPTICAL SOCIETIES.**

The Annual Exhibition of the Physical Society of London and the Optical Society, which is to be held on Wednesday and Thursday, January 7th and 8th, 1925, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, will be open in the afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.).

Among the lecturers will be Mr. C. F. Elwell, B.A., M.I.E.E., who will give a lecture, with demonstration, on "Talking Motion Pictures," at 8 p.m. on January 7th, and at 4 p.m. on January 8th. More than 50 firms are exhibiting scientific apparatus, and a number of experimental demonstrations have been arranged.

We understand that invitations have been given to the Institution of Electrical Engineers, the

Institution of Mechanical Engineers, the Chemical Society, the Radio Society of Great Britain, the Röntgen Society and the Faraday Society.

Admission in all cases will be by ticket only, and members of the societies mentioned should apply to the Secretary of the Society to which they belong. Others interested should apply direct to Prof. A. O. Rankine, Hon. Secretary of the Physical Society, Imperial College of Science and Technology, South Kensington, S.W.7.

#### AMERICAN RECEPTION AT 8 p.m.

An interesting experience of the evening reception of what was probably an American amateur is reported by Mr. N. A. Champness, of Acton, London. On December 6th, at 8 o'clock (G.M.T.), on the evening in question, our correspondent heard the call "2 GF u 1 ANA," on a wavelength between 50-55 metres. If this transmission is confirmed a new record seems to have been established for early evening transatlantic work. A single-valve receiver was used.

#### A GRATIFYING REPORT.

Remarkable reception of his signals by a German amateur is reported by Mr. Leonard H. Crowther (G 2 LH), of Sheffield. According to the French *Journal des 8*, signals from 2 LH were heard by an amateur in Charlottenburg, Germany, with an indoor aerial 4 metres long, and a two-valve receiver (o-v-1). At the time of the transmission in question 2 LH's input was approximately 8 watts, with an aerial ammeter reading of 0.18 amperes.

#### A WIRELESS COMPETITION.

A competition open to amateur constructors has been organised in aid of Chesterfield local charities by Messrs. The Creswick Dixon Electric Co., of Bodega Chambers, High Street, Sheffield. Prizes to the value of £37 10s. are being offered for the best amateur construction of four, three, two and single-valve sets. The competition closes on January 31st, 1925. Particulars regarding entrance fees can be obtained on application to the company.

#### CZECHO-SLOVAKIAN AMATEUR ACTIVITY.

The last few months have seen great advances in the progress of radio in Czecho Slovakia. A powerful commercial station has been established at Poděbrady, estimated to have an effective range of over two thousand miles. Two slightly less powerful stations have been erected at Bratislava and Kosire respectively.

The Government has adopted an encouraging attitude towards the wireless amateur and large numbers of radio clubs have recently been formed. The retail sales of experimental wireless equipment and broadcast receivers are stated to be mounting rapidly.

Coincident with the holding of a special radio exhibition at Prague from March 22nd to 29th 1925, an amateurs' conference will be held in the city, and it is hoped that many Americans who will be attending the amateur conference in Paris will also attend the Prague event.

#### 2 XM.

Mr. W. S. Ritchie, Hon. Secretary of the Downside School Wireless Society, Stratton-on-the-Fosse, near Bath, advises us that the call sign 2 JB no longer belongs to the Society's station. The present call signs are 2 XM, 2 XN, and reports of reception are always welcome.

## Calls Heard

Newcastle-on-Tyne (all Morse, below 150 metres).

French: 8 AG, 8 AQ, 8 AT, 8 AU, 8 BF, 8 BU, 8 CN, 8 FI, 8 GI, 8 GN, 8 GO, 8 GV, 8 JB, 8 PA, 8 PB, 8 RG, 8 RV, 8 SS, 8 SSC, 8 VV, 8 XH, 8 XR, 8 EM, 8 EJ. Belgian: 4 AA, 4 ALS, 4 QS, 4 CE. Dutch: 0 GC, 0 ML, 0 OX, 0 RE. Danish: 7 CM, 7 EC, 7 ZM. American: 1 JKH, 5 MET, 6 OL. Swiss: 9 AA, 9 BR. Miscellaneous: P 2 JF, 3 EAR, FN 2 NM, 2 RRI(?). (o-v-o) F. Thompson (2 AWK).

Acton, W.3 (November 1st to 10th, on 66 to 95 metres).

Weak British: 2 CG, 2 MU, 5 RM, 5 RZ, 5 UQ, 6 FG, 6 ME. French: 8 AB, 8 AL, 8 AQ, 8 AU, 8 AZ, 8 CM, 8 CN, 8 CS, 8 DP, 8 EM, 8 EN, 8 EQ, 8 FQ, 8 GQ, 8 GP, 8 HSM, 8 JBL, 8 MAR, 8 PA, 8 QG, 8 RB, 8 SSU, 8 UU, 8 VR, 8 ZH, 8 ZZ. Dutch: 0 BG, 0 KC, 0 RD, 0 RE, 2 NCA. Danish: 7 BD, 7 WM. Belgian: B 7, W 2. Swedish: SMZY, SMZY. Finnish: 3 CA, 3 CC, 3 CM, 3 MB, 3 SS, 3 ZS, 10 KZ. Swiss: 9 AD. Italian: 1 ER, 1 FP. Luxembourg: 0 AA, 1 JW. Canadian: 1 AR, 1 DM. American: 1 AAU, 1 AJA, 1 AUR, 1 AW, 1 AWW, 1 BDH, 1 BGG, 1 BIP,



Drawn by the Canadian amateur, 1 DD, this cartoon symbolises American astonishment at the irrepressible efforts of the British and New Zealand transmitters.

1 BKQ, 1 BQK, 1 BVS, 1 BY, 1 CCK, 1 CKP, 1 CLN, 1 CMP, 1 CRU, 1 GV, 1 IL, 1 KC, 1 ML, 1 OW, 1 PFP, 1 SF, 1 SW, 1 XAV, 1 XW, 1 XZ, 2 AA, 2 ANA, 2 BQW, 2 BOU, 2 BRB, 2 CEI, 2 CHK, 2 CLA, 2 CVS, 2 CVU, 2 CYW, 2 KUE, 2 PD, 3 BCO, 3 BDO, 3 BG, 3 BP, 3 CHC, 3 COJ, 3 DK, 3 FZ, 3 JR, 3 JW, 3 TJ, 3 WL, 3 ZW, 4 EZ, 4 KU, 4 MA, 4 XE, 5 AL, 5 CN, 5 OX, 5 WZ, 6 HL, 8 CCQ, 9 OKO, 8 PL, 8 UVL, 8 ZG, 9 BH. New Zealand: 4 AA, 4 AK. (o-v-i) N. A. Champness.

Nottingham (November 16th to November 23rd).

British: 2 DX, 2 FN, 2 JF, 2 NB, 2 NM, 2 OD, 2 VQ, 2 WJ, 5 DN, 5 LE, 5 MO, 5 NN, 5 OX, 5 QV, 5 SI, 5 UQ, 5 YL, 6 AH, 6 GH, 6 GM, 6 LF, 6 NF, 6 QB, 6 TM, 6 VP, 6 UD. French: 8 AQ, 8 BAP, 8 BC, 8 BU, 8 DE, 8 DU, 8 EM, 8 FK, 8 NS, 8 QG, 8 SSU, 8 UU, 8 WK. American: 1 AID, 1 ANH, 1 AQM, 1 AZR, 1 BDB, 1 BCU, 1 BOA, 1 CAB, 1 GKP, 1 GV, 1 HN, 1 IL, 1 OW, 1 PL, 1 PY, 1 QP, 1 SF, 1 SW, 1 XZ, 2 APF, 2 BRB, 2 BGG, 2 CEI, 2 PD, 3 ADE, 3 ADQ, 3 ALQ, 3 BGF, 3 MF, 3 AIS, 3 HH, 4 TT, 4 XE, 2 AG, KDKA, NKF. Belgian: P 2. Swedish: SMYV, SMZY. Danish: 7 EC. Candian: 1 AR, 1 DM, 2 CG. Finnish: 2 NCA. Unknown: LOAA, NOBG, WGH. (o-v-o.) (G. J. Whitehouse).

## CORRESPONDENCE

### The Best Crystal Circuit.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have concluded a prolonged period of experimental work with crystal rectifiers with the object of determining the circuit yielding the best results. I find an arrangement similar to that suggested in *The Wireless World and Radio Review* of April 20th, 1924: ("What is the best circuit for crystal reception?") the most efficient of all I have wired-up.

It consists of 22 turns of No. 20 bare wire wound over six grooved ebonite strips spaced round the circumference of two wood discs one foot in diameter. The crystal is mounted on the top of one of the discs with the aerial and telephone terminals. The earth terminal is on the other disc. Connections from aerial and crystal terminals to coil are made by short pieces of flex to which small spring clips are soldered. Aerial and earth are first-class; twin wires 90 feet over all. Aerial clip is best on the eighth turn and the crystal on third.

Position of aerial clip is important; very little difference is observable when the crystal clip is varied. A two-valve note magnifier attached to this arrangement gives a volume of sound on 2 LO much too powerful for a large-sized room.

The coil arrangement is bulky as it stands but a little ingenuity could easily hide this and make it presentable for use in a living-room.

Short pieces of wood should be fastened to the bottom disc so that the coil may stand firmly.

I recommend this circuit to those who want really good crystal reception.

E. J. BRAY.

Finchley, London, N.3.

### Remarkable Transatlantic Reception.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Since the publication in your issue of October 15th of a letter from Mr. D. B. Knock (6 XG), in which he tells of the reception of KDKA on about 65 m. at my station, I have had so many letters and enquiries relating to it, that I feel I must write to you to clear up one or two points. For some time Mr. Dootson (5 KL) of Bolton and myself have been experimenting with short wave tuners, and the tuner in use on that particular night was one that had been made up—with slight modifications—by Mr. Dootson from an article published in *Q.S.T.* and had been sent to me to test. In this test I was kindly assisted by Mr. Knock, who at that time was staying with me.

There is one particular point in the letter from Mr. Knock relating to my aerial which I hope you will correct, as this discrepancy has been pointed out to me several times. The aerial is supported at the lead-in end by a 70 ft. steel mast, the actual height there being 68 ft., and at the far end the height is about 45 ft.

E. H. WILDING (6 KB)

### Porto Rico Broadcasting.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In regard to my reception of station WKAQ, San Juan, Porto Rico, West Indies, on

the occasion of the Madrid tests (28th September 1924), I have received confirmation of this in a letter dated Porto Rico, October 21st. I shall quote some parts of the letter which may prove of interest to readers.

"Our station is erected in the centre of the City of San Juan, Porto Rico, the Island of Enchantment, and its distance records are British Columbia in Canada and *Scotland in Great Britain.*

"Its equipment consists of a Western Electric 500 watt installation. The Radio Corporation of Porto Rico is affiliated with the International Telephone and Telegraph Corporation of New York, as is our sister station PWX of the Cuban Telephone Company at Havana, Cuba.

"At the present time we are broadcasting every Tuesday and Thursday from 9 to 10.30 p.m., and Wednesday from 8 to 9 p.m., Porto Rico time (four hours behind G.M.T.).

Inverness.

JAS. MACINTOSH.

### Daylight Reception of U.S. Amateurs.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In the early morning hours of Sunday, November 23rd, I heard the American amateur 1 PL sending "CQ 1 PL" on a wave of approximately 80 metres, and continued to receive him again at intervals until 9.45 a.m.

It is a definite fact that I heard him at a quarter to ten in the morning, and although his signals were weak they were distinctly readable.

Is this a record for the late morning reception of Americans? If not, what is the latest hour at which they have been heard?

E. KUNZLE.

Birmingham.

### Thermoelectric L.T. and H.T. Supply.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—You mention in your issue of November 26th a thermoelectric device designed for the purpose of supplying filament and plate current, giving various details mostly in its favour.

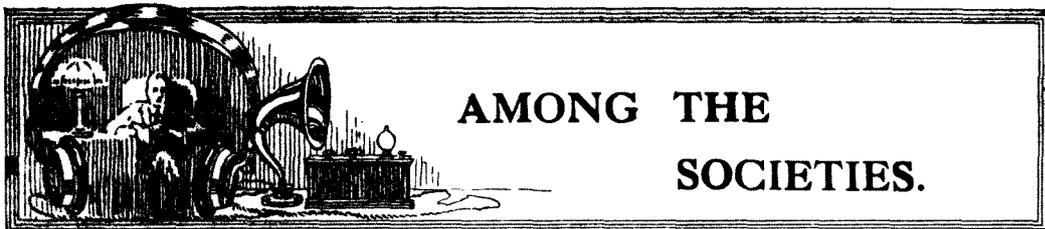
You do not, however, mention the worst and most notorious failing of all types of thermopile—inefficiency. In order to expend about 0.54 watts of energy in the filament of three 3 v. .06 valves, you must use a heater consuming 500 or 600 watts. Unless you are in possession of heat otherwise going to waste it can never "pay" to use a thermopile, as the heat conduction of the elements takes so much more power to useless waste than you get back from the electric effect.

It is only fair to your readers to point this out, as it is cheaper to use dry batteries that cost 4s. 6d. to replace every three months than to pay 1½d. per hour for heating current in the thermoformer.

Incidentally, it is highly unlikely that the thermoformer would do for anything but a dull emitter valve owing to the high specific resistance of metals giving a large thermoelectric effect with each other.

I. A. J. DUFF, B.A.

Golders Green, London, N.W.



## AMONG THE SOCIETIES.

The Annual General Meeting of the Croydon Wireless and Physical Society, held on December 9th, revealed the society's strong financial position and its excellent prospects during the coming months. The President of the Society is Mr. W. Thompson, M.A., B.S.C., and, included among the Vice-Presidents, are Major J. Erskine Murray, D.Sc., F.R.S.E., and Mr. G. F. Mansbridge, M.I.E.E.

A novel evening was spent by members of the North Middlesex Wireless Club on November 28th, when Mr. J. S. Wilson lectured on "Scientific and Other Curiosities." The paper was unique in that the word "wireless" was scarcely mentioned.

A masterly talk on "Broadcasting" was given before the Borough of Tynemouth Radio Society on Thursday, November 27th, by Mr. E. Lynch Odhams, the station director at 5 NO. After an instructive description of the present arrangements at the Newcastle broadcasting station, Mr. Odhams gave particulars of the improvements to be effected in the near future.

In the course of his talk the speaker congratulated the Society on its efforts to reduce interference from "howling."

The East Grinstead and District Radio Society held its first ordinary meeting at "Radio Hall," London Road, on Thursday, November 27th, when over 40 members and friends were present. The feature of the evening was a talk on "Wireless Valves," by Mr. J. B. Price, M.I.E.E., who illustrated his instructive discourse with demonstrations and blackboard diagrams.

One of the youngest wireless societies is that at Englefield Green, near Egham. Although membership is at present small, there are indications that this will increase in the near future. At a recent meeting, held at the "Barley Mow," Mr. Holford gave instructive hints on purity in broadcast reception. On December 17th Mr. Grant lectured on "Component Parts—Doubtful and Otherwise."

Unusual interest has marked the recent activities of the Woolwich Radio Society. Subjects dealt with in lectures and demonstrations have included "Home Made Loud Speakers," by Captain Hughes, and "Remote Control of Wireless Receivers," by Mr. Smith. A lecture entitled "Food for Thought" was given on November 26th by Mr. Bartle, who put the question, "Are we really making progress in wireless matters?" The speaker contended that in many respects components of to-day were

inferior to those of five years ago, and a keen and long discussion ensued.

The second of a series of elementary talks on "Magnetism and Electricity" was given by Mr. Usher before the Tottenham Wireless Society on November 26th. Mr. Usher dealt with the electron theory, conductors and insulators, and Ohm's law. A number of interesting experiments accompanied the lecture.

Some novel switches, suitable for reflex work, and comparative tests were shown at the Beckenham and District Radio Society's meeting on December 4th. Many modifications and improvements were shown on the blackboard.

An instructive paper on "Accumulators" was read by Mr. G. P. Cosway at a recent meeting of the Nuneaton Radio Society. In addition to providing useful information on the care of accumulators, the lecturer handed round samples of various plates for the inspection of his audience.

"Tools and How to Use them," formed the subject of an informative lecture given recently by Mr. W. J. Poole before the Dorking and District Radio Society. Particular attention was given to the cutting out, trimming up, drilling and polishing of ebonite. A special series of talks on the theory of wireless reception has been organised for the benefit of members. The first talk will be given by Mr. L. F. Cooke.

"A Glimpse into the World of a Millionth of a Millimetre," was the title of an absorbing lecture given to the Northampton and District Amateur Radio Society on December 8th. The lecturer, Mr. R. G. Turner, dealt with the ultimate division of matter and the wonderful possibilities of the release of atomic force.

### TYNEMOUTH RADIO SOCIETY.

Owing to recent confusion as to his address, the Hon. Secretary of the Borough of Tynemouth Radio Society wishes it to be announced that all communications for the Society should be addressed to him at Y.M.C.A. Building, Bedford Street, North Shields.

(Correspondence intended for Hon. Secretaries of Societies may be addressed c/o the Editor of this Journal.)

# READERS PROBLEMS

*Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.*

## A FOUR-ELECTRODE SINGLE VALVE REFLEX.

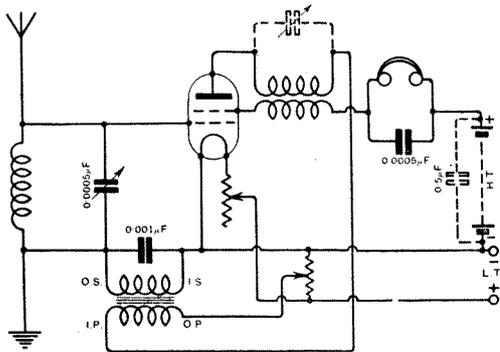
SEVERAL readers have asked whether it is possible to use a four-electrode valve in a reflex circuit, in such a manner that the valve is caused to perform the three functions of high frequency amplification, rectification and low frequency amplification simultaneously.

This certainly is possible, and we illustrate below a suitable circuit. The inner grid of the valve functions in the same manner as the grid of the ordinary three-electrode valve. The outer grid performs exactly the same functions as the anode of an ordinary valve. The anode of this valve serves merely for rectification purposes and takes no part in amplification at either frequency, both frequencies of amplification taking place between the filament and outer grid, the electron emission being controlled by the potential of the inner grid in the usual manner.

mediary of the transformer they reach the inner grid and are amplified at low frequency between the filament and outer grid, passing through the telephones in the usual manner.

The low frequency transformer should be of low ratio, otherwise the set will be extremely unstable. The high frequency transformer is preferably of the plug-in aperiodic type in order to simplify tuning. The correct functioning of this circuit depends on a suitable adjustment of filament rheostat and potentiometer. By suitable adjustment of these, strong reaction can be obtained, and also oscillation, if the filament temperature is too high.

The impression seems to have gained ground that the four-electrode valve is the product of the past few months, and that its only purpose is to eliminate the H.T. battery. This is quite incorrect, these valves having been in existence some considerable time.



*A reflex circuit for the four-electrode valve.*

Incoming signals are amplified at high frequency by means of the outer grid and high frequency transformer. High frequency impulses pass through the primary of the H.F. transformer and across the telephones by means of the 0.0005 μF condenser provided. These high frequency impulses are rectified between the filament and anode by suitable adjustment of the potentiometer, and then the resultant L.F. impulses pass through the H.F. transformer secondary, the L.F. transformer primary, and then through the inter-

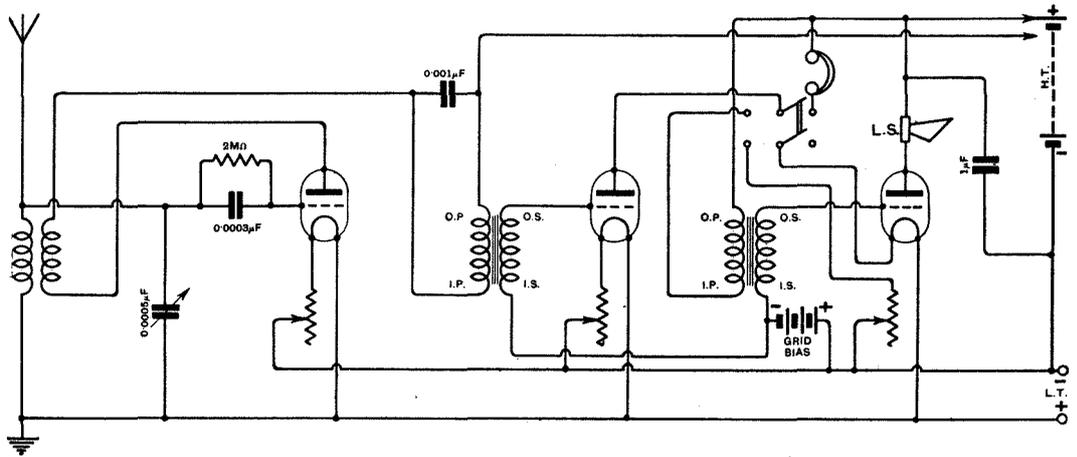
## THE PROPAGATION OF WIRELESS WAVES.

IN connection with the night effect mentioned in a recent paper before the Radio Society of Great Britain by Mr. Barfield, a reader writes to suggest that the increase of signal strength at night time may be due to the fact that the ether is undisturbed by heat or light waves from the sun. He suggests the possibility that wireless waves may have greater difficulty in passing through the ether when it is disturbed by these short wave radiations.

The study of wave motion in material media reveals the fact that the amplitude of the waves at a given distance from the source is unaffected by interference from other waves in the intervening distance. The instantaneous value of the amplitude at a given point may be reduced by interference from waves from another source, but at other points the amplitude will be increased by an equal amount. This principle holds good for all types of wave motion, and for mathematical proof the reader is referred to text-books on physics. It was pointed out in the original paper that no effect near the surface of the earth would account for the difference in signal strength experienced, and that the signal strength over short distances was unaffected. If the light waves in any way affected the propagation of wireless waves, the difference in signal strength could be detected over short as well as over long distances.

### SWITCHING ARRANGEMENTS OF A THREE-VALVE SET.

A CORRESPONDENT has written to ask for a reliable three-valve circuit with simple control, to operate a loud speaker at good strength on a good outdoor aerial about 40 miles from London. He desires that the circuit be arranged so that by the movement of a simple switch the second L.F. amplifier is turned out, the loud speaker switched off, and the 'phones automatically connected in the anode of the second valve. He does not at any time wish for the 'phones to be connected in the anode circuit of the third valve, nor the loud speaker to be connected in the anode circuit of the second valve.



*A three-valve set for telephones or loud speaker.*

We illustrate such a circuit above. The aerial tuning condenser and the reaction coil are the only two controls; thus tuning is not difficult. It will be seen that the switch provided automatically turns out the filament of the third valve and places the telephones in the anode circuit of the second valve in place of the primary of the second transformer. The telephones and loud speaker are always operating after the same number of valves respectively, and no movement of the switch will alter them.

This set should be quite suitable for the purpose desired, and should, in addition, be quite capable of receiving other B.B.C. and continental stations.

### CONNECTING "R" VALVES IN PARALLEL TO OBTAIN INCREASED VOLUME.

A READER writes to ask if it would be possible for him to gain increased volume and clarity from his loud speaker without going to the expense of purchasing a valve of the D.E.5 type, by connecting two "R" type valves in parallel in the last stage of his amplifier.

It would certainly be possible to obtain a greater volume by connecting two "R" valves in parallel than could be obtained by using one valve only, but at the same time it must not be thought that equal results to the D.E.5 could be obtained from the point of view of freedom from distortion. The reason for this is that the length of the straight portion of the valve characteristic available is much greater than in the case of the "R" valves in parallel, so that a much greater amplitude can be applied to the grid of the valve without producing distortion. If, however, it is expressly desired to obtain greater volume without the use of power valves, this method of connecting "R" valves in parallel is greatly to be preferred to the adding of another stage of low frequency amplification, using "R" valves.

### LECLANCHE CELLS FOR H.T.

A READER asks whether it would be feasible to use a large number of wet leclanché cells, such as are used for electric bell work, as the source of H.T. supply to his four-valve set, in order to eliminate the necessity of constantly purchasing H.T. batteries.

There is no reason at all why these cells should not be used for the purpose named, but, owing to their great bulk and weight, they could only be used in cases where the position of the set was absolutely permanent. Thirty of these cells connected in series would be the minimum number possible for supplying H.T. to ordinary types of receiving valves. There is no necessity for the size usually employed for bells to be purchased, a much smaller size being sufficient.

The cells should preferably be placed in a box protected from dust, and should be emptied out and cleaned every four months, fresh sal-ammoniac solution being put in. We would point out, however, that H.T. batteries can now be purchased which will serve a four-valve set for many months without developing noises, and the cost of these H.T. batteries is less than half that of the leclanché battery.



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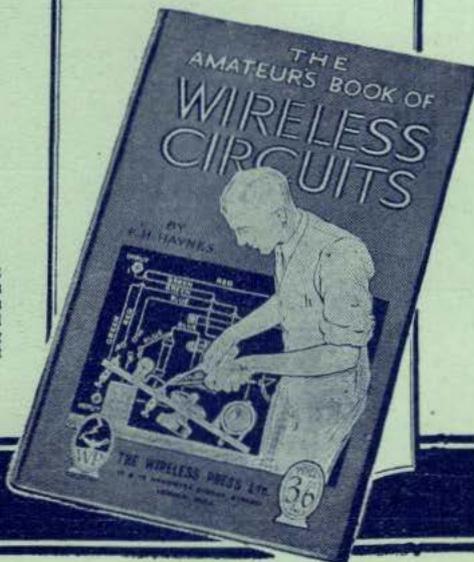
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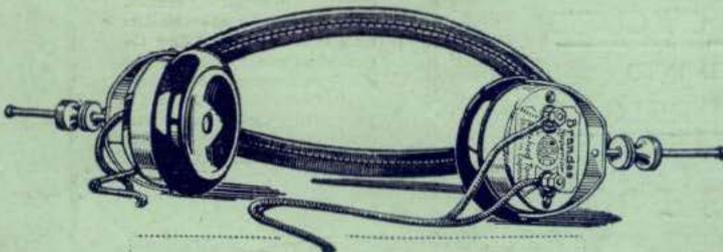


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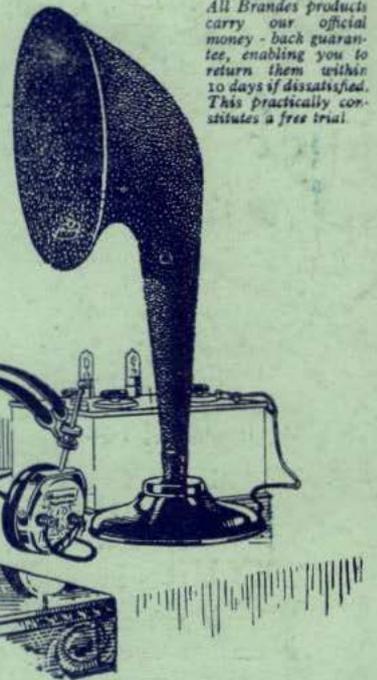
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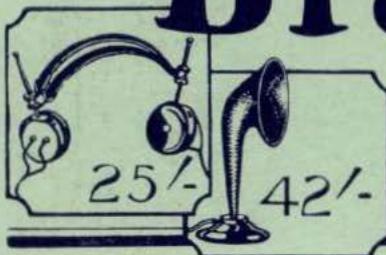
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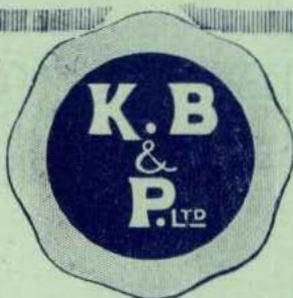


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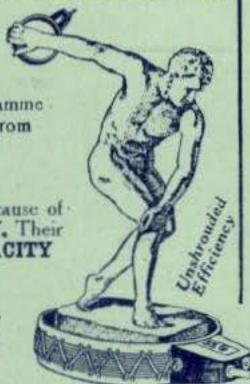
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# THE WIRELESS WORLD AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE RADIO SOCIETY OF GREAT BRITAIN.

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**T**HE EDITOR will be glad to consider articles and illustrations dealing with subjects within the scope of the Journal. Illustrations should preferably be confined to photographs and rough drawings. The greatest care will be taken to return all illustrations and manuscripts not required for publication if these are accompanied by stamps to pay return postage. All manuscripts and illustrations are sent at the Author's risk and the Editor cannot accept responsibility for their safe custody or return. Contributions should be addressed to the Editor, "The Wireless World and Radio Review," 12 and 13 Henrietta Street, Strand, London, W.C.2.

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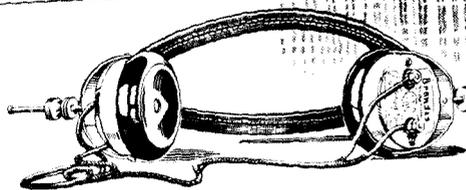
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# The WIRELESS WORLD — AND RADIO REVIEW



## RADIO TOPICS.

By THE EDITOR.

### THE POST OFFICE AND RECEIVING LICENCES.

COMMENCING from January 1st, the Post Office is introducing certain changes in wireless licences for receiving. Instead of the different types of licences for receiving purposes which have been issued in the past, there will now be only one type of licence, and this will be obtainable from the Post Office on payment of 10s. per annum.

The experimental receiving licence which hitherto has been issued from the General Post Office has been abandoned, whilst the B.B.C. licence issued at local post offices has also been superseded by the one general type of licence for receiving. The principal change involved is that the new licence does not make any stipulation with regard to the class of apparatus to be employed, whereas it will be remembered that the B.B.C. licence was conditional on the apparatus used being of British manufacture. The stipulation made in the past that constructors might not use any components that were not of British manufacture, and that B.B.C. licence holders must use British sets, was one which was made in the interest of the British wireless industry in order to give it the opportunity of establishing itself before it was brought into competition with foreign manufacturers. There is no doubt that at the time it was made, this concession to the British wireless industry was a very fair one, because it must be remembered that in the United States of America, in particular, broadcasting had existed for nearly two years before it was introduced in this country, and as a consequence manufacturers there were already organised, so that their output of wireless apparatus was large, and they could have

flooded the market in this country long before the British manufacturers would have had time to get in themselves.

The removal of the ban on the use of foreign apparatus is an indication that in the opinion of the Postmaster-General, sufficient time has now been allowed for the British wireless industry to establish itself, and that it should be in a position to compete with foreign imports.

Just how far the industry may suffer as a result of the competition depends very largely upon the attitude which the public in this country may adopt towards foreign products. We believe that the public here is now sufficiently well educated in wireless to appreciate apparatus and components on merits, and that they are not slow to recognise the properties of really efficient instruments. The net result, therefore, is likely to be keener competition in the production of really high-grade apparatus at reasonable prices, and in this direction we believe from our own observations that the British manufacturer has good reason to feel fairly secure. In the majority of cases the products which we have seen of manufacturers abroad do not compare favourably with those of our own producers.

There is no doubt that a considerable amount of foreign apparatus will find a ready sale in this country, if only on account of its novelty and the interest which the experimenter will find in trying out new components with which he has not previously had the opportunity of familiarising himself, and in this connection we may mention that now that foreign components can be used legitimately, it will be our endeavour to make reference to such components as are of particular merit and available in this country.

Referring again to the fact that the Post Office will now issue only one kind of licence, we observe in particular that this indicates that the Postmaster-General no longer recognises any distinction between the experimenter and the broadcast listener, in so far as receiving is concerned, and therefore the only licence which can be regarded as applicable to the experimenter alone is the transmitting licence.

This decision brings us more into line with the state of affairs in the United States of America. There, however, for receiving no licence is required and no annual payment is made. Licences need only be obtained where it is desired to transmit.

Special reference is made under the new licensing regulations to portable receivers. It is stated that where a portable station is used, in addition to a fixed station, a second licence is necessary. It would be interesting to know what attitude the Post Office would adopt towards those who may be in the habit of using more than one receiver in the same room or building in the course of experimental work. It is surely not intended that the regulations should require that an experimenter should purchase licences in proportion to the number of complete sets he owns, and may make use of in turn or collectively from time to time.

## THE B.B.C. AND CHRISTMAS PROGRAMMES.

**P**ROBABLY no two people would have just the same idea as to what would constitute a suitable broadcast programme for Christmas time, yet we doubt whether this Christmas the British Broadcasting Company has come anywhere near meeting what the public might reasonably have expected at such a season.

Those who paid sixpence for their Christmas number of the official organ of the B.B.C. and turned expectantly to the pages giving details of the programme arranged for Christmas, must have felt sadly disappointed at the prospects held out to them.

To begin with, one would surely have been justified in expecting some wireless enter-

tainment on Christmas Day at an earlier hour than seven in the evening.

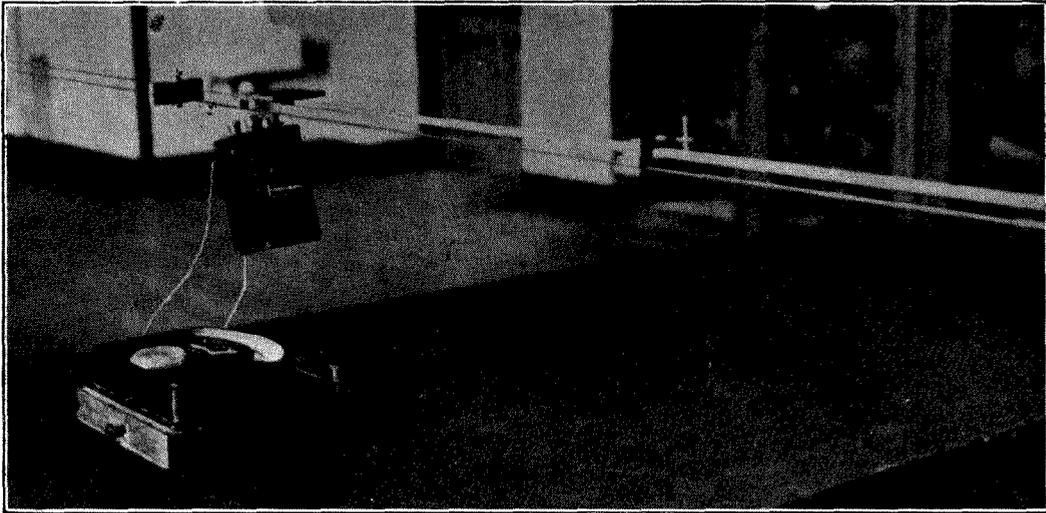
The British manufacturers who are the shareholders of the B.B.C. have devoted considerable energy to pushing their sets as Christmas presents, and have expended a great deal of money in advertising for the Christmas season. This has all been done with the object of inducing the public to purchase wireless sets as Christmas presents, and yet on Christmas Day it is necessary to wait until the evening before it is possible to give the new acquisitions a trial. Children, too, for whom Christmas season means so much more than to grown-ups, are many of them expected to be in bed by this hour, and one can imagine the disappointment which they feel at having had no opportunity of trying out the new present on Christmas Day.

Disappointed with what is provided for Christmas Day, one naturally turned to the programme for Boxing Day to see what better fare was in store for that holiday, but only to feel the same disappointment that no special effort had been made to provide a programme suitable for the occasion.

One might reasonably expect a programme a little out of the ordinary, and specialised items would not be expected to make a general appeal on this day, and yet the programme shows that very little departure has been made from the general routine.

There are two items in particular which seem unsuited to the day. These are both of such a character that they make an appeal to only a limited number of listeners. We refer to the fortnightly bulletin of the Ministry of Agriculture and the talk of the B.B.C. music critic. One would have expected that these items could have been held over for another more suitable day. It is difficult to suppress the feeling that if it were not for the fact that broadcasting in this country is without competition that programmes for the Christmas holidays would have received more consideration, and have been compiled so as to make a more general appeal to the majority of listeners at that time.

At the time of writing we still hope that the B.B.C. will recognise their shortcomings and introduce some alterations to their official programme.



On the table is a milli-voltmeter which, with the thermo-junction just above it, measures the voltage between the parallel wires.

## STANDING WAVES.

The author describes experiments with standing waves on a parallel wire system. The length of short waves, for instance, of 10 metres, may be directly measured with the apparatus described below.

By GUSTAV LAMM and EDWARD GRAHAM.

### INTRODUCTION.

IN an article entitled "Standardising the Ultra-Radio Frequencies" (*Radio News*, April, 1924), the authors, Messrs. Dunmore and Engel, show how it is possible to obtain standing waves on a parallel wire system, and to determine the wavelength with good accuracy by direct measurement.

The wavelength used in their experiments was of the order of 10 metres (30,000 kilocycles). By causing the harmonics from an oscillatory circuit to interfere with the 10-metre wave that can be measured directly on the parallel wire system, it was possible to calibrate oscillatory circuits, condensers, and so on, quite accurately. However, as their work seems to be purely practical, we have treated the problem from both a practical and a theoretical point of view.

A well-known fact is that the propagation of electro-magnetic waves along a wire is slower than the velocity of light. This fact Dunmore and Engel appear not to have taken

into consideration. Thus, the object of the following work is to obtain standing waves on a parallel wire system by induction from a valve generator (wavelength about 10 metres), to study the wave shape and to determine the accuracy with which the wavelength of the waves may be measured.

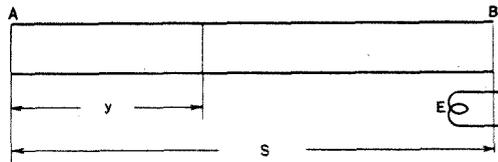


Fig. 1. Two parallel wires, AB, of length S are excited by a valve generator E.

### THEORETICAL DISCUSSION.

If we induce an alternating potential E on the wire system AB (Fig. 1), standing waves will be set up. Further, if the wires are short-circuited, for instance at end A, we have fixed a nodal point. At this point

the potential between the wires must be zero. Starting from A, the voltage between the wires can be measured, the distance between A and the point where the measurement is made being Y. The wavelength is determined by finding consecutive nodal points, which are a distance of half a wavelength from each other. A theoretical analysis will show, however, that the voltage never can fall to zero, except at the point A, because of damping, but falls to a certain fraction of the maximum value.

metres, and a parallel wire system consisting of copper wire (diameter 2 mm.) 50 millimetres apart, as in these experiments, we obtain

$$K = \frac{25Y}{\sqrt{V}}$$

where  $V$  is the frequency.

For the 10 metres wave,  $K = 0.000782$ —a very small figure indeed.

In Fig. 2,  $K$  is plotted against the wavelength. Thus we have found the cor-

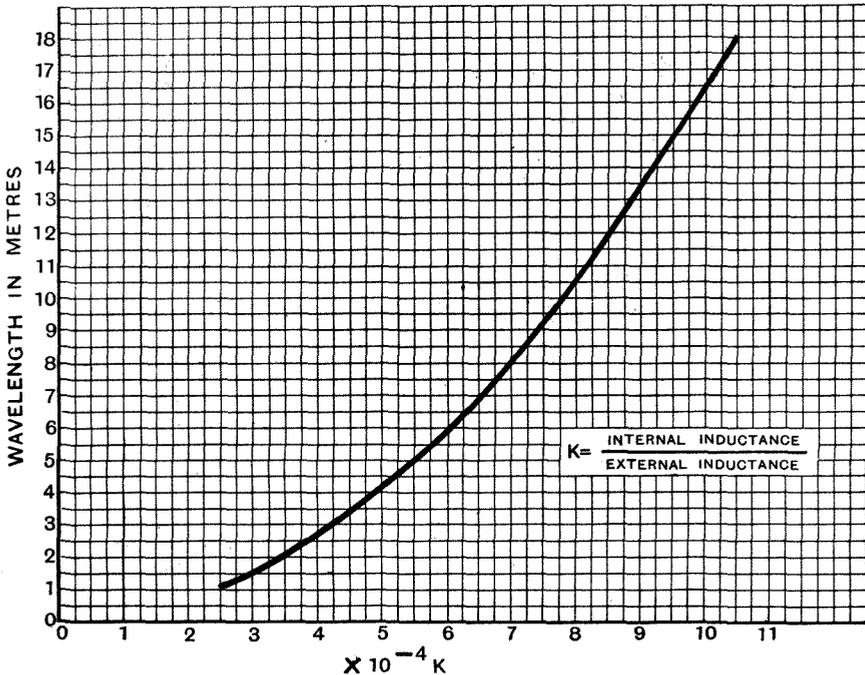


Fig. 2. A curve showing the ratio of the internal to the external inductance of the system ( $K$ ) at various wavelengths.

Moreover, the points of minimum voltage will be removed from the theoretical nodal point (corresponding to the wavelength) in such a manner that the measured wavelength is a little too short.

If  $Y_n$  indicates the  $n$ th measured nodal point ( $A=0$ ),  $n$  a small figure (1, 2, 3), and  $\lambda_{u_0}$  is the wavelength corresponding to the propagation of light, we have

$$\lambda_{u_0} = \frac{2}{u} Y_n (1 + K)$$

where  $K$  is the ratio of the internal to the external inductance of the system.

For wavelengths between 5 and 20

reactions, provided the oscillation is a pure sine wave.

It still remains to investigate to what extent the impedance of the circuit will alter the shape of the curve. It will, of course, be understood that the influence of the measuring circuit will increase as its impedance becomes smaller compared with the characteristic of the parallel wire system, its characteristic being about 500 ohms for these frequencies. We obtain by measurement a figure that is proportional to the r.m.s. value of the potential at the point of measurement, or if the method of

measurement follows the square law, proportional to the square of it. A mathematical analysis will show that the measured voltage can be expressed by the following formula, where

$V_y$  is the voltage of the pure sine wave at point  $y$ ,

$$V = V_y G; \quad G = \frac{I}{\sqrt{N^2 \phi(y)^2 + 2N\phi(y)\theta + I}}$$

$$\phi(y) = \frac{\cos \infty (S-y) \sin \infty y}{\sin \infty S}; \quad \infty = \frac{2\pi}{\lambda}$$

where  $N$  is the ratio between the characteristic of the wire system and impedance of the measuring circuit,  $\lambda$  the wavelength in metres,  $S$  the total length of the parallel wires, and  $\theta$  is the ratio between the reactance component and the impedance of the measuring circuit.  $\theta$  may have any value between  $-I$  and  $+I$ . If the measuring circuit is a

measuring circuit, the length of the wires, and the impedance inserted at the end terminals of the wires. If we want to get the original curve, the impedance of the measuring instruments should be great compared to the characteristic of the parallel wires. A measurement of the wavelength, however, is always possible.

PRACTICAL WORK.

The wire-system, mentioned above, has proved to be quite satisfactory, its total length being about 16 metres. The wires are carried by heavy ebonite blocks at the ends and stretched with weights (100 kilograms).

The diagram is given in Fig. 3. In the generator  $C$ , the oscillation and grid coils consist of a single turn of copper ribbon ( $0.5 \times 10.0$  millimetres of a diameter of 20 centimetres) mounted on a coil-holder of the ordinary type, the grid coil being

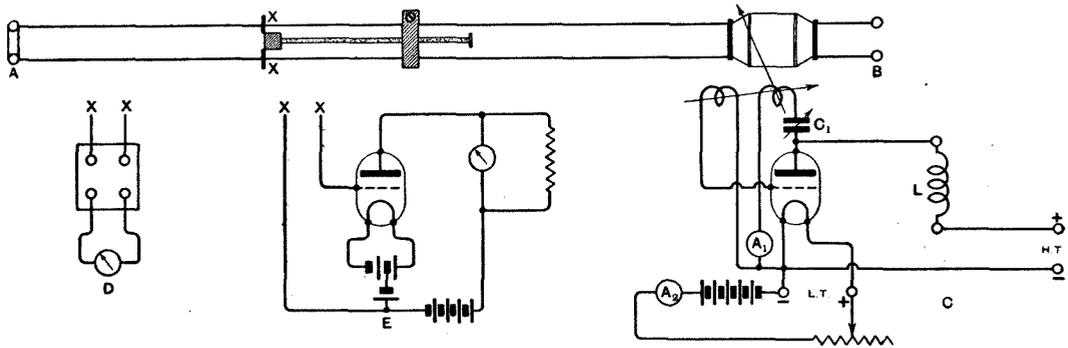


Fig. 3. The arrangement of the apparatus.

pure resistance, we obtain the following expression for the voltage:

$$V = V_y \frac{I}{\sqrt{N^2 \theta(y)^2 + I}}$$

As the impedance of the measuring circuit gets greater,  $N$  gets smaller, and if  $N$  approaches zero,

$$V \equiv V_y$$

The analysis above is made assuming that the wire system is short-circuited at end A, and opened at end B. However, we can connect a resistance between the terminals at end B, and carry out similar calculations. The result will be that we can obtain any form of curve from a pure sine wave. How it will come out depends upon the impedance and the phase angle of the

mounted on the moving holder. The condenser  $C_1$  is variable (max.  $0.0001 \mu F$ ). The coil  $L$  must be wound with a minimum of self capacity; 14 turns of No. 15 on an 8 centimetres former is a very good coil for that purpose. The method of measurement using vacuo-thermo-junction with millivoltmeter  $D$  has been generally adopted. The resistance of this measuring circuit is about 60 ohms. The photograph at the head of this article shows the wires and the measuring arrangement. The scale is graduated in millimetres, thus allowing very accurate readings to be made.

During all measurements the wire system was coupled at the B end, the mutual inductance between the coil of the oscillator and the wires being so small that it can be

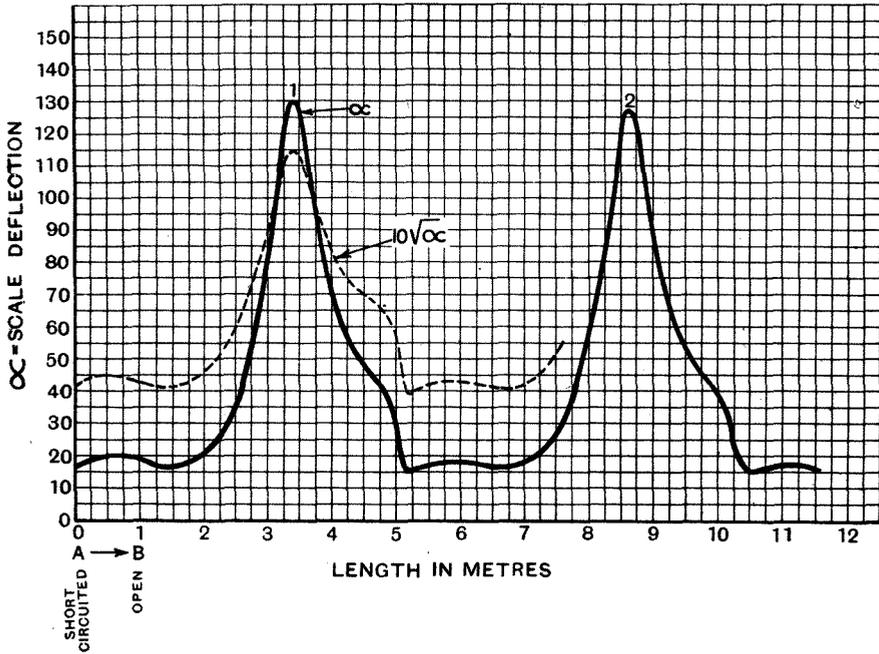


Fig. 4. The curves show the deflection of the measuring instrument at various points of the parallel wires.

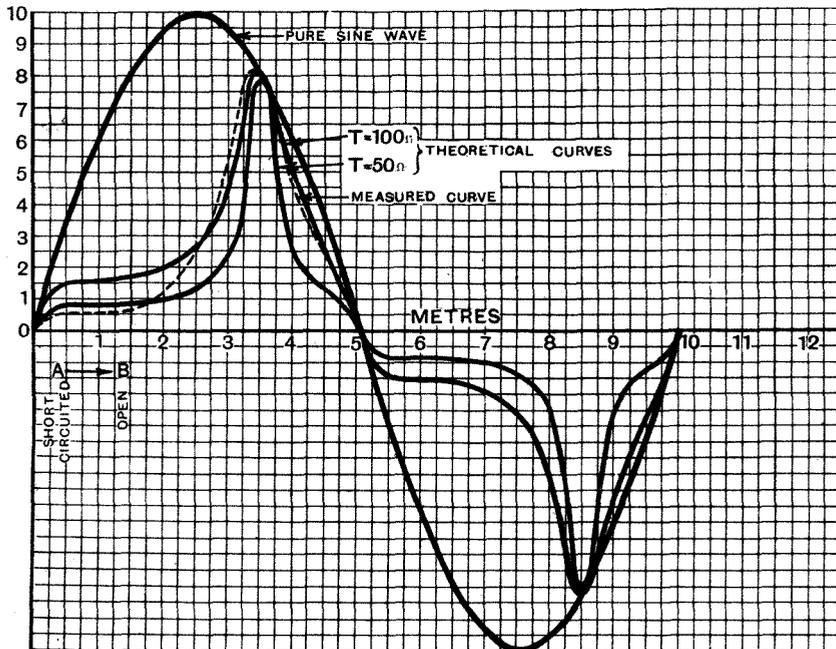


Fig. 5. The curve actually obtained, and the calculated curves. These show the effect of connecting a measuring circuit to the wires. The applied sine wave has a wavelength of 10 metres.

neglected. The measuring-cursor is moved from A ( $A = 0$ ) towards B, and the readings obtained on the instrument immediately put down on a sheet of squared paper. A curve directly obtained by measurements is marked  $\infty$  (scale indication) and a voltage curve is marked  $\sqrt{\infty}$ .

Curves obtained are as follows:—

Fig. 4 ( $\infty \sqrt{\infty}$ ).—The wires are connected at A and open at B. The curve shows a periodical character with a weak and a very strong maximum point per half period.

The dotted curve is obtained from measurements, and the other curves are obtained by calculation, the measuring circuit being considered a pure resistance load. The practical and the theoretical results coincide fairly well. The divergence between them is due to the fact that the measuring circuit never can be a pure resistance in practice.

Fig. 6 ( $\infty$ ).—The wires are short-circuited at A; between the B terminals an electrolytic resistance is inserted. Any electrolyte

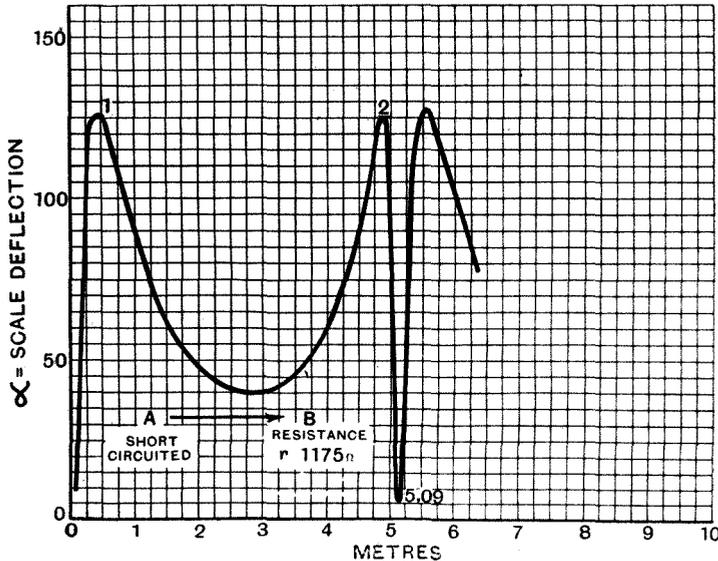


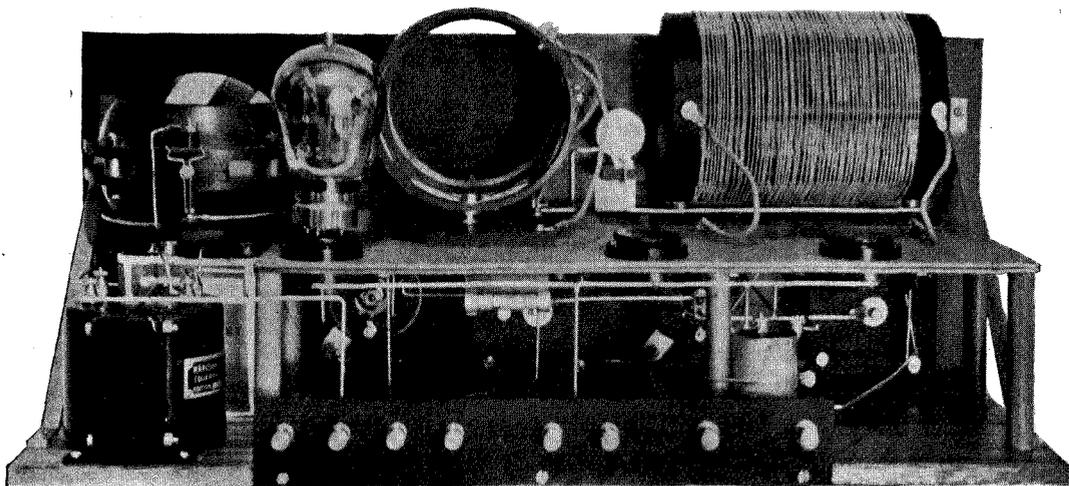
Fig. 6. The results obtained when a resistance is connected between the ends of the wire at B.

The reason why the curve does not drop to zero but gives a definite reading at the nodal points is because of electrical unsymmetry of the wires, causing a current to earth through the thermo-junction. (The theoretical minimum mentioned above should only be 0.000005 of the maximum indication). We have not been able to get rid of this unsymmetry but through proper adjustments of the coils, it was possible to reduce it very much. The dotted curve is obtained from square roots of the  $\infty$  values put in a suitable scale. This is the voltage curve.

Fig. 5 ( $\sqrt{\infty}$ ).—The wires are arranged as in Fig. 4.

having low conductivity and negligible rectifying properties may be used. As electrodes, copper ribbons have been adopted and arranged to give a minimum of capacity load. For each half period we get two points of maximum voltage, 1 and 2 from left to right, 2 being less than 1 up to a certain resistance value of the electrolyte after which 1 is less than 2. The resistance value making 1 = 2 was determined by experiment to be 117.5 ohms (D.C. measured at 4 volts tension). We now have a very pronounced node round which measurements may be taken giving great accuracy.

(To be concluded.)



## IDEAL RECEIVERS—II.

Under this heading the author will describe a number of receivers. Each instrument is to be built to meet certain requirements. No. I of this series, for instance, was designed for the man requiring a three-valve receiver having only one tuning control, and giving high quality amplification. A full discussion of the principles underlying the design and operation of the receivers, and, of course, complete constructional details will be given.

### A THREE-VALVE RECEIVER

With one H.F., Valve Detector and one Stage of L.F.

By W. JAMES.

**T**HIS instrument was designed for the man who has had a little experience in the construction of wireless apparatus, and requires a receiver which is easy to operate, and may be employed effectively in the reception of short wavelength or B.B.C. stations. One stage of tuned transformer-coupled high frequency amplification is employed with valve detector and one stage of transformer coupled low frequency amplification. A variometer is connected in the anode circuit of the detector to provide reaction effects, and a switch is employed to put the windings of the variometer in series or parallel, according to the wavelength of the signals being received.

#### DESIGN OF THE INSTRUMENT.

The general arrangement of the components and the method of mounting some of them may be gathered from the illustration at the head of this article. It will be observed that the front ebonite panel carries a base of wood, which in turn supports a platform of three-ply wood. The platform carries two removable tuning coils of special construction, and the three valve holders.

This arrangement was decided on because it permits one to change quickly the tuning coils or the valves. Further—and this is an important point to be observed in receivers which have removable coils inside the set—the whole of the wiring (with the exception of the wire connecting the transformer) is



or to employ square-law type condensers which may be inferior from the point of view of losses to ordinary condensers. The condensers employed in the receiver illustrated have ebonite end plates, and are used because I have found them better than others. The capacity of the condensers should be decided bearing in mind the tuning range desired with a given set of coils, the degree of selectivity, and the signal strength. If large condensers are employed, the signal strength will be lower than when smaller condensers are used, but the selectivity will be better. In this receiver 0.0002 microfarad condensers are employed, as we require good signal strength, and because we know the selectivity will be reasonably good, as two tuned circuits are employed. Further, the degree of

after the style of the ones illustrated in my articles, "Wireless Theory."\*

The construction of the formers for the coils may be gathered from Fig. 2. A piece of ebonite tube 4 ins. in diameter, with a  $\frac{1}{8}$  in. wall, has pieces cut out, leaving a number of ribs. The cutting out is quite an easy job, it being only necessary to drill two or three holes, and then to cut away the sections with a hack-saw blade. Then the rough edges are filed, and the ribs chamfered. The coil former will be found to be springy. A short length of the ebonite tube is therefore cut along its length and a short piece removed. The ends are shaped as indicated in Fig. 2, and the ring then pushed inside the former. This ring prevents the ribs bending when the wire is wound.

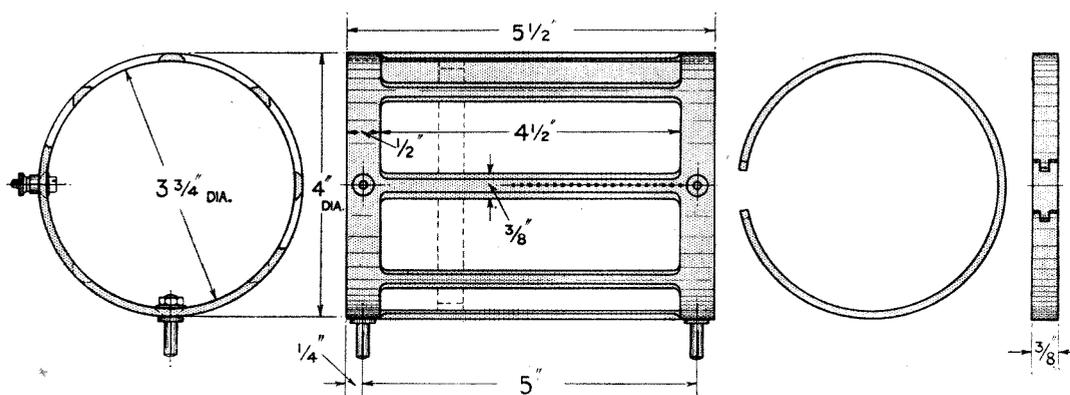


Fig. 2. Details of the formers for the coils. On the left is a part section. On the right is a sketch of the ring which is employed to prevent the ribs bending. The position of the ring is indicated by dotted lines.

selectivity may be made suitable by adjusting the ratio of the high frequency transformers.

#### THE H.F. TRANSFORMERS.

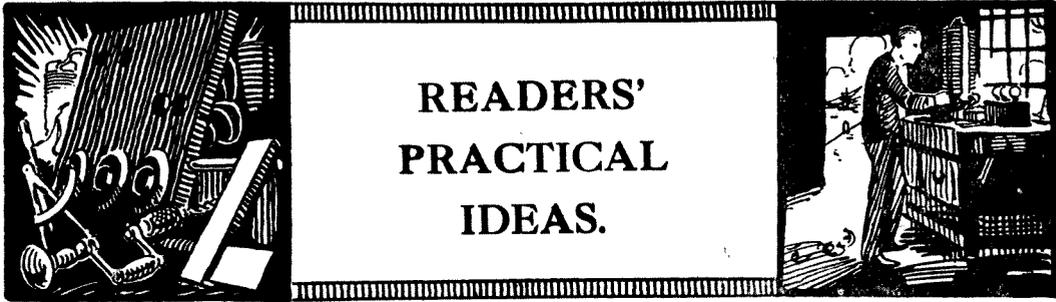
The two transformers are of similar shape, and both are wound in the same manner. To obtain fairly tight coupling of the primary and secondary windings they are wound close together, the primary being inside the secondary. As we wish the coils to be as effective as possible, great care should be taken in their construction. Losses may be reduced by using a skeleton former, a fairly heavy gauge of wire, and by spacing the turns. The coils are therefore constructed

The coupling between the primary and secondary windings is made fairly tight by putting the primary winding inside one end of the tube, and winding the secondary over the tube. For the broadcast wavelengths, the primary may have 10 turns of No. 20 D.S.C. and the secondary 60 turns of No. 20 D.S.C. Both windings are put on in the same direction.

To secure the primary winding a number of holes are drilled along alternate ribs. The primary is then wound on a former about  $3\frac{1}{2}$  ins. in diameter, the coil removed and put inside the coil former. Then each turn is held to the ribs by lacing them with a needle and cotton.

\*December 19th, 1923, pp. 832-833.

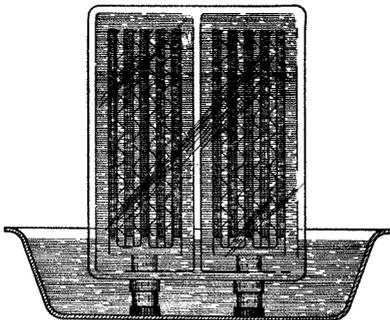
(Constructional details will be given in the next issue.)



This section is devoted to the publication of ideas submitted by readers and includes many devices which the experimenter will welcome.

**Removing Accumulator Sediment.**

**P**ASTE falling from the plates of an accumulator after a while produces a clogged mass in the bottom of the accumulator, which must be removed before it becomes so deep as to reach the bottom of the plates. This sediment may sometimes be dislodged by vigorously shaking the cell after the acid has been removed and replaced by distilled water. Where the deposit has settled down and become hard it can sometimes be



*Thus inverted in a basin of distilled water the deposit now at the top becomes loosened and falls.*

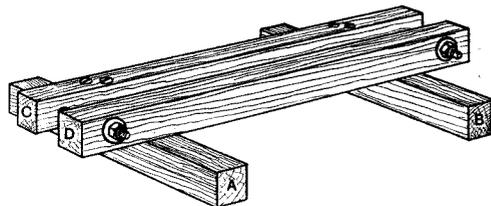
released by completely filling the cell with distilled water and leaving it inverted in a trough so that the paste falls as it becomes detached. Distilled water should fill the cell to the very top.

E. B.

**Panel Holder.**

**A**FTER wiring up a new set it is very convenient to be able to examine it before finally boxing up and while the apparatus at the back is still exposed, tests made as to the direction of connecting up the

various transformers and the suitability of introducing fixed condensers, grid bias, etc. A useful stand can be made up out of four pieces of wood clamped together which will give support to the panel without interfering with the accessibility to the equipment.



*Temporary panel support.*

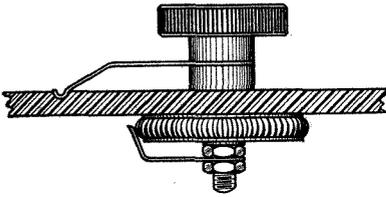
A length of wood is used with a cross section of 1 in. by 1 in. Two pieces are cut off about 7 ins. long and another two pieces about 12 ins. long. One of the longer pieces is securely screwed to the two shorter pieces as shown, whilst by means of a pair of bolts the remaining piece of wood can form a clamp suitable for gripping the edge of the panel. The panel simply stands edgewise, resting on the cross-pieces A and B, while the piece D is clamped up as far as it will go towards C, firmly gripping the edge.

J. G. F.

**Positive Resistance Lock.**

**W**HEN turning off the current supply to a valve filament by rotating the knob as far as it will go in the direction of the minimum setting, one can never be quite sure that the circuit is entirely broken. To ensure that the very minimum has been reached the pointer may be constructed from a piece of soft brass spring and

by bending it round in the manner shown can be made to engage in a small depression in the panel. The indentations are made with the point of a drill, whilst the spring



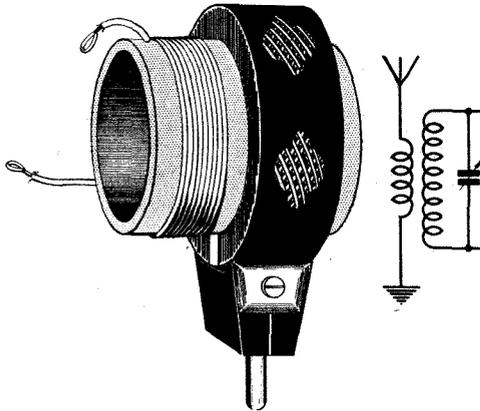
A springy pointer resting on an indentation makes a good stop.

should not press too firmly on the face of the ebonite or the surface will become cut. This arrangement produces a positive lock and it can be at once seen as to whether the rheostat has been rotated to the limit of its movement.

R. H.

**Loose Coupling With Plug-in Coils.**

A DIRECT coupled receiver can be converted to a loose-coupled set by inserting an insulating tube in the centre of the coil and winding on the required number



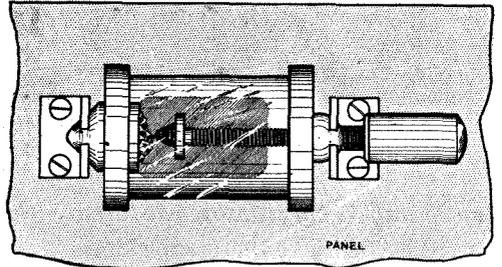
By means of a cardboard tube carrying a suitable winding for aerial tuning a direct coupled receiver can be easily converted to a loose-coupled set.

of turns. Almost any degree of coupling can be obtained by suitably spacing the turns away from the side of the plug-in coil and thus not only will the selectivity of the receiver be improved but a much improved control may be obtained over oscillation in a set making use of reaction.

R. H. B.

**Illuminating the Crystal Detector.**

CRYSTAL detectors cannot always be adjusted or touched and are difficult to adjust when the contact is not well illuminated. Where a crystal is used in conjunction with a valve, the light from the valve filament may be used to illuminate



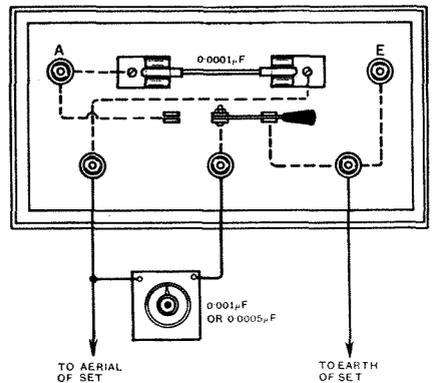
The light furnished by the valve of a crystal and valve receiver can be made to illuminate the detector contacts by placing the valve immediately beneath the detector and cutting away the panel.

the contact. The suggestion is made here that the valve is set up immediately behind a hole in the panel over which the crystal detector is mounted. Light thus passes right through the detector, giving good illumination to the point of contact.

H. J. S.

**Aerial Condenser Switching.**

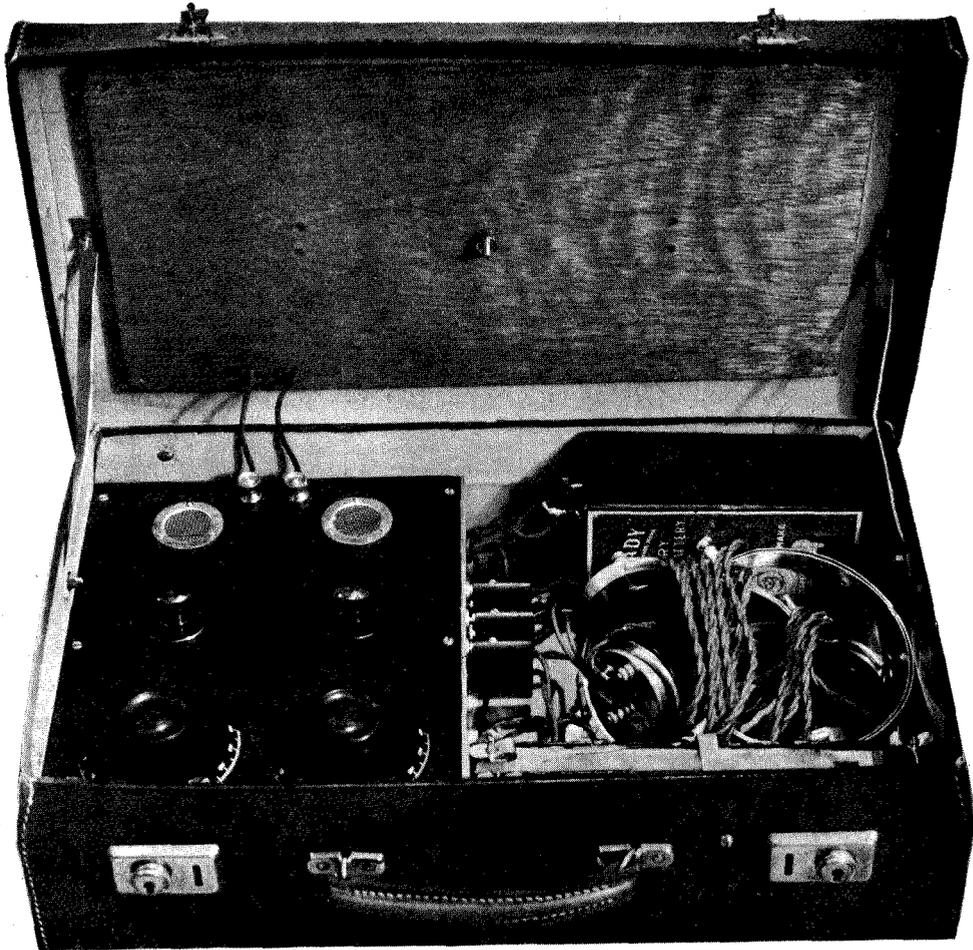
AN examination of the accompanying diagram will reveal that by connecting up the panel in the manner shown a variety of



Simple switch for providing various combinations of the aerial tuning condensers and inductance.

aerial connections are obtainable, consisting not only of the series and parallel arrangement, but provision is also made to employ condensers connected simultaneously in series and parallel with the tuning inductance.

C. R. L.



## A TWO-VALVE PORTABLE SET.

The instrument described below was designed to be really portable ; therefore the whole of the equipment is arranged in an attaché case, the frame aerial being in the lid. It will give good signal strength from 10 to 15 miles from a broadcast station, and should appeal to those readers who live in a flat, or who find it difficult to erect an aerial. This receiver also has the advantage that it can be carried from room to room without the horror of trailing wires.

By H. J. CLARKE.

**T**HE first step should be to secure an attaché case measuring approximately 17 ins. by 10 ins. by 5 ins. deep.

Then cut the ebonite panel to size, which in this instance is  $10\frac{1}{8}$  ins. by 8 ins. by  $\frac{1}{4}$  in., the width of the case being  $10\frac{1}{8}$  ins. When

the panel has been fitted to suit the case, it can be marked out and drilled from the dimensions of Fig. 1. Next construct the aerial and reaction coils. These are two basket coils consisting of cardboard formers of the dimensions shown in Fig. 2, wound with wire. The aerial coil has 30 turns of

No. 28 D.C.C., and the reaction coil 50 turns of No. 36 D.C.C. The aerial is secured to the panel by a 4 B.A. screw, and is spaced from the panel by the thickness of two nuts

upon a piece of 2 B.A. rod, and is secured by a nut placed on each side of the former. This rod passes through the former of the aerial coil and the panel, and

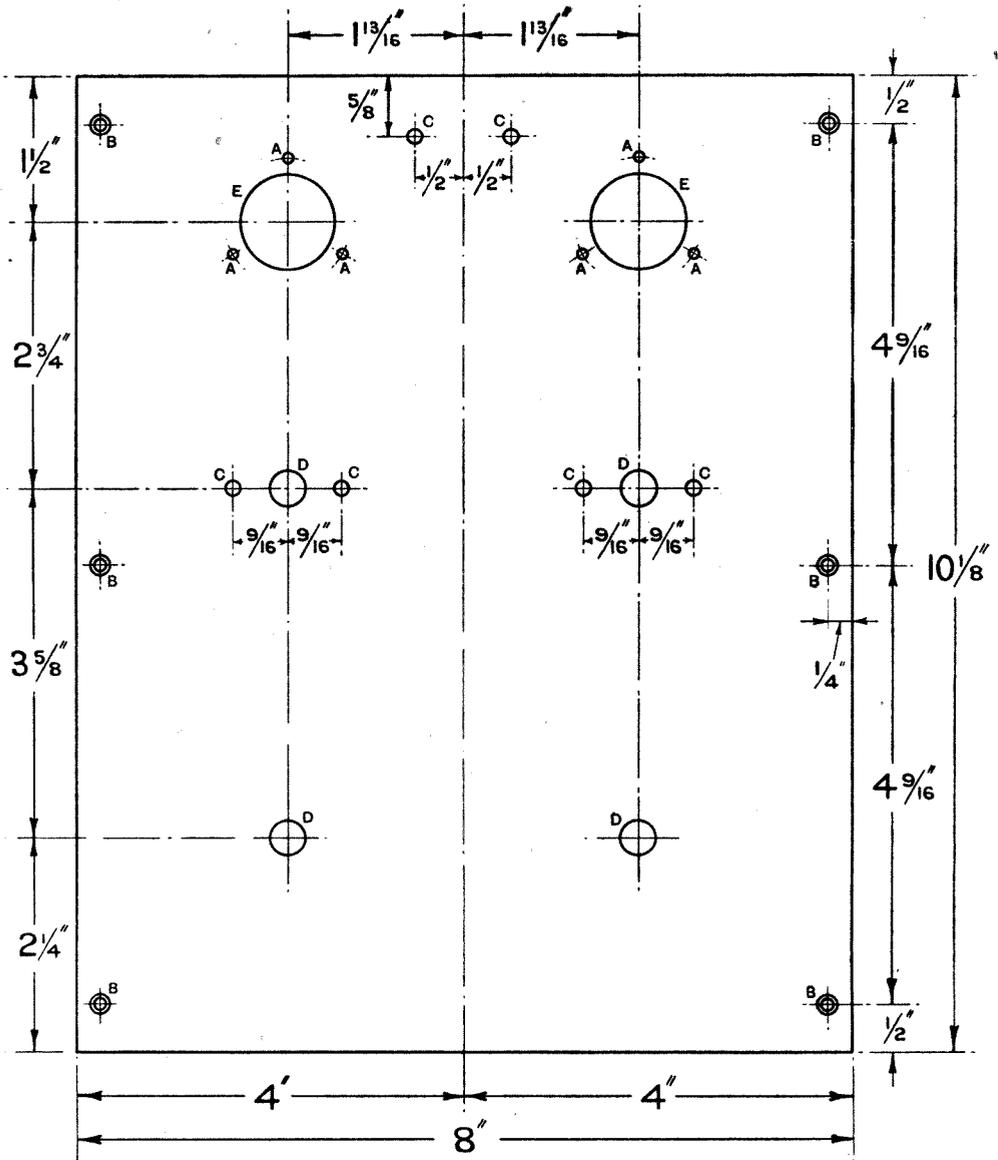


Fig. 1. Drilling details of ebonite panel. A, 3/32 in. dia.; B, 1/8 in. dia., countersunk for No. 4 wood screws; C, 5/32 in., dia.; D, 5/8 in. dia.; E, 1 in. dia.

and a washer. One spoke of the former of this coil is made slightly longer to take two screws, so that the coil can easily be connected to the circuit. The reaction coil is mounted

a knob and dial is screwed to the end which projects through the panel. The position of the reaction coil with respect to the aerial coil may be adjusted by turning this knob.

The distance between the panel and the back of the reaction coil should not exceed  $\frac{7}{8}$  in. A suitable stop for the reaction coil

stop. The brass strip is between the panel and the aerial coil.

The components required are as follows :  
 2 D.E.3 valves.  
 2 Burndept anti-phonic valve holders.

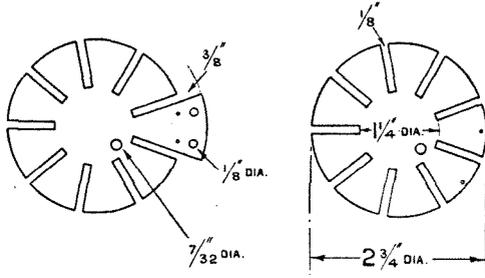


Fig. 2. On the left the former of the aerial coil, and on the right the former of the reaction coil.

can be arranged by soldering a piece of strip brass to the 2 BA rod. This brass strip is stopped by the screw that secures the aerial coil, and another screw can be put through the panel under the dial to form the other

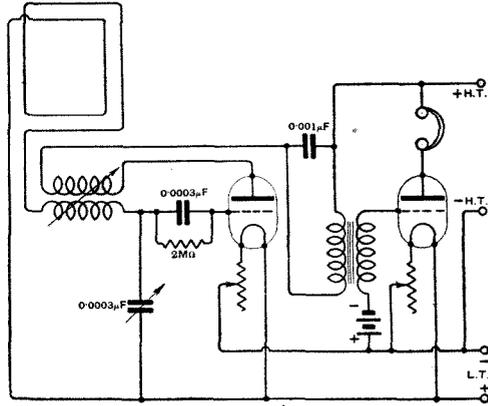


Fig. 4. Theoretical diagram of the receiver.

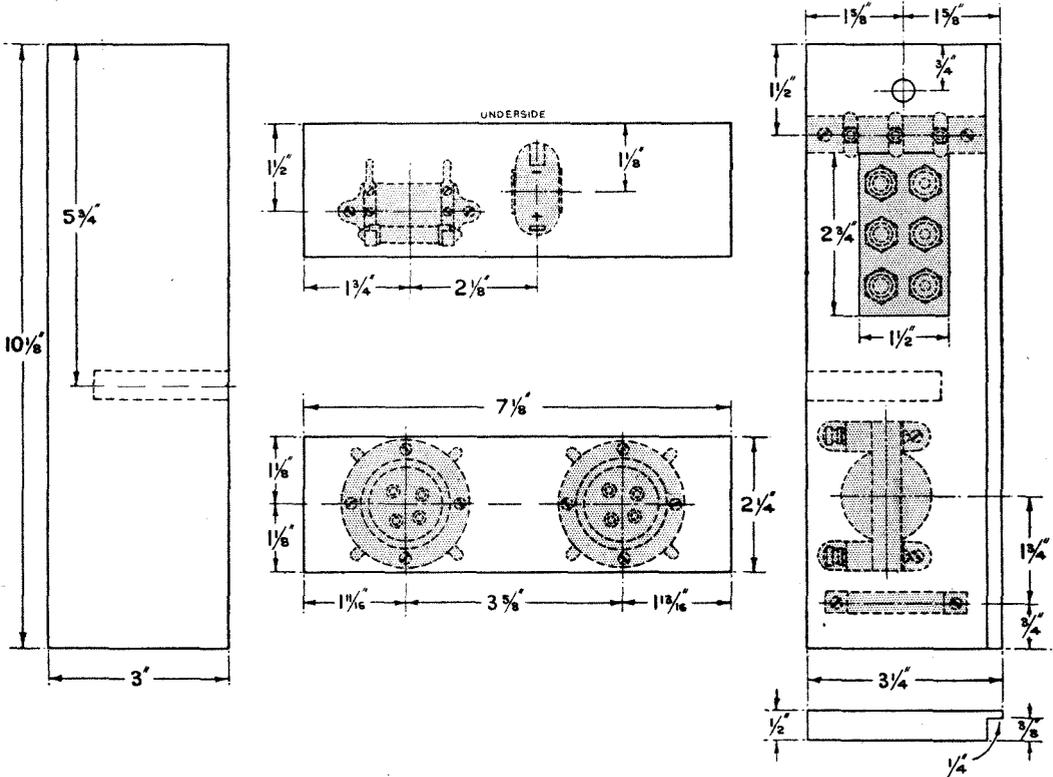


Fig. 3. Details of valve platform and supports. The platform is screwed to the supports at the position indicated by dotted lines. See Fig. 6.

- 2 Burndept 30-ohm filament resistances.
- 2 Valve windows.
- 1 0.0003  $\mu$ F Ormond variable condenser.
- 1 0.0003  $\mu$ F Dubilier condenser with clips and 2-megohm grid leak.
- 1 0.001  $\mu$ F, 600 A type Dubilier condenser.
- 1 Royal L.F. transformer.
- 1 Ever-Ready dry cell battery (3 volts) for grid bias.
- 3 15-volt H.T. batteries.
- 1 Ever-Ready dry battery, type L.T.3.

prise the two filament resistances, the valve windows, the variable condenser, and, of course, the reaction and aerial coils. The position of the parts may be seen by referring to the photograph at the head of this article. Construct next the supports for the ebonite panel, and mount the necessary components on them, as indicated in Figs. 3 and 6. The grid battery is secured by a piece of strip brass which is screwed to the valve platform. The valve platform is

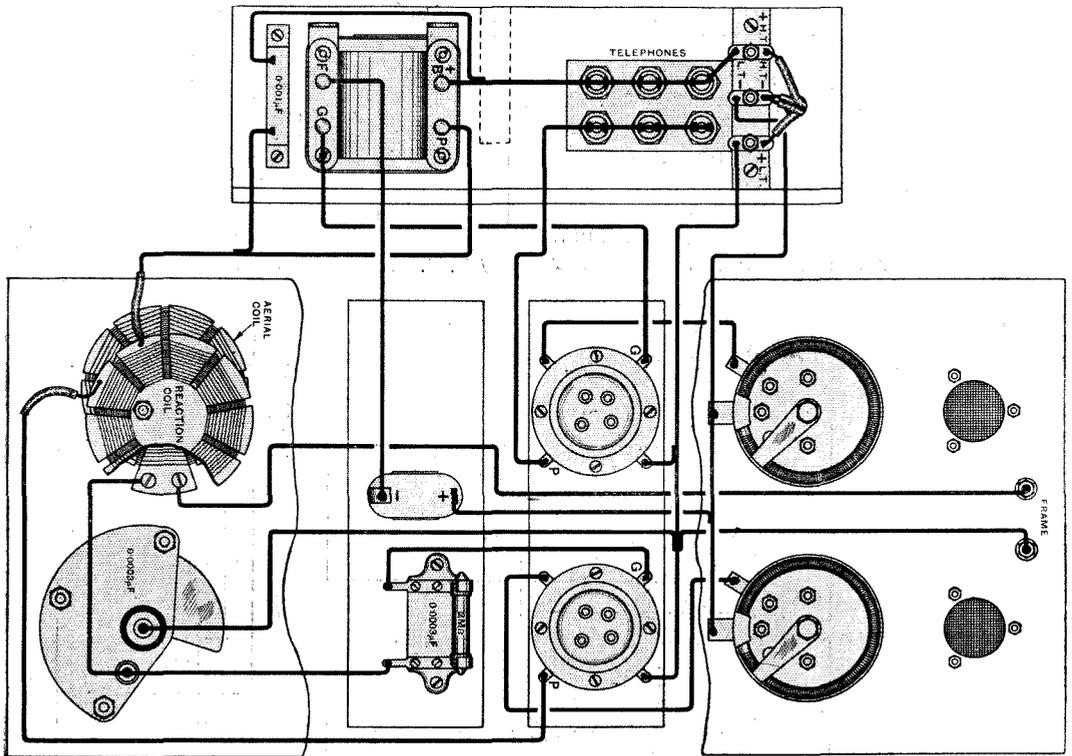


Fig. 5. Wiring diagram.

3 pairs of Sterling telephone sockets and plugs.

$\frac{1}{4}$  lb. No. 20 tinned copper wire.

15 yards of 2 mm. flex.

2 ft. of brass strip.

1 piece of mahogany 1 ft. 6 ins. by 8 ins., by  $\frac{1}{2}$  in.

Various wood screws, and a small quantity of No. 28 and No. 36 D.C.C. wire.

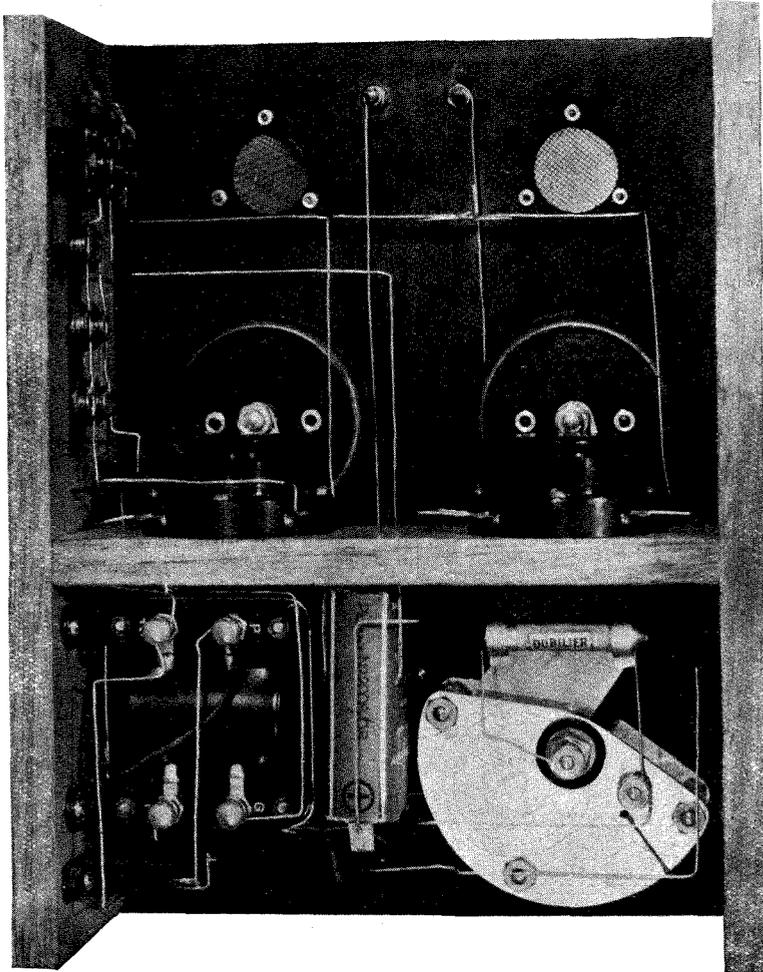
Next mount the components that are housed on the ebonite panel. These com-

ponents are the two filament resistances, the valve windows, the variable condenser, and, of course, the reaction and aerial coils. The position of the parts may be seen by referring to the photograph at the head of this article. Construct next the supports for the ebonite panel, and mount the necessary components on them, as indicated in Figs. 3 and 6. The grid battery is secured by a piece of strip brass which is screwed to the valve platform. The valve platform is

screwed to the side of the supports by four 1-in. wood screws. On one of the wooden supports the telephone sockets are mounted. The sockets themselves may be secured upon a piece of ebonite  $3\frac{1}{2}$  ins. by  $1\frac{1}{2}$  ins. by  $\frac{1}{4}$  in., being spaced  $\frac{7}{8}$  in. apart, and the pins arranged  $\frac{3}{4}$  in. apart. The ebonite strip upon which the flexible leads from the batteries are soldered is next constructed. The strip consists of a piece of ebonite 3 ins. by  $\frac{5}{8}$  in. by  $\frac{1}{4}$  in., upon which is screwed three small pieces of brass to form

connecting tags, the whole being secured by two screws. It will be noticed that the hole through which the flexible leads pass has an ebonite bush. This bush was the ebonite portion of a wander plug. If the flex is obtained in four different colours it will greatly facilitate the wiring to the batteries as it is somewhat difficult to trace the wires through the ebonite bush.

The frame aerial, which is mounted in the lid, consists of 14 turns of flexible wire wound upon wood strips  $\frac{1}{2}$  in. wide by  $\frac{1}{4}$  in. thick. Holes are bored with an  $\frac{1}{8}$ th in. drill through the thickness of the strips and are spaced  $\frac{1}{4}$  in. The strips are secured by screws upon a thin piece of three-ply wood  $15\frac{1}{2}$  ins. by  $8\frac{1}{2}$  ins. The ends of the frame aerial are passed through the wood at the



*Fig. 6. View of the back of the panel showing the valve platform and supports. The aerial and reaction coils are between the panel and the L.F. transformer.*

The receiver is now ready for wiring. This can easily be done if the wiring of the panel is completed before the panel is screwed down. Flexible wire must of course be used for the connections from the reaction coil. The wiring diagram is Fig. 5.

position opposite the frame aerial terminals. To hold the frame in position, a 2 BA screw is passed through the lid of the case, and a nut screwed on.

From the general lay-out, Fig. 7, the reader will see the position of the batteries.

A piece of strip brass  $\frac{3}{8}$  in. by  $\frac{1}{16}$  in. is used to secure these batteries to the case.

When the receiver is finished it may be found that the wires from the reaction coil

It is also advisable to try the valves (of the D.E.3 type) in different positions as one valve may operate much better as a detector than another.

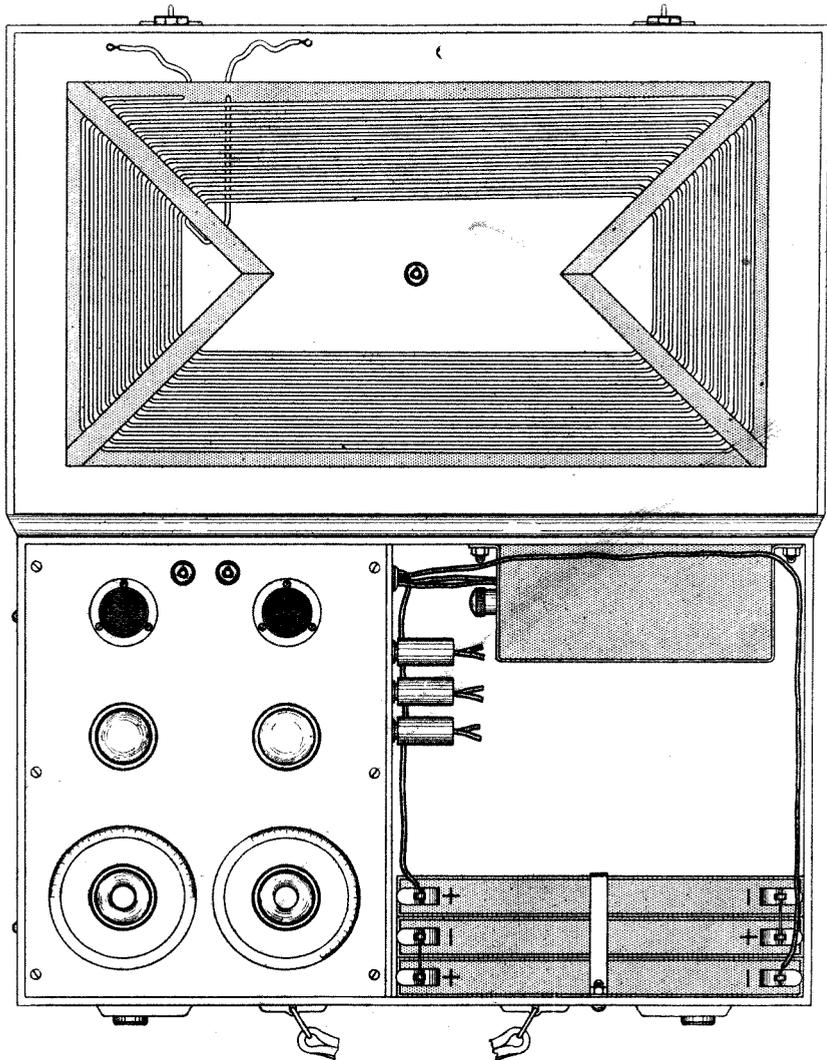


Fig. 7. General arrangement of the receiver in the attaché case. To show the frame aerial clearly, it is drawn reversed.

have to be reversed, and that better signal strength is obtained by spacing the reaction coil a little further from the aerial coil. These adjustments are easily made.

The frame should, of course, be pointed in the direction of the transmitting station so far as possible, if maximum signal strength is required.

# THE EXPERIMENTER'S NOTE BOOK.

By W. JAMES.

## The Super-Heterodyne Receiver.

IT is an easy matter to employ effectively several stages of high frequency amplification to strengthen signals of long wavelength, and very difficult to amplify signals of short wavelength. The difficulty with short wavelength amplifiers is to secure a reasonable degree of amplification and selectivity with stability and ease of operation. Usually it is found necessary to employ sharply tuned circuits if the set is to be effective, but when the circuits are tuned to the incoming signal, the amplifier oscillates. Hence we find, even for the broadcast wavelengths, that more than two stages of tuned high-frequency amplification are rarely employed, and even then the amplifier is "neutrodyned," or very specially designed and constructed. The instability and ineffectiveness is due chiefly to the capacity between the circuits and the elements of the valve. Of course, these capacities are present, whether the amplifier is designed for short or long wavelength amplification, but they become more important as the wavelength is reduced.

The super-heterodyne or supersonic receiver is primarily an instrument designed to change the incoming short wavelength signals into long wavelength signals, so that they may be strengthened effectively by a long wavelength amplifier. With the super-heterodyne receiver, therefore, we are able to amplify the signals to a much

greater extent than would be possible if the original signal was applied to a short wavelength amplifier, and further, we can secure the desired degree of amplification with relative ease, as long wavelength amplifiers can be made stable and do not require sharply tuned circuits.

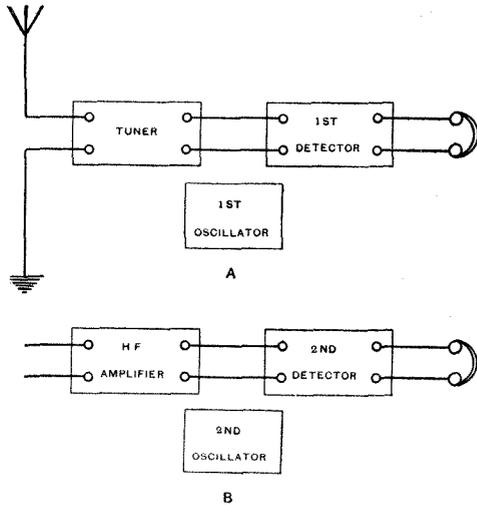


Fig. 1. A. The first portion of a super-heterodyne receiver.  
B. The second portion of the receiver.

The high degree of amplification obtainable with a super-heterodyne receiver is only one of several advantages to be derived from its employment. Extraordinarily good

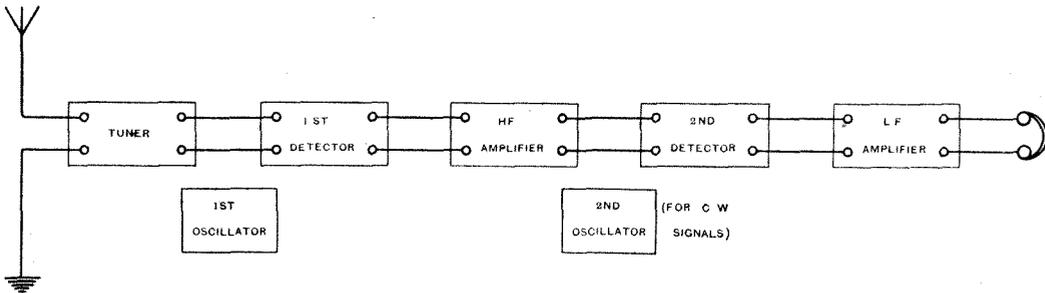


Fig. 2. Schematic arrangement of a super-heterodyne receiver, combining Figs. 1 A and B.

selectivity is automatically secured, as will be shown later.

### The Principle of the Super-Heterodyne Receiver.

The principle of the super-heterodyne receiver may be understood with the aid of the schematic diagrams of Figs. 1 and 2, and the curves of Figs. 3 and 4. From Fig. 1A it will be seen that the aerial is connected to a tuner, which in turn is joined to a detector, and if the incoming oscillations are telephone signals, the speech will be heard in the telephones connected in the anode circuit. So far, therefore, we have an ordinary tuner and detector.

To receive continuous wave signals, however, it is necessary to set up oscillations to beat with the incoming signal. The desired result may of course be obtained by employing a reaction coil coupled to the tuner, but a better method consists in using a separate oscillator. The frequency of the oscillator is adjusted to be a few hundred, or perhaps a thousand cycles lower or higher than the frequency of the incoming signal. If the C.W. signal has a frequency, for instance, of 1,000,000 cycles (300 metres), the oscillator would be adjusted to a frequency of about 1,001,000 (or 999,000) cycles, producing a note having a frequency of 1,000 in the telephones. If the oscillator was adjusted to a frequency of 1,000,500 cycles, the note in the telephones would have a frequency of 500 cycles; if the frequency were 1,010,000 cycles, a current of 10,000 cycles would flow through the telephones.

A note of 500 or 1,000 cycles is comfortably audible, but few people would hear a note of 10,000 cycles. By setting the oscillator to a frequency of, say, 1,020,000 cycles, the frequency of the current passing through the telephones would be 20,000 cycles, which would not produce an audible note.

The effect of altering the frequency of the local oscillation will probably have been noticed by those who allow their receivers

to oscillate when receiving telephony. The circuits may be so adjusted that the locally generated oscillations have the same frequency as the incoming signal. No beat note is then heard. As the tuning of the receiver is changed, however, a beat note is produced which may be varied in pitch from a low to a high value until the beats become so high that they are inaudible.

The operation will more readily be understood by referring to Fig. 3. Curve A represents an incoming C.W. signal of 1,000,000 cycles (300 metres), which is

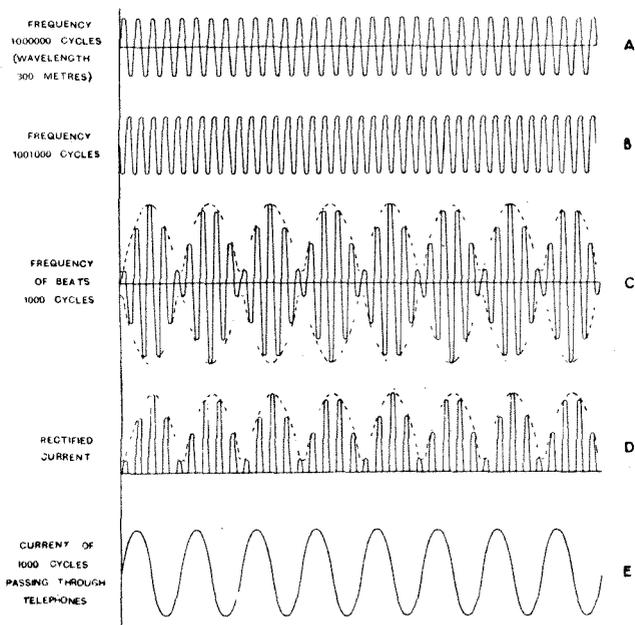


Fig. 3. Curves explaining the operation of the first portion (Fig. 1A) of a super-heterodyne receiver.

flowing in the oscillatory circuits of the tuner, and curve B represents the locally generated oscillations having a frequency of 1,001,000 cycles. These two oscillations—assisting one another when they are in step or in phase, and opposing one another when they are 180 degrees out of phase—produce oscillations which vary in amplitude as in curve C, the frequency of the beats being the difference between the frequencies of the two oscillations, in this instance 1,000 cycles. The currents flowing in the anode circuit of the detector are therefore of the form indicated in curve D. A condenser is usually provided to carry the high-frequency com-

ponent of the rectified current to the filaments of the detector, and the low frequency component passes through the telephones, producing a note of 1,000 cycles.

It is important that the reader should understand that the beats may be given any frequency, so that instead of the currents represented by curve E, Fig. 2, producing an audible note, their frequency may be so high that they will oscillate in an ordinary tuned circuit adjusted to resonance.

The relative strength of the locally generated oscillations to that of the incoming signal and various other factors affecting the operation of the receiver need not be considered for the time being.

**The High Frequency Amplifier.**

Now that we understand that by suitably adjusting the frequency of the local oscillator beats of almost any frequency may be set up in the detector circuit, it is not difficult to realise that if a circuit tuned to the frequency of the beats is connected to the anode circuit of the detector, oscillating currents of the beat frequency will flow. These may be applied to an amplifier, as indicated in Fig. 1B, and strengthened to the desired extent. The amplifier should be one designed to amplify oscillations of the beat frequency. For instance, the beat frequency in a practical case may be 60,000 cycles, corresponding to a wavelength of 5,000 metres.

Having amplified the signals to the desired extent, it is necessary to heterodyne them and to rectify them in order that they may be heard in the telephones. We therefore connect the H.F. amplifier to a detector, and couple an oscillator to the circuit of the detector as indicated in Fig. 1B. The reason for the second detector and oscillator will readily be understood if the oscillations

flowing in the H.F. amplifier are considered as being long-wavelength C.W. signals. As to the frequency of the second oscillator, this should be adjusted to be, say, 1,000 cycles above or below the frequency of the oscillations in the H.F. amplifier—in this instance 61,000 or 59,000 cycles. Then a beat note of

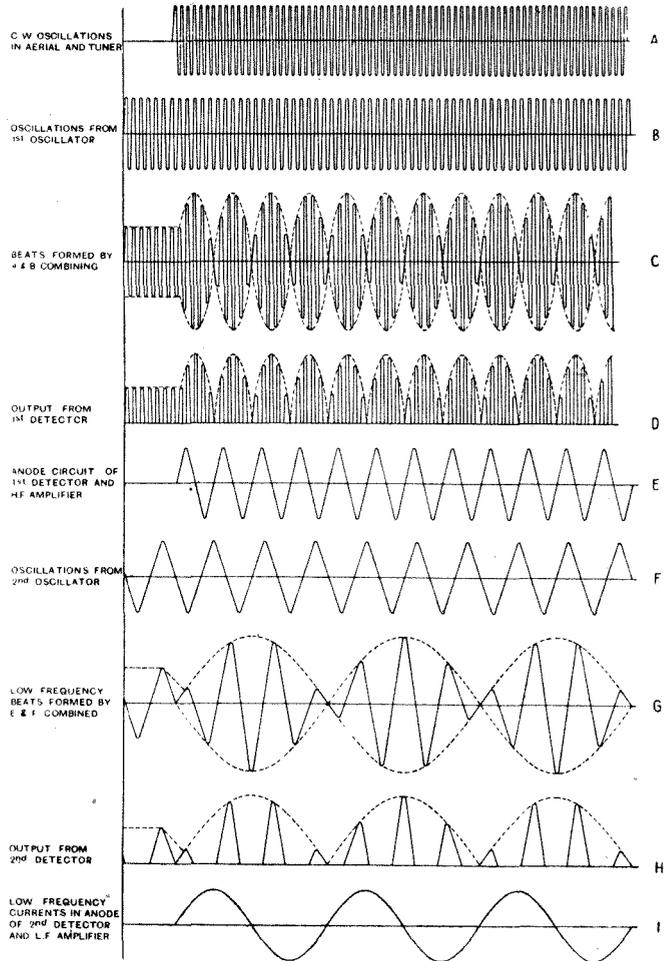


Fig. 4. Curves explaining the operation of a complete super-heterodyne receiver.

1,000 cycles will be heard in the telephones. By combining Figs. 1A and 1B, we obtain the layout of Fig. 2, which represents a complete super-heterodyne receiver arranged for the reception of C.W. signals. The second oscillator (as will be explained later) is not required when receiving modulated signals such as telephony.

The operation of a super-heterodyne receiver for the reception of C.W. signals is fully explained by the curves of Fig. 4. We have first the low wavelength oscillations flowing in the aerial circuit. These are received by the tuner (Fig. 2), and are represented by curve A. The first oscillator is coupled to the tuner, and delivers oscillations of a different frequency as represented by curve B. Thus beats are formed,

passed to the H.F. amplifier as indicated by curve E. These are strengthened by the amplifier, and are applied to the second detector. At the second detector we have the oscillations which were amplified by the H.F. amplifier and the oscillations set up by the second oscillator. (The oscillations from the second oscillator are represented by curve F.) These oscillations form beats of audible frequency as indicated by curve G,

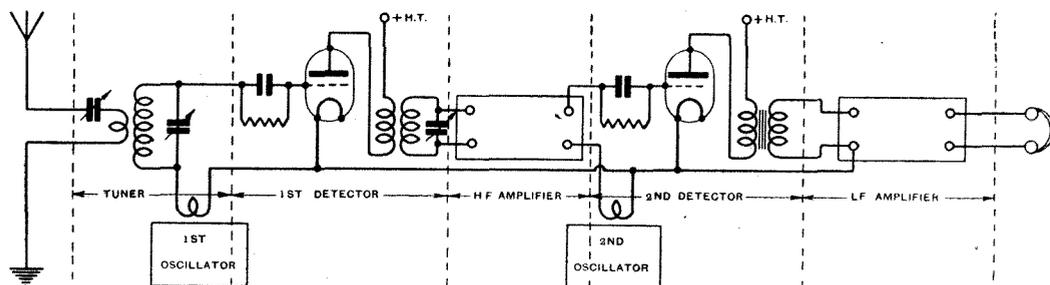


Fig. 5. The schematic arrangement of the super-heterodyne receiver of Fig. 2, but showing essential components.

curve C, the frequency of the beats being determined by the difference between the frequency of the incoming C.W. signal and that of the oscillator. The beats are rectified by the detector, so that we have oscillations of the form of curve D in the anode circuit of the detector. As the anode circuit of the detector contains a circuit which is tuned to the frequency of the beats, currents of the beat frequency flow in this circuit and are

which are rectified by the detector as at H. The low frequency currents I are then heard by connecting telephones to the detector, or a low-frequency amplifier, as in Fig. 2, may, of course, be employed between the second detector and the telephones.

The diagram of Fig. 5 shows the essentials of the super-heterodyne receiver, which will be fully described in the next number of this journal.

## BOOK REVIEW.

**The Book of the Wireless Valve.** (The Mullard Radio Valve Co., Ltd., pp. 71. Price 1/6.)

This little volume provides interesting reading to all wireless men, even though they may use valves other than those manufactured by the publishers. It opens with a short historical note on the evolution of the valve, the second chapter giving a simple explanation of the elementary principles underlying its action.

Much of the good advice contained under the heading "Points of a Good Valve" cannot, unfortunately, be carried into effect owing to the present-day valves being more or less opaque.

A few simple notes on receiving circuits are next given, but it is a pity that the "jar" has been used as the unit of capacity. Most wireless men, outside the Services, are more conversant with the microfarad and therefore references to  $\frac{1}{4}$  or  $\frac{1}{3}$  jar do not convey much to them until converted into the more generally used unit.

The remainder of the book is taken up with a description of the several Mullard valves on the market, Receiving, Power, Rectifying and Transmitting, with useful notes on the various types. A number of photographs of typical valves and their characteristics completes the work.

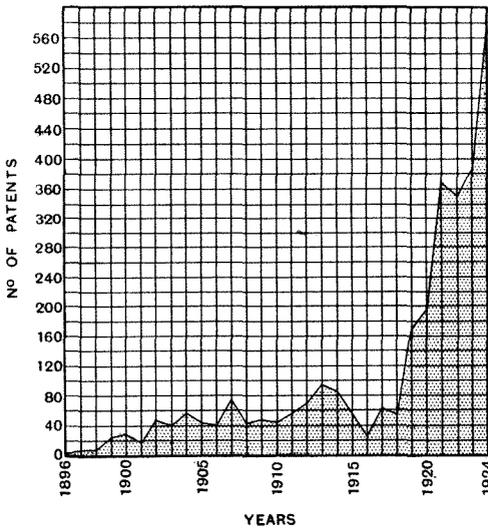
# A RECORD OF BRITISH WIRELESS PATENTS.

IN a recent note in this journal, reference was made to the fact that since the introduction of broadcasting in this country, the number of patents taken out through the British Patent Office has increased to an enormous extent. The note was intended primarily to draw attention to the large number of worthless inventions reaching the Patent Office, due to ignorance on the part of applicants. It has since been pointed out to us in correspondence that it might have been explained also to our readers that it is incorrect to assume that the application for a provisional patent

have been included which could be regarded as of direct wireless interest. In the year 1896 only two patents were taken out and the number has steadily increased until the year 1919, when a very marked increase in the number of patents filed took place, but it was not until after the war that what can be described as a rush of applications for patents occurred.

Number of Patents Granted for Period 1896-1924 (November 30th).

1896	..	..	2	1911	..	..	57
1897	..	..	8	1912	..	..	69
1898	..	..	8	1913	..	..	93
1899	..	..	23	1914	..	..	85
1900	..	..	29	1915	..	..	55
1901	..	..	19	1916	..	..	27
1902	..	..	46	1917	..	..	61
1903	..	..	40	1918	..	..	55
1904	..	..	58	1919	..	..	169
1905	..	..	42	1920	..	..	193
1906	..	..	40	1921	..	..	368
1907	..	..	75	1922	..	..	351
1908	..	..	42	1923	..	..	386
1909	..	..	49	1924	..	..	564
1910	..	..	44	(Up to November 30th)			



NOTE.—The increase during the years 1921 and 1922 is largely accounted for by the fact that many of these were filed under the Peace Treaty and claimed prior dates of application.

constitutes a protection. The principal purpose of a provisional patent is to date an invention. An application for a patent is therefore of no value unless it is followed up by the complete specification and the patent is accepted and sealed at the Patent Office.

As a matter of interest, the chart illustrated here has been compiled, giving an indication of the number of patents granted between the years 1896 and 1924. Only those

The war upset the records to a certain extent, because applications from abroad were largely held in abeyance during the years of the war and were subsequently granted in the years 1921 and 1922 under the Peace Treaty and prior dates of application were allowed in most cases. This accounts for the large number taken out in these two years 1921 and 1922, and if this fact is taken into consideration it only serves to emphasise the enormous increase in wireless patents since broadcasting commenced. Taking these figures as showing the number of completed patents, one realises how great must be the number of applications made which were never completed.

# WAVEMETERS.

By L. B. TURNER, M.A., M.I.E.E.

(Continued from page 422 of previous issue.)

## DISCUSSION.

Mr. C. F. Phillips in opening the discussion said: I have been studying wavemeters of the sub-standard type for some considerable time so that I have been more than interested in the lecturer's very able description not only of the types of wavemeters that it is possible to use but of the various purposes for which they can be correctly adapted, because it is a most important thing not to use the wrong type of wavemeter for the job you have in hand. I noticed with some interest that the author spoke of enclosing his standards in wax. I expect he knows a great deal more about wax than I do and I expect that his standards have remained constant but I have enclosed things in wax and although I had thought that they would remain constant, after about three years I found the wax had cracked and had occasioned quite a difference in the capacity of an enclosed condenser. The author treated the oscillating valve wavemeter a little unmercifully, to my mind. He admitted that it was possibly the instrument of the greatest precision that we had in our laboratories and yet he seemed to say that it was not suitable for sub-standard work. By sub-standard, I mean an instrument that can be used with an error of say two or three parts in 10,000 for calibrating other instruments. I do not mean a sub-standard of the precision that might be necessary at the National Physical Laboratory. I believe that it is possible to construct valve wavemeters of a precision of two parts in 10,000, and venture to say that it is possible to maintain practically that accuracy if certain precautions be taken. The most important thing is to choose the proper type of valve; do not be tempted to use the modern valve in which the vacuum is obtained by the modern system known as "gettering"; for wavemeter purposes the electron emission must remain very constant and to attain this end it is essential that the valve be properly evacuated by the older methods. In order to get a valve that will last for many years, it is desirable that the filament be run well below its rated voltage, and in order that this may be done without impairing its qualities as an oscillator, it is desirable to select a valve which normally has a very high emission. These qualities are filled by a valve known as the "L.S.5" which, when run at 4.5 volts, has an emission of nearly 100 milliamperes; run at 3.2 volts it will oscillate freely and has an almost unlimited life; further, the construction is very rigid and very uniform in different specimens, this uniformity being due to the fact that the valve is primarily designed for Post Office telephone repeater stations, where exact conditions must be reproduced in all valves.

The grid condenser and leak have values of 0.0025 microfarads and 100,000 ohms respectively, and have the peculiar effect of making the oscillating frequency practically independent of emission

changes within the valve, and further, of allowing valves to be changed without very materially affecting calibration accuracy, provided one type of valve be adhered to. This effect is very fully explained by Professor Morecroft\*, so I will not labour the point. If an accuracy of the order of two parts in 10,000 is to be maintained, it is necessary, every time the wavemeter is used, to reproduce the conditions of calibration; Fig. 1 shows three measuring instruments inserted in the circuit to that end. "A" is a filament voltmeter which allows one to adjust the filament to exactly 3.2 volts (if so calibrated) every time the instrument

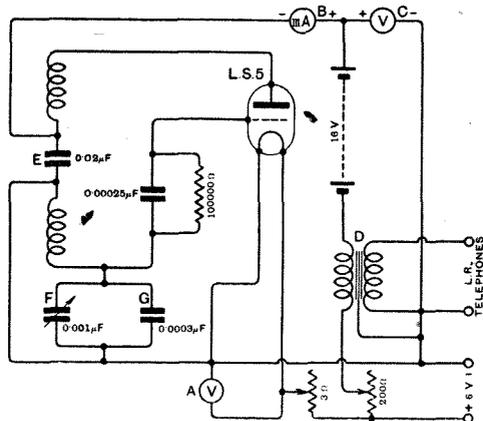


Fig. 1. Connections of the heterodyne wavemeter described by Mr. Phillips.

is used. "B" is a 1.5 milliamperemeter which is in the plate lead and allows one to check the emission; this must always be done at a constant setting of the main tuning condenser, say at maximum value. The next thing is to adjust the voltage of the plate supply. I use a 16-volt plate battery connected to a potentiometer across the filament battery, thus giving an adjustable voltage between 16 and 22, which is always indicated by the 24-volt meter marked "C" in the diagram. A word of warning about that voltmeter. It is useless to use the usual pattern taking about 18 milliamperes at full scale, as that would rapidly exhaust the 16-volt battery, but it is easy to obtain a special meter with a galvanometer movement taking 1.3 milliamperes only. Both voltmeters "A" and "C" must be permanently in circuit, while the wavemeter is in use, as if switched off the reduction in load would increase the voltages.

\* "Principles of Radio Communication," by J. H. Morecroft, 1921, page 795 *et seq.*

"E" is quite a large condenser and "D" is a telephone transformer, preferably of the shielded pattern, with core and shield connected to L.T. —. Finally connect L.T. — to earth, and if possible shield the whole instrument with an earthed lining of thin copper. A last precaution is to put a good fixed condenser "G," 0.0003  $\mu$ F, in parallel with the tuning condenser "F"; this ensures that no part of the calibration curve below a shunt capacity of 0.0003 shall be used, a condition which is very desirable for accurate work.

If a wavemeter be constructed in the way I have indicated, I believe that it is possible to have a wavemeter which will hold its calibration to two parts in 10,000 or thereabouts.

#### Mr. R. E. H. Carpenter.

The paper is so extraordinarily complete that it is very difficult to find anything useful to add to it, but there are one or two quite minor points which the author did not mention, although they are undoubtedly known to him, which it may not be entire waste of time to mention. He referred to the click method for determining when a standard LC circuit is in resonance with an oscillation generator. I have found in practice that a very much more convenient laboratory method than that consists in arranging an oscillator with a milliammeter in the anode circuit and a grid leak and condenser as shown in Mr. Phillips' diagram, and bringing a standard LC circuit up to it. If, then, you swing the variable L or C in either circuit, the milliammeter needle will kick at some adjustment and, by noting the point at which the anode current changes, you can assess quite readily—without having to go about with telephones on your head, which is often inconvenient—when these two circuits are in resonance. It is surprising how accurate a result you can get in this way, provided the coupling is made weak enough. There is a small practical point which I should like to mention in connection with buzzers. It is a common practice to use the wavemeter current to operate the buzzer; *i.e.*, that you have to choose the current which you put through your wavemeter sufficiently large to operate the magnet of the buzzer. I have found it more convenient to have a buzzer with two contacts. One of the contacts operates the buzzer as such—in my own case a tuned reed which gives much steadier results—and there is an entirely separate contact for the wavemeter. In that way you can control the current put through the wavemeter and cut down the sparking due to that current at this auxiliary contact quite readily without disturbing the mechanical operation of the buzzer reed. Furthermore, I make the hummer contacts of carbon; they act as a kind of microphone and the thing hums at an extraordinarily small current, about 4 milliamperes. A single dry cell will operate the hummer portion indefinitely and it hums extremely steadily. The buzzer contacts proper for the circuit are entirely separate and are metallic, to get a sharp break.

#### Mr. W. M. Holbeach.

I should like to ask if the author has tried to interrupt the oscillatory currents of a heterodyne wavemeter. Can the author suggest the best method of interrupting and which part of the circuit should be broken? The author also made some

remarks about good and bad buzzers and what a lot of trouble they were to some people. I have heard of the Telefunken buzzer as being very good but it cannot be obtained now and I am wondering whether the author knows of a good one, a better one for instance, than the Ericsson. Regarding the Moullin voltmeter method, I take it that the voltmeter is put right across the LC circuit; does that take a lot of energy in the ordinary way and is it fairly sensitive?

#### Mr. F. L. Hogg.

May I ask Mr. Phillips a question with regard to his wavemeter which he says will give an accuracy of two parts in 10,000. The point arises in connection with the variable condenser. I remember discussing this question with some people who have had considerable experience in the manufacture of condensers and their opinion was that it is quite impossible to get a wavemeter—a sub-standard such as this—to be accurate within more than 0.1 per cent. for any period, say more than six months at a time, even if you expend something of the order of £20 or £30 on a condenser. I saw at the recent exhibition a large condenser with a wheel on top to adjust it, but I am told that even such condensers cannot be relied upon for an accuracy of more than 0.1 per cent. for anything more than two or three months at a time and I should be very glad if Mr. Phillips can tell us some way to get out of this difficulty because I am extremely anxious to possess a wavemeter of the accuracy he has mentioned.

#### Mr. C. F. Phillips.

I omitted to stress the fact that no wavemeter could be read more accurately than the tuning condenser could be set. Such special condensers are very expensive and usually have a worm-drive with micrometrical reading arrangements. I use a Bureau of Standards type, in which 1/16th in. movement corresponds to a capacity variation of 0.6  $\mu$ F; this permits a close estimation down to 0.12  $\mu$ F.

#### Mr. E. H. Robinson.

The lecturer has referred to the difficulty of getting the decrement of the buzzer side of the wavemeter low. I have had some experience in calibrating all sorts of wavemeters and I have noticed the same thing. Wavemeters, for some obscure reason, vary considerably. Several wavemeters of different well-known makes use the little buzzer which has been so extensively used in the Army. In one particular wavemeter the tuning of the buzzer appeared to be very sharp and I could never account for it. It was superior in this respect to many other buzzer wavemeters, such as the Townsend, and, judging by the sharpness of tuning, it appeared to be almost as good as an I.C.W. wavemeter. By heterodyning the buzzer oscillations on fairly long wavelengths, one obtained almost a tonic-train heterodyne note. I was rather surprised that a buzzer working at about 1,000 interruptions per second should permit such a low decrement.

I should like to ask the lecturer about a difficulty I have experienced when using heterodyne wavemeters, and that is the extraordinary variation of frequency with filament temperature on long wavelengths. This variation of frequency with

emission is much worse on the longer wavelengths. On short wavelengths, say 300 metres, I have found it possible to plug in all sorts of valves and it does not make much difference to the pitch of the heterodyne note, but on 6,000 metres the wavemeter was practically useless unless you adopted every single one of the precautions to which Mr. Phillips has referred. I have my own idea of the reason for this but I should like to have the author's opinion.

Another point of interest is that many of us who are now trying to work on short wavelengths desire to calibrate our receivers or wavemeters down to 60 metres or lower. At the time we started this work there were very few standards available and I believe a number of experimenters in common with myself used the harmonics from broadcasting stations as standards for arriving at short wavelengths. The local broadcasting station produces strong enough harmonics down to the fourth, but when one wants to carry the tuning to about the tenth they become very attenuated indeed. I found a very convenient and simple way of getting these harmonics strongly down to about the thirteenth, and this is simply to take a crystal set and tune it to whatever the fundamental broadcast wavelength happens to be. If the crystal is rectifying properly, it has the effect of distorting the wave and introducing harmonics in a similar manner to that which the lecturer has mentioned as occurring in a valve oscillator operating under asymmetric conditions. Just get this crystal set tuned to the broadcast wavelength, and you find if you couple a much shorter wavelength receiver or wavemeter to the broadcast set you will hear very powerful harmonics right down to the thirteenth or fourteenth. This provides a very simple method of calibrating from high harmonics and in a few minutes you can calibrate a receiver right down to at least the fourteenth harmonic of the station you are using.

#### Mr. L. F. Fogarty.

There is only one point I should like to ask the author, but I am afraid that it may seem rather a silly one. He mentioned that he had prepared a standard of 50 metres by taking a suitable condenser and coil and casting them in wax. I was wondering what would happen, because although you can adjust the correct values of inductance and capacity before they go into the wax, they must alter materially afterwards.

#### Mr. G. G. Blake.

The author has referred to one of the early methods of calibration which rather interests me, and that was the method in which the nodes and loops are measured along two stretched wires, I believe (going back into history) General Ferrié at the Eiffel Tower, was probably one of the first to employ the method for measuring the wavelengths of a transmitting station. In 1901 he stretched a wire from the base of the Eiffel Tower, and by means of a hot wire ammeter, inserted near the Tower end of it, he adjusted its length until he obtained maximum readings in the ammeter. He was then able to trace the nodes and loops along the wire and tell what wavelength was being radiated.

Another thing in the lecture which interested me was that little contrivance for tuning up a

station, which acts on the principle of a "wavetrap" on the absorption principle. I refer to the tuned circuit embedded in a block of wax which has already been mentioned several times in this discussion.

It is a very simple method of tuning. I do not think there is such a thing on the market. If one of our manufacturing firms could make up such a little tuned circuit and guarantee it to be reasonably accurate, it would, I am sure, prove a very useful commodity for the experimenter and it could be quite cheap. I hope this will be dealt with in the manner I have suggested.

#### Mr. P. R. Coursey.

If one may mention the rather much discussed "block of wax," I should like to ask the author whether any correction was made for the temperature co-efficient of the articles inside that block, because both the inductance and certainly the condenser must change in value with the temperature, and unless the standard is used at one constant temperature, I do not know whether it would be of much value as a standard.

#### Mr. W. M. Holbeach.

I am wondering whether the author has noticed the apparent discrepancy between the wavelengths of B.B.C. stations as given out by the British Broadcasting Company, and those published by the National Physical Laboratory.

#### The President.

I should like to say that I was very glad Mr. Turner covered so wide a ground. He began with absolute measurement and went on to relative measurements. He evaded the controversy that always arises when absolute measurement is discussed, by not mentioning it, namely, we may measure either the period of a wave in absolute measure, in terms of mean solar seconds, or we may measure the length of the wave in terms of the standard metre or the standard foot. The method of harmonics—the multi-vibrateur or similar method, uses the second of time as the principal or fundamental unit. Another man may measure the wavelength by Lecher wires and he would use the standard metre as the fundamental unit. To pass from one measurement to the other we have to know the velocity of the waves perfectly accurately. If we do not we cannot translate kilo-cycles into metres or metres into kilo-cycles; therefore people using these two systems of measurement would arrive at the conclusion that the thing they had measured had two values very nearly alike, but not quite the same. This is because we do not know the velocity of the waves in each particular instance precisely enough. Another thing I was delighted to hear the author go into was the use of harmonics for calibrating wavemeters, for the reason principally that amateurs will now have to take up seriously the very short wavelengths of, say, 10 metres or 5 metres. This does seem possible, in the first place, because those who want to use 90 metres or 100 metres commercially will begin to drive the amateur off that range. That is one reason; that is the human reason. The other reason is that the 10-metre waves are probably going to prove better for amateurs than the 100 metres. It seems that as soon as the amateur is turned out of one territory into another he begins

to demonstrate that he is in a better Eldorado than anybody anticipated. It seems that at 10 metres there will be no fading, no atmospheric disturbances,

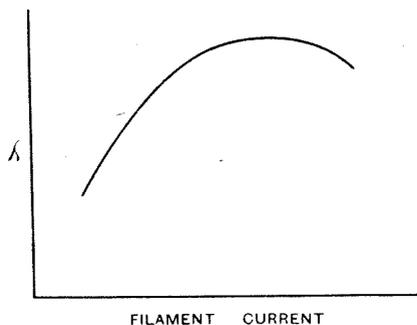


Fig. 2. A curve showing the variation of wavelength with filament current.

and that distances ranging to the Antipodes will be more easily covered than with 100 metres. Mr. Turner's suggestions of the use of harmonics for calibrating wavemeters are very appropriate at this juncture from that point of view. I should like to support the speaker who suggested that manufacturers ought to stock wavelengths; pieces of wire and sheets of copper fixed in some way that would not vary too much with temperature or with abuse and could be relied on to a reasonable degree of accuracy, and I hope the manufacturers will turn their attention to it. The other thing that has arisen during the discussion rather than during the paper is the degree of accuracy that a triode oscillator ought to achieve in the way of wavelength. I think you will find in a paper by Dr. Vincent and myself, read before the Royal Society in 1919, a description of how wavelength varies with filament current, *i.e.*, with emission, and with anode voltage. If we plot a curve with filament current as abscissae and wavelength as ordinates we get a curve like this (Fig. 2). If the coupling is not too close we always get a level part. If the filament current is kept at that level part, slight variations in filament voltage, through the running down of batteries, matter not at all and the variations in an ordinary battery are so slight that in practice it can run for an hour and the wavelength does not alter more than one part in 100,000, using an ordinary commercial triode. Moreover, if we measure the emission by putting a milliammeter in the plate circuit, we can substitute another triode, get the same emission, then vary the filament current until at the maximum point of the curve (Fig. 2), and correct the emission again; the wavelength will then be very nearly the same to a high order of accuracy. One can use this knowledge of the variation of wavelength with filament current and anode voltage to save the use of the numerous meters which Mr. Phillips introduced and which cost quite a considerable sum of money.

Mr. Turner, replying to the discussion, said:—

Mr. Phillips has spoken of the cracking of the wax of sealed condensers and coils, and several other people have referred to wax sealing. I am a

firm believer in wax, and I think there is no need for a block of wax to crack. If you use the proper mixture it will not crack; moreover, any wax may be poured in successive small quantities, time for solidification being given after each pouring. I have sealed many pieces of apparatus in this way, using generally ordinary paraffin, and have found the process quite satisfactory. Mr. Phillips spoke of a triode oscillator of great accuracy and constancy, obtained by taking special precautions—elaborate precautions—to keep the triode in the same condition. These precautions are of the sort I had in mind when I said the thing is not, in my opinion, a convenient every-day instrument.

Mr. Carpenter spoke of a milliammeter placed in the anode circuit of the oscillator, to take the place of the telephone in what I called the "click" method of observing resonance. I have used it often myself and I like it very much. It is closely akin to the "click" method, and is sometimes very much more convenient; and I do not see why it should not be at least as sensitive. As to the buzzer with two contacts, I am not sure. It is very nice if you can get a good buzzer with two contacts but it seems to me rather a difficult instrument to provide.

It is a good thing in principle to separate the driving contact from the exciting contact, but I am not sure that I understand its advantage as a means of obtaining a very small current. Generally you want a fairly good current to get enough power—it is about 0.2 amps. in this wavemeter, for example. I am alive to the fact that I might have reduced this current in order to avoid sparking trouble; and I did reduce it experimentally, but I got no improvement in decrement. I suspect that if I had reduced it by 100 times I should not have got any better decrement. It seems to be a poor contact, not a spark phenomenon.

Mr. Carpenter.

The point rather is this, that if you have a wavemeter consisting of a condenser, with unchangeable currents but varying L's and varying R's also, you have the thing running quite satisfactorily on a small coil and you have certain battery power. You change the coil of the buzzer and you have to find more dry cells to correct the thing by, and then you change back again. If you keep the two functions separate, you use one dry cell only. You have one contact which you adjust for working the buzzer and the other thing is separated out. The two things being separate, it is much more convenient in practice. Also, if you have one contact, that contact must interrupt the current through the shunted L of your coil and there may be a greater tendency to spark.

Mr. Turner.

There may be a great advantage, and in principle it is right; but from some cursory experiments I have referred to, the trouble in this case seems not to be spark trouble. I should be glad if Mr. Carpenter could quote decrement figures obtained with his buzzer.

Mr. Holbeach asked about interrupting the currents of a heterodyne wavemeter to make the oscillations audible. He asked what is the best method. The best method is to have an acoustic

valve oscillator and associate it with the H.F. oscillator in any way by which acoustic modulation of the H.F. amplitude is produced. If you use a buzzer, it does not matter where you put it, provided only that you do not excite the circuit under test by means of the buzzer directly. The buzzer must affect the oscillator and the oscillator must affect the circuit under test. There is such a variety of circuits that one must not generalise too carelessly, but I would put the buzzer in a place where it will not interrupt the anode current. I would let the buzzer short-circuit the reaction coil, or do something of that sort, rather than cut off the anode battery. The same speaker also asked what is the best buzzer. Years ago, when one was keenly interested in getting a good buzzer, I used to think of trying to design one; but I gave it up and lately I have not thought about it. I should say, however, that the type I have used here, the little tiny one which is so well known, is as good as any I have met. Then Mr. Holbeach asked about the Moullin voltmeter. It is really only a calibrated triode rectifier, working with negativated grid, and the current taken by it is negligible. The most important correction to be made for it is in regard to its capacity. You are adding another 10 micro-microfarads or so to the condenser across which you put it, and that may sometimes matter.

Mr. Hogg spoke about the difficulty of getting a good variable condenser. I sympathise with him very much. In this wavemeter I have avoided a variable condenser and have used a variable inductance instead. I do not think you can get a reliable variable condenser for precise measurements unless you are prepared to pay a large sum—not perhaps as much as he suggests, but £10 or more. The old Seibt condensers, now copied more or less by the Sterling people, I believe, were of beautiful workmanship and had a huge capacity for so small a space; but they are necessarily much upset by even very slight axial displacement because the air gap is so small. If you do not mind spending £10 or £20, and can allow bulk, you can get a thing whose calibration will be guaranteed, by a reputable maker, to stand constant to a fraction of one per cent. for a number of years.

Mr. Robinson spoke about heterodyning low-damped buzzer signals. That is an interesting point. A buzzer can be used in a practical way for receiving C.W. signals in the absence of a triode oscillator. It is quite a convenient thing to do. He also spoke of the use of a crystal for increasing the strength of high harmonics from a broadcasting station. It is an interesting suggestion, but I cannot offer any comment on it. I do not understand what was done. As the President has said, the measurement of very short waves is becoming more and more important, and any device such as Mr. Robinson has found satisfactory should be valuable.

Mr. Fogarty asked how I allow for the change of capacity of the various parts of the circuit due to the wax. What I do is to leave a little loop of wire standing up above the wax level, and bend it to make adjustments before giving the last dose of wax. It is not difficult to prepare a precisely adjusted sealed instrument in this way.

I thoroughly agree with Mr. Blake's suggestion that manufacturers should take up this question of selling wavelength standards and put on the

market simple and cheap units for the purpose. As to constancy, I do not know that I can quote evidence; but I may point out that the best standard condensers one can buy are wax-sealed mica condensers.

Mr. Coursey suggested that the temperature coefficient of the articles embedded in the wax would cause trouble. I do not quite understand what he means. The articles have a temperature coefficient whether they are waxed or not, and the position is no worse in the wax than outside it. If you consider the actual temperature coefficient of any substance, such as copper, I do not think the change of dimensions due to change of ordinary temperatures is going to matter. It all depends on what accuracy you are working to; for half per cent. I do not think the temperature effect need be thought of.

Mr. Holbeach asked whether I would recommend him to take the wavelengths supplied by the B.B.C. or the N.P.L. as correct. Personally, I should have no hesitation in taking the N.P.L. figures. I was enquiring about the accuracy of the B.B.C. advertised wavelengths recently, and was told that, while they are very constant from day to day, they are distinctly inaccurate. For that reason I have not used them for calibration purposes. It would be a great convenience if the accurate wavelengths could be stated.

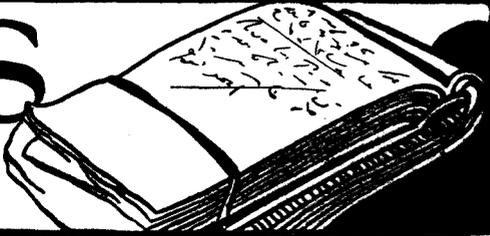
#### Mr. Reeves.

I have the pleasant task and the easy one of asking you to express our great appreciation of Mr. Turner's paper this evening. Like most of us here, I have made wavemeters of some sort or another for some time, but I have never so completely realised how essential it is to go for a higher degree of accuracy than I have hitherto done, particularly in view of the possibilities of shorter and shorter wavelengths being thrust upon us. I am sure therefore that the paper has come at a most opportune moment and I have very much pleasure in proposing that a very hearty vote of thanks be given to Mr. Turner for his paper.

#### Mr. C. F. Phillips.

It is a considerable pleasure to me to second this vote of thanks because it is a subject in which I have been interested for a considerable time and I do appreciate the very large amount of time which Mr. Turner must have given not only to the subject itself, but to the presentation of it to us this evening in such a very intelligible manner. When we have a scientist of Mr. Turner's standing coming to us and giving us a lecture upon so complicated a subject in such a simple manner, we must feel grateful to him. Very often one is apt to leave the lecture hall knowing little of what the lecturer has intended to convey and it is only later on, when one gets the printed paper, that a glimmering of what it is all about starts to dawn upon us. In this case, however, I think we have from Mr. Turner's lecture and diagrams learned as much as we shall learn later from the paper, through it being so particularly lucid. Therefore I will add my thanks to Mr. Reeves' and I have no doubt that you will be equally appreciative.

# NOTES & NEWS



The proposed chess match by amateur wireless between the Universities of Oxford and Harvard has been prohibited by the Postmaster-General.

\* \* \* \*

The Argentine amateur, Mr. J. C. Braggio, DA 8 (ex CB 8), reports the reception of signals from G 5 NN (Mr. J. Ridley, of South Norwood), on November 23rd.

\* \* \* \*

It is proposed to install broadcast receivers in the State-owned public houses of Carlisle.

\* \* \* \*

CNRA, the new broadcasting station of the Canadian National Railways at Monckton, New Brunswick, has been received at Bangor, County Down.

\* \* \* \*

The reception of time signals from Annapolis, Panama, Santiago; Nauen and other stations, is proving of great assistance in control surveys now

being conducted in the Mackenzie River District, Canada.

\* \* \* \*

A Presidential address will be given before the Radio Society of Great Britain on Wednesday, January 21st, when Sir Oliver Lodge, D.Sc., LL.D., F.R.S., will speak on "Matter and Radiation."

\* \* \* \*

### AN IRISH WIRELESS EXHIBITION.

The first Irish wireless exhibition to be held on a large scale, is to take place in Dublin, we understand, from February 23rd to 28th. Ample space will be provided both for amateur and commercial



Reproduced by courtesy of *Radio Electricite*.

*A recent photograph of the famous American inventor, Dr. Lee de Forest, who is seen operating a telephony transmitter on board the s.s. "Paris."*

displays, and it is expected that a prominent exhibit will be furnished by the Radio Association of Ireland.

#### AMBITIOUS PRIVATE RADIO STATION.

The Island of Anticosti, in the mouth of the St. Lawrence River, Canada, is being fitted with a wireless station under novel circumstances. The island, which is British, is wholly owned by M. Gaston Menier, the French chocolate manufacturer, whose object in installing wireless is to be able to "rule" his possession from his chateau in France.

#### DX WITH THE FAR EAST.

What is believed to be the first amateur two-way communication between England and Mesopotamia was established on Monday, December 8th, by Mr. J. H. D. Ridley (G 5 NN) and an amateur at Mosul, Iraq. The wavelength employed was 97 metres. 5 NN worked with an input power of 90 watts, while the Mosul amateur used 250 watts D.C. Communication was maintained for 2½ hours, a detector valve only being used at Mosul, whilst 5 NN employed a detector and note magnifier. The signal strength in both cases was in the neighbourhood of R 8, though the signals from Mosul were sometimes as strong as R 10.

As we go to press a report of similar communication with Mosul reaches us from Mr. E. J. Simmonds (2 OD) of Gerrard's Cross, Bucks.

#### FRENCH AMATEUR'S DAYLIGHT TRANSMISSIONS.

Remarkable results of tests with America on wavelengths between 35 and 48 metres are reported by M. Léon Deloy (8 AB), of Nice. The aim of these experimental transmissions was successful daylight communication, and recently M. Deloy's signals were heard in Hartford, Conn., at 1 p.m. (E.S.T.). The power used on this occasion at 8 AB was in the neighbourhood of 500 watts, a wavelength of 35 metres being employed. M. Deloy states that seven-tenths of the distance covered was in daylight, and claims that a record is thus set up for transatlantic amateur communication.

#### A MULLARD ANNIVERSARY.

On Tuesday, December 16th, the original male staff of the Mullard Radio Valve Co., Ltd., were entertained by the directorate to commemorate the fourth anniversary of their united efforts. During a pleasant evening's entertainment appropriate remarks were made by the managing director, Mr. S. R. Mullard, M.B.E., A.M.I.E.E., and Mr. C. F. Elwell, director, on the remarkable progress made by the company since its inception in 1920.

#### SUCCESSFUL DX WITH FINLAND.

Another British transmitter to effect two-way communication with Finland is Mr. G. L. Morrow (6 UV), of Berkhamsted, Herts, who successfully worked with Finnish 2 NCA, at 10.30 p.m. (G.M.T.) on December 13th. The operator of the Finnish station, Mr. Kairenius, of Helsinki, reported Mr. Morrow's signals as R 6 to R 7 on a single valve receiver, and communication was maintained for

nearly an hour. 6 UV's transmitter made use of the conventional reversed feed back circuit, the oscillator being an L.S. valve supplied with 300 volts D.C. During the communication referred to, which took place on 115 metres, the aerial ammeter at 6 UV recorded 0.40 of an ampere.

#### CHILEAN AMATEUR DESIRES TESTS.

Mr. Edmundo Guerara, of Casilla 69, Vileun, Chili, would be glad to arrange communication tests on short wavelengths with British amateurs. Mr. Guerara, whose call sign in CHEG, is carrying out improvements in his short wave transmitter, and would welcome transmission schedules from British amateurs who may be interested.

#### MARCONI D.E. 5 VALVE AS TRANSMITTER.

An interesting "low power" transmission to America was effected by Mr. D. B. Knock (6XG) on December 16th, when he established two-way communication with the American 1 BHM, using as "transmitting" valve a Marconi D.E.5. Good signals were reported by 1 BHM, and messages were exchanged on 102 metres. Unfortunately soon after contact had been established Mr. Knock's 12-volt accumulator supplying current to the M.L. anode converter began to run down, and communication was cut short. The actual input at 6XG was 10 watts, with a plate voltage of 500, yielding an aerial ammeter reading of 0.4 of an ampere.

#### THE WIRELESS ANNUAL.

So many and extensive are the ramifications of wireless to-day that the amateur frequently finds it difficult to keep in touch with all branches of this ever-growing science. The need of a handy and informative reference book is supplied in the shape of "The Wireless Annual for Amateurs and Experimenters for 1925."\* This book is valuable to the wireless enthusiast for the vast amount of useful data which it contains, but its value is still more enhanced by numerous articles on important subjects by writers of repute.

Among these is a fascinating contribution by Senatore Marconi, entitled "My Laboratories Ashore and Afloat," in which an historical account is given of the famous inventor's researches from his early experiments at Bologna, Italy, to the recent investigations on board the "Elettra."

Another absorbing article, by Dr. A. J. Fleming, F.R.S., deals with the early days of wireless research. Among the articles dealing with the latest developments of the science are "Broadcasting Microphones," by Captain H. J. Round, M.I.E.E., "The B.B.C. High Power Station," by Captain P. P. Eckersley, M.I.E.E., "Progress of Broadcasting in 1924," by Lord Gainford, "Time Signals," by W. G. W. Mitchell, B.Sc., and "Directional Aerials," by R. Keen, B.Eng. Other contributions of general interest include "Characteristic Valve Curves," by W. Sidney Barrell, explaining the basic principles of valve curve plotting, "Telephone Transmitters," by W. James, and a description, by Captain A. G. D. West, of the methods employed in special broadcast transmissions. Amateur progress

\*Published by the Wireless Press, Ltd., 12-13, Henrietta Street, London, W.C.2, pp. 192 + lvii. With 8 illustrations. Price 2s. 6d. nett. Postage 4d.

in 1924 is reviewed in an article from the pen of Mr. Hugh S. Pocock.

The reference section of the volume contains a fund of information relating to licence regulations, experimental transmitting stations in Great Britain and France, regular wireless transmissions, calibration waves, and useful data concerning components, radio symbols, and inductance and capacity calculations. Not the least useful section is the directory of manufacturers, and all amateurs and experimenters will derive benefit from the wireless atlas of the world, with which the volume concludes.

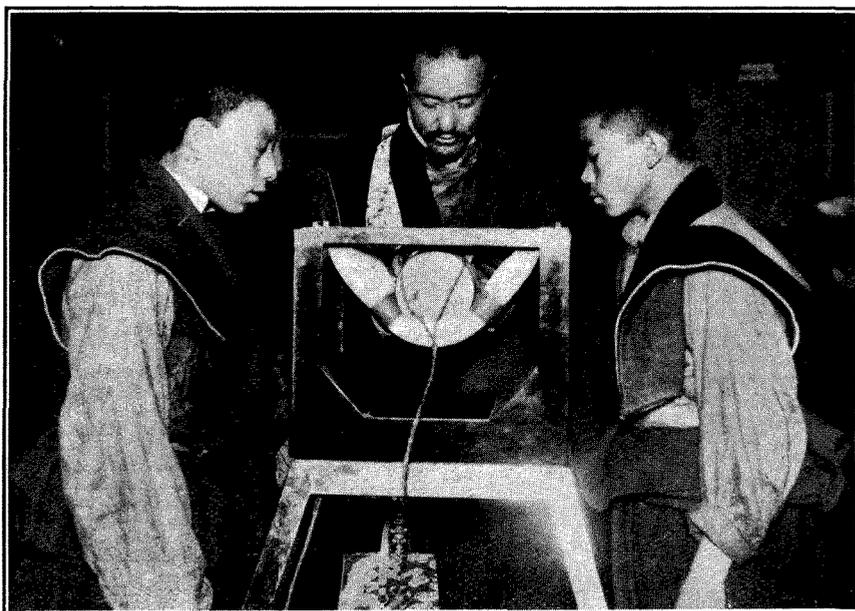
#### A QUESTION OF IDENTITY.

We regret that in the caption under the photograph appearing on page 179 of our issue of November 5th, which included portraits of Captain

M.A.R.S., Ltd., is Ashburton Road, Trafford Park, Manchester.

#### RADIO COMPASS FOR U.S. AIRMEN.

A successful attempt at straight flight in a fog with the aid of a radio compass has been carried out by the U.S. Army Air Service and Signal Corps. The pilot, Lieutenant George W. Goddard, chose a hazy day for the experiment, and decided to fly in the airway between Dayton, Ohio, and Moundsville, W. Virginia. Guided entirely by signals from the Radio towers at Dayton and Moundsville, he was able to fly in virtually a straight line. When he was on the straight course only dashes were transmitted from the two stations. On deviating to the left, however, the pilot was warned by a dash and a dot repeated at intervals of 10 seconds; similarly a dot and dash signal warned him of a deviation to the right.



*A number of Tibetan priests recently broadcast their native music from 2 LO. The photograph depicts three of the party investigating the mysteries of the microphone.*

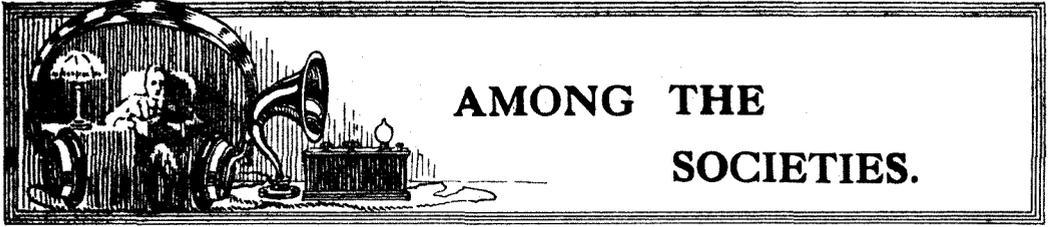
P. P. Eckersley and Mr. Arthur Lynch, a mistake occurred regarding the identity of the third member of the group. This gentleman is Mr. C. P. Edwards, Director of the Radiotelegraph Branch of the Department of Marine and Fisheries at Ottawa.

#### RUNBAKEN MAGNETO CO., LTD.

We have been advised that the Motor Accessories, Repairs and Spares, Ltd., has been formed to take over all the assets of the Runbaken Magneto Co., Ltd. The whole staff at the company's depots has either been retained or increased, and an improved service is assured for the supply of spare parts for magnetos, dynamos and batteries. The address of

#### BOOKS, ETC., RECEIVED.

- Measuring and Testing Instruments.** Technical Pamphlet for Workmen, issued by Post Office Engineering Department (London: H.M. Stationery Office, Adastral House, Kingsway. W.C.2. pp.24 + x. Price 6d. net.)
- Burndept Bulletin.** Vol. I, No. 1. A little publication for radio enthusiasts. (London: Burndept, Ltd., Aldine House, Bedford Street, Strand, W.C.2.)
- Recommendations for Regulations of Radio** adopted by third U.S. National Radio Conference, October 6th to 10th, 1924. (Washington: Government Printing Office. Price 5 cents.)



Several papers of interest have recently been given before the Sunderland Wireless and Scientific Society. The subjects covered have included "Condensers—Fixed and Variable," by Mr. Aldridge; "The Electron," by Mr. L. L. Ruderman, B.Sc.; and "An International Language for Radio," by Mr. Fairburn, of the Esperanto League. The Society has now been allotted a transmitting licence with the call sign 2 SN, and constructional work on the new transmitter is being actively proceeded with.

\* \* \* \*

In consequence of a considerable number of complaints of broadcast interference in the district, members of the Dulwich and District Wireless and Experimental Association recently carried out some interesting D.F. tests with two mobile stations. Frame aerials were employed, and a number of bearings were taken. The results of these investigations are not at present available.

\* \* \* \*

The first wireless exhibition in North Wales was recently held at Wrexham with great success under the auspices of the Wrexham and District Wireless Society. The attendance was unexpectedly large and fully justified the efforts of the manufacturers and amateurs who provided exhibits of apparatus and accessories. A feature of the event was the demonstration of loud speaker reception on a receiver constructed by a member of the Society. A number of interesting competitions were arranged, and prizewinners included Mr. R. N. Edwards, for the best crystal set, Mr. G. Eastwood, for a single-valve receiver, and Messrs. W. S. Featherstonehaugh, and C. Cathrall for multi-valve sets.

\* \* \* \*

The language difficulty in radio, and a guide to its solution, formed the subject of a lecture by Mr. Harold Bell before the Hackney and District Radio Society on December 15th. The lecturer dealt with some surprising facts concerning the growth of Esperanto, and referred to the large number of continental broadcasting stations which now transmit programmes and talks in this artificial tongue.

\* \* \* \*

On Friday, November 14th, an interesting paper on "Inductance and Capacity" was given by Mr. H. R. Prescott, A.R.S.M.,

## AMONG THE SOCIETIES.

B.Sc. (member), before the Radio Section of the West Bromwich Engineering Society. The paper was accompanied by a large number of practical experiments.

On Friday, December 19th, Mr. J. A. Cooper, Engineer-in-charge of the British Broadcasting Co., gave an instructive paper, dealing with the Birmingham Broadcasting Station. Mr. Cooper dealt with the history of "5 IT" dating back to November, 1922, when the station was situated at Witton. Some excellent lantern slides, showing the studio and the power plant, etc., were shown.

GENERAL POST OFFICE,

LONDON, E.C.1.

P.O. reference .....



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Sir (or Madam),

I am directed by the Postmaster General to say that under new licensing arrangements which will be introduced on the 1st January, 1925, the separate type of wireless receiving licence issued at Headquarters for experimental purposes will be abolished and one type of receiving licence only, available for all purposes, will be obtainable at any Post Office at which Money Order business is transacted. As the fees for existing experimental receiving licences fall due, it will be necessary under the new arrangements to obtain a licence of the new type. The new type of licence affords equal facilities to those enjoyed under the old form of experimental licence.

The period covered by the fee paid for the experimental licence in respect of your station at

expires on the last day of the current month, and if it is desired to maintain the station after that date, a receiving licence of the new issue should be obtained within fourteen days of the date of expiration. Such a licence can be obtained by application personally or by post to the Postmaster of..... or, if preferred, on application at the most convenient local Post Office.

Where a portable station is used, in addition to a fixed station, a second licence is necessary. If it is not desired to maintain the station, I am to ask you to be so good as to inform the Postmaster of..... to that effect as soon as possible, and say whether your apparatus has been dismantled.

I am,

Your obedient Servant,

H. N. BUNBURY,

Comptroller and Accountant General.

### THIS NOTICE SHOULD BE PRODUCED AT THE TIME OF PAYMENT.

Cheques should be made payable to "The Postmaster General or Bearer" and crossed "a/c H.M. Postmaster General." Money Orders and Postal Orders should be made payable to the Postmaster General and crossed like cheques. Treasury Notes should only be sent in a registered letter.

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*An interesting circular which has been received by holders of receiving licences. This circular, which sounds the knell of the Experimental Licence, is discussed under Radio Topics in this issue.*

# READERS PROBLEMS

*Readers desiring to consult the "Wireless World" Information Dept. should make use of the coupon to be found in the advertisement pages.*

## EFFICIENCY OF "SPADE" TUNING AND SCREENING PLATES.

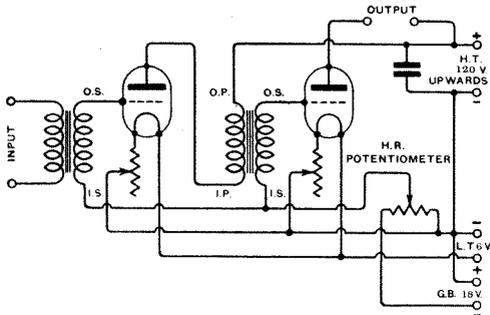
A CORRESPONDENT writes criticising the placing of metal screening plates at the back of the panel of wireless receivers, in order to avoid hand capacity effects, owing to losses by eddy currents set up in the plate. Another correspondent writes condemning the growing practice of using "spade" tuning as being technically bad practice for similar reasons.

Experience has shown very conclusively, however, that provided a metal of high conductivity is used for the "spade" tuner or screening plate, as the case may be, the losses due to high frequency eddy currents of small amplitude are negligible.

It is this fact that has made possible the use of this form of tuning, which is coming more and more into favour both with manufacturers and home constructors.

## A DISTORTIONLESS POWER AMPLIFIER.

WE give below a diagram of a distortionless power amplifier designed to give maximum amplification and minimum distortion.



A power amplifier giving high quality reproduction.

The transformer method of coupling is used, and provided that transformers and valves are correctly chosen, and that correct values of filament current, anode voltage, and grid bias are used, the quality of reproduction will fall very little short of the best type of resistance-coupled amplifier without the attendant high anode voltage and loss of amplification peculiar to this instrument.

If the amplifier is intended to follow a valve receiver employing ordinary general purpose valves, the first transformer should be of the 2.7 to 1 type, but if a D.E.5 type of valve is used as a detector, or the amplifier is designed to follow a crystal set, a 4 to 1 ratio may be used. A higher ratio is not recommended in any case. The valves used should, of course, be power amplifiers, and can be either of the D.E.5 or the L.S.5 type.

If the former, a 4 to 1 transformer is recommended, although a 6 to 1 ratio can be used if one is prepared to sacrifice a certain amount of quality. A 4 to 1 ratio, however, is recommended for best results, but with valves of the L.S.5 type a 6 to 1 ratio is permissible. With regard to correct anode voltage and grid bias, a suitable table is given below:

D.E.5 and similar types.		L.S.5 Type.	
Anode Voltage.	Neg. Grid Volts.	Anode Voltage.	Neg. Grid Volts.
80	2 to 3	120	8—9
100	3 to 4	150	9—10
120	4 to 5	200	11—12
		250	13—14
		300	15—16
		350	18—19

The 120 volt value will be found to give best results.

120 or 150 volts on the anode is quite sufficient for normal working.

## THE THERMOFORMER.

WE have received a large number of enquiries from readers regarding the "Thermoformer," concerning which an article appeared in a recent issue. Most of the enquiries are concerning its practicability, and whether it is entirely suitable for supplying L.T. or H.T. for valves from A.C. mains or from D.C. mains in cases where a persistent commutator ripple is known to exist. Readers also desire to know where this instrument can be purchased in this country.

Owing to the principle of operation of this instrument, it should be entirely suitable for operating off D.C. or A.C. mains. It should be distinctly understood that the instrument embodies

two distinct electrical circuits with no connection between them, and the house lighting mains are never at any time in electrical contact with the receiver circuits; the lighting mains are used to supply energy, not as electricity, but in the form of heat, and in this transference of energy all commutator ripples, etc., naturally disappear.

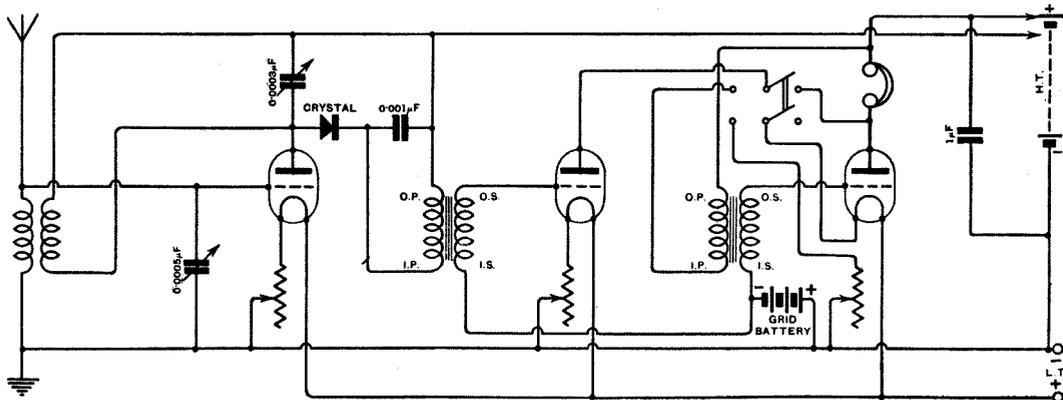
There are many advertisements appearing at the present time in American radio periodicals, in which cabinet sets of the more expensive type are advertised as operating from the house lighting circuits by means of this instrument, which is built into the receiver cabinet, a length of flex and an adaptor being provided for connection to the lamp socket. Both L.T. and H.T. of varying values, suitable for the different valves in the receiver, and also grid bias, are derived from this instrument.

So far as we are aware, no agents have yet been appointed to handle this product in this country, and we recommend that all enquiries for further details of this instrument should be addressed to the manufacturers, whose head office address is as follows: The Sabin Electrical Products Corporation, 15 Warren Street, New York City, U.S.A.

be power valves such as the B.T.H., B.4, the D.E.5, or similar types in other makes. A suitable anode voltage for these valves is 120 volts, with 4 or 5 volts negative grid bias. The high frequency valve can, of course, be of the ordinary "R" type.

#### APERIODIC AERIAL COUPLINGS.

IT is very common practice in short wave receivers to use a tuned secondary circuit connected between grid and filament of the first valve, and to couple this tuned circuit to the aerial by means of a few turns of wire, wound over the secondary winding. The method has several advantages for short wavelengths. The number of adjustments is reduced, as it is no longer necessary to tune the aerial circuit, or to vary the coupling with the secondary circuit. In addition, a step-up of voltage is obtained, which would not be obtained if the receiver were directly coupled to the aerial. The signal strength obtained is perhaps not so great as would be obtained with two tuned circuits variably coupled together, but, owing to the



*A valve-crystal circuit giving good reproduction and ease of control.*

#### A VALVE-CRYSTAL CIRCUIT FOR PURE REPRODUCTION.

A READER desires to construct a set suitable for the reception of two or three B.B.C. stations, at least one being at good loud speaker strength. He desires that particular attention be paid to the elimination of distortion in the low frequency portion of the set, and specifies that a crystal must be used for rectification purposes, in order to assist in attaining the desired standard of purity.

We illustrate a suitable circuit above. The crystal rectifier is preceded by a stage of high frequency, using the tuned anode method of coupling, and a reaction effect is obtained by coupling the anode coil back on to the aerial coil. As a crystal is used for rectification there is no special need to employ a low ratio transformer in the first stage, and both transformers should be of 4 to 1 ratio. Both, however, should be of good make. The valves employed should preferably

simplification of the controls, far more stations are likely to be received.

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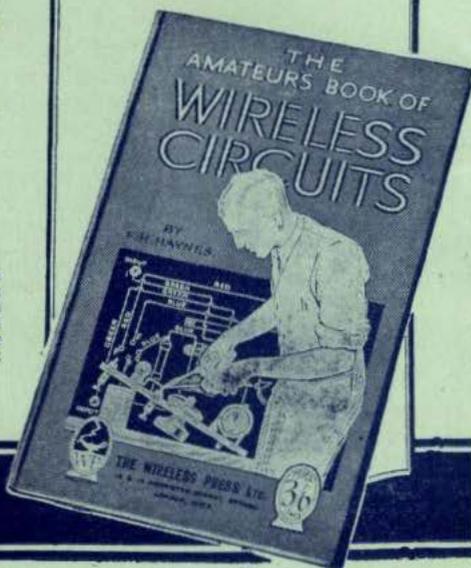
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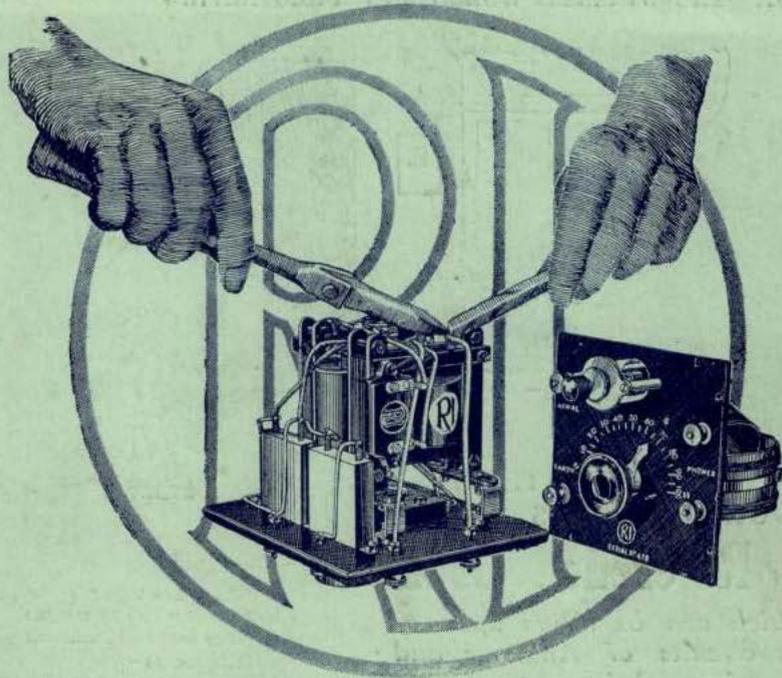


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