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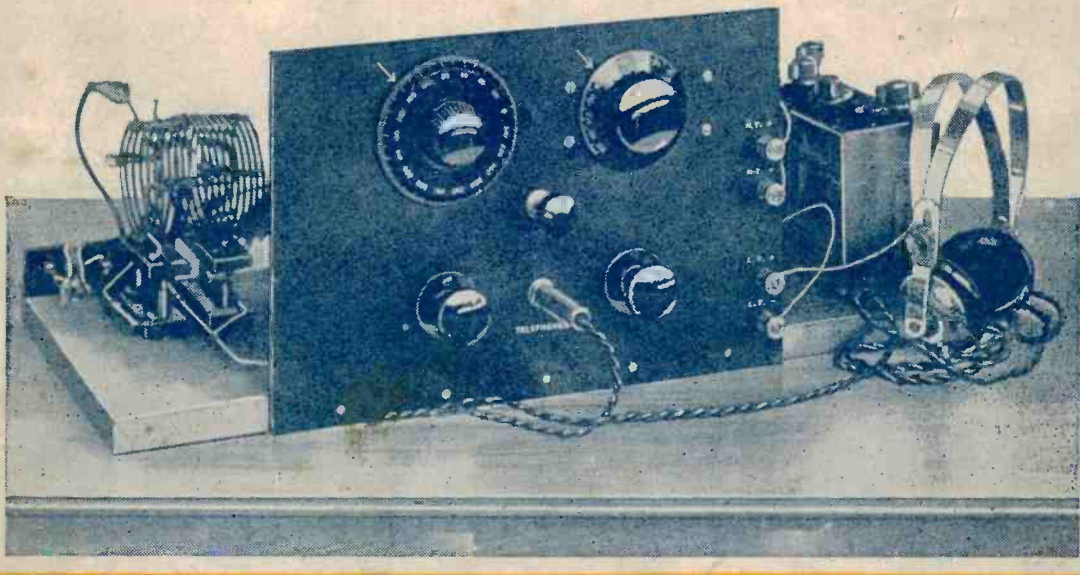
Wireless Weekly

Vol. 7. No. 3.

A SIMPLE SHORT-WAVE RECEIVER

By C. P. ALLINSON

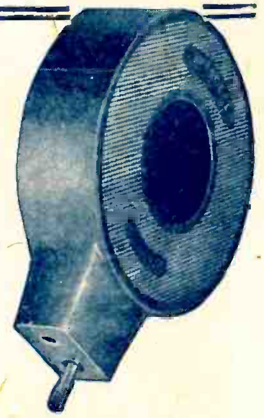


The new Burndept Coils

— *cover all waves from* **20 metres** *upwards*

— *are enclosed in special sealed containers*

—*fit all makes of tuners and coil holders*



IN the latest pattern Burndept Coils, several important changes have been made. Each Coil is enclosed in an hermetically sealed moulded container, on the outside of which the tuning range and number is indicated. The new Coils, which fit all standard makes of tuners and coil holders, are numbered to correspond with somewhat similar coils of other makes, and are all the same size externally: 4¼ in. long, 3⅜ in. wide, and 1-1/10 in. thick. As the Coils are perfectly protected from damp and dust, they will maintain their original high efficiency indefinitely. The complete set covers all waves from 20 to 22,000 metres.

Coils 3 to 20 are intended for ultra short waves—20 to 150 metres. They are wound with heavy gauge bare copper wire on Grade A ebonite formers; so-called "low-loss air-spaced" coils are *not* essential for successful short wave reception. Coils 3, 5, 10, 15 and 20, 5s. each.

Coils 25 to 60 are the famous Burndept Concert Coils, covering all waves from 150 to 800 metres. These coils which give unequalled signal strength and extraordinary clarity, each consist of a single-layer winding on Admiralty Paxolin formers. Coils 25, 35, 40, 50 and 60, 4s. 3d. each. Coils 75, 4s. 6d.

Coils 100 to 1,500 are the celebrated Burndept patent multi-layer coils, covering all waves from about 700 to 22,000 metres. Coil 100, 5s.; Coil 150, 6s.; Coil 200, 7s.; Coil 300, 8s.; Coil 400, 9s.; Coil 600, 10s.; Coil 1,000, 15s.; Coil 1,500, 17s. 6d. These Coils may also be purchased in sets, as follows:

No. 955.—For Broadcast Reception (200 to 800 metres). Set of four Concert Coils, 35, 50, 60 and 75, 16s.

No. 956.—For Long-Wave Reception (700 to 22,000 metres). Set of eight Coils, 100 to 1,500, £3 17s. 6d.

No. 957.—Complete set of nineteen Coils, covering all waves from 20 to 22,000 metres, £6.

The 1924-25 pattern Burndept Coils have been considerably reduced in price. Full particulars of these reductions will be sent free on request.

Full particulars of these new Coils are given in Burndept Publication No. 44, a copy of which will be sent to any reader of this journal on application. The Burndept Range includes everything for radio reception from components to complete installations. Build your set with Burndept Components and be sure of best results.

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Alarums and Excursions

CONSIDERABLE apprehension has been aroused by a statement which appeared in a daily paper recently to the effect that the British Broadcasting Company contemplated closing down certain of the relay stations to avoid interference with certain Continental stations. Hundreds of thousands of listeners in the neighbourhood of relay stations rely entirely upon crystal receivers, and it is therefore not surprising that consternation has been caused in thousands of homes by the possibility of their broadcasting service being cut off.

Wireless Weekly would be failing in its duty to the public if it were not closely observant of any proposed changes of this kind, and we can state at once that much of the fear expressed by numerous correspondents and inquirers is groundless. Although the British Broadcasting Company is considering the practicability of closing down certain relay stations, such steps will not be taken unless an equivalent service is immediately offered to the crystal user. To make this point clearer, let us imagine that, for example, the B.B.C. were to consider the closing down of the Plymouth Relay Station. At the present time crystal users in the Plymouth area are entirely dependent upon their local station for broadcast programmes. They are outside the range of Bournemouth or Cardiff. The British Broadcasting Company has on more than one occasion expressed the hope that it will be permitted to increase the power of its main stations, and therefore to increase their range. If it were permitted to increase the power of both Cardiff and Bournemouth to, say, 10 kilowatts (the power we believe they would like to use), Plymouth might conceivably come on the edge of the crystal range of both Bournemouth and Cardiff stations. In our opinion, however, this would not be a satisfactory service. It is therefore unlikely that the Plymouth station will be shut down. When, however, we come to consider other relay stations, such (to take a case at random) as Liverpool, a considerable increase in the power of the Manchester station might possibly give a crystal service in Liverpool equivalent to that of the present Liverpool station.

We understand that the British Broadcasting Company will in no case shut down a station without an equivalent service being provided to all present crystal users.

YOUR CRITICISMS!

On another page we publish a number of questions addressed to our readers, which we should much like them to answer. Such question forms have been a feature of Radio Press publications from time to time, and have enabled us to improve the journals in a number of directions. Only by maintaining an intimate contact with our readers can we give them the full service we are desirous of providing, and if they will kindly fill in the answers to these questions and forward the replies to us, we shall be greatly assisted in still further improving *Wireless Weekly*.

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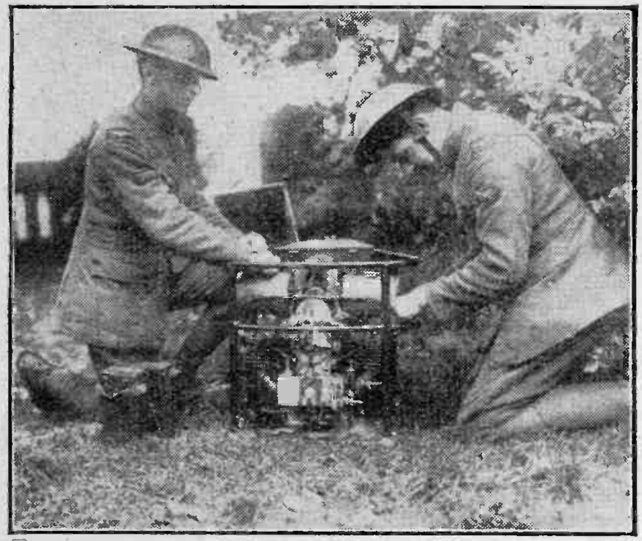
Edited by
JOHN SCOTT-TAGGART,
F. Inst. P., A.M.I.E.E.
October 7, Vol. 7, No. 3.

Wireless in the Army Manœuvres

By Major JAMES ROBINSON, D.Sc., Ph.D., F.Inst.P., Director of Research to Radio Press, Ltd.

In his article in our last week's issue on "Wireless in the Army Manœuvres" Dr. Robinson gave some general information relating to the organisation of and general methods employed by the wireless personnel of the R.A.F.



The twin-cylinder motor-cycle type of engine used for driving the generator for the transmitter used at a ground station.

Artillery Observation

ONE of the most important functions of wireless for modern war conditions is its use in spotting enemy guns or targets for our own guns. For this purpose there are special squadrons called Artillery Observation Squadrons. Each particular aeroplane is sent up to spot for a particular battery, and each Artillery Observation Squadron is given a special portion of the Front for this purpose. Depending on the density of the troops on both sides, there are more or less aeroplanes per mile of Front. Under certain circumstances the wireless receiving stations can be exceedingly close together, again depending on how close the batteries are together.

Reliable Information Essential

The information must be reliable, and if we have four aeroplanes on a mile of Front, it is obvious that there might be a considerable amount of jamming unless very special precautions are taken. Again, for a very wide Front, if the density of the batteries is very great, and if each battery has its observing aeroplane in action at the same time, there will be a tendency to considerable jamming, because each receiver will be able to hear not merely his own aeroplane but signals from aeroplanes some miles to his right and left.

Observation of Hostile Forces

On the other hand, it is absolutely essential to provide very reliable reception, because in case a particular aeroplane spots a target which should be immediately destroyed, such as a huge concentration of enemy troops, it is absolutely necessary that not only his own battery but every battery within gun range should hear him, and should thus be able to concentrate on this excellent target.

Importance of Selectivity

The problem thus becomes highly complicated. On the one hand there must be provided sufficient selectivity of some type so that each particular line of communication can be carried on—that is, that each battery can listen independently to its own aircraft—but, on the other hand, that there shall be so little selectivity that every battery within gun range of a good target should be able to hear any particular aeroplane.

Wireless in the Great War

In the last war this problem was solved, and exceptionally good results were obtained, so much so that the General Staff looked upon wireless as absolutely essential for artillery observation purposes. Spark transmission was made use of, with crystal reception on the ground. There was not a large range of wavelengths over the whole of the Front in France and Belgium, and, as there were many lines of communication required, it was necessary to employ the same wavelength for a flight of aeroplanes, and sometimes for two or more flights. Selectivity was obtained by using different notes on the same wavelength. This applied to neighbouring stations, so that each particular operator on the ground had to recognise the note of his own particular aeroplane, and to concentrate on this for ordinary shoots, but he had to be sufficiently wide awake to pick up any special call from any aeroplane within range.

Successful Methods

This was no easy matter, but our wireless operators on the ground became so good that an exceedingly small percentage of failures was recorded. The interesting fact emerged that it is possible for an operator

A small shelter tent is the only accommodation available for the wireless personnel under active service conditions.

In this concluding article will be found some interesting details concerning the apparatus used on aircraft and at ground stations, together with some indications of the problems involved in satisfactory communication in War.

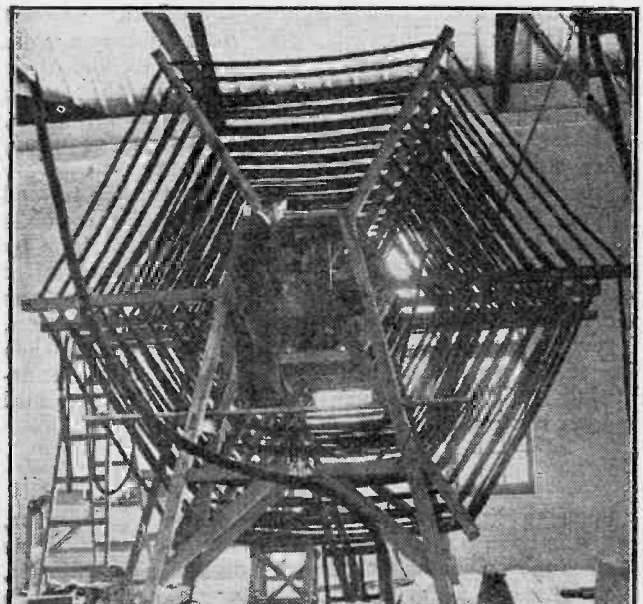
to concentrate on one particular signal when a number of signals can be heard, and to read this signal correctly.

Ground Stations

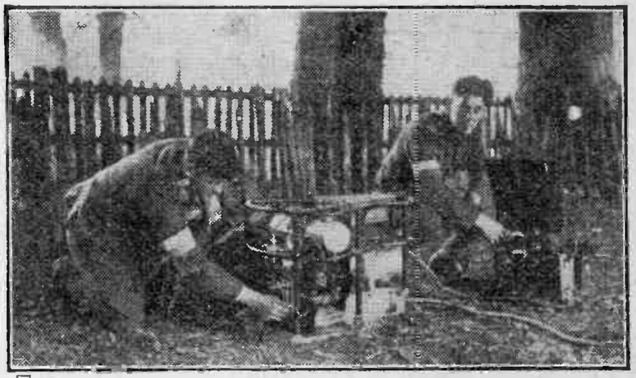
On the ground the organisation for reception is carried out by the Royal Air Force, and the operators are R.A.F. operators, the particular receiving stations naturally being attached to batteries of the Royal Artillery. In this respect the most important thing is that the receiving station on the ground should be self contained, and that it should not require replacements too often. In the last war crystal receivers were used, and these are ideal because they do not require replacements at frequent intervals.

Valve Apparatus

The use of valve sets is not easy for such stations, as they are liable to be broken, and as accumulators need recharging and as the high-tension batteries need replacing frequently. Thus the use of valve receivers at artillery observation reception stations is not an easy matter, but the Royal Air Force is trying out a system whereby the huge advantages of valve receivers are obtained, and whereby the disadvantages of the valve accessories have been overcome. The present manœuvres will have given a severe test to this form of receiver.



Some idea of the dimensions of the main inductance coil at the Hillmorton wireless station may be gathered from this photograph.



Another view of the engine and generator shown opposite, showing also the accumulator charging-board.

Apparatus in Aeroplanes

As regards the special transmitters in the aeroplanes, the transmission is done by an observer who is not necessarily a wireless expert. For this purpose he must be trained in Morse to a reasonable speed, and, further, it is necessary to arrange special codes which are simple and reliable. The wireless duties are performed by the Squadron Signal Officer, who is responsible for the functioning of all the apparatus in all the aeroplanes and for their correct wavelengths being used, which is by no means an easy matter, as the wavelengths are so close together.

Wavelengths

The wavelengths used are around 400 and 500 metres (750 and 600 kc.), and a trailing aerial is used on each aeroplane. A valve transmitter is made use of, the power being supplied by a wind-driven generator on the wing of the aeroplane. A trailing aerial of about 150 ft. is used. This form of aerial produces directional effects, and it is found that transmission is best when the aeroplane is flying towards the receiving station; thus an aeroplane in observing flies away from his station to the distance required, which may be six to ten miles, makes his observation, and turns round to fly back towards his station, when he sends his message and again turns round towards the enemy territory for another observation. In this way the observer of the aeroplane can direct the fire of his particular battery on to his special target.

Bombing Aircraft

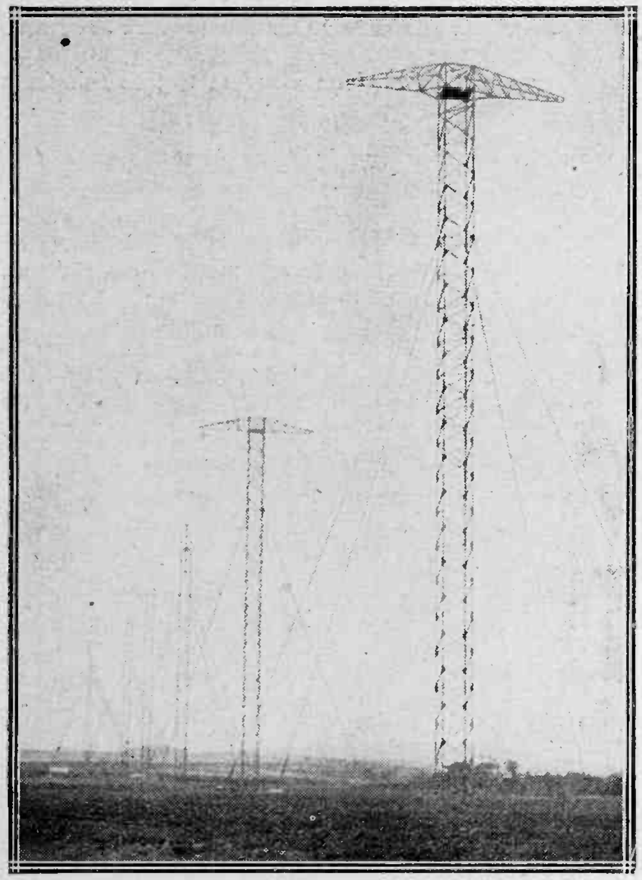
A very essential operation is the bombing of enemy territory. As is well known, this is carried out by the largest type of aeroplanes, which are capable of travelling some hundreds of miles. Their range is thus considerable, and may be up to six or seven hundred miles. During the last war the maximum range for efficient bombing was probably two hundred miles, but in the next war this range will be considerably increased.

Essential Lines of Communication

On such operations it is obvious that aeroplanes should act in consort for protective purposes, and also for obtaining more efficient results on any particular target. It is obvious that in such operations wireless must play a very important part. In the first place, such aircraft must be able to communicate with their base station. It is absolutely essential for them to be kept up to date with the latest information about the enemy, such as where defending enemy aircraft may be, etc.

Enemy Aircraft

Also it is of great importance that they should inform the base of any knowledge they obtain as regards the position of enemy aircraft. Thus it is essential to carry apparatus to operate over distances of a few hundred miles. For this purpose bombing aircraft are equipped with continuous wave transmission and reception apparatus such as that already described for reconnaissance aeroplanes.



Six of the ten masts to be used for supporting the aerial system at the Beam station at Bodmin, Cornwall, now being constructed by the Marconi Co. for communication with Canada and South Africa.

Internal Communications

Another function necessary is intercommunication inside a squadron. Such squadrons must act in unison, and they should be comparatively close together. This is necessary for protection, and also that the squadron leader should be able to control the dropping of bombs of each of his aircraft. For this purpose very short distance wireless is required. It is obvious that the form of wireless must be such that pilots of each aeroplane will understand immediately any orders from their commanding officer, and thus it is preferable to use telephony. This should be of such short range that it cannot be heard by the enemy, though in actual practice it is not easy to satisfy this condition.

Bombing Raids

Bombing aircraft must operate at such long distances from the base that they are likely to be attacked, and thus deviated from their course. It is quite probable in certain cases that they may be so deflected from their course that they are not absolutely certain of their position. With aircraft it is vital to know one's position. Even though an aeroplane may have so lost its position as not to have succeeded in its bombing operation, it is vital for the machine to get back to its base. It is thus obvious that Wireless will be greatly utilised on aircraft in enabling them to know where they are.

Wireless Navigation

Certain methods of Wireless Navigation are fairly well known. One method which is being used is for the aeroplane to transmit, and for the ground station to plot bearings, and determine from the bearings of various stations the actual position of the aeroplane. When this is done the ground station informs the aeroplane of its actual position. On bombing operations, of course, this system has the disadvantage that the enemy can also determine by Wireless where the attacking aeroplanes are.

"Wing-Coil" Installations

It is much better to determine one's position without the aeroplane having to transmit. Actually it is usually sufficient for the aeroplanes to be able to find their own bearings on their Home Station, so that when their operation is completed they can head for home, the Base Station transmitting for them as required, either continuously or for 2 or 3 minutes in every quarter of an hour. Equipment of this type is termed "Wing Coil" installation, the direction-finding coils actually being fitted to the wings of the aeroplane by the Robinson method. This system consists of a maximum coil in the fore and aft line of the aeroplane and of a minimum coil at right angles to this direction, a reversing switch being employed to indicate when the aeroplane is heading directly towards the transmitting station. Thus the pilot turns his aeroplane until he gets it on to its correct course for home.

Wireless Operators

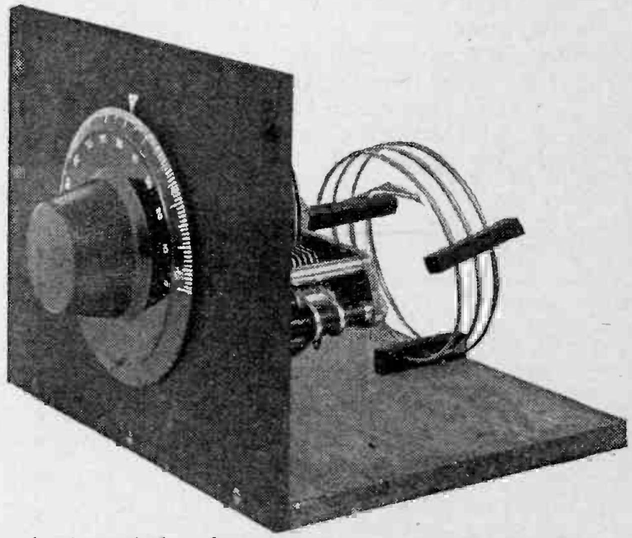
Such aircraft thus employ many forms of Wireless, and it is essential to carry a Wireless operator. Some of the operations must be done by the pilot himself, even though a Wireless operator is carried, such operations being the giving of orders to the other aeroplanes or receiving them, and also putting the machine on its correct course.

Some of the methods which have been tried out for Wireless communication during the manœuvres have been described. Sufficient examples have been given to show the complications of communication in the Services, and how efficient our Signal personnel must be. We can rest assured that out of the various systems tried, the best methods will be chosen by the senior officers who are in charge of the operations.

Calibrating a Short-Wave Absorption Wavemeter

By D. J. S. HARTT, B.Sc.

The accurate calibration of a wavemeter for wavelengths of 20 metres or less presents no great difficulty if the Lecher wire method of calibration is employed, as described in this article.



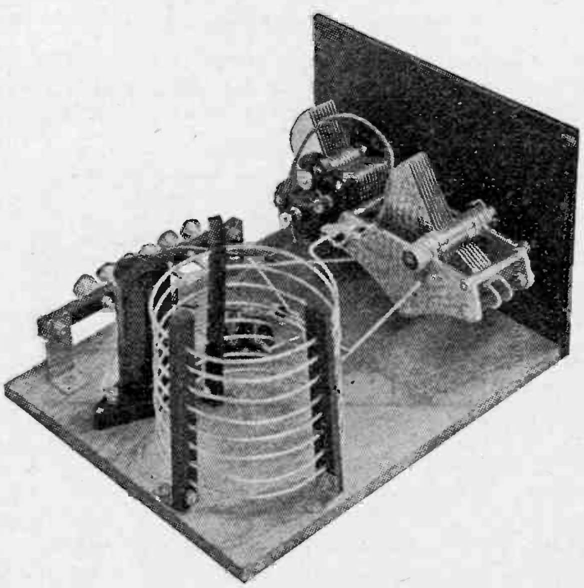
A view of the absorption wavemeter showing the method of mounting the bare wire coil.

AS our knowledge of the peculiarities of the short waves has increased, so it has become increasingly easy to construct and manipulate receivers to operate on these higher frequencies, and many an experimenter has proceeded so far and constructed a set which he has been able to make oscillate and at the same time control. Here, however, he encounters a difficulty; how is he to know on what wavelength he is operating?

On the broadcast and higher wavelengths it is a comparatively easy matter to determine the wavelength for any given adjustment of a receiver, and there are many accurate standards available for checking purposes. However the use of the ultra-high frequencies is modern practice, and experimental work has been largely confined to individual efforts, so that we do not find the same state of affairs existing here.

Working on Twenty Metres

We know that if a reliable design is *carefully* followed, say, for a 20-metre (14,991 kc.) receiver, and coils of a particular type and size with certain definite



The oscillator used in the experiment. The air-spaced coil is seen on the right with the R.F. choke on the left.

turn numbers are employed, we can be reasonably certain that the wavelength will be somewhere in the vicinity of 20 metres, but if one has not had any previous experience of operating on these frequencies nothing whatever may be tuned in until the degree of sharpness of tuning is appreciated.

I do not wish to convey the impression that there is anything very difficult in working on these high frequencies, for this is not so, and, provided certain reasonable precautions are observed, matters are perfectly simple.

Effects of High Frequencies

The essential thing to remember is that high-frequency effects, which are less apparent on the broadcast band, are very much more marked when we increase the frequency and come to wavelengths between 15 and 30 metres (19,988 and 9,994 kc.). In this connection I would refer readers to my article on the restriction of tuning ranges in *Wireless Weekly*, Vol. 6, No. 20, and an article on the same subject in Vol. 7, No. 2. It is very disappointing to construct a short-wave receiver designed, say, for 20 metres (14,991 kc.), and to find that the lower limit of its wavelength range is only about 25 or 30 metres (11,993 or 9,994 kc.), simply because certain essential precautions in reducing various stray capacities have been neglected.

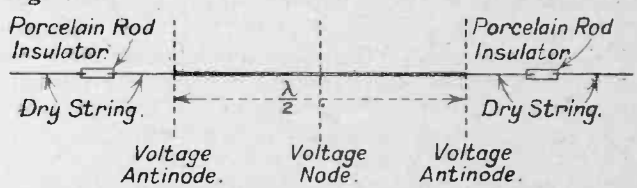
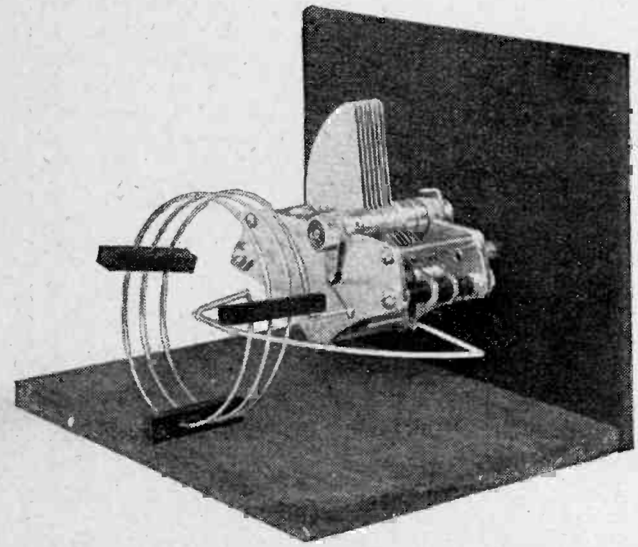


Fig. 1.—Illustrating the electrical characteristics of a single straight isolated wire oscillating electrically at the fundamental frequency.

Assuming, then, that such a receiver has been designed and made so that its tuning range does include, say, the 20-metre wavelength, what we want now is some *simple* and accurate means of calibrating it, or of calibrating a separate piece of apparatus (some form of wavemeter) which will enable us to tell with a fair degree of accuracy on what wavelength we are operating.

Assistance of NKF

Some great assistance to amateurs has been given in this direction by the United States Naval Station NKF, with whom *Wireless Weekly* are arranging a series of scheduled tests on various high frequencies, including the 20.8-metre wavelength. However, for those who are beginning this type of work, it is a somewhat haphazard way of calibrating one's set if the set has to be constructed and then one has to rely on picking up these signals on it for only one calibration point. An independent method, then, which can be employed at home and which demands no special or complicated apparatus is what is required.



This photograph shows clearly how the absorption wavemeter is constructed and wired up.

Calibration with Lecher Wire

It is a happy coincidence that, owing to the *shortness* of these waves, we are able to make use of the properties of stationary waves in stretched wires to help us over the difficulty we have been considering.

I refer here to the Lecher wire method of calibration. This, although striking for its simplicity, does not appear to be very widely used, but it is nevertheless capable of giving quite accurate results.

Erecting the Wire

The most simple arrangement is shown in Fig. 1. Here we have a tightly stretched single wire, well insulated with dry string, broken by two suitable porcelain insulators. When this is oscillating electrically at its fundamental frequency we have a voltage antinode at each end of the wire and a voltage node in the centre; the fundamental wavelength is then double that of the wire, or x (the length of the wire in metres) $= \frac{\lambda}{2}$

It is essential that the wire be well away from neighbouring objects, and for the purpose of these experiments it is best to arrange the wire out in the open air well above the ground, say, 5 or 6 feet.

The Absorption Wavemeter

I do not recommend you to calibrate the actual receiver. This may be convenient in some cases, but the receiver is somewhat susceptible to various changes which may render any such calibration inaccurate, and at the same time prevent any further experimental work being done on that particular receiver. It is much better to make use of a supplementary piece of apparatus, consisting simply of a suitable coil with a condenser connected across it, as shown in Fig. 3, which may be termed an absorption wavemeter. This may be made reasonably constant, calibrated and kept separately as a standard.

The method by means of which this calibration is carried out is as follows:—An oscillator, tuning over the calibration band, is required. This acts as a link between the Lecher wire and the absorption circuit, so that the final calibration of the latter is independent of any factors which may alter the constants of the oscillator.

The Oscillator

A suitable circuit for use as an oscillator is shown in Fig. 2. It uses the familiar circuit arrangement sometimes attributed to Reinartz, and a unit made up employing this circuit is shown in one of the accompanying photographs.

The coil is 4 in. in diameter, has eight turns of No. 14 S.W.G. bare copper wire spaced at $\frac{3}{8}$ in., and is supported on three ebonite strips, one end of each of which carries a small bracket to enable the coil to be secured to the baseboard. Several firms will make up coils of this description at a reasonable price to your specification. (The 8-turn coil shown was made by The Scientific Appliances, Ltd.)

Components

The other components used in the oscillator are one .0003 μF variable square-law condenser (Igranic), one .0003 μF do. (Collinson), one Burwood anti-capacity valve holder, one Lissen H.F. choke, six terminals, two Burndept clips, one 8 in. by 6 in. by $\frac{1}{4}$ in. panel, and a baseboard, 8 in. by 10 in. by $\frac{3}{8}$ in. The method of construction will be clear from the photographs.

Construction of Wavemeter

The absorption wavemeter consists of a .0003 μF variable square-law condenser (Igranic) and a three-turn, $3\frac{1}{2}$ in. diam. coil, with the turns of No. 14 bare copper wire and air-spaced at $\frac{3}{8}$ in. This coil should be made as *rigid* as possible; this is best done by drilling the holes in the ebonite strips for a tight fit on the wire, but this procedure makes matters somewhat difficult when the strips are threaded on to the

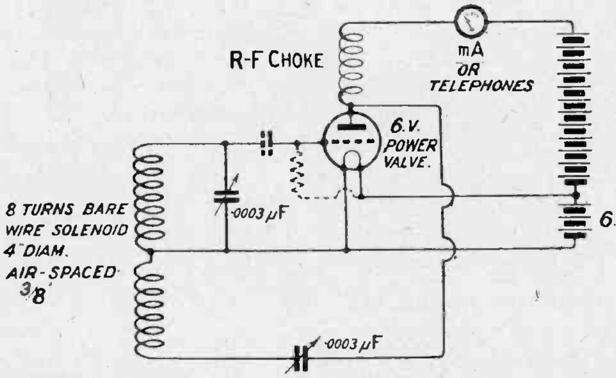


Fig. 2.—The inclusion of a grid condenser and leak, shown dotted in this diagram of the oscillator circuit, may in some cases be an advantage.

wire, unless one is possessed of a fair measure of patience. The completed coil is secured to the baseboard by two small brass woodscrews through one of the strips, and thick rigid connections are made from its ends to the soldering tags on the condenser.

Valves to Use

So much, then, for the constructional part; the method of calibration will now be discussed. First be sure that the oscillator does oscillate; preferably take it out into the open air, for I find that no 20-metre oscillator will oscillate in my receiving room, which contains much other wireless apparatus. A 6-volt power valve such as the B4, D.E.8, D.F.A. or similar type, is to be recommended; a filament resistance can then be dispensed with and the full 6 volts of the accumulator put on.

Indicator for Oscillation

Adjust the H.T. voltage until the set oscillates evenly over the whole range of the grid condenser; (for the following experiments I used 4 turns in the grid circuit and 4 turns for reaction; one Burndept clip was connected by a short length of flex to the end of the tuning condenser remote from the grid and the other to the end of the reaction condenser remote from the plate); a milliammeter in the anode circuit gives the surest indication of oscillation, by a sudden change of anode current when oscillation sets in.

Now measure off a 10-metre length of, say, No. 20 bare copper wire, stretch it taut, and suspend it as indicated in Fig. 1, about 5 or 6 feet above the ground. Only the smallest possible loops should be made at the ends of the wire where the string is attached.

Calibration

The oscillator is then set into the oscillating condition and brought near to the centre of the wire, so that the turns of the oscillator coil and the wire are in one plane. This, I think, is most conveniently done by

Fig. 3.—The circuit of the absorption wavemeter described.

having the oscillator, batteries, and milliammeter (if one is used) on a board, and lifting the whole into the desired position on some temporary support. Then rotate the grid condenser of the oscillator slowly, and note the position when oscillation stops. This will be shown by a sudden change in the anode current

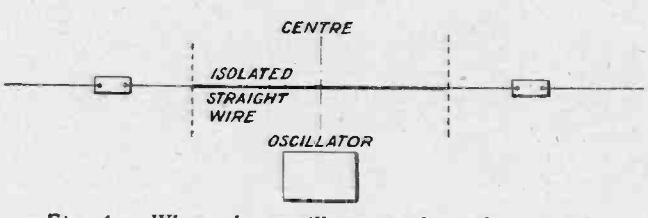


Fig. 4.—When the oscillator is brought near the centre of the isolated wire, it will stop oscillating at the fundamental frequency of the wire.

indicated on the milliammeter. If a sudden rise in anode current took place when oscillation started, the cessation of oscillation will be marked by a *sudden* decrease. Do not be misled here, for a slow change in anode current may take place as the grid condenser is rotated, on account of the varying intensity of the oscillations at different settings. On the higher range of the tuning condenser, for instance, the oscillations will generally be more feeble.

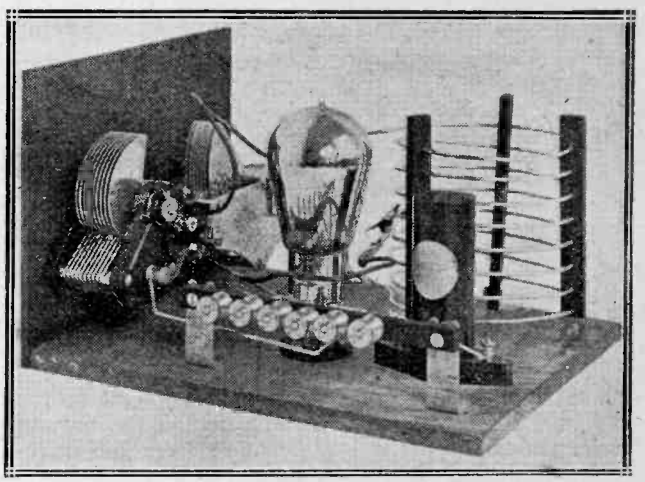
Telephones to Check Calibration

If a milliammeter is not available, a pair of telephones may be used in its place, and the point where oscillation ceases will be indicated by two clicks in the 'phones (if the condenser can be turned slowly enough), one when oscillation ceases and the other when it starts again after the point has been passed.

Usually, however, these clicks are only heard as one click as the point is passed, even when the condenser dial is carefully rotated. I need not emphasise the *necessity* for some form of extension handle in all this work, or some type of vernier dial on the condensers. Anyone who has experimented even on 50 or 60 metres (5,996 or 4,997 kc.) will have realised this.

Transferring to Wavemeter

When the particular point at which oscillation ceases has been found, the oscillator is tuned to 20 metres



The oscillator with valve inserted. All necessary connections are made to the terminals seen in the foreground.

(14,991 kc.) (*i.e.*, when a 10-metre wire is used as indicated). The oscillator is left at this adjustment and is then removed from the vicinity of the wire and the absorption wavemeter brought near to its coil. The condenser on the wavemeter is slowly rotated until the oscillator ceases to oscillate. This point is determined as before, either with a sensitive milliammeter or a pair of 'phones in the anode circuit of the oscillator. This then gives us one calibration point for the absorption wavemeter. Some form of indicator will be required for the latter, and the dial should be tightly secured to the spindle before any calibration is attempted.

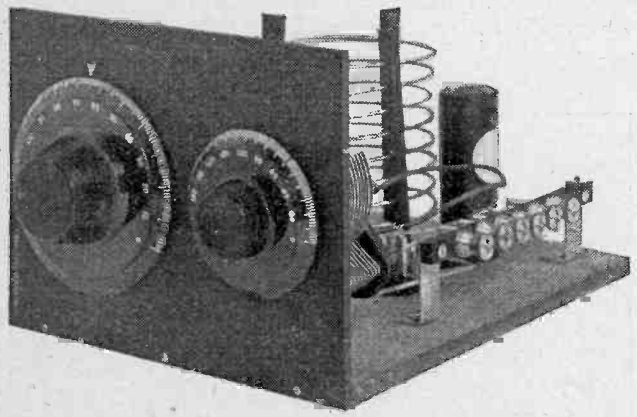
Calibration Curve

In a similar manner we can determine other points; a 7.5-metre wire will give us a 15-metre (19,988 kc.) point, a 12.5-metre wire a 25-metre (11,993 kc.) point, and so on. A complete calibration curve can therefore be plotted. The lowest point I actually plotted for the apparatus shown in the accompanying photographs was 15 metres (19,988 kc.); this occurred on 45 deg. of the wavemeter condenser (about 15 deg. on the oscillator); similarly the 20-metre (14,991 kc.) point was 56 deg. on the wavemeter and about 32 deg. on the oscillator.

Provided then that we use a good condenser and a rigid coil, we have a piece of calibrated apparatus which is not susceptible to any changes which will materially affect its calibration.

The Oscillator as a Receiver

By simply including a grid-leak and condenser of conventional values (shown dotted in Fig. 2) the oscillator can be used very successfully as an ultra-short-wave receiver. It may be desirable to experiment with different values of grid-leak to secure convenient control of oscillation, but the usual 2 megohms is satisfactory in most cases. An ordinary outdoor aerial may be used or a short vertical wire, loosely coupled to the oscillator inductance by means of a 2- or 3-turn coil connected between the aerial and the earth. This should be coupled just tightly enough to allow of free oscillation (if the coil is brought too near it may stop oscillation; a series condenser or loading coil in the earth lead is sometimes useful to detune the natural wavelength of the aerial system away from the wavelength on which it is desired to operate).



The two variable condensers are the only components mounted upon the panel of the oscillator.

Receiving NKF

When this has been done it is interesting to listen to one of the special tests from NKF on 20.8 metres (14,414 kc.), and when this has been tuned in, to leave the receiver in the oscillating condition, and bring the absorption circuit near and determine the corresponding point of tune on its condenser. The 20.8 metre (14,414 kc.) wave from NKF is guaranteed to be correct to at least 0.1 per cent., so this will provide an independent check on the Lecher wire calibration.

If the latter has been carried out in a confined space, it is quite conceivable that some error in the calibration may result, but if the more ideal open-air conditions are possible there is no reason why the calibration should not check up exactly with that from NKF.

Conclusions

It is thus seen that the method is very simple to work and demands only an extra coil and condenser and a few odds and ends over the ordinary ultra-short wave equipment, so there is really no reason why anyone who has made such a set should complain that he does not know "where he is." The noises from motor ignition systems are a convenient guide for wavelengths "somewhere near" 20 metres (14,991 kc.), but in this class of work some more precise calibration such as the above is needed.

A SCREWDRIVER TIP

A SCREWDRIVER, when purchased, will usually be found to be ground down so as to have a fairly sharp edge to the blade. This type of "chisel" edge may give considerable trouble when the screwdriver is used for the insertion or withdrawal of small screws, especially if these latter are at all stiff to turn. The blade will tend to jump out of the slot in the screw-head, so that the slot will gradually be cut away and the screw may become difficult to turn at all.

A Remedy

A suggested method of preventing the occurrence of this trouble is to alter the shape of the blade: this can usually be done with a file. The sharp edge of the blade is first filed down till it is quite blunt, about 1/32 in. of metal being removed. The edge should now be filed off quite square, particular care being taken to see that the corners are not burred over. The width of the edge of the blade should be such that it will just fit into the slot of a small screw.

It will often be found that, when a screw is to be inserted at an awkward point in a wireless receiver, it can be wedged on the blade of a screwdriver treated in this way, and in this way easily placed in the required position. A. V. D. H.

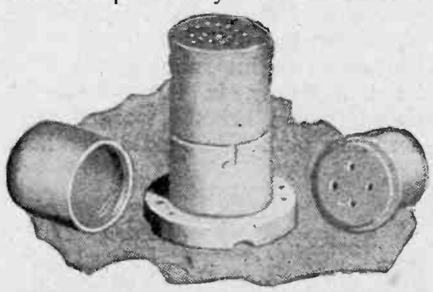
Sir Hamilton Harty, who conducted the Wireless Symphony Orchestra when they broadcast recently from the London Station.

Inventions and Developments

UNDER THIS HEADING MR J.H.REYNER,B.Sc.(Hons),A.C.G.I., D.I.C., OF THE RADIO PRESS LABORATORIES, WILL REVIEW FROM TIME TO TIME THE LATEST DEVELOPMENTS IN THE RADIO WORLD.

A Valve without a Glass Bulb

RECENT developments which have been made in the matter of the construction of receiving valves have all been in the direction of improving existing patterns of thermionic valves. That is to say, the valve is still made with comparatively small electrodes and is enclosed in a glass bulb, from which as much gas as possible is exhausted.



The valve inserted in an American type of valve holder.

Filament Construction

The biggest disadvantage of this system of construction lies in the fact that the filament, which is the most fragile portion of the whole unit, is not replaceable except at a cost very nearly as high as that of a new valve owing to the necessity for re-exhausting the bulb after the repair is effected. It is not surprising, therefore, that attempts have been made from time to time to depart from the existing type of construction, particularly in the case of transmitting valves, which cost several pounds each. If a satisfactory valve could be produced in which the filament were readily replaceable, then obviously the financial saving in a transmitting station would be considerable.

Little attention, however, appears to have been given to the question of receiving valves, and it would seem that we must continue to use the existing type of valve with its various defects. Certainly, the introduction of dull emitting filaments has rendered the life of a valve very considerably longer than of old, and this may have tended to discourage experimenters from producing any radically different pattern of valve.

A Vacuumless Valve

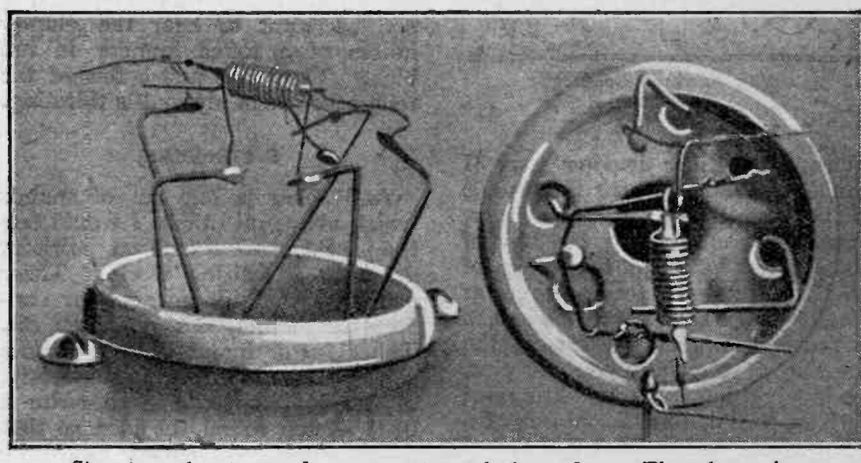
Mr. E. V. Myers in America, however, has tackled the problem with a fair amount of success, and he has actually produced a valve in which all the electrodes are exposed to air, and are simply enclosed in an insulating chamber to protect them from mechanical damage and draughts.

Two views of the valve are shown in the larger photograph, from which it will be seen that it is essentially the same in construction as the ordinary type of thermionic valve, except for the fact that the glass bulb is missing. The principal point of difference lies in the filament, made of a particular substance which, of course, is the patent of the inventor. In the particular valve shown in the photograph, this filament measures .035 of an inch in diameter (about the thickness of the lead in a pencil), and is about five-eighths of an inch long. It has a fairly high resistance, and is operated from 110 volts lighting mains, at which voltage it takes a current of about half an ampere. It is understood to run at a temperature of about 800 degrees Centigrade.

Characteristics

Actual details of the characteristics are not at present available, although one would certainly expect the valve to be somewhat soft. This, however, depends upon the nature of the emission from this new filament, and without further details it is impossible to make any reliable comment. Some figures are given from which it appears that the parameters of the valve are somewhat similar to those of the existing

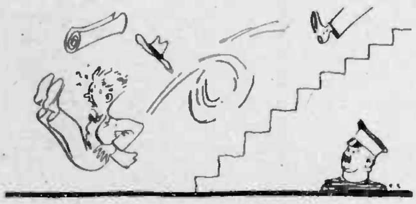
(*Continued on page* 85)



Showing the internal construction of the valve. The electrodes are arranged in the conventional manner.

Noises

EVERYONE has naturally his own views about the best kind of items in the broadcast programmes. Some adore sloppy songs, some those of the hale and hearty type; some bless entertainers, some cuss them; some delight in instrumental solos, some in orchestral pieces, some in news bulletins and some in topical talks. But my vote goes for none of these things. If there is one item in any programme that appeals to me more than all others it is one of those noise turns. We have had quite a number of them, as you will remember, but there can never be enough for me. We have had the sounds of a liner leaving port (I would have liked to hear the sounds on the same liner a few hours later, when she was crossing the Bay of Biscay); we have had the noises of the Zoo and of feeding-time at Wembley; we have heard the splash of the waves upon the beach, the chanting of pierrots upon the pier, the jug-jugging of the nightingale; we have heard, too, the noises of a coal strike—or was it a coalpit? I really forget which; and we have had the sounds that occur upon the foot-plate of an express engine.



. . . *Being bumped down the back stairs* . . .

In a Newspaper Office

Only the other day we heard something of the clatter that goes on in a newspaper office—I say "something" advisedly, for, if you will believe me who know, there was quite a lot that we did not hear. To our ears, for example, there came nothing of the moaning of the reporter whose beautiful two-column article has been cut down to three lines by a ruthless sub-editor. We did not hear the would-be poets being bumped down the backstairs, the editor's telephone conversation with a star contributor once more late in sending in his copy, or the office boy explaining that something came to pieces in his hand.

Suggestions

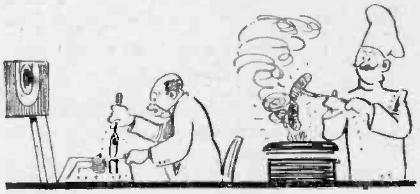
There are simply heaps of other noises that I am longing to hear. I want the B.B.C. to arrange a butter slide on the pavement of Savoy Hill and to place a microphone close by. I want to hear the battle cry of the slipper-limpet (this is the noisy noise that annoys) as it attacks the oyster in his little bed. I want to hear an expert tracing a fault in his wireless receiving set. I want to hear the gluggy noises of a toffee foundry in full blast. These are just a few of the things for which my soul is thirsting.

Set Building

And there is one set of sounds which above all others I would beg the B.B.C. to broadcast without delay to a waiting world. These are the sounds of an amateur constructor building his receiving set. Think for a few blissful moments what it would mean. Somebody, of course, would have to write a little sketch round the idea so that quite a cast of actors could be worked in as well as the wireless orchestra.

"Noises Off"

The most important actor, though, would not be the constructor himself, but the fellow responsible for the "noises off." You see these would have to be magnified a little in order to come through properly and sound like the real thing. For example, you would simply never hear the sounds of the harried constructor running his hands through his hair as he strove to draw a full-sized wiring diagram, unless they were emphasised a little. The best way, I think, to reproduce them would be to draw a stiff brush across a sheet of glass-paper. We should hear the pencil travelling over the drawing paper (the studio gramophone turned on with the needle on the blank middle part of a record). Then would come the sound of his rubbing out what he had drawn (a large lump of dough being briskly worked with a rolling pin). We should also hear



. . . *Sausages frying over hot flame* . . .

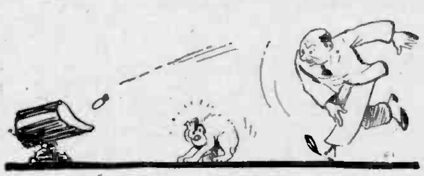
him say "tut." The scream of pain as he endeavoured to extract a recalcitrant drawing pin might be produced in the natural way. Then would come the marking out of the panel with the scriber (one file drawn over another). The natural voice could be relied upon once more for the proper exclamations when the constructor pricked his finger with the scriber or allowed the set square to slip. The sounds of centre punching would be helped out with the big drum, the actor himself making at intervals a noise like a hammered thumb. It is a little difficult to suggest a good way of bringing out in emphasised form the sounds of the breast drill, though a mowing machine run over the carpet might answer fairly well. Whilst the working of ebonite was in progress listeners would be requested to throw a piece of old motor tyre into the fire in order to get atmosphere.

Soldering

But the pièce de resistance of the whole show would, I think, be soldering. The constructor applies a dab of flux (an outsize in plaice is dropped on to a slab of slate). The flames of the gas ring are heard roaring (business with a knife machine); the constructor tests the heat of the iron by holding it to his cheek as he has seen professionals do (sausages fried over a hot flame; shrieks by the actor assisted by the clarionet and bassoon). He brings the point of the iron to the well-fluxed terminal (more sausages). Several lots of sausages will be required here, since the business of making the first joint always requires many minutes. Listeners will be requested to place more bits of motor tyre on the fire and to add to them some lard or gearbox grease.

Unstuck

The joint having been made, the triumphant cry of the constructor will be heard, changing rapidly into dismal woe as the wire comes away in his hands (sack of sheet-metal scrap thrown downstairs) when he pulls it. At about this point the expert friend enters and the constructor begs him to help. The expert friend does so at first in a verbal way only, and the constructor is heard tearing his hair (ripping of a sheet of American cloth), groaning (euphonium and bombardon), and saying "tut" (the actor himself) as he follows out the instructions. Presently the expert friend says, "Here, let me show you how to do it!" and now we hear the ill-suppressed cackles of the constructor and the still worse suppressed "tuts" of the expert



. . . Burnt-out valves hurtling through the air . . .

friend as he proceeds to give his practical demonstration. After prolonged frying, the expert friend says, "There now, I have shown you how to do it, and I am afraid that I must rush off to keep an urgent appointment."

Success

We next have a brief musical interlude by the orchestra, at the end of which the constructor sings—

"To work! to work! I must not linger
Until the job is done.
I've still got one good unburnt finger;
And who wants more than one?"

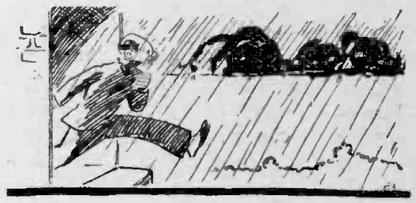
A few more sausages are fried, and then he announces that soldering is done and he is about to test out the fruits of his toil. We hear him attach the aerial, earth and battery leads (heavy ropes dragged across the floor of the studio, and business with ratchet brace).

Connecting Up

We also hear several piquant remarks about high - tension batteries, first of all when he endeavours to tighten down both H.T. leads at once with one hand on each terminal, and secondly, when he discovers by the well-known blue flash process that he has attached them inadvertently to the L.T. terminals. Next comes the sound of the burnt-out valves hurtling through the air and landing in the coal-scuttle (business with a sack of broken glass). At length he gets his connections as they should be and inserts four new valves into the holders. He switches on and moves the knobs of his condensers now this way, now that (a mincing machine filled with sand). This is all we hear. Otherwise there is a profound silence. At this moment his small son enters and suggests attaching the loud-speaker leads to the output terminals of the set. The lad is told not to be so silly and bustled out of the room. When he has gone the constructor adopts his advice.

Tuning In

Tuning now continues (squeaks, etc., provided by the violin, trombone and a battery of motor horns). The constructor says "tut" at frequent intervals. Meanwhile the wind is heard rising outside, and presently a loud crash tells us that the aerial has fallen through the greenhouse. We hear the constructor striding out into the night, disentangling the coils of wire, climbing a tree and refixing the free end. We also hear him descending the tree rather more quickly than he intended. He now comes within once more and gets down to it again. Presently an indistinct voice is heard coming from the loud-speaker. Prodigies of tuning are performed, half the instruments in the orchestra lending their aid to reproduce the screams, howls, roars, groans, chirps, yells and cat-calls; and then clear and distinct we hear the announcer's voice whilst the constructor heaves a sigh of relief (balloon motor tyre punctured by skewer). "This is 2LO," says the voice, "We are now



. . . Striding out into the night . . .

closing down for the night. Good-night everybody. Good-night."

I Leave it to Them

Well, anyhow, I have done my bit. I have made to the B.B.C. a present of this beautiful idea, and have even gone so far as to show them just how to carry it out successfully. If they adopt it, joy will be brought into the homes, stately and otherwise, of England on that night. I omit Scotland, since in Northern homes signs of joy will probably not be apparent until about lunch time the next day. If the B.B.C. does not adopt it, then, at all events, you cannot blame me.

WIRELESS WAYFARER.

SHORT-WAVE TRANSMISSION.

Anyone picking up the following message on 25 metres (11,993 kc.) is asked to send a report on the signals heard:—CQ de G5DH.—QRA, G.P.O. Radio Research Station, Dollis Hill, London.

This station transmits from about 4.30 to 5 a.m., G.M.T., and also may be heard calling CA at 9 p.m., G.M.T., daily.

Reports are also asked for on transmissions by G2OC, which station may be heard working on 23 metres (12,304 kc.). These reports may be sent to Capt. D. Sinclair at the Air Ministry.

Some Practical Insulation Tests

By A. JOHNSON-RANDALL, Staff Editor.

The importance of good insulation as a factor in the efficient operation of wireless apparatus hardly needs emphasising, and in this article some simple methods of testing insulation are described.

GOOD insulation is one of the most important factors in serious experimental work. Unless the insulation of all of the components in a wireless receiver or transmitter is of a high order, it is an absolute impossibility to collect accurate data upon which to base calculations if they are to have any real value in future work. In the case of the broadcast listener, the efficient working of his set depends upon the insulating properties of certain important components, and hence it should be his object, provided he desires to obtain the best results, to make sure that these parts are up to standard in this respect.

Possible Methods of Testing

Let us consider the methods of insulation testing available to the experimenter. Now the usual commercial practice is to use some form of high voltage testing machine, such as the well-known "Megger," and to make rapid tests between the important points in a circuit.

The "Megger."

These machines are simply small D.C. generators, capable of an output of 100-500 volts, and in some cases 1,000 volts, according to the particular type chosen. Two flexible leads from the Megger are attached to the test piece, and the handle of the instrument is turned at a constant speed of usually about 100 revolutions per minute. In many cases the machine has a "slipping clutch" arrangement, by

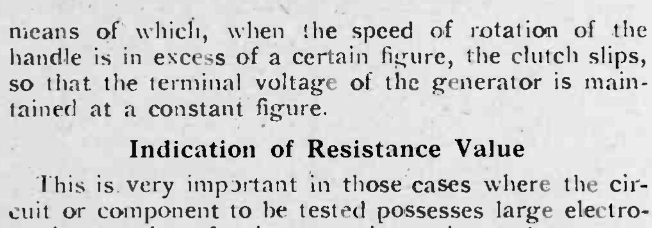


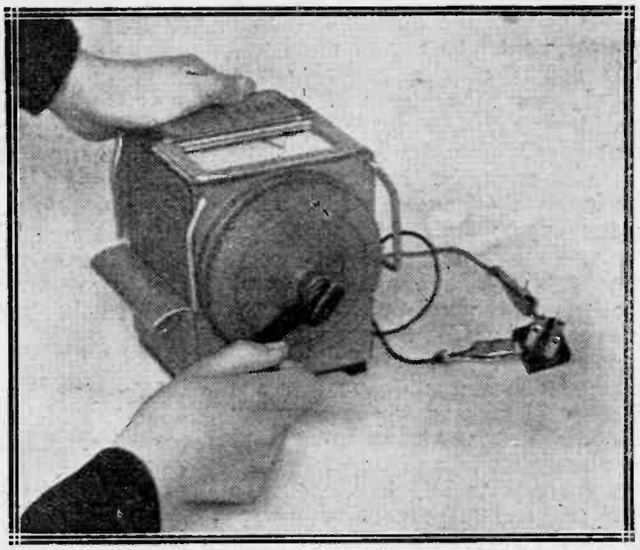
Fig. 1.—Leads from A and B are taken to the component whose leak resistance is to be tested, and a simple calculation from the readings on the meters will then give the value of this resistance.

means of which, when the speed of rotation of the handle is in excess of a certain figure, the clutch slips, so that the terminal voltage of the generator is maintained at a constant figure.

Indication of Resistance Value

This is very important in those cases where the circuit or component to be tested possesses large electrostatic capacity; for instance, in testing a large condenser it is essential that the terminal voltage of the generator should be absolutely constant.

The resistance of the article under test is indicated by a pointer and scale on the Megger, and should its



The instrument used by the author in making some of the insulation tests described is of the "Meg" type shown here.

resistance be too high to measure at that voltage the pointer will move across the scale to "Infinity," and the test piece may be assumed to be O.K.

Another Form of "Megger."

Within the last few years there have been placed upon the market small portable insulation testers at a price within the reach of many amateurs, whilst at the same time there are also a number of these still to be obtained from those firms who sell Government disposal goods. For example, the well-known makers of the "Megger" now supply a number of smaller and cheaper testers under the trade-mark "Meg." They may be obtained both with and without clutches, the latter being somewhat lower in price. My own insulation tester is one of these latter. The serious experimenter would do well to consider the very many possible uses of the various testers of this type upon the market before dismissing them from his mind as being beyond his means.

Alternative Method of Testing

The second method of insulation testing is to place a micro-ammeter in series with the component to be tested and a battery such as an H.T. unit (Fig. 1).

The leak resistance of the test piece at any given voltage can be measured by reading the current flowing in micro-amps., and calculating the resistance by Ohms Law.

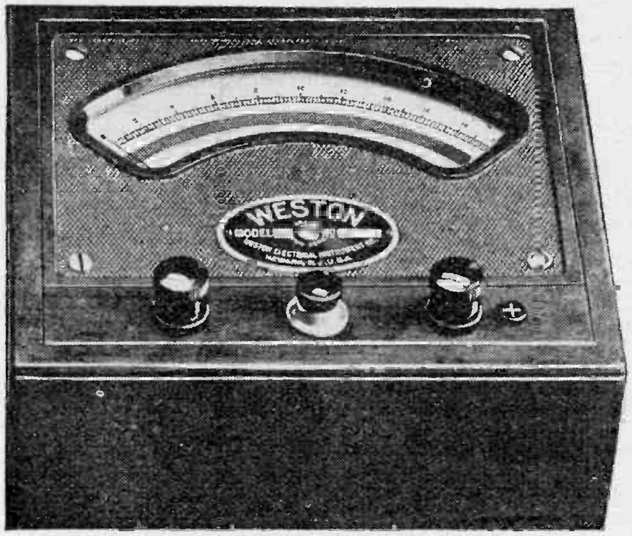
A Practical Example

For example, let us suppose that the particular test piece is a valve-holder, and that the flexible leads from A and B in Fig. 1 are joined to the grid leg and one of the filament legs.

Let the voltage between E and F be 100 and the current indicated by the micro-ammeter be 2 micro-amps. By Ohm's Law we have

$$R = \frac{E}{I} \text{ where}$$

R = resistance in ohms.
E = voltage across EF.
I = current in amps.



A typical micro-ammeter of well-known make, which may be used in conjunction with suitable apparatus for the accurate measurement of resistance values.

Then

$$R = \frac{100}{2 \times 10^{-6}} \text{ ohms} = \frac{100 \times 10^{6}}{2} = 50\text{M}\Omega$$

Therefore if the applied voltage is 100, a deflection of 1 micro-ampere will be equal to 100 megohms. If no deflection takes place the resistance of the test piece may be taken as infinity. This method of testing can be applied to condensers large or small, and is also useful for measuring the resistances of grid-leaks.

Precautions

It is a good plan to insert a limiting resistance in the micro-ammeter circuit, to avoid injury to the instrument in cases where the resistance of the test piece might be low. With a small micro-ammeter reading up to 50 micro-amps., a 2-megohm grid-leak in series would prevent injury to the instrument with 100 volts applied. This could be subtracted from the calculated resistance of the test piece, or neglected altogether in many cases, according to the magnitude of the leak.

A Further Test Method

Another method would be to use the test piece as a grid-leak in an oscillating valve circuit, but I do not propose to deal with this in detail in this short article, since the method requires careful investigation, and may form the subject of a separate article at some future date.

In all insulation measurement the experimenter should view the matter in the proper perspective, and separate those portions of the circuit where the insulation should be of a high order from those in which a moderate degree of insulation is all that is necessary.

Testing Components

Low-frequency transformers, for instance, should give " Infinity " when tested :—

(1) between windings.
(2) from primary to core.
(3) from secondary to core.

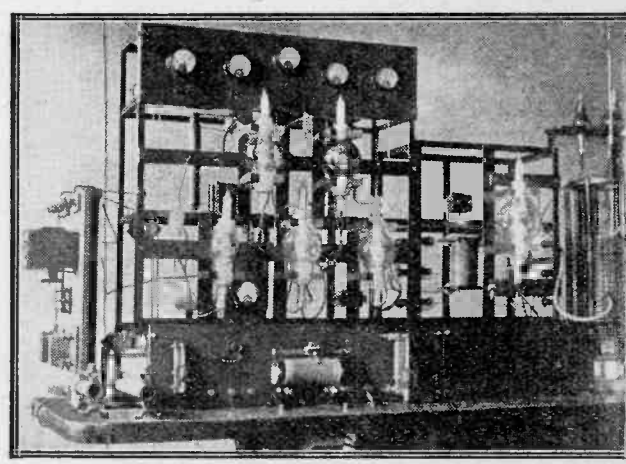
Infinity should also be obtained between the grid and filament legs of valve sockets, between the windings of H.F. transformers, the terminals of condensers and coil sockets, and also between any two points on an insulating panel, etc. On the other hand, it would be futile to aim at infinity in certain components which, when connected in circuit, are shunted by a comparatively low resistance.

A Point to Note

An adapter in my possession at the moment is made of an insulating material, which on test shows a resistance of about 50,000 ohms between the connecting lugs. In practice this adapter carries a resistance which is used to control filament current when a 6-volt accumulator is used with certain valves in place of another of 4 volts. This resistance, which has a value of a few ohms, is therefore connected across the two connecting lugs referred to, and a moment's thought will reveal the fact that a leak of 50,000 ohms in parallel with, say, 10 ohms is quite immaterial in practice.

Importance of Good Insulation

Going to the other extreme, however, I have also a 2 μF condenser, which on test shows an 80,000-ohm leak. The effect of employing this as an H.T. shunting condenser would be to draw from the H.T. battery a steady flow of current approximating to the load imposed on it by one valve, which would be a very undesirable state of affairs.



A view in the transmitting room at the Sheffield Broadcasting Station.

WE ASK FOR YOUR CRITICISM.

In Your Own Interest turn to Page 103 in this Issue.

High-Tension Battery Voltmeters

The use of an unsuitable type of meter for checking the voltage of a high-tension battery may cause serious damage to the cells, and the desirable features of the correct form of instrument to employ for this purpose are indicated in these notes.

THE other day I was shown by a friend a voltmeter which he had purchased for the purpose of testing high-tension batteries. Being of an economical turn of mind he had bought a very cheap one reading up to 120 volts, and was not very satisfied with the results obtained with it. The instrument, which was of foreign make, was of the moving iron pattern. He suggested trying it across my own high-tension battery to demonstrate that its readings were inaccurate. This offer I firmly declined, but went round with him to his house, taking with me a milliammeter.

Heavy Current Taken

When the voltmeter was placed across the extreme terminals of a 100-volt high-tension battery, the needle, after wild movements, finally settled down for a moment at about 60 volts. It then began to drop quite steadily down the scale. I wired my milliammeter in series with it to ascertain what amount of current it was passing, and was not surprised to find that this was in the neighbourhood of a quarter of an ampere.

Damage to Battery

It cannot be too strongly insisted upon that voltmeters of this kind are absolutely useless for obtaining readings of the plate battery voltage. What happens when they are used is that the battery is practically short-circuited. An enormous load is put upon it which causes its cells to become polarised rapidly, so that the voltage at once drops considerably. The battery itself suffers greatly during the process, and the application of such a voltmeter to it for even the few seconds necessary to allow its pointer to come to rest may take more out of it than weeks of actual working in connection with the receiving set.

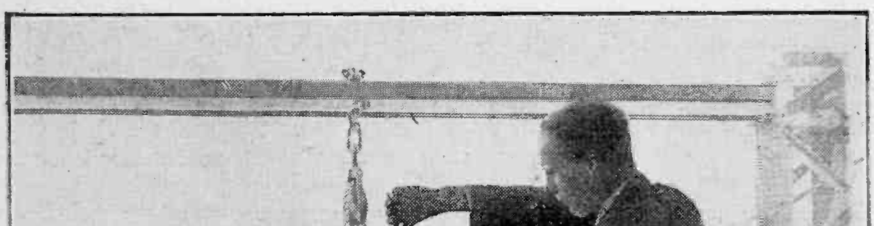
Instruments to Use

The only voltmeter suitable for use with high-tension batteries is a moving coil instrument of high resistance—the resistance should certainly not be less than 100 ohms per volt. These instruments are more expensive than those of the moving iron type, but the extra expenditure is well worth while since, besides giving accurate readings, they inflict no injury upon one's high-tension battery.

A Suitable Meter

A type which I have found very satisfactory for use with the wireless set is the double range pattern which gives readings from 0 to 6 and from 0 to 120 volts. My own instrument has a resistance of 900 ohms on the lower scale and 18,000 ohms on the higher. It thus passes a maximum of about 7 milliamperes of current, whether the accumulator or the high-tension battery is being tested. This load can certainly do no harm to the filament battery and it is not excessive even for a plate battery composed of small cells, since, owing to the deadbeat action of the pointer, readings can be taken almost instantaneously.

R. W. H.



Adjusting the aerial lead-in and insulator at the Government wireless station at Hillmorton, near Rugby, claimed to be the world's largest wireless station.

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An important WIRELESS DEVELOPMENT

Dear Sir or Madam,

The determination to supply wireless users with valves combining the utmost efficiency and reliability with the lowest possible running costs has resulted after the most painstaking research in the production of a complete range of wireless valves embodying the very latest improvements.

These valves, which are marketed by The General Electric Co. Ltd., will in future be sold under the name OSRAM—a name known to everyone in connection with electric lighting and one which has always been associated with sterling quality.

You may, therefore, have the assurance in purchasing an **OSRAM VALVE** that you will obtain the same high degree of satisfaction unfailingly given by **OSRAM** Lamps.

What the **OSRAM** Lamp is to light, the **OSRAM VALVE** is to wireless. It is the proved and universally trusted wireless valve.

Yours faithfully.

THE GENERAL ELECTRIC COMPANY LTD.

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Advt. of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C. 2

THINK IN KILOCYCLES

In a recent issue of "Wireless Weekly" it was notified that frequency equivalents in kilocycles would in future be given together with wavelengths in metres. It has now been decided to adopt the practice of referring to kilocycles in preference to metres, and the reasons for this development are given in the accompanying article.

A SHORT time ago it was pointed out in these columns (*Wireless Weekly*, Vol. 6, No. 17) that the use of frequencies rather than wavelengths was very much more scientific, and had much to recommend it. In view of these advantages, it was decided that the frequency nomenclature should be adopted generally by the Radio Press publications in order that a lead should be given to the radio world in general on this important subject.

Difficulties Involved

The change, however, from wavelength to frequency, although desirable, is one which will demand a certain diligent application in the early stages. We must become accustomed to thinking in terms of kilocycles rather than metres, referring (for instance) to 2LO as working on 838 kilocycles rather than 357 metres.

Accuracy

For the last few weeks we have been giving the kilocycles equivalent after wavelength figures, in order to prepare the ground for this change in nomenclature. These frequency figures, however, have been somewhat difficult to deal with for two reasons. In the first place, a round number in metres very often does not convert into an equally round figure in kilocycles. In the second place, the conversion tables which have been used are worked out on the accurate basis, assuming the velocity of propagation of the wave to be 2.9982×10^8 metres per second.

A Slight Alteration

The difference, however, between the kilocycles figures already stated and those on the basis of the more readily remembered 3×10^8 is only about 0.1 per cent., and in the majority of cases the frequencies employed are not accurate to this percentage. Hence the conversion of wavelengths to frequencies on such an accurate basis is both unnecessary and, in the present state of affairs, undesirable.

Convenience

The use of the approximate figure is in many ways more convenient. For example, 600 metres will be found to be 500 kilocycles, 300 metres is 1,000 kilocycles. In order, therefore, to assist our readers still further in this matter of speaking in frequencies, we shall in future give the frequency figure worked out on the approximate basis, and for a time we shall give the wavelength also in brackets. By this means we hope to familiarise our readers with the frequency nomenclature, and it will become common practice to speak of the 500 to 1,000 kilocycle band rather than the 300 to 600-metre band. It will readily be seen that the two terms are equally convenient.

A Possible Objection

It may be suggested that this action in adopting the approximate conversion is unscientific and undesirable. But the kilocycle nomenclature is bound to come, and the leading authorities in this country, in Europe and in America are all tending towards the adoption of the frequency basis. When this basis is finally adopted, then stations will be rated in terms of kilocycles, and the frequency will be adjusted to a round number of kilocycles.

Changes to be Expected

There is little to be gained by continuing to convert metres to kilocycles on the accurate basis in ordinary conversation, because when the change actually does come all the kilocycle figures will be rounded off into more or less integral values, so that we might just as well adopt these reasonable values at this stage of the proceedings. Many readers may find this change a little inconvenient at first. We have pointed out, however, that there are many advantages to be gained from the use of frequency, and, secondly, that the use of frequency is bound to come. A short table is appended giving the frequencies of the main British and Continental broadcasting stations. In the case of the British stations, the frequencies given are the actual frequencies as measured at our Elstree laboratories, and not those corresponding to the published wavelengths of the British Broadcasting Co., Ltd.

Frequencies of Broadcasting Stations.

The figures are given to the nearest kilocycle, and are arranged in order of frequency.

Station.	Call Sign.	Frequency kc.	Station.	Call Sign.	Frequency kc.
Eiffel Tower	FL	113 / 136	Newcastle	5NO	747
			Madrid	EAJ7	765
Amsterdam	PCFF	153	Bournemouth	6BM	782
Radio-Paris	SFR	168	Schenectady	WGY	789
Daventry	5XX	187	Manchester	2ZY	806
Konigswusterhausen	LP	231	London	2LO	838
Geneva	HB1	273	Cardiff	5WA	852
The Hague	PCGG	280	Leeds	2LS	867
Hilversum	HDO	283	Petit-Parisien	—	869
Lausanne	HB2	353	Plymouth	5PY	887
Prague	PRG	540	Hull	6KH	895
Berlin	—	594	Dundee	2DE	906
Aberdeen	2BD	606	Edinburgh	2EH	914
Swansea	5SX	620	Nottingham	5NG	920
Birmingham	5IT	628	Liverpool	6LV	952
Ecole Superieure ..	PTT	655	Bradford	2LS	967
Leipzig	—	660	Schenectady	WGY	970
Belfast	2BE	683	Stoke-on-Trent	6ST	981
Stockholm	SASA	702	Sheffield	6FL	996
Rome	IRO	705	Radio-Toulouse ..	—	1,091
Glasgow	5SC	706	Brussels	SBR	1,131
Munster	—	732	East Pittsburgh ..	KDKA	4,410

Ship and shore stations on 375, 500 and 666 kc. (spark).

A Use for Discharged Dry Batteries

Dry cells which have run down after giving good service are often thrown away as useless, since of course they cannot be recharged in the same manner as secondary cells. A method of giving a new and almost indefinite life to such cells is described in the accompanying article.

MANY ideas have been published from time to time for the utilisation of discharged dry cells. Most of these are found on trial to be unsatisfactory on account of the very temporary service rendered by the treated cells, the trouble taken to rejuvenate them usually not being worth while. Also, the current output is too small and dwindles too rapidly to be of any practical use for filament heating.

Low Cost

The treated cell here described does not suffer from any of these defects, and can be recharged as often as desired at a cost of less than 2d. each time. The voltage is just under 1.5, and the cell will deliver a steady current for hours at a stretch.

Causes of Failure

The chief reason for the failure of a treated cell is usually to be attributed not only to the method of treatment, but also to the construction of the cell itself. In the ordinary type of dry cell the centre carbon element is considerably smaller than its zinc container, to allow for the surrounding layer of impregnated plaster of Paris, as shown in Fig. 1. This results in a small current output, which is further reduced by the high resistance of the plaster layer, choked with the semi-insoluble waste product of the original charge.

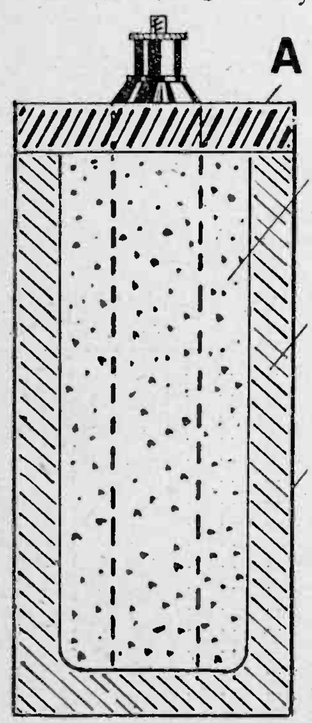
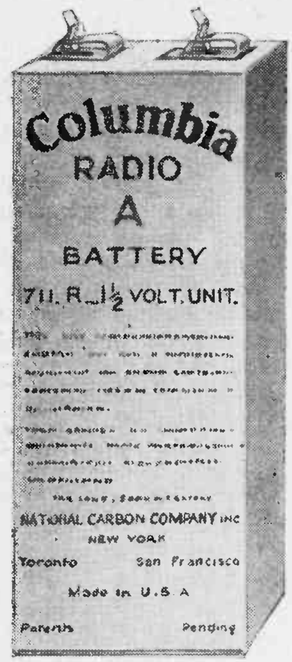


Fig. 1.—Here A is the sealing, B the carbon compound, C plaster of Paris, and D the zinc container.



A cell of the type described by the author as suitable for the treatment recommended.

Construction of Cell

Owing to the extensive use of dry batteries for filament heating, dry cells have been developed especially for this purpose. These are designed with regard to the necessity for a comparatively large and steady current output. This is achieved by constructing the cell on the lines indicated in Fig. 2. The zinc container is fairly large to commence with, and is entirely filled with the carbon compound, except for a thin layer of porous paper lining the case. The thickness of this layer has been exaggerated in the illustration for the sake of clearness; actually it will be found to be very little thicker than the zinc container.

Dismantling

This type of cell is particularly suitable for conversion into a wet battery, and as such it will give far superior results to the more conventional and old-fashioned porous pot Leclanche battery. Very little work is entailed in the process of conversion; the old zinc container, the sealing compound, and the paper must first be removed, taking care not to break the carbon compound block in so doing. Then soak the latter in cold water for a few hours, finally tying it round with a piece of rag or cloth, as illustrated in Fig. 3. A thin sock tied or sewn at the ankle, with the lower part cut off, makes a good sack for this purpose.

Re-assembly

A solution is now made up consisting of 3 or 4 ozs. of sal ammoniac to a pint of water. The sack is placed in a

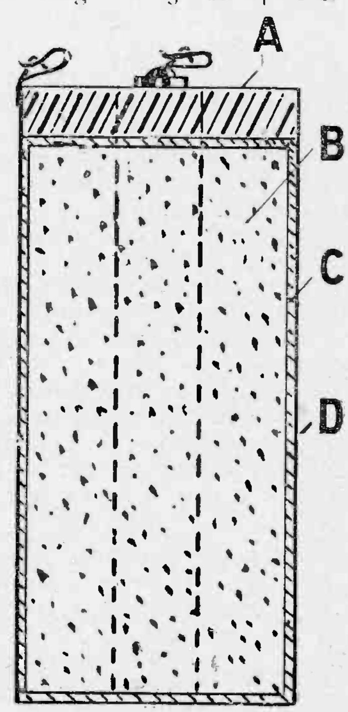


Fig. 2.—A similar type of cell to that shown in Fig. 1, in which C is a wrapping of porous paper.

large jam jar and enough solution poured in to cover it, leaving the carbon rod and terminal projecting. A piece of zinc will also need to be placed in the solution to form the negative element of the cell. For this purpose the old zinc may be

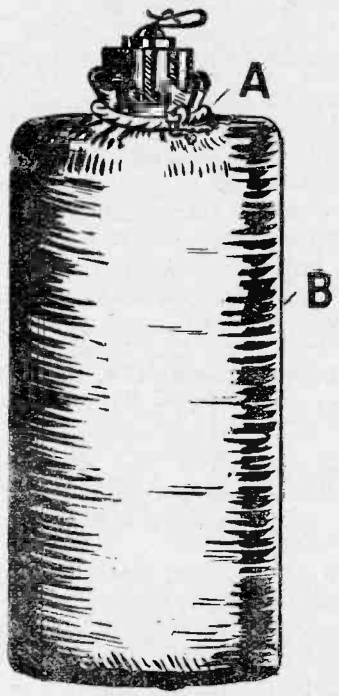


Fig. 3.—Showing how the carbon compound block may be tied up in a piece of cloth.

opened out and placed round the sack. This, though effective, is not, however, entirely satisfactory.

Local Action on Zinc

When the zinc is placed in the solution, what is known as "local action" takes place. Particles of impurities in the zinc set up minute electric currents, and it is thus eaten away by the same process as when the cell is actually in use. A better plan is to obtain a new zinc battery rod for a few pence and amalgamate it. After this, no action will take place except when the cell is working.

Amalgamation

When the rod has been in the solution for a few hours it will be found to be clean and bright. If it is now placed in contact with a globule of mercury the mercury will unite with it, and may be spread in an even coating all over the rod.

Advantages

This cell with an amalgamated zinc rod has an advantage over all other batteries and accumulators in the fact that it may be left unused for any length of time without deteriorating, and will immediately give its full voltage and current, with only the addition of sufficient water to make up for that lost by evaporation.

Suitable Cells

For the benefit of those who like to know the actual articles used in experiments, of which descriptions are given, it may be mentioned that the cells used by the writer were those known as "Columbia Radio A Batteries," but any cell of the new type will do for the purpose.

Discharge Current

One converted battery will supply current for a valve of the one-volt 0.25 amp. class for several weeks of average use. Two in series will light a valve of the .06 type for about two months at each charge.

INVENTIONS AND DEVELOPMENTS

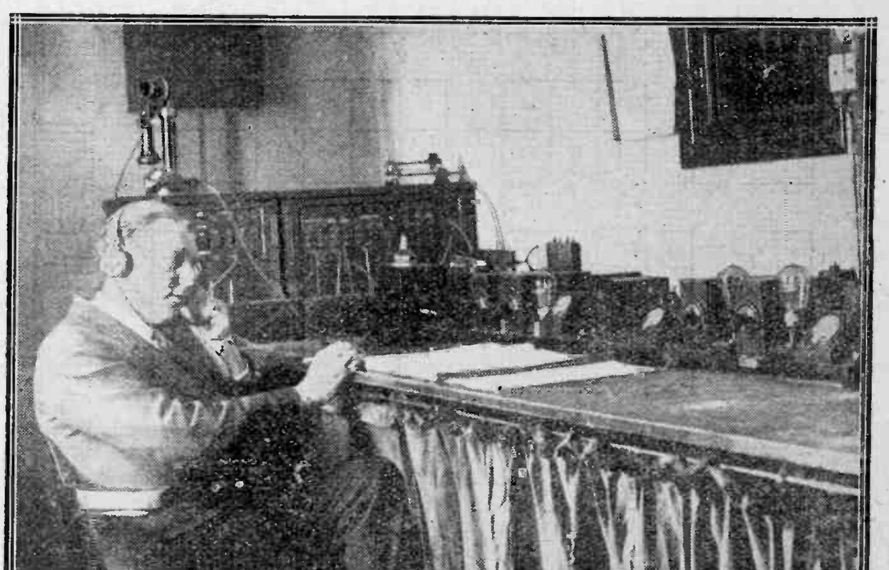
(Continued from page 77)

types. The anode to filament impedance is given as 65,000 ohms, and the amplification factor as 14. The grid to filament impedance is given as 4,000 ohms only. If this is correct it is, of course, a radical departure from the existing type of valve, in which the grid to filament impedance is nearer 400,000 ohms.

Reduced Cost

If this type of valve proves satisfactory in actual use (and it has certainly given every indication that it may do so), it will result in the complete elimination of the exhausting process in valve manufacture. Since the exhaustion of the ordinary type of valve accounts for something like 50 per cent. of the actual cost of manufacture, it will be seen that a very considerable reduction in the price of valves would result if this invention became generally used. The filament is reasonably robust, but even if it should be broken, it can easily be replaced by undoing two screws and inserting a fresh length.

The whole valve is mounted on a four-pin socket, which is made to fit the American valve holder, and is provided with a cover to shield it from draughts. The assembly of the complete valve in a valve-holder of the American type is shown in the smaller photograph.



In the control room of the Sheffield Broadcasting Station.

THE WIRELESS EXHIBITION

We give below a list of Exhibitors and Stand Nos. at the Wireless Exhibition being held at the Horticultural Hall from October 10 to 16, and a general plan of the hall showing the arrangement of the stands.

BERTRAM DAY & Co., LTD., 9, Charing Cross, S.W.1. (69).

BRANDES, LTD., 296, Regent Street, W.1. (34.)

BRETWOOD, LTD., 12–18, London Mews, Caple Street, W. (63),

BRIT. ENGIN. PRODUCTS Co., Windsor House, Victoria Street, S.W.1. (51).

BROWN, LTD., S. G., Victoria Road, North Acton, W. (9, 10, 11).

BULLER, W., 28, Holywell Lane, E.C.3. (13).

C. A. C., LTD., 10, Rangoon Street, E.C.3. (48, 49).

CASSELL & Co., LTD., La Belle Sauvage Yard, Ludgate Hill, E.C.4. (30).

CLEARTRON RADIO, LTD., 1, Charing Cross, S.W. (44).

COLLINSON PRECISION SCREW Co., LTD., Provost Works, Macdonald Road, Walthamstow, E.17. (62).

CURTIS, LTD., PETER, 75, Camden Road, N.W.1. (27, 28, 29).

ENERGO PRODUCTS, LTD., 2, Olivers Yard, E.C.1. (25, 26).

ENGINEERING WORKS, Thurlow Park Road, W. Dulwich, S.E. (70).

FELLOWS MAGNETO Co., LTD., Cumberland Place, N.W.10. (12, 17, 18, 23).

FINSTON MFG. Co., LTD., 2, Finsbury Ave., E.C.2. (61).

FORMO Co., Crown Works, Cricklewood, N.W.2. (71).

GRAHAM & Co., R. F., Norbiton Engineering Works, Kingston-on-Thames. (58).

HINDERLICH, A., 1, Lechmere Road, N.W.2. (3).

IGRANIC ELECTRIC Co., LTD., 149, Queen Victoria Street, E.C. (32, 33).

J. R. WIRELESS Co., 6–8, Rosebery Avenue, Clerkenwell, E.C. (7).

J. W. B. WIRELESS, LTD., 320a, Euston Road, N.W.1. (65, 66).

LOVELAND BROS. & SONS, Crescent Place Works, Norbury, S.W.16. (52).

LOWENADLER, F. W., Ely Place, Holborn Circus, E.C. (1).

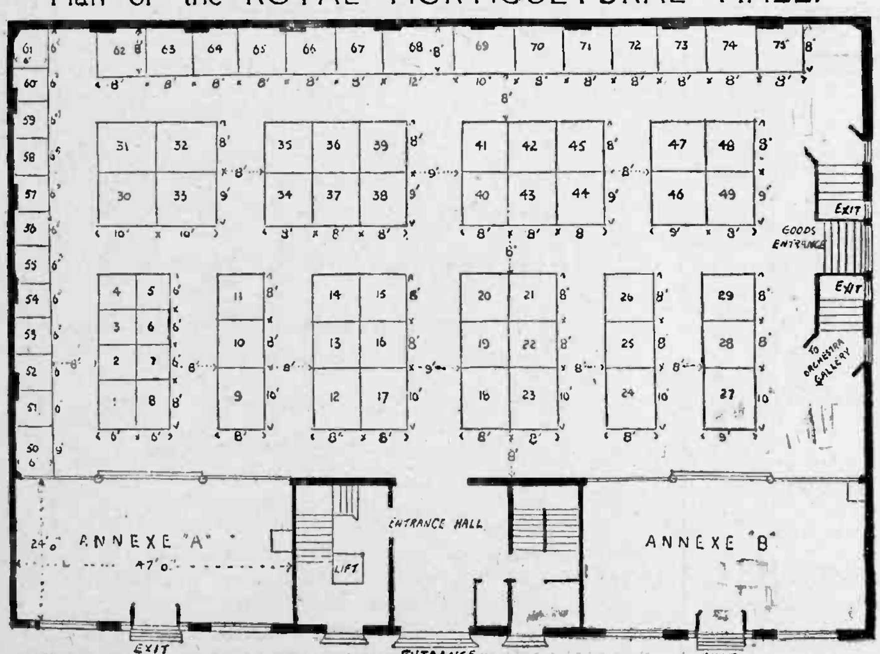
MICROHM ENGIN. Co., 1a, College Street, E.9. (57).

MOTORISTS PURCHAS. ASSN., 62, Conduit Street, W.1. (15, 16).

NEW LONDON ELEC. WORKS, LTD., East Ham, E.6. (40-41).

NEW TIMES SALES Co., 61, Leather Lane, E.C.3. (14).

Plan of the ROYAL HORTICULTURAL HALL.



ORMSBY & Co., L., 28, Page Street, Westminster, S.W.1. (75).

PENTON ENGIN. Co., 15, Cromer Street, W.C.1. (73.)

PETTIGREW & MERRIMAN, LTD., 122, Tooley Street, S.E.1. (67, 68).

PORTABLE UTILITIES Co., LTD., Fisher Street, Southampton Row, W.C.1. (42, 43).

RADIARC ELEC. Co., LTD., Bennett Street, Chiswick, W.4. (22).

RADIO PRESS, LTD., Bush House, W.C.2. (45.)

RADIO RECEPTION Co., 110, Wilton Road, Victoria, S.W. (56).

RAPINIT, LTD., 39, Gretin Road, Earlsfield. (31).

READ & MORRIS, 31, Eastcastle Street, Oxford Street, W.1. (72).

REFLEX RADIO Co., 45, Stamford Hill, N.16. (4).

REIGATE RADIO Co., Leigh, Reigate, Surrey. (6).

ROTAX, LTD., Willesden Junction, N.W.10. (35, 36).

SCLERINE CRYSTAL Co., 4a, Aubery Road, Walthamstow, E.17. (5).

SEAGULL, LTD., 5a, Newcastle Place, Edgware Road, W.2. (24).

SEL-EZI WIRELESS SUPPLY Co., LTD., 6, Greek Street, Soho, W.1. (20, 21).

SERENADO MFG. Co., LTD., 22, Paper Street, E.C. (19).

SEXTON-BARNES, LTD., 61, Borough Road, S.E.1. (53).

SILVERTOWN Co., Silvertown, E.16. (46, 47).

SIMON BROS., LTD., 21, Panton Street, Haymarket, S.W. (2).

SPARKS RADIO SUPPLIES, 43, Gt. Portland Street, W.1. (55).

STELLA PRODUCTS, LTD., 31, Wybert Street, N.W.1. (8).

TRADER PUBLISHING Co., LTD., 139, Fleet Street, E.C. (50).

WATMEL WIRELESS Co., 332, Goswell Road, E.C. (54).

WESTERN ELECTRIC Co., LTD., Connaught House, Aldwych, W.C.2. (37, 38, 39).

WOODS, H. W., 15–16, Railway Approach, London Bridge, S.E.1. (64).

ZEITLIN & SONS, 41, High Holborn, W.C.1. (74).

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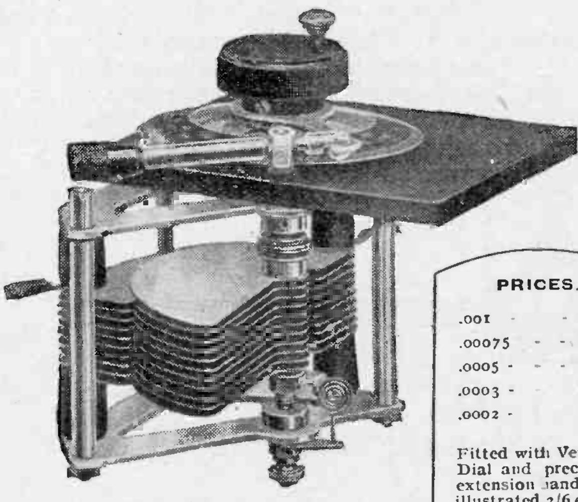
THE VICTORIA VERNIER DIAL

You can obtain a micrometer variation of the whole condenser by using the "VICTORIA" VERNIER DIAL, which has a ratio of 300 to 1, obtained by a precision screw motion. No gears, therefore no back lash. Coarse and fine tuning provided for. Suitable for use with any standard condenser or variometer. Price 4/9.



For purposes of illustration, section of panel is not shown in correct position.

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.001	16/-
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Fitted with Vernier Dial and precision extension handle as illustrated, 2/6 extra on prices quoted above.

From your Dealer.

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Victoria Works, Oakfield Road, Altrincham, Cheshire.

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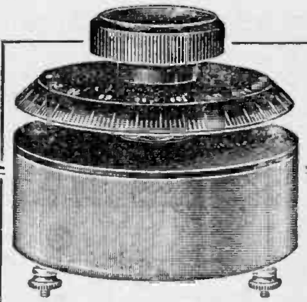

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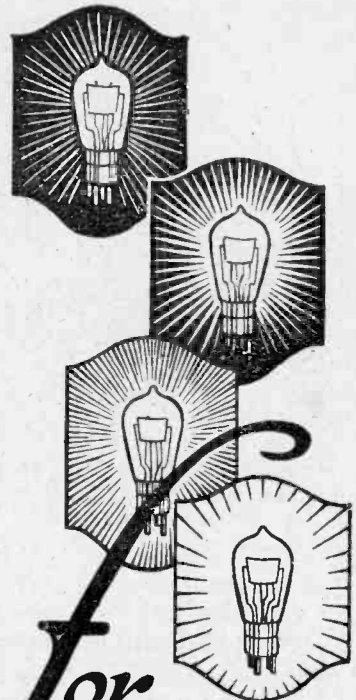

The Efesca Vernistat (Patent) is the most delicate filament control yet invented, and should be used wherever a separate rhetostat is employed for H.F. and detector valves. The Vernistat is smooth and silent in operation, and absolutely safeguards the valves from an accidental burn-out through too rapid switching on. Three complete turns of the knob are required to bring in or out the whole resistance.

for DELICATE FILAMENT CONTROL

The Vernistat is made for both dull and bright emitter filament control, resistance 5 ohms or 30 ohms.

Price complete 6/- each.

Examine the possibilities of Efesca Components for experimental work. Their precision, their convenience and their instrument finish, quite apart from the many patents incorporated in their design, lend themselves particularly to the work of the experimental enthusiast and the home constructor who aims at utmost efficiency.

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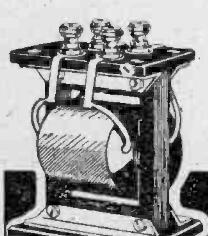

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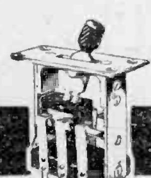

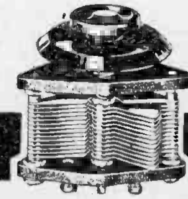

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Wireless News in Brief.

Mr. Ford and the Post Office. Having defied the postal authorities to enter his house under the provisions of the Wireless Telegraph Act, Mr. R. M. Ford, of Park Row, Albert Gate, W., wrote to the Postmaster-General offering—

"to keep any appointment you may see fit to make at this address, when I shall be ready to give your spies a fitting and hearty reception to an Englishman's home."

As a result, two representatives of the Post Office went to the house.

Answering one of the officials, who asked if Mr. Ford declined to allow them to examine any wireless apparatus the premises might contain, Mr. Ford said he did not admit that he had any wireless apparatus, but he would not allow a search to be made.

The officials then withdrew. A further visit has now been made by a Post Office official and a policeman. On this occasion they found nothing but an aerial, of which they took possession.

* * *

The New Wavelength Tests. In a short talk broadcast recently, Capt. Eckersley stated that as a result of the tests carried out by European broadcasting stations on wavelengths especially allotted for the purpose of these tests, it has been provisionally decided at the subsequent Conference at Geneva to make the necessary changes in the allotment of wavelengths in November or December of this year. Capt. Eckersley laid some stress on the fact that the European countries represented at Geneva have in mind an ideal of the internationalisation of wireless broadcasting, while the B.B.C. in particular are equally anxious to give the utmost service to the crystal user. It seems probable, therefore, that the general tendency in the future of broadcasting in Europe will be towards the establishment of a small number of comparatively high-power stations.

* * *

More Broadcasting. An extension of broadcasting hours for the benefit of night workers, hospital patients, and others who are debarred from listening during the evening, is being made by the B.B.C.

As an experiment, the B.B.C. are transmitting from Daventry additional programmes from 11 a.m. to 2 p.m. daily, except on Saturdays and Sundays. Programmes consist of studio performances relayed from London, and of outside broadcasts taken from London restaurants and places of entertainment. No gramophone records are included.

* * *

Broadcasting in Italy. Messrs. Marconi's Wireless Telegraph Company, Ltd., have received an order for a broadcasting station in Rome of a larger power than the one which was erected by them there some time ago, and which is now working. As soon as the larger station, which is a 12 kw. station, is in operation, the smaller, a 6 kw. station, will, we understand, be removed to Naples. Naples will thus be added to the foreign stations available for British long-distance listeners.

* * *

Wireless in Greenland. The new wireless station at Julianehaab, in South Greenland, recently established direct connection with the Lyngby Station, in Denmark, for the first time. Julianehaab Station is the largest of the four wireless installations which Denmark has been erecting during the past twelve months; it is intended for direct communication between Copenhagen and the Faroe Islands.

The broadcasting station at Angmagssalik, on the south-east coast of Greenland, was opened in July, and will be used for the transmission of official messages via Iceland, Godhavn and Godthaab; the other two wireless stations in Greenland, are intended for communication with Julianehaab. That at Godhavn is already open, and that at Godthaab is expected to be completed very soon.

* * *

Mr. Guy Burney, late Managing Director of the Sterling Telephone & Electric Co., Ltd., has opened offices at Morning Post Building, 346, Strand, London, W.C.2 (telephone: City 2373). Mr. Burney proposes to interest himself in the development of patented articles—mechanical, electrical, and other kinds—and he will be pleased to hear from his old friends in the industrial world, and others desirous of placing any new invention before him.

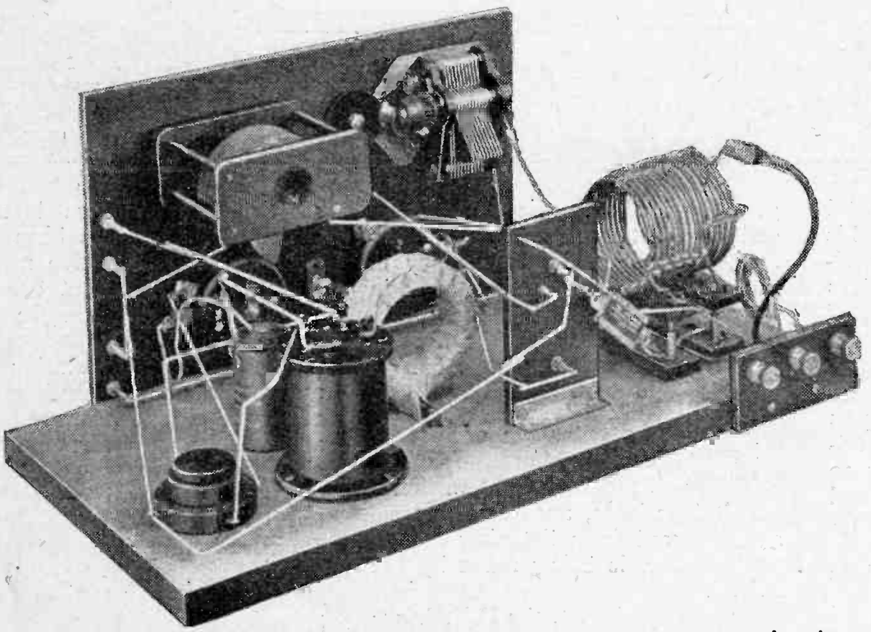
* * *

Wireless and Farmers. According to a recent survey by the United States Department of Agriculture, the increase in the number of farms using wireless sets, from 365,000 in 1924 to over 550,000 in the present year, is due to the need for prompt market information in merchandising farm products, the educational value of wireless and its entertainment features. The growth in the use of broadcasting by the agricultural population of America is a notable point in the phenomenal development of wireless communication of the last few years.

A SIMPLE SHORT-

By C. P. ALLINS

With the approach of longer eve
improvement to be expected in
many people will be turning th
struction of a short-wave recei
The receiver described here has
in its simplicity of constructio



This view shows clearly the connections to the valve holder and how the air-core choke coil is mounted.

THE following article describes a short-wave receiver with interchangeable coils. Capacity reaction is used, thus doing away with swinging coils and their disadvantages as regards obtaining fine adjustments, and also the marked effects they produce on tuning.

This time last year saw the amateur who was interested in short-wave reception intent on the design of a receiver that should go down to 50 metres (5,996 kc.), so that he might receive the transmissions from KDKA which were being sent out on a wavelength in the neighbourhood of 60 metres (4,997 kc.).

Shorter Waves

This year, with the amazing developments of the last few months with regard to long-distance daylight communication on 20 metres (14,991 kc.), sees old sets being re-designed. If we examine the sets used last year for 50-metre work, we find in many cases that they are unsuitable for 20 metres. Either the tuning inductances are fixed, giving only a limited tuning range, or else undesirable self-capacity is found to be present, setting a limit to the lowest wavelength that can be received, or both. How serious this problem of self-capacity can be is shown by a receiver that the writer had used with great success down to 60 metres, American amateurs, for instance, on the 75-80-metre (3,998-3,748 kc.) band being received at great strength.

Stray Capacities

On attempting to get down really low, it was found impossible to get below 20 metres, even with a two-turn coil, and, further, it was found that with this coil a .0003 μF tuning condenser only gave a tuning range of from 20-26 metres (14,991 to 11,532 kc.). A rough consideration of the components in use led to the conclusion that the stray capacities present in the circuit due to the minimum capacity of the tuning condenser, the valve-holder and valve, the coil mounts and wiring, amounted to about 100 $\mu\mu$F, and on calculating the effect of this on the tuning range it was found to tally approximately with the figures obtained.

Design of Receiver

It was therefore decided entirely to re-design the receiver and to re-build it on improved lines. No cabinet was to be employed, as, at the very high frequencies involved, it is better to have the field of the inductances as free as possible. The size of the panel, too, was to be kept down, and though this possibly might have been drilled out with some slight advantage as regards reducing the amount of solid dielectric present, and also perhaps reducing the capacity between component and component, it was decided that the effect would be so small as hardly to warrant the extra work involved.

Special Features

The completed receiver is shown in the photographs, and reference to these will help to make clear

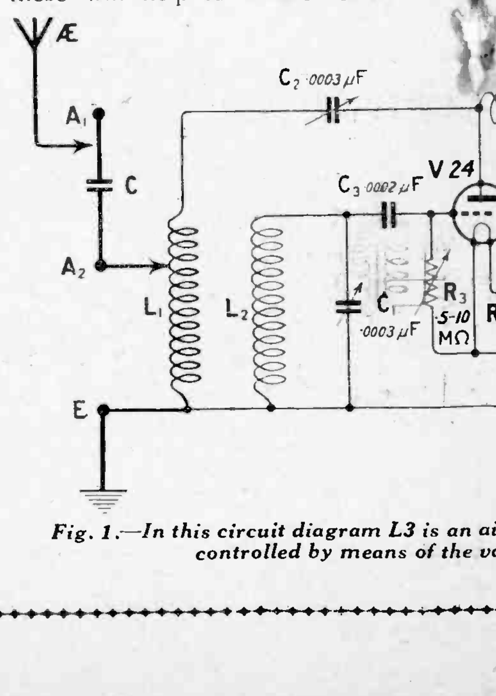


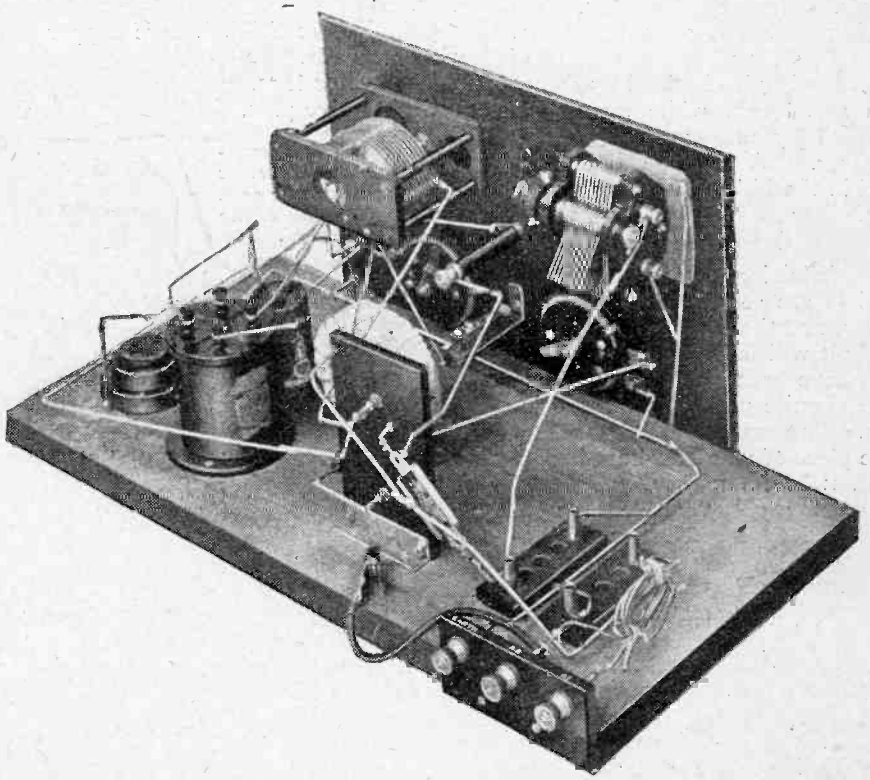
Fig. 1.—In this circuit diagram L3 is an ai
controlled by means of the v

WAVE RECEIVER

SON (6YF).

nings and the consequent long-distance reception, eir attention to the con- ver for the coming winter. s much to recommend it nt and ease of operation.

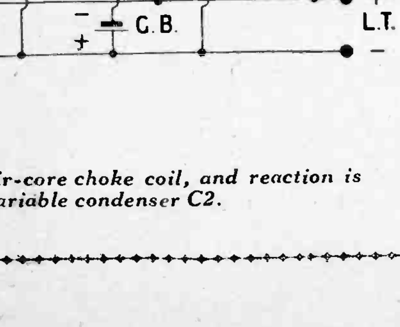
some of the points in its design which may here be discussed. Viewing the receiver from the front, the chief point to note is that only the H.T. and L.T. terminals are carried on the panel. The telephones are placed in circuit by means of a plug and jack, the jack being conveniently placed in the centre of the panel. The left-hand dial is that of C1, the tuning condenser, and has a 20-1 reduction gear incorporated. Even with this, tuning is found to be somewhat critical below the 40-metre (7,496 kc.) mark. The right-hand dial controls C2, the reaction condenser, which is also a geared type with insulated spindle. The variable grid-leak, which is adjusted by the knob in the centre, is found of great use in enabling a perfectly smooth reaction control to be obtained.



In order that the receiver may operate satisfactorily on short wavelengths the wiring must be well spaced out.

Terminals

Looking at the receiver from the back, it will be seen that the aerial and earth terminals are carried on a small strip of ebonite on the right-hand side. This enables the aerial and earth leads to be kept well out of the way, so that (in the case of the aerial lead, and perhaps also the earth lead if a long one) they will not be so near to the body as to cause the introduction of variations in tuning whenever the experimenter moves nearer to or further from the set. It will be noted that two aerial terminals are provided, and the odd-looking object connected between them is a small series condenser, the construction of which will be dealt with later in the article. The two coils L1 and L2 are mounted close together, and the clip shown is used to connect the aerial to tappings on L1, small pieces of copper wire being soldered to the coil for this purpose. The short connection between one side of L2 and the grid of the detector is clearly shown. This could not have been made shorter without bringing the valve mounting too close to the field of the coils. As will be seen, a V24 valve is used, this type being particularly suited to the reception of very short waves.



r-core choke coil, and reaction is ariable condenser C2.

Hand Capacity

In constructing this receiver, the scheme of wiring should be closely followed, as it has been spaced out as widely as possible without making connections unduly long. The shielding of the tuning condenser is found of great use in helping to eliminate hand-capacity effects, and this is also helped by the position of the earth and L.T. leads close to the bottom of the panel. Filament rheostats of the dual type are used, so that either bright- or dull-emitter valves may be used, while a single dry cell is permanently connected in the grid circuit of the L.F. amplifying valve, though with some valves two or three may be used with advantage.

Turning to Fig. 1, the circuit diagram, those who have read the article on the "Novel Three-Valve" receiver, described by the writer in *Modern Wireless* for May, 1925, will see that the circuit used is very similar to that used in this receiver. Instead, however, of a swinging coil being used for L1, this is fixed, and a variation of aerial coupling is obtained by means of an aerial tap, while reaction is controlled by means of a variable condenser. A choke coil is connected in the H.T. + lead, as shown at L3.

Components

The following components and materials are required to build this receiver, and those who wish exactly to copy it will find that the makers' names have been given :—

One ebonite panel, 12 in. x 8 in. x $\frac{1}{4}$ in. (Paragon).

One piece of wood for base-board, $17\frac{1}{2}$ in. x $8\frac{3}{4}$ in. x $\frac{3}{4}$ in.

One .0003 μF variable square-law geared type condenser (Collinson).

One .0003 μF variable square-law geared type condenser (Success).

One .0002 μF fixed condenser (Therla).

One low-frequency transformer (Success).

One radio choke coil, or $\frac{1}{4}$-lb. No. 24 d.c.c. copper wire.

One V24 valve and holder (Marconi Scientific Instrument Co.).

One antiphonic valve - holder (Burndept Wireless, Ltd.).

Two dual type filament resistances (Burndept Wireless, Ltd.).

One variable grid-leak (Bretwood).

One single-circuit jack (Elwell).

One piece ebonite, $3\frac{1}{2}$ in. x $1\frac{3}{4}$ in. x $\frac{1}{4}$ in., for terminal panel.

Six pieces ebonite, 3 in. x 1 in. x $\frac{1}{4}$ in., for coil plugs and mountings.

$\frac{1}{2}$ lb. No. 12 S.W.G. bare copper wire for coils.

Four valve legs.

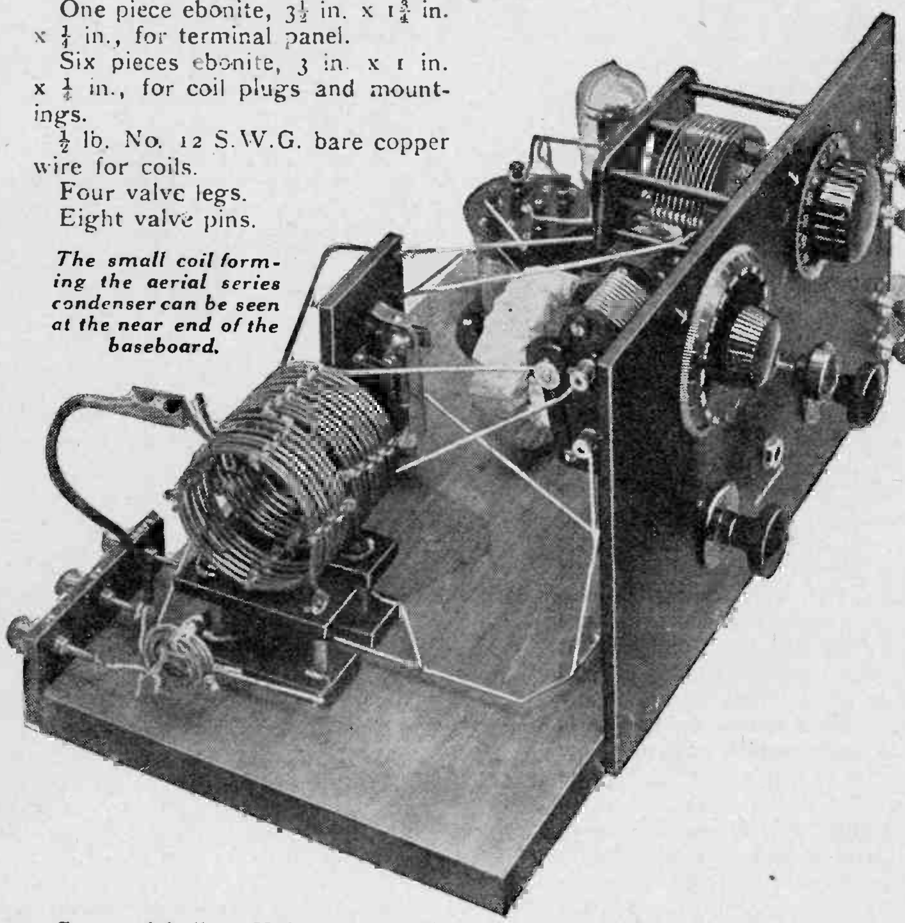
Eight valve pins.

Seven nickelled W.O. type terminals.

One spring clip (Burndept Wireless, Ltd.).

One dry cell for grid bias and quantity of square tinned copper wire for connections.

One set Radio Press panel transfers.



The small coil forming the aerial series condenser can be seen at the near end of the baseboard.

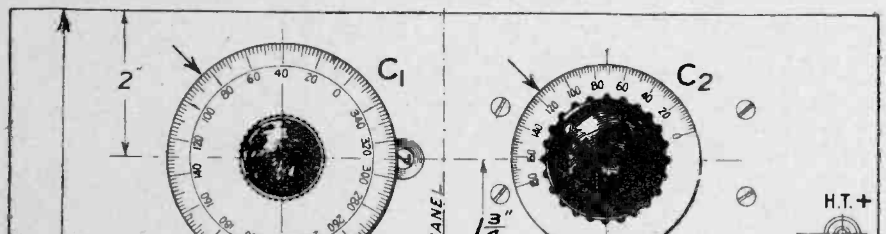


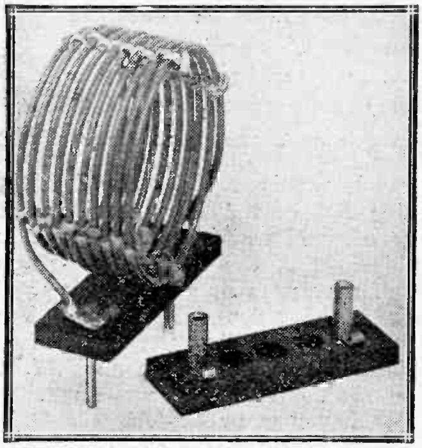
Fig. 2.—The dimensions given above for marking out the panel may be used to obtain the layout of the actual set described.

Ebonite Panel

A dimensioned panel lay-out is shown in Fig. 2, and this will assist in determining the position of the components on the panel. The holes for fixing the components having been drilled, the panel transfers should be applied next, after which, if necessary, the panel may be wiped over with a slightly oily rag to give it a rich black surface, taking care to wipe off any excess of oil, otherwise dust will collect on the panel, to the detriment of its appearance and insulation. This having been done, the components and terminals which go on the panel may be mounted.

Coils and Mounting

The construction of the coils should next be undertaken. Those shown were wound on a former about $2\frac{1}{2}$ in. diameter and sprung off. They were then made self-supporting by binding the turns together with string, the string having previously been soaked in paraffin wax so as to render it immune from damp. The coil mounts or plugs are pieces of ebonite, 3 in. x 1 in. x $\frac{1}{4}$ in., in which two valve legs are fastened



Holes may be drilled between the sockets, if desired, to reduce the amount of solid dielectric present.

2 in. apart with a soldering lug under each lock-nut. The ends of the coil go through two holes outside the valve legs and $2\frac{1}{2}$ in. apart, and a short length of wire is soldered on to the lug and the coil, thus making connection with the valve legs. The coil-holders are made from similar pieces of ebonite with valve sockets into which the legs are inserted. Connections are again made by the use of lugs. The valve sockets may either be tapped into the ebonite strips or else fastened by means of lock-nuts. In the latter case the strip must be carried clear of the base-board when mounting it, by means of washers.

Holes to Reduce Capacity

The strips have three $\frac{3}{8}$-in. holes drilled in them, as shown in the above photograph, so as to reduce the amount of dielectric between the pins or sockets, thus not only reducing the capacity of the mounting but also reducing losses to a certain extent.

Coil Sizes

Four coils are required to cover the wavebands between 70 and 15 metres (4,283 and 19,988 kc.), and with the former of the size given the numbers of turns required are 10, 7, 5, and 4. For wavelengths above the topmost range of the 10-turn coil, other coils would need to be constructed. In order that the aerial may be connected as desired, small pieces of copper wire are soldered to the coil at a couple of points in the case of the larger coils, and in one place only (not at the centre) with the smaller ones. By reversing the coil in the holder the proportion of the coil that is included in the aerial-earth circuit may be varied, thus avoiding the need for more than one tap.

Next mount the V24 valve-holder on a small piece of angle brass by means of two 6 B.A. screws passed through the corners, two holes being drilled in the angle so as to allow these to come through. Two other holes allow of wood screws fixing the whole on the base-board.

The Choke Coil

The radio choke coil employed was made by winding 150 turns of No. 24 d.c.c. copper wire honeycomb fashion on a former of the spoke type. The coil was then dipped in molten paraffin wax and the surplus wax carefully shaken out. When cold the whole was wound over with empire tape and fixed to a small strip of ebonite, and mounted on the base by means of two $\frac{1}{2}$-in. wood screws. It should be mounted as shown with its axis at right angles to the axis of the tuning coils, so as to prevent interaction between their fields.

Aerial Series Condenser

Lastly, the small terminal panel carrying the two aerial terminals and the earth terminal may be constructed and mounted in position. The series condenser mounted between terminals A1 and A2 consists of about 18 in. of No. 18 gauge d.c.c. copper wire (previously waxed to exclude moisture) twisted together, the end of one wire being soldered to A1 and the end of the other to A2. If the aerial is such that it is difficult to make the set oscillate, it may possibly be found necessary to reduce the length of the two wires forming this condenser, while if oscillation is readily obtainable a little more may be used. The chief point is that when using it in the aerial circuit the set should oscillate over the whole waveband covered by the smallest coil.

Wiring

All the components that go on the base-board may now be mounted and the panel fixed thereto. The wiring diagram shown in Fig. 3 shows the relative positions they should occupy, and also gives the wiring scheme, which should be carefully followed. All leads should be spaced well apart, especially any that have to run parallel for any distance. The wiring is all perfectly straightforward, and the only point that requires mention in any way is the lead from the reaction con-

(*Continued on page* 99.)

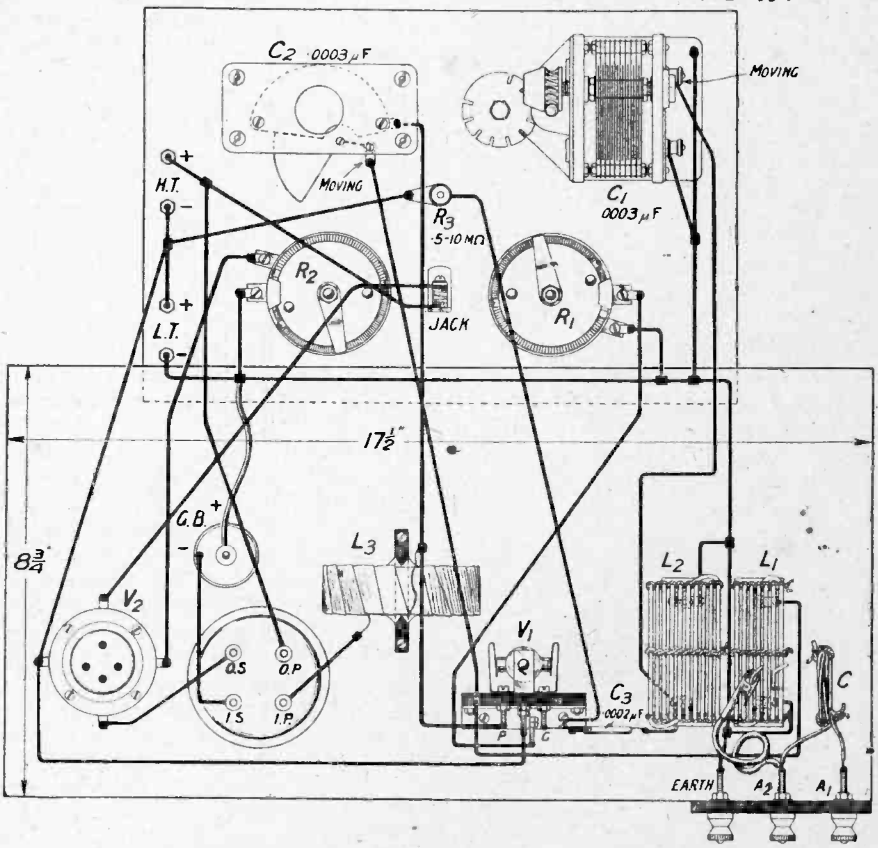
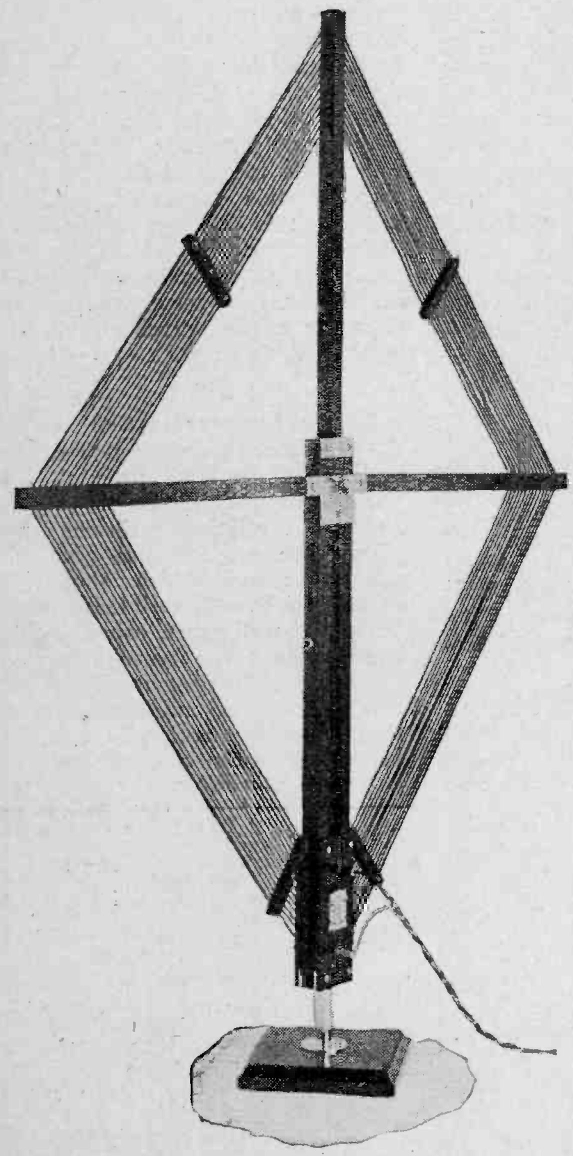


***Fig. 3.**—The components on the baseboard are well spaced, and the choke coil, L3, is mounted at right angles to L1 and L2.*

SOME NOTES ON FRAME AERIALS

By J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., Staff Editor.

Users of frame aerials who have been at a loss to account for the lack of directional properties often exhibited by this form of aerial will find that these notes will go some way to explain the reason for the phenomena encountered.



A frame aerial of a type commonly used for the broadcast frequencies.

WITH the increasing use of super-heterodyne receivers and other forms of portable sets, frame aerials have recently come into prominence for amateur receiving equipment. One of the advantages which is claimed for the use of the frame aerial is that the directional effect may be utilised in reducing interference from unwanted stations.

Lack of Directional Effect

It is often found, however, in practice, that this directional effect, although present, is not sufficiently marked to enable the full advantage to be obtained. The rotation of the frame certainly produces a variation in the signal strength, but it is very often impossible to reduce the signal strength actually to zero. If any undesired station is to be eliminated it is, of course, essential that there should be some position of the frame at which the signal strength is zero, so that unless the frame is operating satisfactorily it will not counteract the interference.

Response of a Frame to a Wireless Wave

Now there are reasons for this state of affairs, which will readily become apparent if the action of the frame is considered in a little more detail. A frame aerial is often spoken of as responding to the magnetic field of the wireless waves. Although this is perfectly correct, a frame aerial may be considered from the same point of view as an ordinary aerial, that is to say, as responding to the electrostatic field. The electric and magnetic fields are merely different manifestations of the same phenomenon, so that, for the sake of consistency, many people prefer to regard a frame from the electric point of view rather than the magnetic.

Effect of Incoming Wave

Let us take first of all a simple loop aerial such as is shown in Fig. 1. Here an electric wave passing this aerial will affect the side AB of the loop as a simple aerial, and will induce voltages in this side of the loop. The waves will now pass over the frame, and since the sides AC and BD are parallel to the direction of travel of the wave, there will be no E.M.F. induced. When the wave reaches CD, however, an E.M.F. will again be induced in this leg of the frame, acting as a simple aerial.

Difference of Phase

These two E.M.F.'s which have been induced in the frame will produce currents in opposite directions round the frame, and will thus tend to cancel each other. When the frame is in the position shown, however, the electric wave reaches the side AB before it reaches the side CD. There is thus a slight phase difference between the two E.M.F.'s, so that they do not completely cancel each other, and a small resulting E.M.F. is left. If the frame is turned at right angles to the direction of the wave, then the waves will affect the sides AB and CD simultaneously, so that

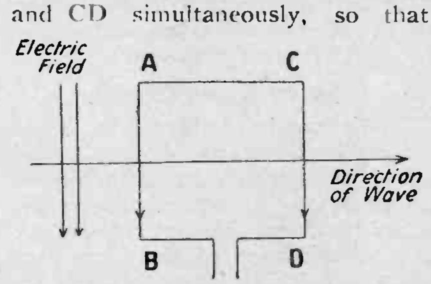


Fig. 1.—When the frame is in the plane of the wave there is a maximum phase difference between the E.M.F.'s in AB and CD.

there will be no phase difference, and the two E.M.F.'s will actually cancel each other. In this position, therefore, the reception on the frame will be a minimum.

Loop and Frame Aerials

If now instead of having a simple loop of wire we have a frame consisting of several turns of wire, then each individual turn will act in the manner just described, and the resulting E.M.F. will therefore be several times as great as it would

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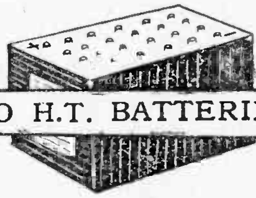

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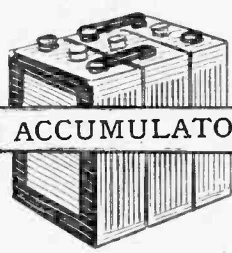

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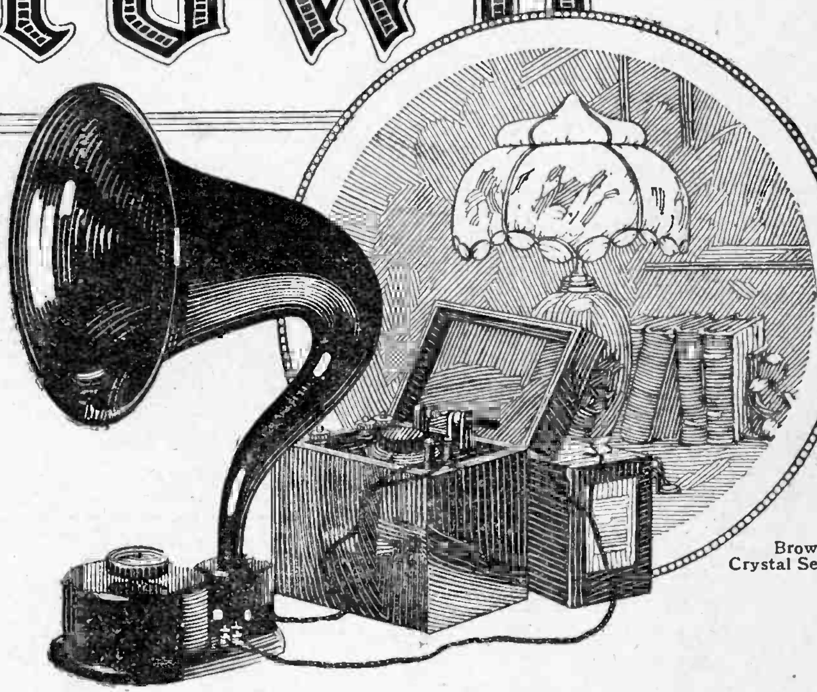

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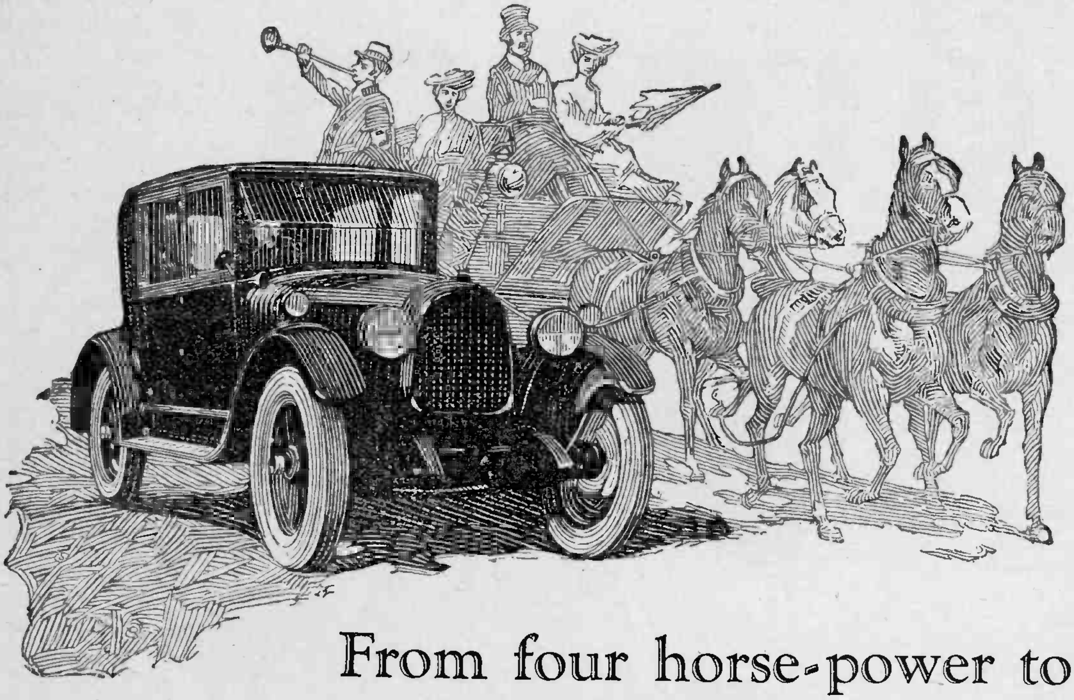


From four horse-power to 40 h.p.

—from the first Bright Emitter Valve to the Super-sensitive Wuncell Dull Emitter

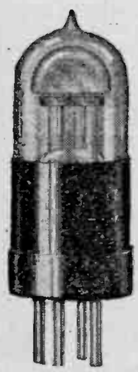
NOTHING can stem the pitiless tide of progress. The four-horse coach of two decades ago has now been superseded by the 40 h.p. car. And the bright emitter valve of two years ago is now being rapidly superseded by that most economical of all Dull Emitters—the Wuncell.

Wireless enthusiasts are everywhere realising that economy in valves means much more than actual current consumption. It means *long life.* Obviously a valve with an ultra-low current consumption and a short life—due to its fragile nature—cannot truthfully be called an economical valve.

The Wuncell puts life first and current consumption second. In spite of this, its wattage is still less than one-sixth of any bright emitter valve. That is to say, any six-volt accumulator which might, for example, have given 20 hours at a charge with bright emitters would give 120 hours using Wuncells.

The abnormally long life of the Wuncell Valve is due to its special filament, manufactured under a patent process known only to Cossor. Instead of being whittled down, as in most dull emitters, it is actually built up layer upon layer until it is as stout as that used in any standard bright emitter, and when in use it merely glows at a temperature not exceeding the embers of a dying match.

Its prolific output of electrons—harnessed to the well-known Cossor principles of construction—ensures a sensitivity which has no counterpart in any make of valve. For the first time since the Dull Emitter appeared on the market, users are saying that here at last is a perfect match in performance for the best bright emitter valve ever made.



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be for a simple loop. The question of the best size of frame and the best number of turns, etc., is outside the scope of this article, but may possibly be discussed at some future date.

From the point of view of the action of a frame, however, it may be considered as a simple loop, such as is shown in Fig. 1.

"Aerial" Effect

The E.M.F.'s set up in the sides AB and CD of the simple loop have been seen to combine to produce a resultant current round the loop itself, this being the ordinary loop effect, which is directional.

The various parts of the loop or frame, however, have a certain capacity to earth, and the E.M.F.'s set up by the action of the wave

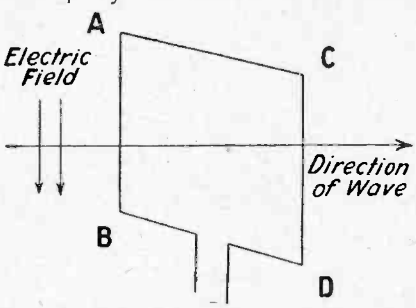


Fig. 2.—When the frame is at right angles to the plane of the wave, E.M.F.'s in AB and CD are in phase and reception is zero.

will produce currents through this capacity. The arrangement thus behaves as an aerial connected to earth through a small series condenser.

This aerial is not tuned to the frequency of the wave, so that this capacity current is normally quite small. It is, however, independent of the direction of the signal, so that as the frame is rotated towards the zero position, the legitimate "frame" current grows smaller and smaller while the "aerial" current remains constant.

Thus signals will still be heard when the frame is in the zero position, and, instead of a crisp zero, a more or less flat minimum will result.

Reduction of "Aerial" Effect

The currents set up by this aerial effect produce voltage variations between the grid and filament of the first valve of the receiver, as illustrated in Fig. 3. In order to neutralise this effect, the middle point of the frame is connected direct to earth. The capacities of the two ends of the frame to earth are then approximately equal, so that the grid and filament of the first valve are at practically the same potential as far as these capacity currents are concerned. Fig. 4 illustrates such a circuit.

Filament Battery Not Earthed

With a set operating directly from a frame, as in Fig. 4, the

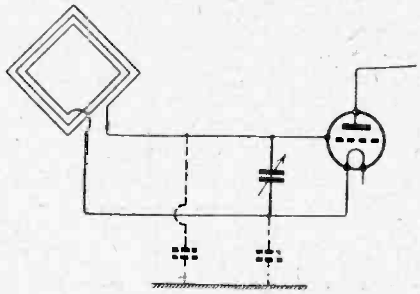


Fig. 3.—The E.M.F.'s in the frame also produce currents through the capacity to earth.

negative of the filament should not be earthed. This would stabilise one end of the frame, but there would still be a capacity between the other end and the earth, and since this other end is connected direct to the grid of the valve, the full aerial effect would be noticeable.

Effect of Size of Frame

We have seen that this aerial effect is normally only troublesome near the zero position of the frame. It is, in fact, a serious trouble in direction-finding equipment, and special care has to be taken to eliminate it before the apparatus is brought into use.

Except at the minimum region, however, the aerial effect is usually negligible with a fairly large frame. The frames employed for broadcast receivers, however, are not large, and the actual E.M.F. induced therein is comparatively small.

The aerial effect is not reduced to anything like the same extent, so that it is not uncommon for the aerial E.M.F. to be greater than

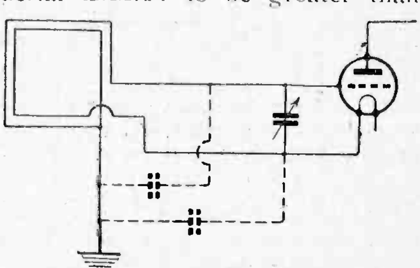


Fig. 4.—Earthing the middle point of the frame eliminates the aerial effect.

the maximum E.M.F. produced by the frame.

A Remedy

Under such conditions the set will obviously exhibit very poor directional properties, and this is often found to be the case in practice. The earthing of the middle point of the frame will usually cure the trouble and result in reasonably sharp zeros being possible.

Other Forms of Circuit

The circuits so far shown have been direct-coupled, but it may be desired to use a frame loosely coupled to the receiver, as illustrated in Fig. 5.

In such a case the aerial effect is still obtained, but in this case the capacity currents induce voltages on to the grid of the valve through the coupling.

To remedy the defect in this case the middle point of the coupling coil is earthed. The currents in the two sides of the frame then flow through the two halves of the coupling coil in opposite directions, and so produce no effect in the secondary.

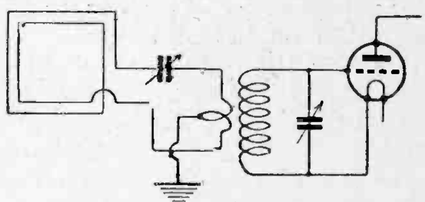


Fig. 5.—In the case of a coupled circuit the middle point of the coupling coil is connected to earth.

Night Effects

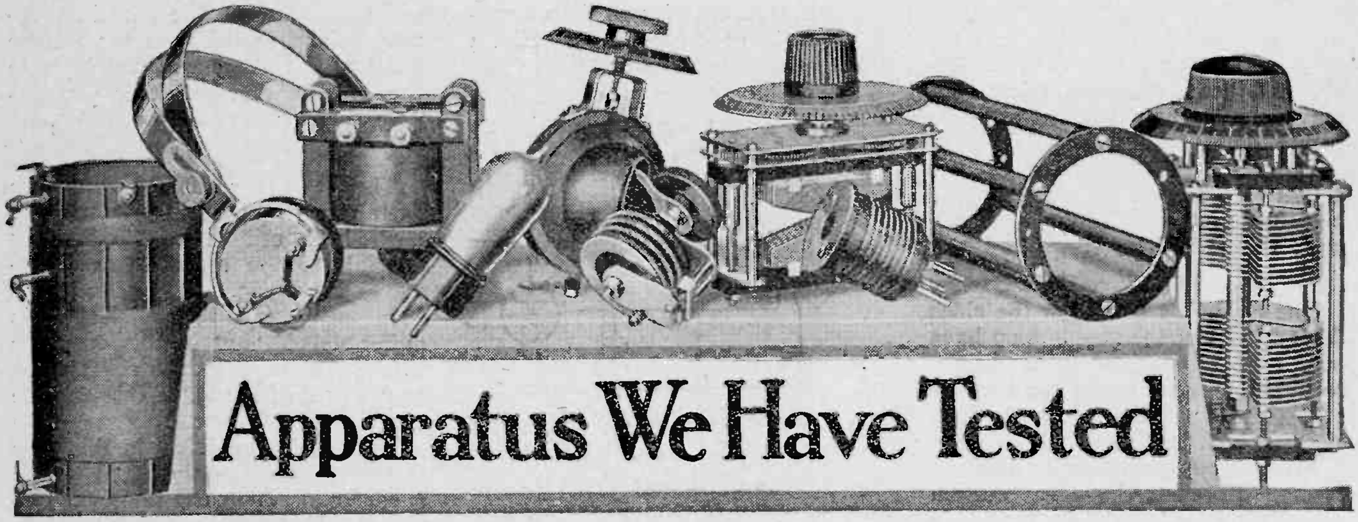
It should not be forgotten, however, that there are secondary effects which may also produce peculiar behaviour in a frame aerial.

The electric field in the "direct" wireless wave is substantially vertical, as illustrated in Figs. 1 and 2. There is also, however, a reflected wave which arrives from the upper atmosphere, and as has been explained in previous articles, this wave may arrive from a slightly different direction, or it may be horizontally polarised.

Fading

These effects give rise to the night variations which are so common on direction-finding work, in addition to which there are the fading effects, due to interference between the direct and reflected waves.

The remarks given above concerning aerial effect thus deal with one aspect of frame reception only. The question is an important one, and a distinct improvement may be expected from the earthing of the middle point, as described, but it should be emphasised that the method is not a cure for night effect and fading.



Apparatus We Have Tested

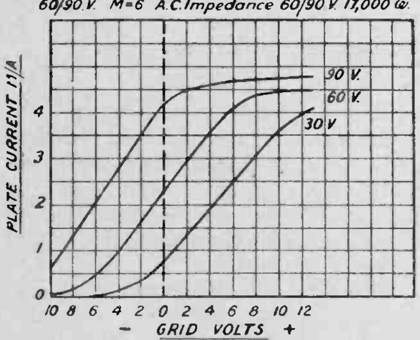
Conducted by A. D. COWPER, M.Sc., Staff Editor.

Apex Valves

Messrs. the Apex Valve Co. have submitted samples of their .06 type of general-purpose valve, and of types P4 and P6 low-frequency power amplifying valves.

The .06 type is rated at 3-3.5 filament volts, and .05 to .07 ampere, with 20-60 volts H.T. for detector or H.F. amplifier, or 50-100 volts as L.F. amplifier. At 3 volts the valve tested showed a maximum plate-current of around 5 milliamperes with high H.T. and positive grid-bias; at this rating the filament demand was 0.07 amperes. It is a small valve, with a small diameter anode of normal shape but more open below than usual. The filament is straight, and the grid is of the usual spiral form. On test, the mean amplification factor between 60 and 90 volts H.T. came out at about 6, whilst the A.C. impedance was of the order of 17,000 ohms in this region. The valve showed a similar behaviour to others of this .06 G.P. class of

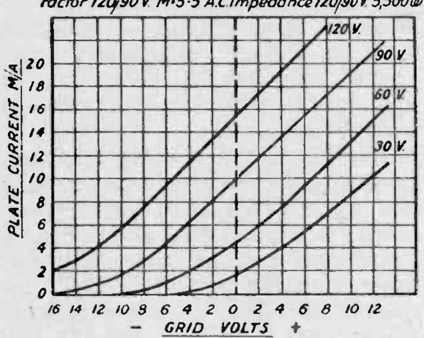
APEX VALVE ·06 GENERAL PURPOSES TYPE
Fil. 3 Volts ·07 Amp Mean Amplification Factor 60/90 V. M=6 A.C. Impedance 60/90 V. 17,000 ω.



moderate amplification factor; as a detector for local loud transmissions 50 volts H.T. and a 2 megohm leak appeared suitable, whilst for distant transmissions 30 volts and a 4-megohm leak gave good results and smooth reaction; the grid current, under ordinary working conditions, increased rapidly above 0.6 volts positive potential. For a moderate degree of loud-speaking, 120 volts H.T. and up to 10 volts negative grid-bias were demanded, but the valve would not, of course, handle much power without blasting.

The Apex P4 power amplifier is rated at 3.5-4 volts and 0.3-0.32 amperes, with 10-50 volts H.T. as

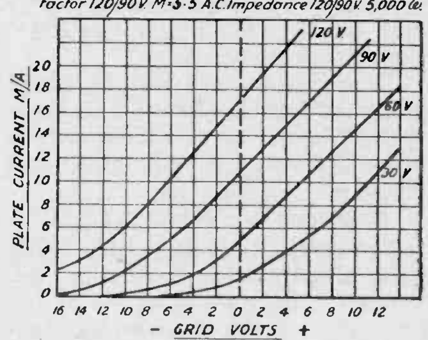
APEX VALVE. P.4. POWER AMPLIFIER.
Fil. 4 Volts 0·32 Amp Mean Amplification Factor 120/90 V. M=5·5 A.C. Impedance 120/90 V. 5,500 ω



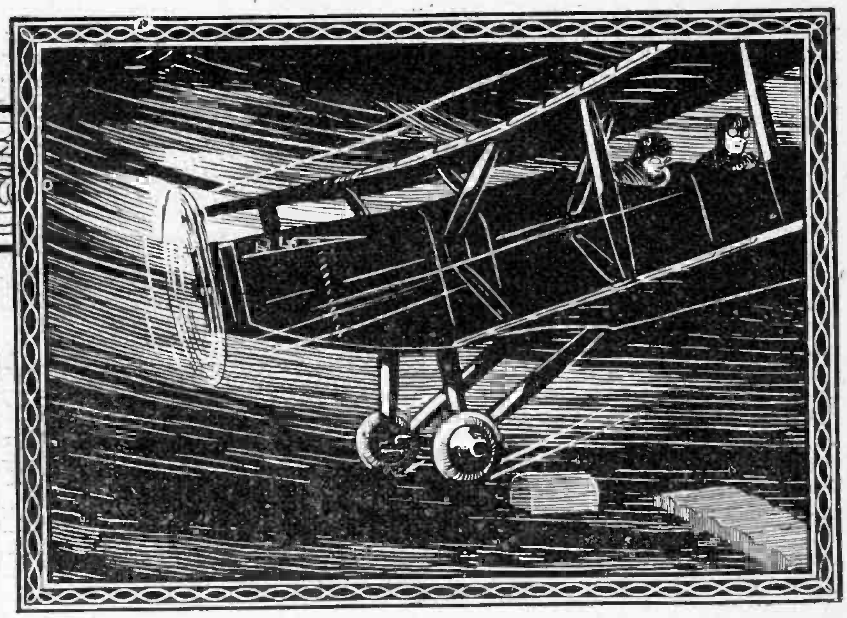
detector and 50-120 volts H.T. for L.F. amplification. This is a low-impedance power-valve of the modern type, designed to handle a great deal of signal energy without giving rise to the distortion which results from over-running the characteristic of the valve. It has a large oval box-like anode, with a V filament and a grid of fine wire wound on a frame. It was tested at 4 volts and 0.32 amperes in the filament; the saturation current was not reached at all under these circumstances. The characteristics showed a large available sweep of grid-voltage in a straight portion of the 120-volt curve to the left of the zero grid-volts line; on trial with loud signals and with 120 volts H.T. and 6-9 volts negative grid-bias this was confirmed, powerful loud-speaking resulting without distortion. As a rectifying valve, a much smaller reaction coil than usual was required; for smooth operation but 30 volts H.T. and a 2-megohm leak were suitable on the local transmission, or some 15 volts H.T. and a high value of leak for long-distance work. The grid current was small (under usual conditions) up to some 0.8 volts positive.

The P6 power valve is rated at 5.5-6 volts and 0.25-0.27 amperes, with H.T. values as for the P4; also the bulb is pipless. The characteristics proved to be very similar, the amplification factor being the same reasonable figure (for a power amplifier) of 5.5 and the A.C. impedance slightly lower than that of the P4. The filament emission was very large. At first some anomalies were noticed in the grid current; these were finally traced to a small H.T. leakage across the base of the valve. On carefully cleaning this the grid current approached the same characteristics as observed with the P4 valve. As a result of this small leak the valve operated as a detector quite well without external leak; with 50 volts H.T. and a moderate additional leak, local strong signals were well received, or without a leak and but 15 volts H.T.

APEX VALVE. P.6. POWER AMPLIFIER.
Fil. 5·5 Volts 0·28 Amp. Mean Amplification Factor 120/90 V. M=5·5 A.C. Impedance 120/90 V. 5,000 ω.



long-distance reception resulted, a very small reaction coil being used. Even 4 volts H.T. gave good results in distant reception. For handling a large amount of power in L.F. amplification the valve proved excellent with 120 volts H.T. and up to 9 volts negative grid-bias. For real loud-speaking on



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Barclays Ad.

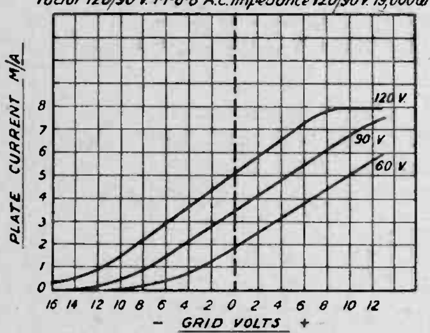
the local transmission, or in a second or third stage of L.F. amplification in general, the P.6 was able to handle even more signal energy than the average 5-volt .25 amp. power-valve, without a trace of distortion; for this purpose it can certainly be recommended.

Ediswan Power Valves

Messrs. Edison Swan Electric Co., Ltd., have sent for our trial samples of their small power valves for L.F. power amplification: the P.V.6 and the P.V.5 D.E.

The P.V.6 is a valve of moderate size, the internal elements of which closely resemble those in the A.R.D.E., L.F. valve of the same make, but with a cylindrical anode of rather larger diameter. It is rated at 1.8-2 volts and 0.4 amperes, and 60-120 volts respectively. A saturation current of over 8 milliamperes was reached under working conditions with 1.8 volts and 0.45 amperes in the filament, under which conditions the characteristics were determined. A mean amplification factor of M=6.8 was recorded with 90-120 volts H.T. and an

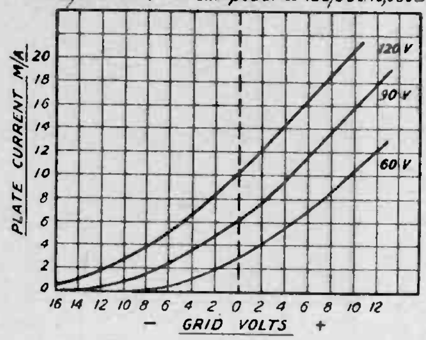
EDISWAN P.V.6. VALVE.
Fil 1·8 Volts 0·45 Amp. Mean Amplification Factor 120/90 V. M·6·8 A.C. Impedance 120/90 V. 19,000 ω



A.C. impedance in this region of about 19,000 ohms. An available swing of a total of 10 or 12 volts in the 120-volt curve, below the zero-volts line, appeared to promise a fair measure of distortionless loud-speaking; on trial, with 6 volts negative grid-bias, this was confirmed, though full power could not be handled without some rectification occurring on the local station's transmissions. For moderate loud-speaking in a small room the valve proved excellent, and could be operated conveniently in conjunction with the A.R.D.E. types with a common 2-volt L.T. accumulator. As a rectifier, the valve operated well in long-distance work with 20 to 30 volts H.T. and a high leak, 4-8 megohms.

The P.V.5 D.E. is a rather larger valve, with large oval box anode and V filament, with a fine grid wound on a frame over the filament. It is rated at 5 volts and 0.25 amperes in the filament, with 50 to 150 anode volts. The specimen tested showed a consumption close enough to this: 0.3 amperes at 5 volts, at which rating saturation was not reached with 25 milliamperes plate current. The amplification factor was about what might be expected in a low-impedance power amplifying valve, around 6.7, whilst the A.C. impedance in the same 90/120 volt region was rather higher than that expected, being about 10,000 ohms. Accordingly, good loud-speaking was to be expected with 120 volts H.T. and a grid-bias, from the curves,

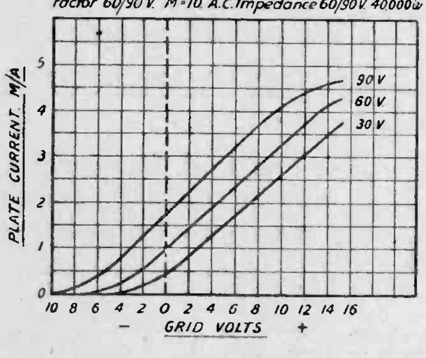
EDISWAN P.V.5. D.E. VALVE.
Fil. 5 Volts 0·3 Amp. Mean Amplification Factor 120/90 V. M·6·7 A.C. Impedance 120/90 V. 10,000 ω



of around 6-8 volts; but not of the order implied by the use of two stages of efficient L.F. amplification on local transmissions. Practical trial showed this to be the case, as a large volume of sound was obtainable without distortion except when quite hard pressed and nearing the practical limit of a large loud-speaker. For the loudest transmissions an extra supply of H.T. up to 250 volts, with correspondingly increased grid-bias, proved necessary. As a detector the valve operated well under similar conditions to those given for the P.V.6.

For distortionless loud-speaker reproduction under ordinary domestic conditions of reception these small power valves can be well recommended, the P.V.5 D.E. in particular, in conjunction with a 6-volt L.T. battery. The performance of the samples was noticeably uniform.

EDISWAN A.R.D.E. VALVE. (H.F.)
Fil. 1·8 Volts 0·28 Amp. Mean Amplification Factor 60/90 V. M=10 A.C. Impedance 60/90 V. 40000 ω

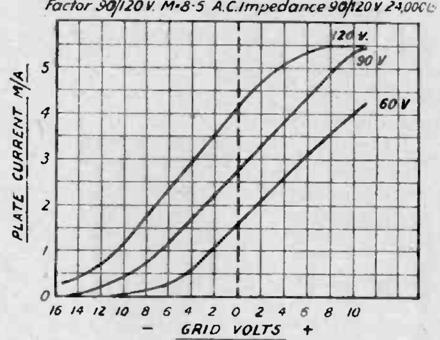


Ediswan A.R.D.E. Valves

Two samples each of the new L.F. and H.F. patterns respectively of the familiar 2-volt .3 ampere D.E. valve have been sent for our test by Messrs. Edison Swan Electric Co., Ltd., and have been submitted to extensive tests. These have the usual vertical cylindrical anode and straight axial filament, with a spiral grid; the anode of the H.F. (red line) pattern is larger in diameter, and the grid appears to be a little more open than in the L.F. (green line) valve. The rating is the same in both cases—1.8-2 volts and 0.3 amperes, with 20 to 100 plate volts.

On test, the H.F. valve showed straight characteristics and a moderate available grid-volts swing on 60 volts H.T., at which voltage practical trial showed that it functioned well as an H.F. amplifier. The voltage-amplification factor came out at the satisfactory figure of M=10 in the 60-90 volt region, the valve being operated at the convenient figure of 1.8 volts and 0.28 amperes in the filament. The maximum emission under ordinary working conditions was around 5 milliamperes at this filament heat; grid current was noticeable above 0.5 volts negative, and was quite large at zero grid volts. For detection a high grid-leak and 30 volts H.T. appeared suitable except for strong signals, when 50 volts H.T. and as low as 1 megohm leak were best. In L.F. amplification, for which the valve was not designed, but moderate power could be handled with 120 volts H.T. and 4 volts negative grid-bias.

EDISWAN A.R.D.E. VALVE (L.F.)
Fil. 1·8 Volts 0·28 Amp. Mean Amplification Factor 90/120 V. M·8·5 A.C. Impedance 90/120 V. 24,000 ω



The impedance was fairly high—40,000 ohms at 60-90 volts.

The L.F. pattern showed, on test, a more modest amplification factor, around 8.5 in the 90-120 volt region, and a much lower impedance of 24,000 ohms here. The maximum plate current was well over 5 milliamperes; the characteristics showed a large available swing of grid volts on the 120-volt curve, with 4-6 volts negative grid-bias. On practical trial, moderate loud-speaking resulted under these conditions on a local transmission. As a rectifying valve this valve was better than the H.F. type; with 22 volts H.T. and a 4 megohm leak, or with 30 volts and an 8 megohm leak, excellent long-distance reception resulted and smooth reaction; or for local loud transmissions with full H.T. and a low-value leak. The valve oscillated with ease. Grid current was small below the zero grid-volts point, but increased rapidly above this point.

It was noticeable with both L.F. and H.F. valves how very uniform in their characteristics the two samples of each submitted proved to be. For their specific purposes these valves should give every satisfaction.

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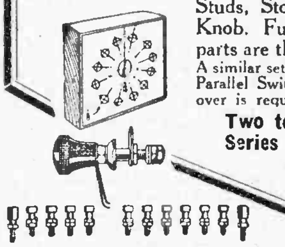

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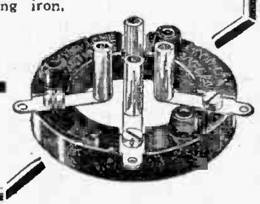

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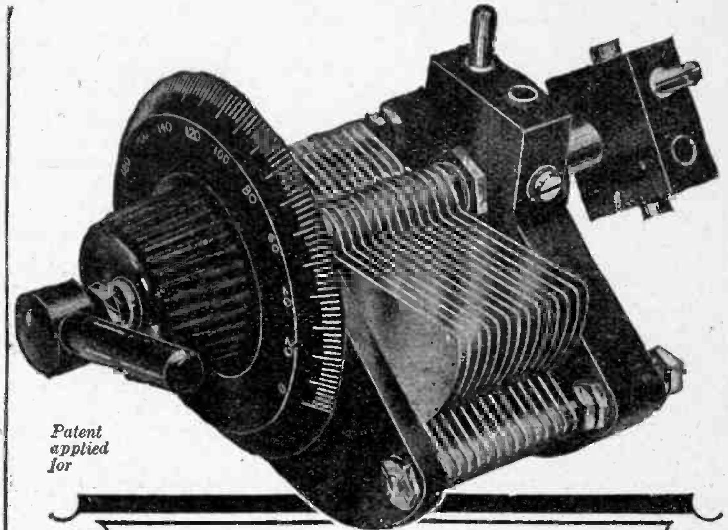

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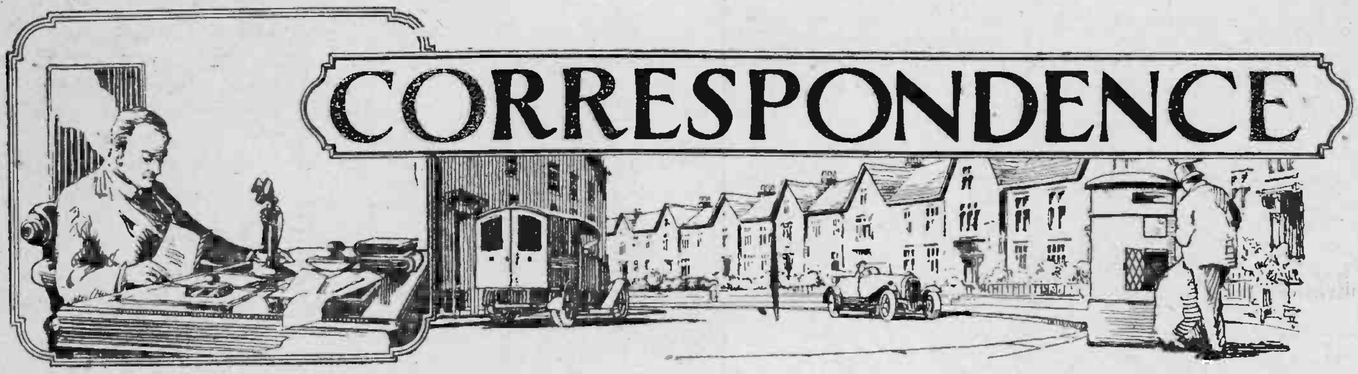


ENVELOPE NO. 3

SIR,—I feel I should like to tell you of the results I have had from the "Three-Valve Simplicity" set as described by G. P. Kendall, B.Sc., in Radio Press Envelope No. 3. May I tender my thanks for the extremely simple way in which every detail is described. This was especially beneficial to me, as that was the first set I had ever constructed, and I am only sixteen. Birmingham and Daventry come in with tremendous strength, and have to be considerably de-tuned to be at all comfortable to listen to. I have a room at the top of the house at the back from which 80 ft. of Electron wire laid double runs to the front room and the loud-speaker. One evening, a few days ago, while Birmingham, our local station, 3½ miles away, was on, I received London (100 miles) at excellent loud-speaker strength; in fact, it could be heard all over the house. Manchester comes in just as well, and Bournemouth almost as well. These stations are free from interference from Birmingham except for a faint background absolutely inaudible when music is on from the station being received. Cardiff, which I believe comes in very badly round here, we have received about as well as Bournemouth, with a more appreciable background from Birmingham, but not enough to prevent any enjoyment of the programme. Aberdeen, Glasgow and Newcastle are loud on the 'phones, while Belfast comes through as well as Bournemouth on the loud-speaker. Of the relay stations, Nottingham is the best, being as good as Manchester, although with more interference from Birmingham. Stoke-on-Trent and Leeds-Bradford are good loud-speaker strength, while Liverpool is audible twenty feet away from the loud-speaker. Swansea, Dundee, Edinburgh, Plymouth and Sheffield are received at loud 'phone strength while Birmingham is not broadcasting.

Of foreign stations, I have received Madrid, Barcelona, Radio-Paris and Radio-Toulouse at excellent loud-speaker strength. I have also heard on the 'phones Hamburg, Zurich, Brussels and Rome, and numerous other stations which I have been unable to identify. I think these results speak for themselves as to the undoubted efficiency of the set. In fact, a friend with a much more complicated three-valve set cannot get nearly such good results. Thanking you for the description of the set and wishing your periodicals every success in the future.

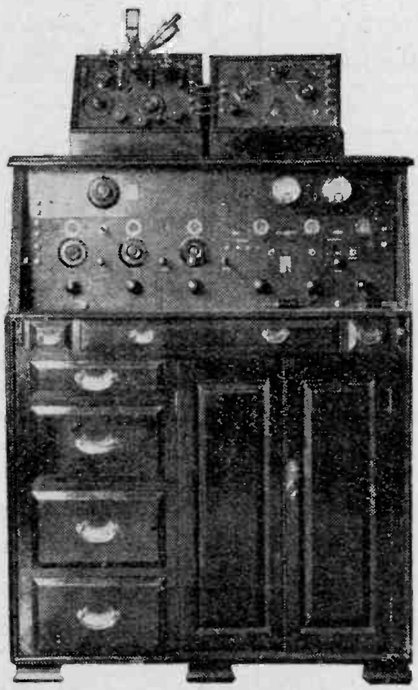
Yours faithfully,

W. G. JOHNSON.

West Smethwick.

THE ANGLO-AMERICAN SIX AND TRANSATLANTIC V

SIR,—The enclosed photograph of my Anglo-American Six (*The Wireless Constructor*, January and February issues, by Percy W. Harris, M.I.R.E.) with the original Transatlantic V (*Modern Wireless*, November, 1923, by



Mr. Marlow's handsome Anglo-American Six receiver with his Transatlantic V set above.

Percy W. Harris, M.I.R.E.) may interest you. You will note that the panel of the A.A. Six has been extended to take an ammeter, milli-ammeter and the special A.A. Six wavetrap. The set slides out when required. As the panel is set back 6in., this makes the operation of the set comfortable, and provides space for 'phones, coils, etc. The top lifts back on hinges for changing coils, etc. The cupboard is divided into two, the top half taking the H.T. batteries and the bottom the L.T. battery, the leads from which are all out of sight. There is ample room in the drawers for coils, H.F. transformers, etc., which are to hand when wanted. I am very pleased with the set, and find the milliammeter very useful in tuning. I have fitted C.A.T. and find it an improvement.—Yours faithfully, FRANK MARLOW.

Didsbury.

THE ANGLO-AMERICAN SIX IN SWITZERLAND

SIR,—It may interest you to hear that one of your "Anglo-American Six" receivers (described by Percy W. Harris, M.I.R.E., in the January and February issues of *The Wireless Constructor*) has been constructed and is now in service on the highest observatory of the earth. Jungfrauyoch is at 11,000 ft. above sea level, in the Swiss-Bernese Alps. Continuous snowstorms sweep the place, and even in the finest weather the temperature stays far below zero.

The set has been in operation now for four months, and gives excellent results. On some occasions receiving conditions are astounding, and as many as 25 stations are heard on the loud-speaker. On other occasions only a few stations come in clearly. Local static discharges are sometimes very strong, and on one occasion destroyed part of the set. The antenna consists of nearly 300 ft. steel wire, which runs between two rocks along an ice slope, and which is continuously covered arm-thick with ice, so proper insulation is an absolute impossibility. On the high-power stations, such as Daventry, Paris, etc., the second low-frequency stage gives practically too much power for the small loud-speaker. Nearly all other stations come in at full loud-speaker volume.

On a station of the Jungfraubahn Railway (at 7,200 ft.), a first-class American super-het. is installed. It seems as if this kind of apparatus does not suit our receiving conditions. Atmospheric noises are amplified so much that no speech or music can be followed. Your "A.A." set is giving great service to the station, as weather reports are received daily from Rome, Zurich, Paris, London, and at midnight from Norddeich; time signals from London, Paris and Berlin.—Yours faithfully, ALFREDO KOLLIKER,

Observer.

Astronomical Observatory,
Jungfrauyoch.

A SIMPLE SHORT-WAVE RECEIVER
(*Continued from page 91*).

denser to one side of L1. This passes through a hole drilled in the corner of the detector valve mounting, so as to support it and prevent vibration on account of its length.

Connecting Up

Having completed the wiring and checked it over, the two valves should be inserted in their holders and two coils into their mounts, say, the 7-turn coil for L1 and the 10-turn for L2. Connect the L.T. battery first, and see that the valves are correctly controlled by means of the filament resistances. Next connect the H.T. battery, and, with C2 set at zero, plug the 'phones in. Increasing the value of C2 should result in a soft plop being heard in the 'phones as the set goes into oscillation, and, provided that the coils have been wound in the same direction, this will occur unless the H.T. and L.T. values are too low.

Operation

If everything is all right, connect the aerial and earth to A2 and Earth respectively, and see if the set will oscillate over the whole range of the tuning condenser. If not, the aerial should be transferred to A1, and in nine cases out of ten this will be the right terminal for the aerial to be connected to. A very short aerial, such as an indoor aerial, should preferably be used for the reception of stations working on less than 40 metres (7,496 kc.), as it will probably be found that there is very little diminution of signal strength as compared with a large or outside aerial, while any atmospherics that may be present will be greatly reduced.

On wavelengths above 40 metres it will be found that the setting of the reaction condenser C2 will have but little effect on the tuning; below this, however, it may be found that, as C2 is decreased (so as to get the set just on the oscillating point), C1 needs to be increased, and *vice versâ*.

Wavelength Ranges

With the four coils of the sizes given, the writer's receiver will tune approximately as follows:—L1 7-turn, L2 10-turn, from 88 metres to 24 metres (3,407 to 12,496 kc.); L1 4-turn, L2 5-turn from 45 to 15 metres (6,663 to 19,988 kc.). If a 3-turn coil is constructed for use as L1 and the 4-turn coil used in the grid circuit, the minimum wavelength on which the receiver is capable of receiving is in the neighbourhood of 12 metres (24,985 kc.).

Test Report

The receiver has been given a pretty thorough test, and has been found to be most efficient. Swedish, Belgian, Dutch, German and French amateurs have been received at excellent strength on an indoor aerial about 15 ft. long on the 40-80-metre bands. On 20 metres Canadian 1AR has been received comfortably readable at 2255 G.M.T. American 1II was strong on the same aerial on 20 metres at 2323 G.M.T., the latter reporting an input of only 90 watts. Many telephony transmissions have been heard on the short waves, but their exact origin was not an easy matter to establish.

The writer would be glad to receive reports as to this receiver's action under varying conditions, as he is inclined to be of the opinion that reception conditions in his particular neighbourhood are none too good.

THAT elusive distant station will readily respond to Western Electric Head Receivers. Remember that the best components give the best results in the long run and you cannot do better than pin your faith to apparatus that has been proved by all wireless experts. Western Electric Head Receivers are fitted with a leather covered head band to ensure greater comfort for the listener. Write for our new Booklet No. W 546.

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Western Electric Head Receivers

L.E.S. (FOLKESTONE) asks us for a theoretical circuit diagram of a selective four-valve receiver, employing a high-frequency stage with Neutrodyne control, a valve detector and two transformer-coupled low-frequency amplifiers. A separate H.T. tapping is required for each valve, and a switch to cut the last completely out of circuit if required. The set is only required for the reception of stations on the lower broadcast band.

In Fig. 1 we give a circuit of a four-valve receiver, which should adequately meet our reader's requirements, whilst still being simple to operate. In order to obtain good selectivity without the further control necessitated by a normal loosely coupled arrangement, a low-loss coil has been shown for the aerial circuit, tapped suitably to obtain a semi-aperiodic aerial system. The coil may be wound on a Collinson type low-loss former 3in. diameter and 6in. long, and should consist of 80 turns of 22 s.w.g. enamelled wire wound in the slots provided to give suitable spacing. One end of the coil should be taken to the grid of the high-frequency valve and the other to the earth terminal, whilst the aerial tapping is made between 15 and 25 turns from the earth end. With most aerials it is not advisable to reduce the number of turns between the earth connection and the aerial tapping below 15, since although selectivity is improved, signal strength may suffer. A coil of this type with a parallel condenser of .0005 μF should adequately cover a range from below 300 metres (1,000 kc.) to somewhat above 500 metres (600 kc.).

For the H.F. coupling, either a neutrodyne unit or two plug-in coils of low self-capacity may be used, the anode coil L_3 being tuned by a parallel condenser of .0003 μF. Where plug-in coils are used, L_2 and L_3 should be of the same size, mounted close together so as to be separated only by a small distance, such as $\frac{1}{8}$in., and should be of such a size as to cover the same wavelength range as the grid coil L_1. NC is an ordinary type neutrodyne condenser. Magnetic reaction has not been introduced by the usual method of a coil in the plate circuit of the detector valve coupled to the grid coil L1, since reaction effects may readily be obtained by slightly upsetting the balance of the neutrodyne condenser.

To cut the last valve in and out of circuit, whilst at the same time permitting the two amplifying valves to have separate high-tension tappings, a 3-pole 2-way switch is necessary. The connections to this are fairly straightforward, and it will be seen that with the switch in the upward position four valves are employed, whilst in the lower the last valve is cut out of circuit, the loud-speaker then being inserted into the plate circuit of V3, and V4 extinguished. Separate grid bias tappings have been indicated for both L.F. valves, being shown as G.B. – 1 and – 2 respectively.

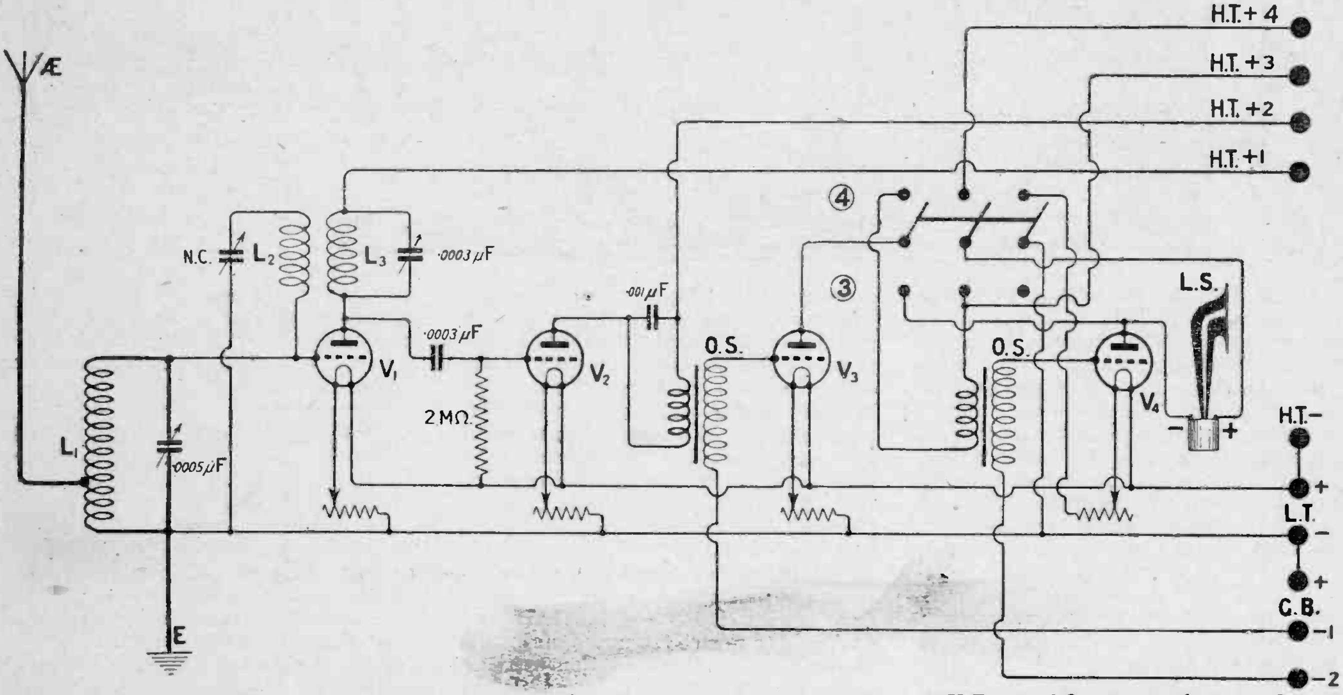

Fig. 1.—The circuit diagram of a selective four-valve receiver, employing a stage of H.F. amplification with neutrodyne control and a switch for providing one or two stages of L.F. amplification. (L. E. S., FOLKESTONE.)

We Ask for Your Criticism

In our endeavour to improve "Wireless Weekly" at every appearance, we are particularly desirous of ascertaining which features our readers find most acceptable and what further features they most desire. If they will answer the questions printed on this page, tear out the page and return it to us, they will help us materially in our efforts to produce just the periodical they want.

1. Which features in *Wireless Weekly* do you like best?

2. Would you like *Wireless Weekly* to give more designs for receiving sets, or do you think that these should be left to the other Radio Press publications which cater more particularly for the constructor?

3. Have you any suggestions for regular features?

4. Is the type used in *Wireless Weekly* too big, too small, or satisfactory?

5. Do you think we neglect any aspect of wireless which you regard as suitable for treatment in *Wireless Weekly?*

6. Do you like articles on transmission?

7. Would you like more attention given to reception on other wavelengths than the normal broadcast bands?

8. Would you like more or less attention given to short-wave subjects?

9. Do you want more theoretical or practical research articles?

10. Do you desire the humorous feature to be continued?

11. Do you wish the feature "Information Department" to be continued? It is to be understood that this feature does not provide a means of answering any individual reader's queries, since these are all dealt with by post. The queries published, with their answers, are only selected as a matter of general interest.

12. Place in the order of your preference the names of the more regular contributors to *Wireless Weekly.*

13. Do you wish to have more articles dealing with the theory of the Super-Heterodyne?

14. Do you wish for series of articles of an instructional type?

15. Which articles appearing during the last few months do you consider the most valuable?

16. What general criticism have you to make? The more outspoken your remarks, the better.

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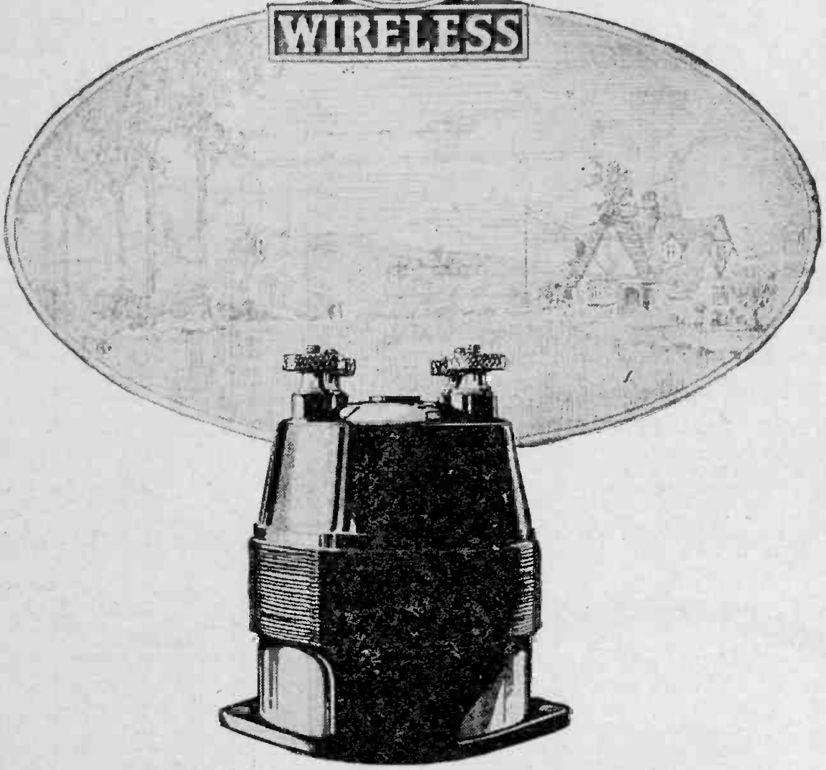

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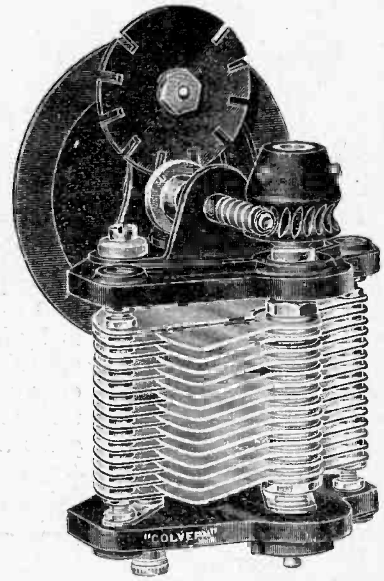

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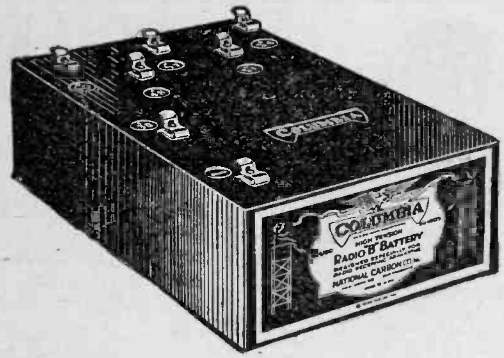

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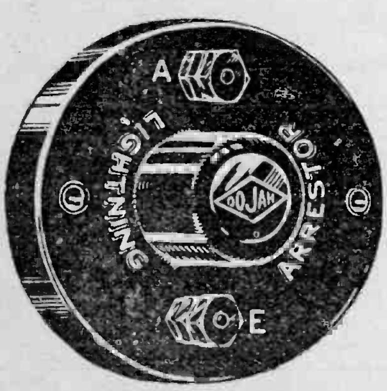

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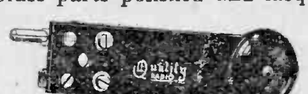

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REAL SERVICE - HIRE OR MAINTENANCE

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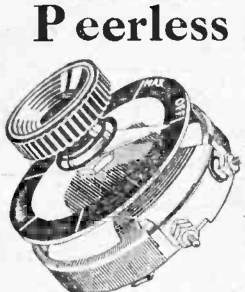
Peerless in name *and* in performance



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6, 15, or 30 ohms.
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Wireless Wonders at Westminster!

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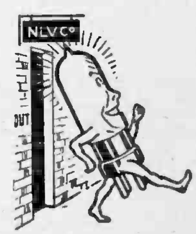

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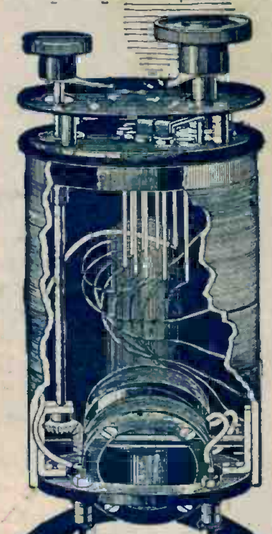

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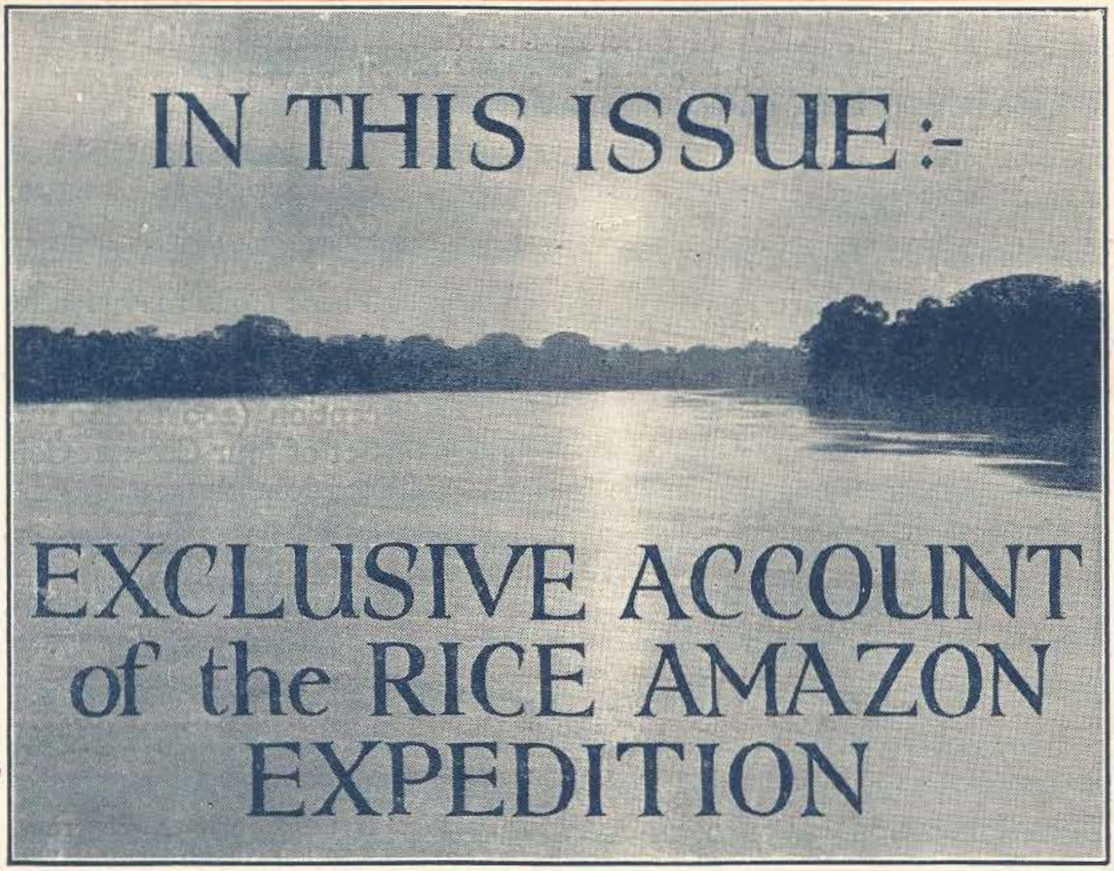

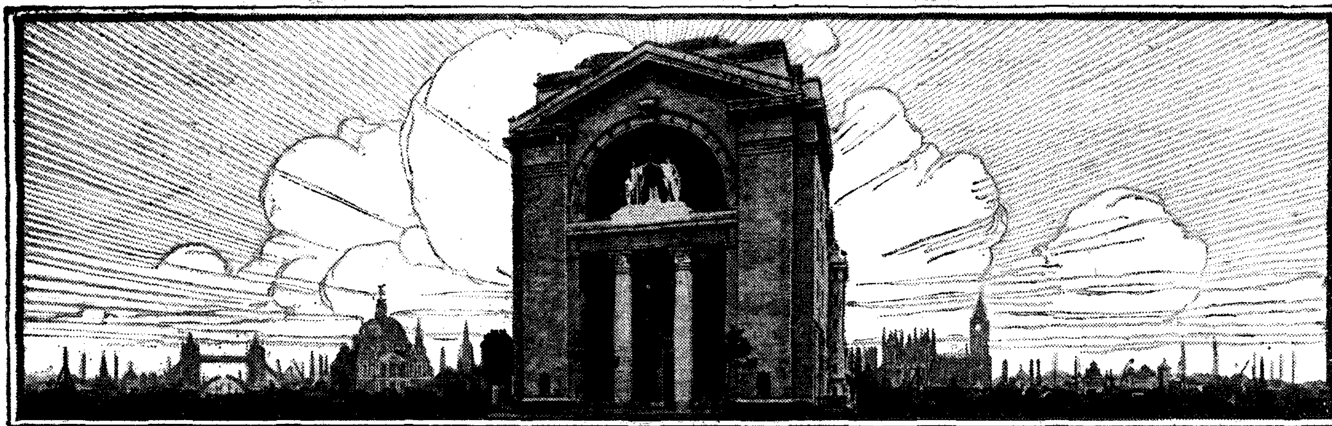

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The Oscillation Peril

WITH the passing of Summer Time and the lengthening of the evenings, telephone receivers will be donned far more regularly and for longer periods than has been the case during the past summer. It does not require much prophetic vision to see that the coming winter will be the greatest radio winter we have yet experienced, and whether or not the full enjoyment of it is the state promised will depend largely upon the amount of radiation that takes place from regenerative receiving circuits. Most readers of *Wireless Weekly* are, of course, well able to handle their receivers in such a way as not to cause interference to others, and while there are some skilled offenders, we believe that practically all the trouble arises from mishandling of sets by those who are quite innocent of any intention to give trouble to their neighbours.

What is the main howling trouble? Does it not arise from the adjustment of sets in such a way that oscillation is taking place and the circuit is just detuned from the carrier wave so as to give a "wail"? If the "wail" heard passes backwards and forwards through the zero point very slowly, it is an indication that the listener is trying to settle down on the zero point of the beat note. On hearing the howl arising from this maladjustment, many people—even experienced wireless men, picture a listener frantically swinging his dial backwards and forwards in a vain hunt for the station he cannot hear. It is not generally realised that these wailing howls generally arise from very slight movements of the dial.

Between the wavelengths of 370 and 380 metres there is a difference of roughly 20 kilocycles, from which it follows that variations in tuning of an oscillating receiver by even a metre would take the beat note from inaudibility to a high piercing whistle.

Readers of *Wireless Weekly* can do much good by short chats with their less experienced friends, pointing out to them that the slightest movement of the dial, when the receiver is oscillating, will cause the trouble to which we have referred; that, even if they are lucky enough to maintain the set on the zero beat, reception in this way is always distorted; and finally that British sportsmanship is required, if wireless is to become a universal hobby.

CONTENTS.

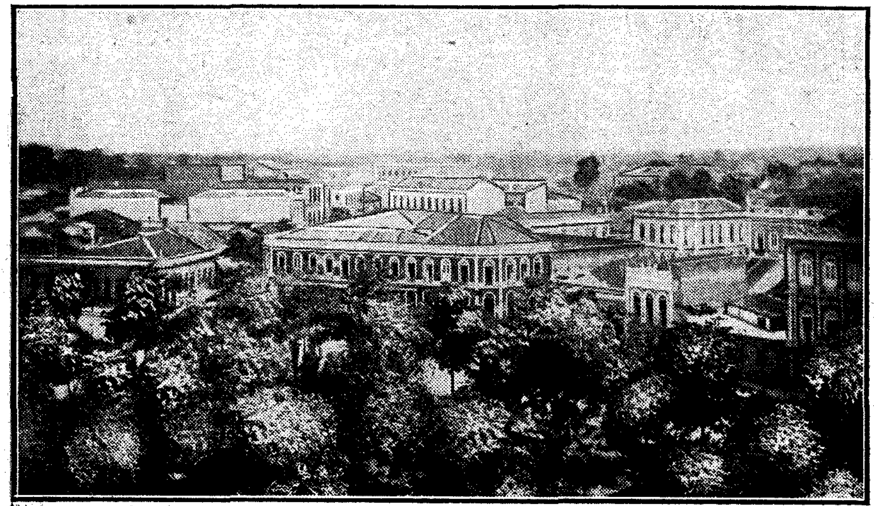
Edited by
JOHN SCOTT-TAGGART,
F. Inst. P., A.M.I.E.E.

October 14, Vol. 7, No. 4.

Wireless with the Rice Amazon Expedition

By T. E. McCALEB.

The author of this article is the wireless operator who kept the Rice Expedition in touch with civilisation from the hitherto unexplored districts of the River Amazon. He gives here some of his personal experiences.



A general view of Manaos, distant over 1,000 miles from the mouth of the River Amazon, which was intended to be a link in the wireless communications between the expedition and New York.

ONE of the outstanding features of the Hamilton Rice expedition to South America in 1924-25 was the successful radio communication carried on between the two radio stations of the expedition with the various points in the civilised world.

Regardless of practical experience and knowledge of combating the elements of the wilds, an expedition cannot plan every preparation for supplies to maintain them for an estimated period of time to reach a goal the position of which is merely calculated, and the intervening territory unknown.

Advantages of Wireless

Many causes that delay progress occur, and wireless can be used to send a request for additional food supplies and medicines. With wireless the party can keep its base or headquarters informed of immediate discoveries, of its progress and of its necessities.

Often while the party may be only 100 miles from civilisation, communication by post to keep those interested in the welfare of the members of the party informed may require many months. This news, welcome as it is, is not satisfactory, because of the time which has elapsed. But with wireless, word may be sent and received in a few minutes.

The Rice Expedition was kept in touch with the world by the A.R.R.L., the original scheme of communication on long waves with the Brazilian station at Manaos having failed because of adverse atmospherical conditions.

Failure of Long Waves

After interruption on the long waves occurred the writer got into communication with 2CVS in New York City, who volunteered to maintain a schedule each night so that communication could be resumed with the outside world. This method was a tremendous time-saver when compared to the earlier process of radio communication from the base station to Manaos, and thence to New York via cable.

Later, a consistent schedule was maintained with Station 2MC at New York, who very efficiently kept a mighty volume of two-way traffic moving.

Other Stations

A number of other American amateurs rendered a great service by accepting messages from persons in the States for the expedition and receiving expedition messages for the United States, not to speak of many times when they stood by for other traffic.

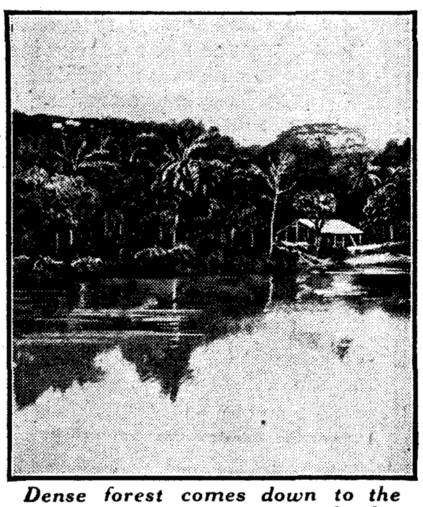
The greatest distance covered was that in exchanging signals and conversation with New Zealand station 2AP, located at Wellington, at a distance of approximately 8,500 miles from our party.

Mr. Gerald Marcuse, of Station 2NM, at Caterham, near London, was the chief English station to connect with the expedition. His station handled several long messages from Dr. Rice to the Royal Geographical Society.

Station 2AG, owned by Mr. S. R. Runyon and located at Yonkers, N.Y., established a record by receiving a message from an individual in New York and telephoning the reply back, which had been received from the expedition, in approximately eight minutes from the time the message was filed.

The Aeroplane

During a period in the dry season when the water was rapidly falling, the advance party had penetrated a considerable distance. The aeroplane, with its pilot and photographer, were awaiting word when a flight could be made to meet the party and for vital information concerning landing conditions. Without these reports the plane would have been flown to a spot where the party was encamped, and, in landing, might have run into rocks below the surface of the water, which would have resulted in a serious mishap. The plane being used was of the scout type, with the engine supported above the head of the pilot on a single strut. Any considerable jar would cause the engine to come falling on to the pilot's head, which might be classified at least as unpleasant; as it was, the radio link between the advance



Dense forest comes down to the water's edge on the Amazon banks.

party and the base kept the pilot well informed of the conditions he would have to meet.

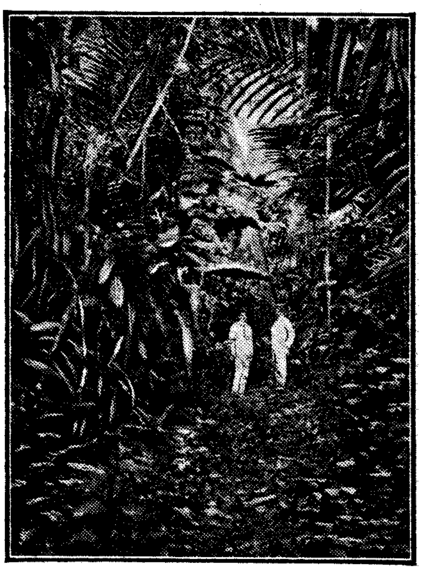
The Base Station

The equipment at the base radio station located at Boa Vista on the Rio Branco consisted of a transmitter using eight 50-watt tubes to generate a power of 400 watts for communication with Manaos, 400 miles south, at a frequency of approximately 100 kc. (3,000 metres).

There are several interesting points in connection with the short-wave receiver and transmitter which will be interesting to the reader who has never found it necessary, in his radio experience, to deal with the diabolical tropical static.

Transmitting Apparatus

The transmitter, instead of following the usual plan, is built upon the tuned plate idea. The inductances—and most of the set, for that matter—were constructed out of parts of the long-wave set and spares carried to the base section. Long before the time set for the return of the party the large valves, 50-watters, began to show signs of disintegration. Not wishing to leave things entirely at the hands of chance, small 5-watt valves were arranged in series to furnish the necessary power. By soldering them to a circular ring very good results were obtained. This particular method of mounting kept the effective inductance in each of the valves the same, so that the maximum output was registered in the aerial ammeter.



The difficulties of wireless in country of this sort can be readily appreciated.

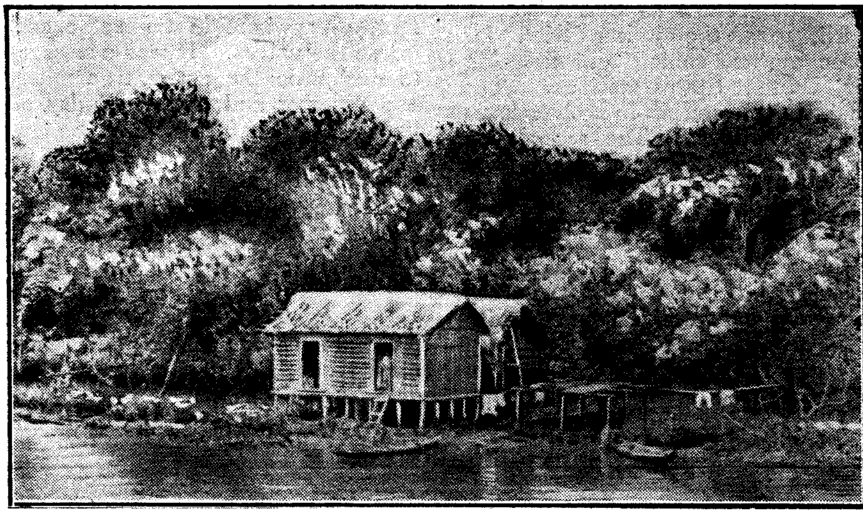
Short-wave Receiver

The receiver is novel. The static conditions were such that the standard circuit sorely tried the operators owing to atmospherics; so, instead of coupling the aerial and earth directly to the tuning inductance of the high-frequency valve, as is ordinarily done—the complete set consists of one H.F. detector and one L.F.—the aerial was connected directly to the plate of the detector and then coupled to the high-frequency valve.

A further decrease in static is obtained by using a very low aerial, possibly only 10 or 20 feet above ground, and very short. Both these decrease the signal strength, but at the same time they decrease the static more, resulting in a net advantage.

Power Supply

The original engine, which was to have been the primary source of power, was a small air-cooled motor-bicycle engine that flew to pieces due to the centrifugal force. An outboard canoe motor was belted to a small generator which furnished power for charging the 12-volt, 80-ampere-hour storage battery. This supplied the dynamotor for the transmitter, which had an approximate power output of 25 watts. The aeroplane mechanic acted as "engineer" when it became necessary to float the generator and battery together for increased power. Upon signal from the operator the engine was shut down for reception. This method was not necessary at all times, since the battery had sufficient charge for 1½ hours' communication.



A typical view on the lower and more open reaches of the Amazon.

Tropical Difficulties

At the next semi-permanent camp the portable station was again erected in the midst of the thickest jungle. But at this camp, which was a little further north and west, there were hills more than 1,000 feet high that entirely surrounded the camp. During terrific tropical storms no difficulty was experienced in communicating with a number of New England and Eastern Seaboard stations, as well as one Canadian.

Fading

Contrary to results showing a great decrease in received signal strength during daylight, the signal from LR at 10 a.m. on several occasions proved to be approximately equal in strength to the night signals. Power conditions were the same in both cases. The distance is about 200 miles. The writer had an excellent opportunity to work stations during partial daylight and darkness on January 18 this year. 9ZT at Minneapolis, Minn., was worked during absolute darkness at Boa Vista. Gradually dawn appeared and then bright daylight about 6.40 a.m. 60th meridian time. The two stations, WJS and 9ZT, signed off. The only perceptible difference was an uncanny clarity in 9ZT's signal just at the crack of dawn. Over the remainder of the change in darkness to light no change could be noted.

An instance of wave-jumping occurred when Station LR, after calling United States stations and hearing no answer, decided to quit on account of unfavourable weather conditions. But he heard, just as he was closing down, from a

Canadian station. Later, in a letter from this station, the operator said: "I was surprised to hear you have been unable to work stations in the States for the last week." It is quite obvious that our waves were skipping several thousand miles. The following night reception was again normal.

Communication with U.S.A.

On the return to Boa Vista, in April, 1925, the writer tried for three nights, calling and listening for United States stations. The final night a station in Philadelphia took all traffic. The records on which the stations were logged have been mislaid.

At the final semi-permanent camp, where the expedition changed from native canoes to smaller dug-outs belonging to the Indians, the wireless equipment was left behind with other material.

When the party had returned to the other side of the five-mile portage the writer and the aeroplane mechanic journeyed over to prepare another canoe and send our numerous messages telling of the expedition's success in reaching its goal high up in the Parima Mountains that form the northern boundary of Brazil, forming the borderline between that country and Venezuela.

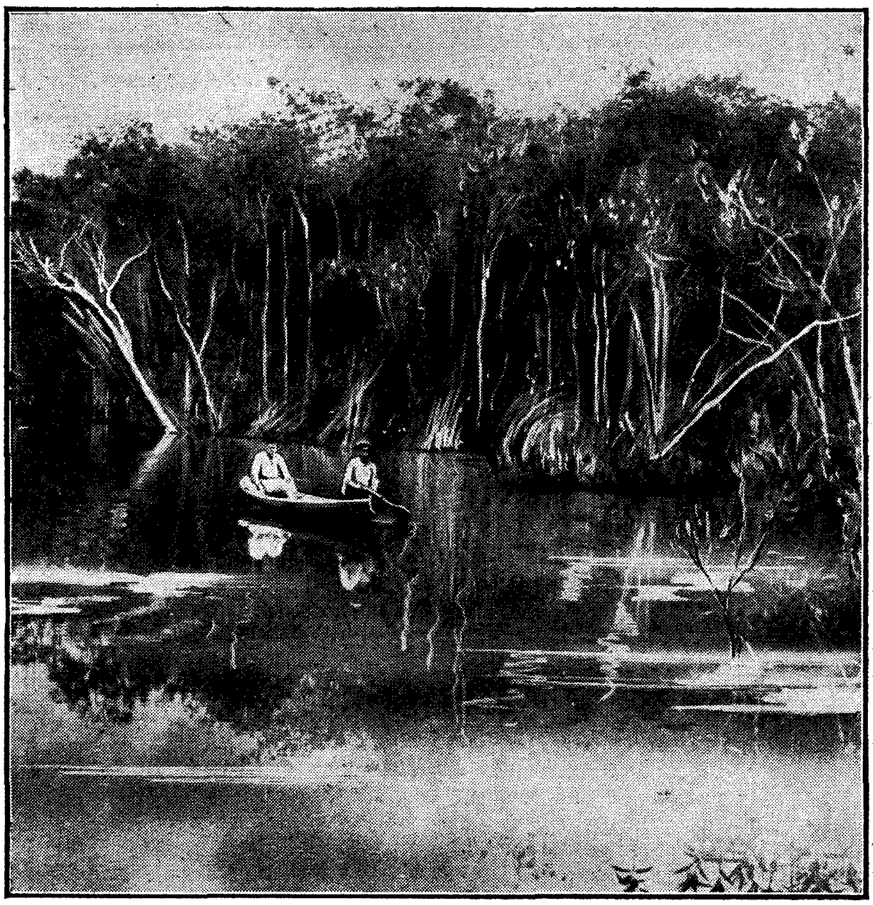
Unusual Troubles

When the trunk in which the entire portable station had been packed was opened, it was found to contain multitudes of ants and their eggs. They had made homes between the condenser plates—in fact, everywhere in the set except inside the valves. It was necessary to dismantle the entire transmitter and receiver and clean and dry all parts.

But, thanks to the station in Philadelphia, about six messages reached their destination, making known to the world that we were safely on the return voyage after the most difficult portion of the trip.

Time Signals

Besides communications, wireless played another important rôle in determining chronometer rates from the received time signals sent out from various government stations. Usually the Press and time check from Balboa, Panama (NBA), was received. The time check from NBA was found to be unreliable for extreme accuracy, and so it became necessary to change and pick up the signals from NSS.



It was sometimes necessary to receive the noon time signals while actually under way on the river in a canoe.

Long-wave Receiver

The long-wave receiver consisted of three valves connected in the usual manner, and had a loop for its collector. Although rather out of the ordinary in constructional details, this receiver worked at all times, despite the drizzling rain and soggy ground on which it often rested. At times it would require a drying by the camp fire to drive the moisture out of the headphones and loop.

Reception Under Difficulties

The most interesting experience in obtaining the time check was brought about by the necessity of receiving the noon time signals while under way in a small canoe bound down stream at a seven-mile per hour rate, dodging some rocks and hitting others. It was decided not to waste any time in going ashore, so the apparatus was set up, and the operator cautiously stood in the canoe, supporting and rotating the loop of the set to maintain maximum signal strength. This was highly essential, as the canoe followed all sorts of crooks and turns in the river. Perfect checks were obtained, and no time lost on our downward journey.

Phenomena Noted

However, it can be stated that one important discovery was of the association of the presence of high winds with an increase in atmospheric disturbances. This, no doubt, directly follows the theory of dust moving at a high velocity, giving rise to the atmospheric charges which affect radio receivers.

It can also be said that local meteorological conditions have no perceptible influence on the reception of wavelengths below 100 metres. Radio communication from South America to North America on short waves in the vicinity of 80 metres will not be as reliable during the summer months of North America. This fact cannot be attributed to any definite reason. A curious phenomenon observed was the complete trapping of short-wave signals for several days at a time, while again later they would come through with strength.

[We are indebted to the Booth Steamship Co., Ltd., organisers of the Amazon Cruises, for permission to publish the photographs illustrating this article.]

Practical Short-Wave Reception

I.—THE CHOICE OF A CIRCUIT.

By G. P. KENDALL, B.Sc., Staff Editor.

The reception of the shorter waves is becoming a matter of greater and greater interest, and no doubt many readers will be turning their attention to this subject during the coming autumn and winter. For the particular assistance of readers in this position, a special series of articles is being written by Mr. Kendall, which are intended to form an introduction to the subject in its practical aspects.

UPON first taking up the subject of short-wave reception, by which I mean the reception of signals upon frequencies of 1500 kc. and above (200 metres and below), one is at first apt to think that all that is required is a receiver suitably modified as to its wavelength range, and that the experience gained on the broadcast band will suffice in the new field.

Difficulties at High Frequencies

As a matter of fact, however, the experimenter who starts off on this assumption is likely to receive quite a number of surprises, possibly starting with the initial one of discovering that although he has made the necessary alterations to his circuit and turn numbers and so on, the set will not oscillate, whatever steps he takes. And following on this, when, by the assistance perhaps of some more experienced friend, he has overcome his first trouble, he may find that although the set will oscillate, and give all the signs of functioning correctly, he simply cannot find any stations, in the end discovering that the reason is that he has quite large variable condensers incorporated in the set, and without any sort of vernier, so that he simply misses every signal, because it is not possible to turn the dials sufficiently slowly.

Choosing a Circuit

The difficulties of the higher frequencies, then, are very real, and much time can be wasted and disappointment experienced for lack of a little guidance from someone who has already experienced and overcome the difficulties in question. The first thing that must be done upon deciding to take up short-wave reception is obviously to decide upon the circuit which

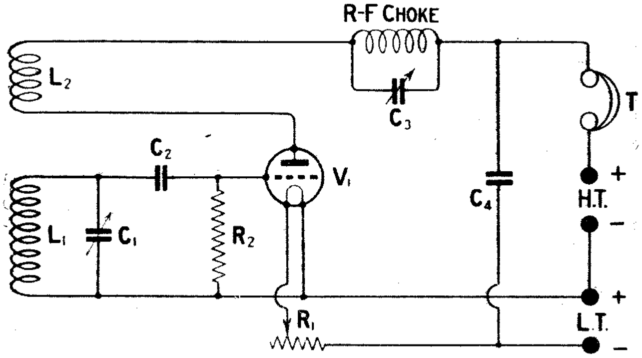


Fig. 1.—One method of producing reaction effects recommended, in which L2 is in a position of fixed coupling relative to L1, and oscillation of V1 is controlled by means of the series by-pass condenser C3.

is to be used, and a discussion of the principal factors involved in making this choice will bring to light a number of the more important points in connection with short-wave reception.

High-frequency Amplification

The first point that must be realised is that the ordinary methods of high-frequency amplification are practically useless upon the really high frequencies, and hence it follows that for fairly simple and straight-

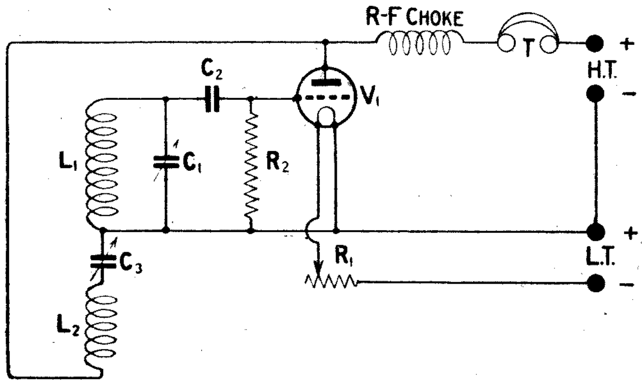


Fig. 2.—A modified form of the Reinartz method of controlling oscillation is shown here, C3 being the reaction condenser.

forward sets high-frequency amplification effects must be obtained by reaction alone. The first valve of the short-wave receiver will therefore be the rectifier, and this, with the aid of a good method of controlling reaction, will produce results upon the higher frequencies, which will seem very wonderful to those who are accustomed to the limited carrying power of the frequencies associated with broadcasting.

Low-frequency Amplification

To ensure good signal strength in the headphones from practically every station picked up, it is advisable to add a second valve as a note magnifier, and I therefore advise that the reader's first set should consist of two valves, a detector and a note magnifier. This combination, providing that the receiver is designed in accordance with certain rules which will be laid down presently, will be found to give adequate results for all general purposes. If the reader desires to work a loud-speaker from one of the telephony stations, such as KDKA, a second note magnifier valve should, of course, be added, and some scheme of switching provided to bring it into use for this special purpose. It is not desirable to use the three valves for headphone work in general.

Control of Reaction

Since we are to depend upon reaction for the amplification of the signals prior to rectification, it is obvious that it is well worth while to devote considerable attention to the details of the reaction producing and controlling methods available. It may be laid down as a general rule that the scheme of a swinging reaction coil, which serves the purpose fairly well upon the lower frequencies, is not suitable for the high ones which we are now considering; the changing of tuning produced by the movement of the coil becomes relatively large, and it is difficult to obtain any delicacy of control.

Magnetic Reaction

A method of employing ordinary magnetic reaction and yet of overcoming to a very large extent these difficulties, is that adopted in the Grebe short-wave set, and this is illustrated in its essential features in Fig. 1.

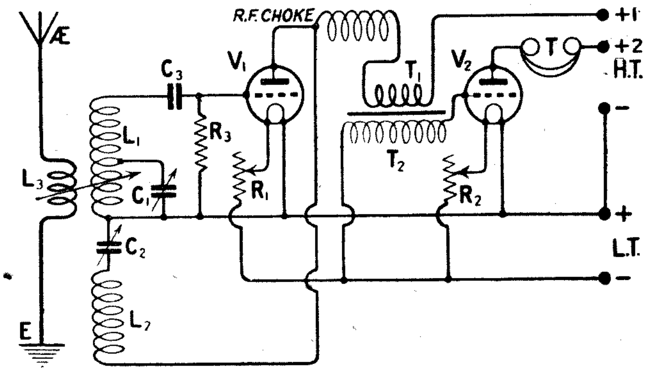


Fig. 3.—A circuit of this type employing a detector and one stage of L.F. amplification, which will be dealt with in detail in subsequent articles in this series.

As will be seen, there is a reaction coil which is placed in a fixed relationship to the grid coil, and the necessary control of reaction is obtained by placing in series with this coil a large radio-frequency choke, shunted by a variable condenser, which serves as a by-pass. Increasing the capacity of this condenser will, therefore, increase the reaction effect, and a very smooth and convenient control is obtained in this way, which has very little effect indeed on the tuning of the grid circuit. This plan may be thoroughly recommended, although it must be understood that a little experimenting with the turn numbers of the reaction coil will probably be necessary to secure satisfactory results.

Interchangeable Coils

Both the reaction winding and the grid winding can be arranged upon the same former, and a little ingenuity will produce some scheme for complete interchangeable units, since it is necessary as a rule to change the size of the reaction coil when the grid coil is exchanged for one of a different tuning range. Under these conditions this scheme is thoroughly practical and gives very good results.

Tuning Range

One of the great difficulties of short-wave reception is the extremely wide tuning range required, so that quite a number of interchangeable inductance units are generally needed, and for this reason a scheme of reaction production which would otherwise be extremely attractive, namely, that in which a variometer is used in the anode circuit of the valve, is practically ruled out. Where only a limited range of frequencies is required to be covered, such as in a set which is designed for one specific purpose, such as the reception of KDKA, a suitable variometer is an extremely attractive scheme, but for general work it is very difficult to cover a sufficiently wide range of tuning.

Reinartz Type of Reaction

The only other reaction method which I have found really effective is some form of the Reinartz method, and probably the majority of short-wave sets use this system. A good method of arranging Reinartz reaction in the type of set which we are considering is that illustrated in Fig. 2, and it will be seen that this is practically the standard Reinartz circuit, the aerial arrangements being omitted. I believe that the majority of readers will not require a detailed explanation of the working of the Reinartz reaction scheme, since this has been given many times, but a little information as to turn numbers, etc., may be useful.

Coil Sizes

Here again complete interchangeable tuning coil and reaction coil units are desirable, and the relative sizes of the two for most purposes with the type of valve most employed for short-wave reception is that the reaction winding L1 shall be something like two-thirds of the size of the grid winding L2. It is wise, however, to provide some means of varying the number of turns upon L1 in use at any given time, since a number of factors may produce quite wide variations in the number of turns required to produce reaction.

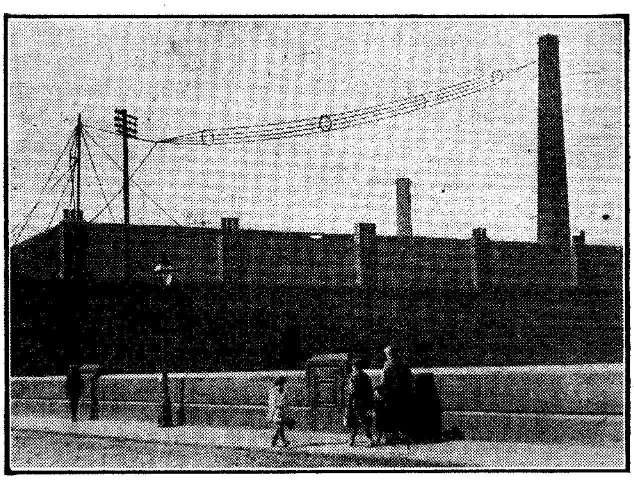
Aerial Systems

It will have been noticed that in neither of the circuits so far given is any aerial or earth arrangement shown, and a few words upon this part of the arrangement are desirable. It must be realised that the greater part of our reception will be upon wavelengths *below* the natural wavelength of the aerial, and it is therefore as a rule not desirable to attempt actually to tune the aerial circuit. One of the so-called aperiodic schemes is probably the best, with a separate winding variably coupled to the grid winding of the receiver.

What is required, in most cases, is a small coil of from 1 to 6 turns, according to the frequency being received, inserted in series between aerial and earth, and variably coupled to the grid coil, and this addition is shown in Fig. 3.

Hand-capacity Effects

Another feature which will be noted in Fig. 3 calls for a word of explanation, and that is the fact that the



The cage aerial of the Sheffield Broadcasting Station is supported by a factory chimney and a single mast.

variable condenser for tuning the grid circuit is connected across only part of the grid winding. This is quite a useful scheme in practice, the effect being to reduce considerably the hand-capacity effects upon the tuning condenser and also to apply a higher voltage across the grid and filament of the valve than would have been available if the condenser were connected across the whole coil.

An Alternative

The latter effect could no doubt have been obtained by the use of a very small variable condenser across the whole coil, since the effect is then very similar, but the desired reduction in hand capacity does not follow. The scheme illustrated, of course, limits the tuning range obtainable with any given coil, just as would the alternative method of using a very small variable condenser across the whole coil to serve the same end of automatically maintaining a large value of inductance in the circuit. When this method is employed, it is therefore necessary to provide a rather larger number of interchangeable coil units.

Construction of Receiver

It will be seen that I have shown in this figure the addition of the necessary second valve as a note magnifier, with a separate high-tension terminal for its anode supply. I will consider this circuit again next week, and deal with the practical points involved in the construction of the set, such as the turn numbers of the coils and the values of various other components.

Super-regenerative Circuits

Before leaving the subject of the choice of a circuit, it is perhaps only fair to those readers of greater experience upon the lower frequencies (longer wavelengths) to mention two other types of circuit which have very distinct advantages for short-wave work, but which are not suitable for the relative beginner. I refer to the super-regenerative circuit and to the super-heterodyne. With regard to the first of these, there is no doubt, of course, that it offers very great attractions indeed for short-wave work, but information is at present decidedly lacking as regards the practical details involved. This state of affairs will no doubt be remedied at an early date.

Super-heterodynes

The super-heterodyne is a very delightful instrument to use upon the higher frequencies, since the extremely critical nature of the tuning and general adjustment of the ordinary reaction circuit are absent in the case of the super-heterodyne. The short-wave super-heterodyne is decidedly more difficult to get into proper working order than one for the broadcast frequencies, and I would strongly urge that no reader who has not obtained considerable experience with this instrument upon broadcasting should attempt to use it for short-wave work. Those who possess the necessary qualifications, however, should, with a little patience, be able to secure the remarkable results of which this instrument is capable upon the higher frequencies also.

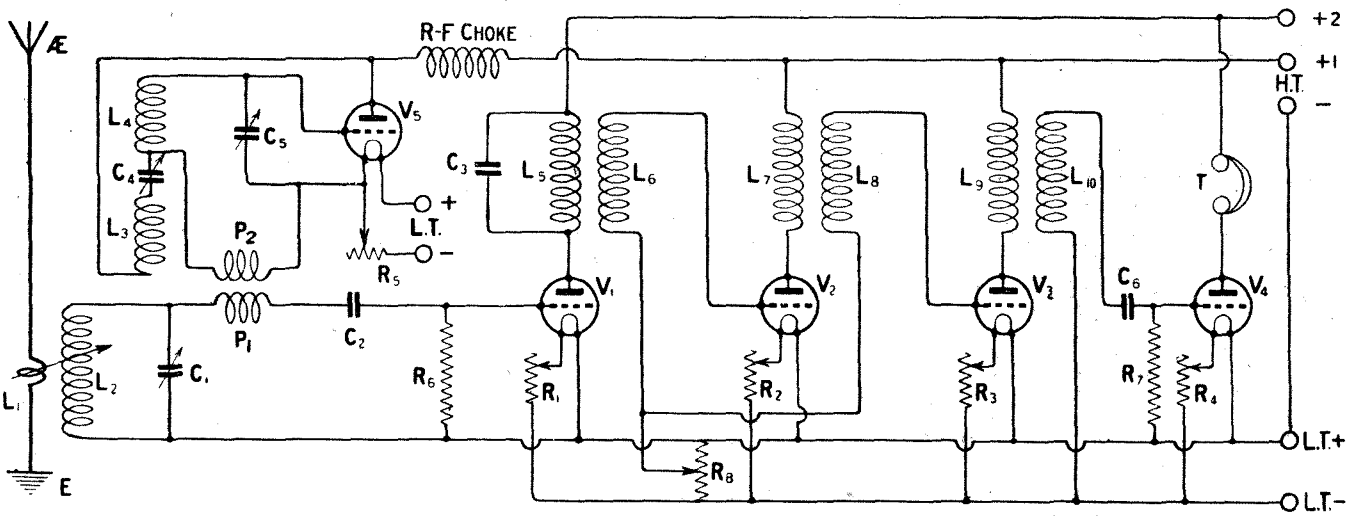


Fig. 4.—The complete circuit diagram of a super-heterodyne receiver, using a separate oscillator valve, V5, coupled by means of two small pick-up coils, P1 and P2, to the grid circuit of V1.

A Practical Circuit

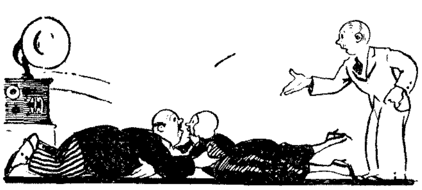
A circuit is given in Fig. 4 which will provide the basis for the necessary work, and this simple set will be found to operate satisfactorily with a very small amount of experimenting with the lay-out of the parts and so on. In the set illustrated only five valves are required, one of these being a separate oscillator using the Reinartz circuit. This latter arrangement I have found very useful for the separate oscillator on a short-wave super-heterodyne, the reaction condenser being a variable one, for the purpose of adjusting the circuit to suit different types of valves which may be used for the oscillator.

The Separate Oscillator

Once set, the oscillator will generally cover quite a wide range of frequencies without requiring any readjustment of its reaction condenser. Any such readjustment, of course, should be avoided, since it upsets any calibration which may be attempted of the oscillator circuit. This oscillator circuit is coupled by means of two small pick-up coils, P1 and P2, to the grid circuit of the first detector. I have found three turns in each of these coils quite sufficient for most purposes, and they may be wound side by side upon the same piece of 2in. tube. The turn numbers for the other inductances must, of course, depend upon the frequencies which it is proposed to receive. The aerial used with this set I have found should only be a few yards of wire, preferably hung across the ceiling of the room in which the instrument is being employed. The remainder of the circuit follows perfectly standard lines, and I have found it to work quite successfully with the ordinary input filter and intermediate transformers supplied by Messrs. Bowyer-Lowe for use in super-heterodynes arranged for broadcast reception.

Violence

"MR. WAYFARER," announced Poddleby's maid, ushering me into his drawing-room the other afternoon. As I stepped gracefully in preparing my company smile, I was just in time to see Poddleby and his better half collapse in a gasping heap in the midst of the floor. I rushed forward and seized Poddleby by the scruff of the neck. "Coward!" I cried, "to strike a woman. Good evening, Mrs. Poddleby. How are you? Still well, I hope, despite the cave-man treatment which I have just witnessed." When I had helped them both to their feet they started to explain, both talking at once, that what I had mistaken for a violent quarrel was really a tango. And then I noticed that the loud-



. . . *"Coward!" I cried* . . . .

speaker was saying something like "Advance the right foot in a north-easterly direction, turn slightly on the ball of the left, bringing the toe of the right foot below the left knee. At the same time swing your partner gracefully round." And so on and so on.

Dancing Lessons by Wireless

I had seen something about these dancing lessons by wireless, but being myself by far the best performer in Little Puddleton it had not occurred to me that I was in any need of them. Therefore I had not tuned in on such occasions as they were being given. Both Poddleby and Mrs. assured me that it was the very finest thing that had ever been invented by the fertile brains of the B.B.C. And would I mind just sitting down for five minutes and smoking a cigarette whilst they went on with it? Being, as you know, always willing to oblige, I sat down and filled both my cigarette cases from Poddleby's box. I then selected the best cigar that I could find from his stock and settled down to watch.

Tangoing

"A chassez forward and then turn," said the voice. Poddleby and Mrs. charged down the room and would, I think, have executed a very creditable turn, had they not tripped simultaneously over the loud-speaker leads. As it was, they collapsed once more, whilst the loud-speaker joined them on the floor, deafening Poddleby by continuing to bawl into his ear in spite of its rough treatment. Your real dance enthusiast is not easily dismayed. Poddleby and Mrs. arose with my help, and having replaced the loud-speaker on top of the piano were at it again in a moment, whilst I returned to my chair making a mental note to bring a cigar case next time. During the last part of the lesson a slight misunderstanding occurred, the instructor having forgotten to mention to which partner he was referring when he said "advance the right foot smartly."

A Misunderstanding

The pupils whose performance I was witnessing both obeyed with alacrity, and then proceeded to hop round the room separately each on one foot. This movement I applauded loudly as being quite one of the most interesting and novel steps for ballroom purposes that I had yet seen. Luckily for both of them the lesson came to an end by the time that they had ceased to hop, and we spent the rest of the time in less strenuous pursuits. "It is simply splendid," panted Poddleby, sinking on to the sofa, "and there is still something better to come. Have you heard that they are going to broadcast physical exercises?"

"Physical Jerks"

I looked at him coldly. "Some years ago," I said, "there was a War, and if I remember right not the least of its horrors was a thing called 'physical jerks.' You got up in the early morning and had to run round and wave your arms and kick your legs about and do all sorts of hateful things at the bidding of a fellow with a bulging chest who wore a striped jersey. Thank you, Poddleby, I know all about physical exercises." "My dear chap," cried Poddleby, "just think how good they are for you. About half a dozen of us have agreed already to form a Physical Exercise Society and we are going to meet each morning to follow the instructions given by the loud-speaker. It will

. . . *A fellow with a bulging chest* . . .

make new men of us." "If it will do that," I said. . . . . Poddleby held up his hand. "Do not scoff," he begged. "We are going to regain the suppleness and vigour of youth. It would do you all the good in the world, my boy. You have simply got to join up and be one of us."

An Idea

The suggestion set me thinking. My own perfect figure has little need of physical jerks to add to its beauty. But for fellows like Poddleby and a few others I could mention, this drilling idea seemed to be just what was wanted. "I tell you what," I said at length. "Why should we not get all the fellows at the wireless club to take up the scheme and have exercises each morning in the club house?"

"An inspiration," cried Poddleby. "Why of course we will. We are already the brainiest club in the country and shortly we will be the healthiest. Every one of us will go about vaulting over pianos and slapping people on the back, or pushing invalids in bathchairs at twenty miles an hour down the street. When he does things like that you know that a man is perfectly healthy. And when our little daily dose has got to work, we will probably surpass even these feats."

The Club Agrees

Next evening Poddleby and I attended a meeting of the wireless club and put our proposal before the members in honeyed words. Most of them agreed at once, though there was at first a little opposition from General Blood Thunderby, Admiral Whiskerton Cuttle and Bumpleby Brown—all of them, of course, fellows whose figures badly need a little paring down. However, we persuaded them before we had done, and by the time that meeting broke up every member of the club had solemnly promised to present himself at the hut suitably garbed at the appointed hour on the following Monday morning.

We Make a Start

I have always thought Monday a rotten kind of day, and my

. . . *Clad in a dressing-gown and a bowler hat* . . .

opinion of it was confirmed in the early hours of the next one that came along, for my beauty sleep was rudely disturbed by Poddleby's application of a large wet sponge to my face. "Lazy beast," he said. "There you are, or rather there you were, snoring away when you ought to be up drinking in draughts of the glorious morning air. Jump up now and hurry down to the hut." I jumped up, not because I wanted to go to the hut, but because I did want to land Poddleby a straight left in the ribs. He dodged rather neatly and seizing my bedclothes dashed with them through the door. I tried crawling in between the two mattresses, but the top one always kept slipping off. In the end I gave it up, garbed myself in a pair of tennis trousers and a sweater, and strolled down to the club house.

Strange Attire

On the way there I met Professor Goop clad in a dressing-gown and a bowler hat. He was carrying, I noticed, an umbrella and an attaché case. He told me that just as he was about to leave the house he could not quite think why he had got up so early, but it suddenly occurred to him that he was going to catch the early train to London. But for my intervention he would probably have done so. I steered him to the hut, where he pulled off the dressing gown and disclosed the bathing dress that had created such a sensation during our holiday at Trouville. Poddleby turned up in running shorts and a gym vest, whilst the other members of the club sported a variety of costumes ranging from pyjamas to plus fours. As the zero hour struck the loud-speaker was switched on and we prepared for action as instructed.

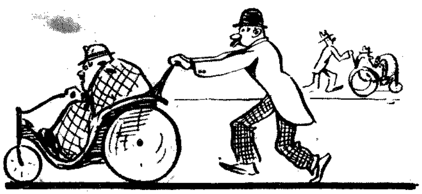
Mishaps

Our space was just a little bit cramped perhaps for some of the freer movements, but I do not think that General Blood Thunderby need have bitten my finger when on extending my arm smartly as ordered I found my hand in his mouth. However, I got my own back during the arm-swinging movements. All went very well as long as we were on our feet. What I was waiting for was the order to lie down, and sure enough it came before long. I can assure you that the sight of General Blood Thunderby and Poddleby lying side by side upon their backs and waving their legs in the air was one that I would not have missed for anything. But the best of it all was when we were instructed to turn upon our faces and to balance ourselves upon the tips of our toes and the palms of our hands with arms straight. From that point we had to lower our chins to the floor by bending our arms. Our stouter members made puffing and gasping noises as, with their joints creaking like watchmen's rattles, they strove to lower themselves with decorum. The General got down somehow the first time and managed to heave himself up again somehow afterwards. The second descent, however, defeated him. He brought his chin to the floor all right, but very much more quickly than he intended, and his subsequent remarks drowned even the loud-speaker for a brief space. However, all things considered, our first *séance* passed off very well indeed, and everyone agreed that having once begun we must continue.

That afternoon, seeing the General gazing into the window of a wireless shop in the High Street, it occurred to me that I might as well display some evidence of my new-found health and strength.

Energy

Coming up behind him, I smote him heartily between the shoulder



. . . *The members were in bathchairs* . . .

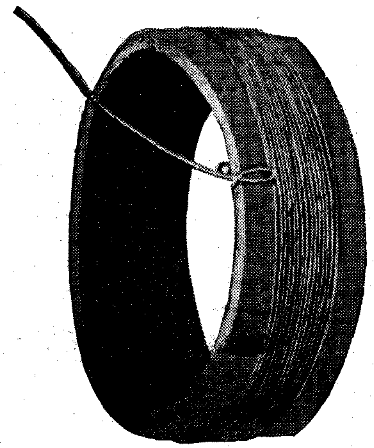
blades. His leap into the air, though I doubt whether it would have cleared a piano, was quite creditable. On coming to earth he simply rounded on me. What the blue blazes did I mean by doing things like that? Didn't I know that he had got rheumatism in his shoulders and lumbago in his back and . . . . I fled. I thought that I would go and see how Poddleby was getting on. I found him huddled in an armchair looking anything but vigorous. "Don't shake my hand too violently," he begged, "I am so stiff all over that I can hardly move." . . . . That evening, just before the time appointed for the meeting of the wireless club, you might have seen a dozen bathchairs in the High Street. The members of the club were not pushing them at terrific speeds in order to show the world how vigorous they were. No, the members were in the bathchairs, being pushed.

WIRELESS WAYFARER.

Some Notes on Tuning and Selectivity

By J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C.,
Staff Editor.

A thorough investigation of the theoretical principles underlying selectivity, and their practical application will be dealt with in a series of articles by Mr. Reyner, of which this is the first.



Are inductances of this type going to replace the existing shapes of coil?

THE word "selectivity" has to-day an almost magical significance. The first test of any set is—how selective is it? Can it cut out London and receive Bournemouth or Cardiff? Mr. Harris in America was principally impressed by the remarkable tuning properties of the receiving apparatus in everyday use over there, and there is little doubt that the trend of development in this country is in the direction of improving the selectivity of the apparatus employed. It is proposed, therefore, to consider some of the aspects of tuning and selectivity generally, in order that investigators in this country may be assisted in the design of suitable circuits.

Simple Tuned Circuit

Let us consider first of all a single circuit. If the circuit in Fig. 1 is connected to a source of supply of which the frequency is variable, then the actual current which will flow in the circuit depends upon the relation between the inductance and the capacity and the frequency of the applied E.M.F. The current is a maximum when the circuit is in tune with the E.M.F., that is to say, when the frequency is equal to $\frac{1}{2\pi\sqrt{LC}}$, L and C being the inductance and capacity in the circuit in henries and farads respectively.

As the frequency of the applied E.M.F. is varied, therefore, the current in the circuit will increase to a maximum at the tuning point and will then begin to decrease again, the current varying as indicated in Fig. 2, which is the well-known resonance curve.

Resonance Curves

Now the nature of these resonance curves is an indication of the selectivity of the set. With a theoretical circuit having no resistance the resonance curve would be as shown in Fig. 3. That is to say, the current would be small until the resonant frequency was approached, when it would rapidly rise to an infinite value, falling again almost to nothing as the resonant frequency was passed. It was often thought that in a theoretical oscillatory circuit like this, having no resistance, the current should be nothing until the resonant frequency was reached, at which point the current would suddenly grow to infinity.

Circuit having no Resistance

This, however, is not the case. The current is controlled by the impedance in the circuit. Now the impedance is made up of a combination of the resistance and the reactance in the circuit, the actual expression for a circuit of this type being

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

where $\omega = 2\pi \times$ frequency.

Now if the resistance in the circuit is zero, this expression reduces to

$$Z = \omega L - \frac{1}{\omega C}$$

We see, therefore, that the impedance of the circuit is made up simply of the two reactances, one due to the inductance and the other due to the capacity. As the frequency is increased, so that ω is also increased, the value of ωL increases, and the value of $\frac{1}{\omega C}$ decreases. At low frequencies the term $\frac{1}{\omega C}$ swamps the term ωL, and the total impedance in the circuit is very high. Towards the resonant value, however, the two terms become more or less equal and tend to cancel each other out. For a short while, therefore, the value of the impedance, which is equal to the difference between the two terms, has a comparatively small value, and of course at the resonant point it falls to zero.

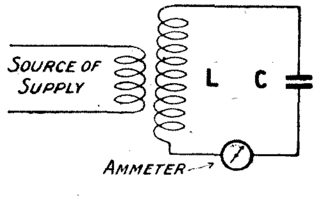


***Fig. 1.**—A simple series circuit.*

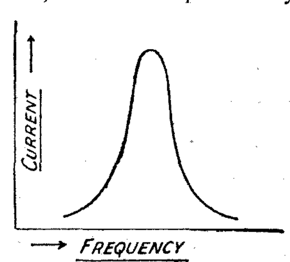


***Fig. 2.**—A typical resonance curve of a circuit such as is shown in fig. 1.*

The current, being dependent upon the voltage divided by the impedance, will thus have a very small value under normal conditions, but will become appreciable near the resonant point and will rise to infinity actually at the tuning point. It will be seen, however, that the rise to the maximum value is gradual and not sudden even when the circuit has no resistance whatever. The curve shown in Fig. 3 is actually plotted for a coil having an inductance of 100 microhenries and a capacity of 500 micro-microfarads.

Effect of Inductance and Capacity

We may now consider what effect on the resonance curve the various possible combinations of inductance and capacity will have. It is possible to construct a circuit to tune to a given frequency with a small inductance and a large capacity or vice versa. It therefore

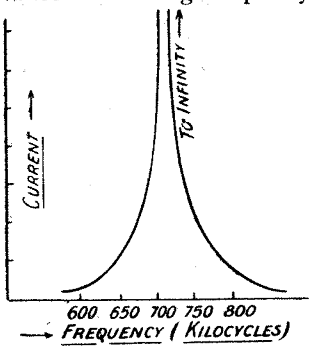


Fig. 3.—A resonance curve for a circuit having no resistance.

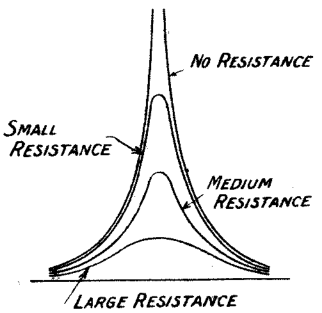


Fig. 4.—The effect of adding resistance is to decrease the current at each point.

remains to determine whether the relation between the inductance and the capacity has any effect upon the resonance curve.

When the circuit is in resonance the current will be infinity, irrespective of the proportion of inductance to capacity. At a small distance away from the resonant frequency, however, the current will fall to some finite value, and the smaller this value, the sharper will be the resonance curve. It can easily be shown that the current is inversely proportional to the capacity in the circuit, that is to say, the smaller the capacity, the smaller will be the current and consequently the sharper will be the resonance curve.

Effect of Resistance

So far we have simply considered circuits in which the resistance was zero. Let us now consider the effect of adding resistance to the circuit. The first effect is that the current at the tuning point instead

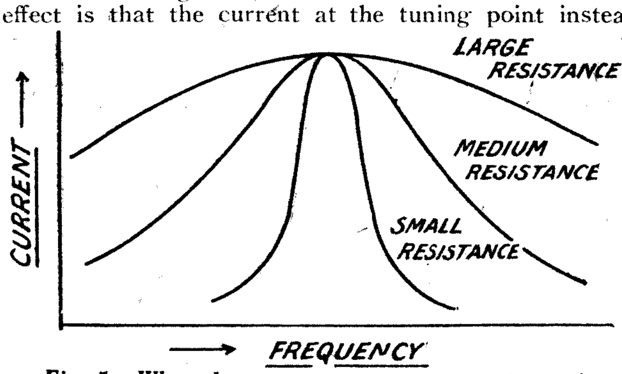


Fig. 5.—When drawn to a correct comparative scale, the addition of resistance can be seen to broaden the resonance curve.

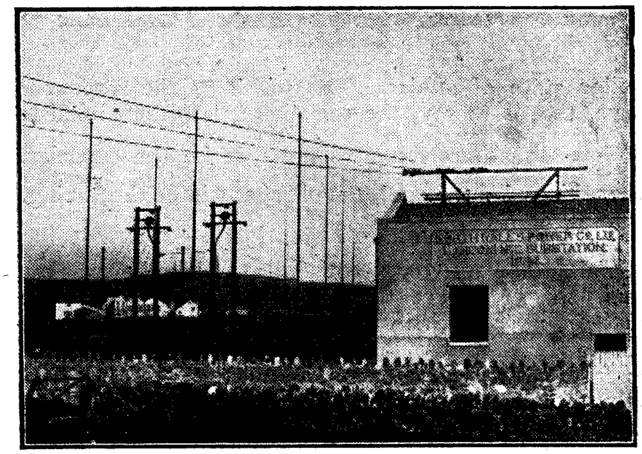
of being infinite, is at once reduced to some finite value. Referring back, it will be seen that at the tuning point $\omega L = \frac{1}{\omega C}$. The total impedance of the circuit, however, is $\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$ which reduces simply to R when the circuit is in tune. Thus at the resonance point the current is given simply by $\frac{E}{R}$.

From this reasoning it will also be clear that at any frequency different from the resonant frequency the current must be slightly less, now that the resistance is added, than in the previous resistanceless case. Consequently the resonance curve of a circuit containing resistance will lie *within* the theoretical resonance curve at every point, because the current at any given frequency must be less than in the theoretical resistanceless case.

Fig. 4 illustrates this point and shows several resonance curves with varying amount of resistance in circuit, and it will be seen that the successive curves all lie one within the other.

Selectivity

Now it will be obvious that the width of the resonance curves with varying amounts of resistance in circuit. A circuit in which the resonance curve falls very rapidly so that the curve itself is comparatively narrow will obviously be more selective than a circuit in which the curve only falls away comparatively slowly, so that the frequency has to be altered by a considerable amount before the current can be reduced to a small value. It would appear, however, from the reasoning which has just been stated that the effect of adding resistance to the circuit is to make the width of the resonance curve smaller and smaller, in other words, the circuit will become more and more selective as resistance is added.



One of the power houses at the Carnarvon Wireless Station. The power is supplied from the town of Carnarvon and the two standards on the left of the photograph convey it on to the transmitting station.

Band Width

This, of course, is absolutely contrary to practice. The explanation is to be found in the matter of the scale. The selectivity is actually measured by the width of the resonance curve at a point such that the current is reduced to a *definite fraction of the maximum value*. Fig. 5 shows several curves of Fig. 4 all drawn out to a suitable scale such that the maximum values of the current are the same in each case. It will readily be seen from this figure that the effect of adding resistance is to broaden the resonance curve very considerably. If we measure the width of the resonance curve at a point such that the current is one-half the maximum value, it will be seen that this width is less, the smaller the resistance in the circuit.

The band width of a resonance curve is measured in terms of cycles per second, and is a very useful quantity. It defines the range of frequencies which is accepted by the particular circuit. This point will be dealt with at a later stage. For the present it will suffice to note that the width of the resonance curve is proportional to the resistance and the quantity $\sqrt{\frac{C}{L}}$

Ratio of Inductance to Capacity

We may now consider the effect of the ratio of inductance to capacity in a practical circuit. In the previous case we considered a circuit having no resistance, and we found that the smaller the capacity, the sharper was the tuning. In this case we have a very similar state of affairs. The width of the resonance curve, that is to say, the selectivity, is proportional to $\sqrt{\frac{C}{L}}$. Thus the smaller we make the capacity, other things being equal, the sharper will be the tuning.

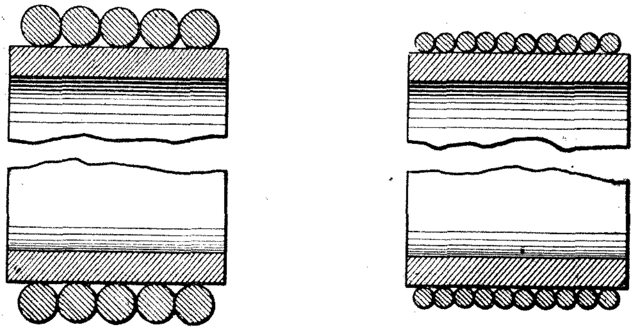


Fig. 6.—With a given shape of coil, to obtain a larger number of turns, a smaller gauge of wire must be used.

Effect on Selectivity

Affairs, however, are not quite as simple as they seem. If we reduce the capacity in the circuit, we must of necessity increase the inductance in order to tune to the same frequency as before. This as a rule increases the resistance at the same time, and the effect is thus complicated. Let us assume for a moment that whatever coil we use, the ratio of resistance to inductance, *i.e.*, $\frac{R}{L}$ remains constant. If now we halve the capacity we must double the inductance in order to tune to the same frequency. Thus the ratio $\frac{C}{L}$ will be one-quarter of its original value and $\sqrt{\frac{C}{L}}$ will be one-half its original value. On the other hand, as we have doubled the inductance, we have doubled the resistance, so that the band width remains exactly the same as before. Thus we see that on the assumptions we have made, the ratio of inductance to capacity has no effect upon the selectivity of the circuit.

Resistance of Coils

The ratio of resistance to inductance of coils, however, is not constant at high frequencies. In the case of a multi-layer coil carrying current at low frequency, so that the resistance is substantially the same of the D.C. resistance, that is, that there is no skin effect, it can be shown that the ratio of resistance to inductance is approximately constant for a given shape of coil, whatever the gauge of wire employed. In the case of a coil used at radio frequencies, however, this is no longer the case. In the first place, it is desirable to use single-layer coils wherever possible. A little thought will show that in a case like this the ratio of resistance to inductance is by no means constant.

Single Layer Coils

Let us assume that we have a coil of a given diameter and a given winding length. If we double the number of turns we shall obtain four times the inductance. The length of wire in the coil is now doubled, so that the resistance will be doubled. In order to get twice the number of turns in the coil, however, we have to use wire only half the previous diameter. This means that the area would be one-quarter of its previous value, so that the resistance will again be increased four times, the total increase of resistance being *eight times*. Thus the resistance is increased by this figure, while the inductance has increased only four times, so that the ratio of resistance to inductance is twice what it was in the former case.

A little thought will show that this reasoning also applies to spaced windings since the spacing employed depends on the diameter of the wire.

Against this must be placed the fact that with the thicker wire, as used in the first case, the skin effect will be somewhat greater, so that the high-frequency resistance in the second case may not be quite as much as eight times what it was in the first case. Experiments show, however, that down to a gauge as low as 18 or 20 s.w.g. there is a distinct improvement in single layer coils by using thicker wire. Thus for the best ratio of resistance to inductance, the inductance itself should be made small so that a comparatively few turns of thick wire may be used for the purpose.

Thus we see that in a practical case the conditions for obtaining maximum selectivity are that the coil should have a small inductance and should be tuned with a comparatively large capacity. This is the direct

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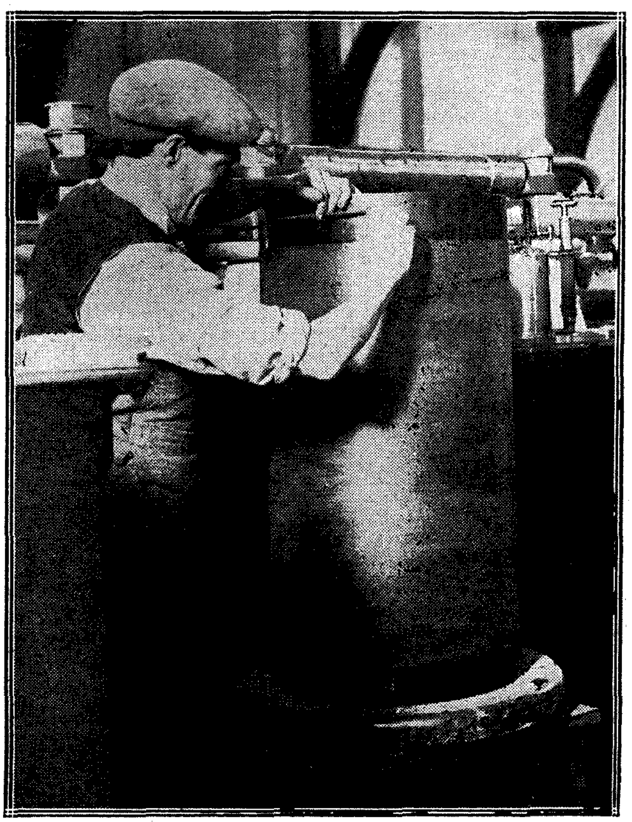


Making final adjustments to one of the coils at the Rugby Wireless Station.

NEW BRITISH VALVES

An account of tests carried out at the Elstree Laboratories of Radio Press, Ltd., of the new series of valves produced by Messrs. Burndept Wireless, Ltd., exhibited for the first time at the recent N.A.R.M.A.T. Wireless Exhibition.

Valve type L240.

WE are pleased to welcome into the general market a new valve factory which has been inaugurated by Burndept Wireless, Ltd. The Managing Director is Mr. C. F. Trippe, whose name is well known in the valve world, as he has up to the present time been responsible for the design of a number of valves which have proved very popular; recently he resigned from the General Electric Co. to take charge of this new valve factory. Mr. Trippe has with him another notable wireless engineer, Squadron-Leader B. N. H. Hamilton, who recently resigned his commission with the Royal Air Force, where he held a responsible position in the Wireless Service.

A complete series of valves has been sent to us for test (the only satisfactory way and one which we would commend to other manufacturers submitting valves), and they cover the whole range of requirements for broadcasting reception.

Nomenclature

For the eight different types of valves a nomenclature has been introduced, which makes it quite easy to recognise the general purpose of each valve. The symbols L and H followed by three figures are used. H distinguishes a high-frequency valve, and L a low-frequency valve. The use of both symbols, HL, indicates that the valve is a general-purpose valve. The first number indicates the filament voltage, and the second and third numbers give the filament current. For instance, one valve is labelled L 240, the L indicating that this particular valve is a low-frequency valve. The three numbers, 240, indicate that the filament

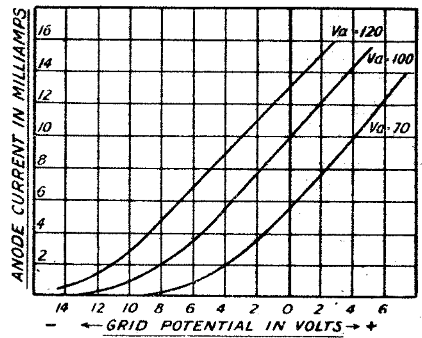


Fig. 1.—Characteristic curves of the L525 type of valve.

requires a potential of 2 volts and takes a current of 400 milliamperes.

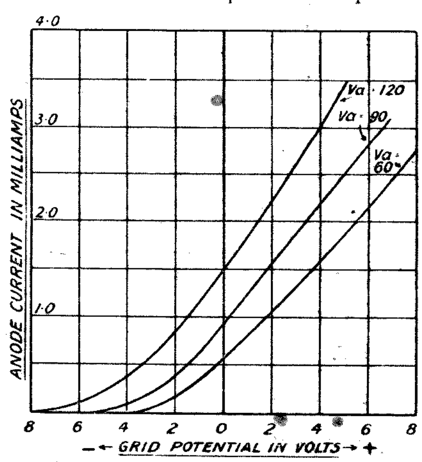


Fig. 2.—Characteristic curves of the valve type H310.

Practical Tests

The complete series of eight valves have been tested on our valve test bench, and, further, the valves were used in some of the well-known Radio Press receivers and amplifiers. The results on the test bench are given in detail. It will be noted in each case that we give the filament potential and the filament current for comparison with the values recommended by

Valve type L550.

the manufacturers. In addition, the flash emission is given for a particular voltage on the grid and anode connected together. Then the circuit is closed for one or two seconds only, and the actual anode current measured. This is called the flash emission.

Flash Emission

Flash emission gives an indication that the filament is capable of operating the valve under working conditions, but it must not be imagined that this anode current can be used. A flash emission test is useful for showing whether the valve is good as regards emission. Thus 10 milliamps. is a suitable value for most receiving valves apart from power valves. Another factor is given, which is the flash emission per filament watt. This is obtained by dividing the total flash emission by the number of watts consumed by the filament, the watts being the product of the volts and amperes on the filament.

In some cases more than one valve of each type was tested, and it was noticed that the valves amongst themselves were fairly uniform. The valves tested in the Radio Press sets gave very satisfactory results as regards volume and purity. One set in which they were tested was the "Harmony Four," in which it was possible to test all the types of valves.

VALVE TYPE L240 (Dull Emitter).

Filament Potential 1.9 V.
Filament Current 0.4 A.

Flash Emission 20.0 mA.
at 120 V.
Flash Milliamps Emission per Filament Watt 26.3 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	−5.0	2.75	4.65	10,500
80	−7.0	3.85	4.90	9,500
110	−11.0	5.15	4.30	9,500

Manufacturer's Rating.

Filament Potential 1.8—2.0 V.
Filament Current 0.4 A.
Anode Potential 60—120 V.

VALVE TYPE HL213 (Dull Emitter).

Filament Potential 2.0 V.
Filament Current 0.12 A.

Flash Emission 7.0 mA.
at 100 V.
Flash Milliamps Emission per Filament Watt 29.2 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	0	1.15	6.9	31,000
80	−1.0	1.5	7.85	28,600
110	−3.0	1.9	8.6	28,600

Manufacturer's Rating.

Filament Potential 1.8—2.0 V.
Filament Current 0.13 A.
Anode Potential 40—100 V.

VALVE TYPE H310 (Dull Emitter).

Filament Potential 3.0 V.
Filament Current 0.1 A.

Flash Emission 14 mA.
at 150 V.
Flash Milliamps Emission per Filament Watt 46.7 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	−0.5	0.42	16.5	83,000
80	0	0.825	17.6	60,000
110	−1.0	1.05	13.0	50,000

Manufacturer's Rating.

Filament Potential 2.8—3 V.
Filament Current 0.1 A.
Anode Potential 40—150 V.

VALVE TYPE H512 (Dull Emitter).

Filament Potential 5.0 V.
Filament Current 0.12 A.

Flash Emission 24.0 mA.
at 150 V.
Flash Milliamps Emission per Filament Watt 40 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	−1.0	0.635	13.5	50,000
80	−0.5	1.4	15	33,400
110	−1.5	1.75	14.3	28,600

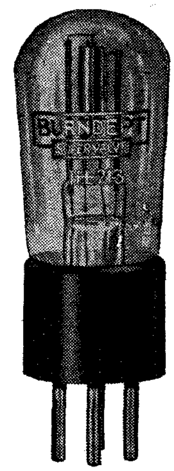
Manufacturer's Rating.

Filament Potential 4.5—5.0 V.
Filament Current 0.12 A.
Anode Potential 40—150 V.

The valves are nearly all of the dull-emitter type, but in spite of this, microphonic noises were not noticeable on the whole, being slightly perceptible in the L 240, but rather bad in the HL 213. The life of the valves has not been tested.

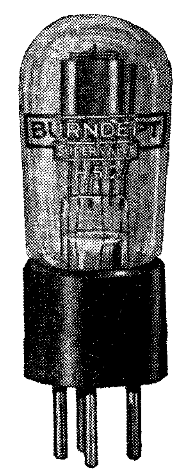
General Remarks

The valves, as will be observed from the photographs, have a good



Valve type HL213.

appearance. As far as can be seen through the walls of the valves, which in all cases shows signs of a getter, the anodes are very small, and most of them appear to be of the oval type, this apparently being to allow a loop filament to be used and a lower impedance to be secured. The smallness of the



Valve type H512.

anode is very pronounced in all cases. This smallness of the anode, however, is obviously good for obtaining low impedance, but there will be the danger that the filament may touch the grid in some samples.

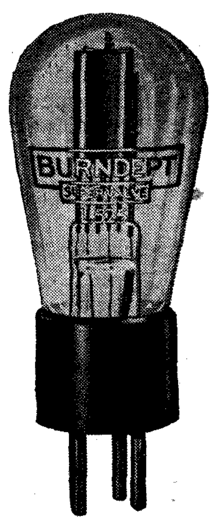
The valves can be distinguished by the letters R.A.L., which represents Radio Accessories, Ltd., the firm formed by Burndept Wireless, Ltd., for the manufacture of valves.

A point in which some improvement seems desirable is the marking of the valves in accordance with the scheme of letters and figures described. In the samples submitted these markings, which are placed on the glass

Valve type HL310.

bulb of the valves, were somewhat indistinct.

As regards the cap, this is made of bakelite, with a ridge to indicate the position of the anode pin. The pins in most cases required opening out before they would fit closely in the holders. The general result of our tests shows that, as was to be expected, the new factory has produced a very good series of valves which readers of our journals can purchase without any hesitation.



Valve type L525.

Another important point to notice is that in the whole of this series of valves the filament current is never less than 100 milliamperes. This, we believe, is done with a definite purpose in order to secure a definite filament tension, and thus ensure uniformity in the characteristics. The filaments are nearly all thoriated.

VALVE TYPE HL512 (Dull Emitter).

Filament Potential 5.0 V.
Filament Current 0.1 A.

Flash Emission 20 mA. at 100 V.
Flash Milliamps Emission per Filament Watt 40 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	−1.0	1.75	9.15	16,700
80	−0.25	2.25	8.1	15,400
110	−4.0	3.4	8.22	13,150

Manufacturer's Rating.

Filament Potential 4.5—5.0 V.
Filament Current 0.12 A.
Anode Potential 40—100 V.

VALVE TYPE HL310 (Dull Emitter).

Filament Potential 3.0 V.
Filament Current 0.1 A.

Flash Emission 8.5 mA. at 100 V.
Flash Milliamps Emission per Filament Watt 28.3 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	−2.0	1.85	5.78	17,300
80	−4.0	2.4	5.5	16,800
110	−7.0	3.11	5.55	17,100

Manufacturer's Rating.

Filament Potential 2.8—3.0 V.
Filament Current 0.10 A.
Anode Potential 40—100 V.

VALVE TYPE HL565 (Bright Emitter).

Filament Potential 5.0 V.
Filament Current 0.63 A.

Flash Emission 13.0 mA. at 100 V.
Flash Milliamps Emission per Filament Watt 4.12 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	−1.0	1.23	9.25	30,800
80	−2.0	1.6	10.0	28,600
110	−4.0	2.0	9.75	25,600

Manufacturer's Rating.

Filament Potential 4.5—5.0 V.
Filament Current 0.65 A.
Anode Potential 40—100 V.

VALVE TYPE L525 (Dull Emitter).

Filament Potential 5.0 V.
Filament Current 0.22 A.

Flash Emission 35 mA. at 150 V.
Flash Milliamps Emission per Filament Watt 31.8 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio.	Internal Impedance in ohms.
60	−2.0	2.63	7.65	8,510
80	−3.0	4.35	7.04	6,930
110	−6.0	5.6	6.65	6,340

Manufacturer's Rating.

Filament Potential 4.5—5.0 V.
Filament Current 0.25 A.
Anode Potential 90—150 V.

Appointment of Mr. H. J. Barton-Chapple,

Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.,

to the Staff of Radio Press, Ltd.

Mr. H. J. Barton-Chapple.

IT is with great pleasure that we introduce to our many readers Mr. H. J. Barton-Chapple, who recently joined the senior technical staff of Radio Press, Ltd., as the outcome of our development policy in connection with the Research Laboratories at Elstree.

Qualifications

He is possessed of high qualifications, largely as the outcome of a particularly successful career. Before entering the City and Guilds (Engineering) College, Mr. Barton-Chapple secured a Whitworth Scholarship, which stands pre-eminent amongst open competitive scholarships in the United Kingdom owing to the high standard of the examination and the rigid conditions for competing.

On entering College in 1919 he passed straight into the second year, and at the final examination of the third year secured the Associateship of the City and Guilds of London Institute (A.C.G.I.), heading the list of successful candidates, and, as a result, securing the Siemens Memorial Medal. He also obtained the Henrici Medal for Mathematics, being the student of greatest merit in this subject. In the same year Mr. Barton-Chapple graduated at the University of London, obtaining the B.Sc. degree in Electrical Engineering with first class honours.

This was followed by a fourth-year post graduate course in radio telephony and telegraphy under Professor Howe, on the successful completion of which he was awarded the Diploma of Membership of the Imperial College of Science and Technology (D.I.C.).

Further Experience

On leaving College in 1922 Mr. Barton-Chapple was appointed Lecturer in Electrical Engineering (specialising in high-frequency and thermionic valve work) at the Bradford Technical College. Since that time he has conducted classes in electrical and radio engineering, being entirely responsible for the courses in the latter subject, and his efforts have met with particular success.

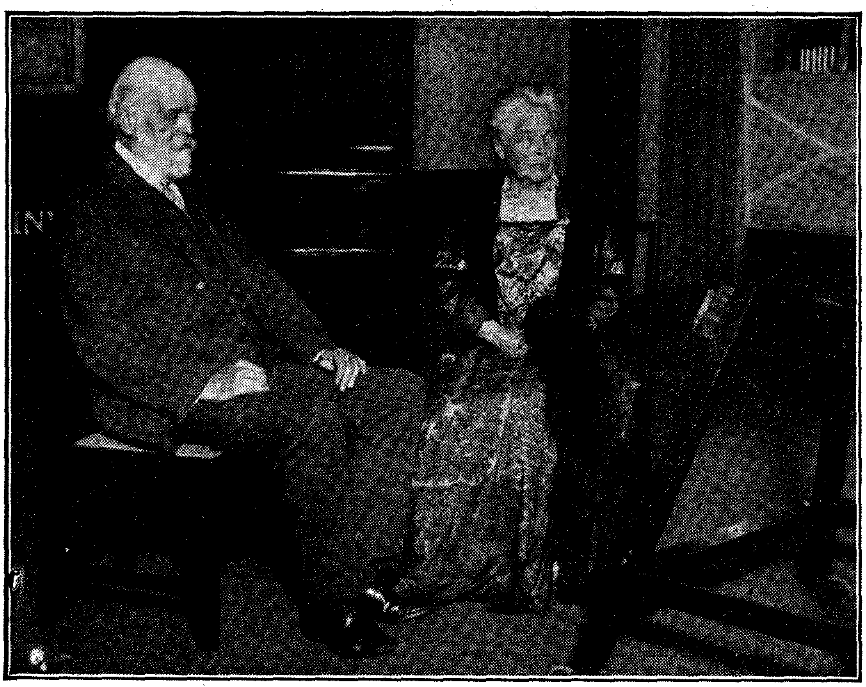
His duties brought him into intimate contact with every type of student, whereby much experience was gained in elucidating problems in such a manner that students were able to secure a clear conception of the normally intricate points.

Practical Research

Mr. Barton-Chapple has had considerable opportunity for research work, and several articles on the results of such investigations have appeared from time to time in the technical Press.

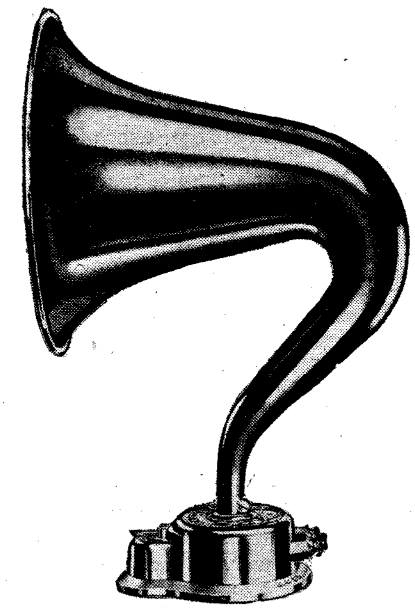
While at Bradford Technical College he was elected an Associate Member of the Institution of Electrical Engineers (A.M.I.E.E.), a distinction which, as our readers know, is of a distinctly valuable character.

Our readers, therefore, may look forward to some very helpful articles from Mr. Barton-Chapple's pen, many of which will be the outcome of research work at our new laboratories which are now in full swing.



Dame Henrietta Barnett, D.B.E., and Sir Oliver Lodge, who recently broadcast a talk from the London Station on "The Things that Matter."

A LOUD-SPEAKER CIRCUIT FOR THE LOCAL STATION



By A. D. COWPER, M.Sc., Staff Editor.

It is often convenient to have a receiver which can be switched on at any time for the reception of local broadcasting, as distinct from long-distance reception, and the circuit described here will no doubt fulfil the requirements in this direction of many readers.

THOSE whose main interest in radio lies in the reception of the local station's transmissions at comfortable strength, with really good quality of reproduction and with the minimum of trouble, will find in the circuit described here a solution of their problem. Even the more experienced investigator might find such a receiver useful as a standby, and to fulfil family requirements in everyday broadcast reception. It does not in the least pretend to be a circuit for long-distance work, nor does it possess striking selectivity, having merely that of any loose-coupled circuit, *i.e.*, enough to minimise any but the worst of local interference when receiving the local station. There is but one tuning control, and that not critical, whilst the tuning is, to a large extent, independent of the aerial characteristics. No reaction is used; the receiver is unable to howl or oscillate, whilst the fixed or semi-permanent crystal detector used will require the very minimum of attention when once set.

Components

Small power valves are used (or a D.E.5B or similar valve and a small power valve), together with ample H.T. and grid bias in order to obtain distortionless reproduction of good volume. One (high-ratio) L.F. inter-valve transformer is specified, which should be of the modern large heavy pattern, with plenty of iron and copper in it, and a section-wound secondary. No appreciable distortion need be feared if the right type of transformer is used here. As the H.T. demands are fairly severe, even when grid bias is used, a small H.T. accumulator of 120 volts should be used: a number of patterns are now available on the market. The loud-speaker windings are protected from the heavy D.C. plate current by the usual device of a choke-capacity filter coupling.

Potential Rectifier

It will be noticed that the crystal detector is used as an almost purely *potential* rectifier, being connected directly in series with the grid of the first (L.F. amplifying) valve. This is an old device, dating from the earliest stages of thermionic valve practice. It has been revived lately in America by H. Gernsback under the (characteristic American) name of the "Interflex" circuit—though it has nothing whatever to do with "reflex" circuits.

Recent work, however, has elucidated the remarkable fact that a crystal detector operates with quite high efficiency in this kind of arrangement, where there is very little D.C. current flowing at all in the circuit, and it is mainly a matter of voltage.

Damping

The present writer lately investigated the matter in a practical manner, with a view to obtaining, if possible, the less heavily damped rectifying device than the ordinary crystal, or a rectifying valve operating with grid condenser and grid-leak; and with this in view he tried the effect of an ample *negative* grid bias on the valve following the detector, so that practically no grid current could flow at all, and therefore energy losses should be a minimum. Unfortunately, however, practical experiment showed that, although an appreciably higher audio signal strength resulted from the combination of potential rectifying crystal and power

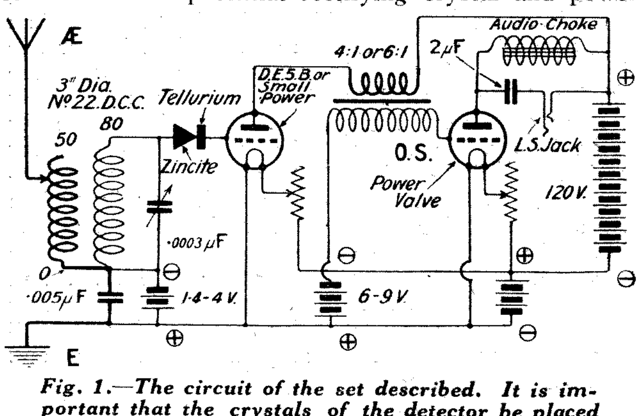


Fig. 1.—The circuit of the set described. It is important that the crystals of the detector be placed in the positions shown here, the zincite being nearest to the grid coil.

amplifying valve than with the same valve operating as a detector without reaction, either with a grid condenser and leak or on the anode characteristic bend, the grid circuit was nevertheless heavily damped by the combination. Since (if the crystal is operating properly) no useful reaction effects can be obtained, the combination is not suitable for distant reception or critical work.

Purity

A redeeming feature of the potential rectifying combination was found, however, in the great ease with which exceptional purity and fidelity of reproduction could be obtained from the local station's transmissions of fair power. Given a reasonably high signal voltage so that the crystal detector is operating on a portion of its characteristic which is practically linear, the completely aperiodic nature of the first valve coupling, combined with the use of a valve which will safely handle the power, ensures signals of a purity which will be found quite comparable with those from the crystal alone, but with quite a fair degree of amplification due to the first valve. By using a modern large L.F. intervalve transformer with ample primary impedance and a section-wound secondary, together with a second power valve, little further distortion is introduced: the practical limit is set, at present, by the fidelity of reproduction by the loud-speaker equipment rather than transformer distortion.

Power Valves

It is of little use to provide for purity of reproduction elsewhere if valves are used (as is so often the case, even in professional demonstrations), which cannot handle the power. Horrible distortion results from

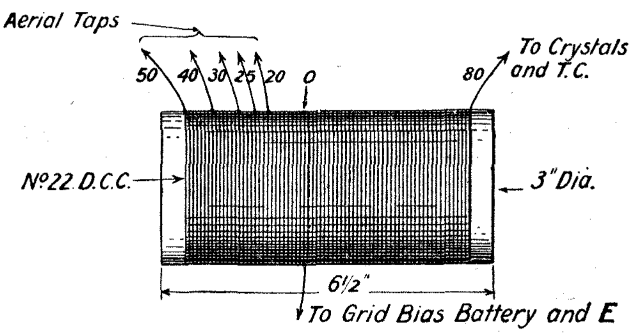


Fig. 2.—The aerial and grid coils are wound on one former with a common earth tapping.

overrunning the characteristic of the valve in such a case. With a *large* outside aerial in the suburban area, or with a small outside or an efficient indoor one of good dimensions very close in to a station, the signal voltage applied to the first valve may easily be more than an ordinary L.F. amplifying valve (or the D.E.5B valve, that would otherwise be chosen for its high amplification factor) can carry, without flattening the peaks of some of the wave-forms: in such a case a power valve should be used here, such as the D.E.5, the D.E.5A, the P.V.6, or others of the same class of low-impedance valves, and ample H.T. and grid bias should be applied. A less effective aerial, or a suburban indoor one, calls for a D.E.5B or D.E.3B (or similar) valve of high amplification factor and moderate impedance.

Makes of Components Used

The call for a valve of ample power is still more urgent in the case of the second L.F. amplifier: a low-impedance valve with generous grid bias and full 120 volts H.T. *must* be used here. The writer found good results on his high suburban aerial with two valves of the 5/.25 class operated in parallel here, following a single valve of the same type in the first position, all with 120 volts H.T. and with 9 and 4 volts grid bias respectively. The result was a full-throated loud-speaker shout of a clarity and faithfulness of reproduction falling very little short of that which the crystal alone gave on the same loud-speaker (but, of course, at a very much lower intensity

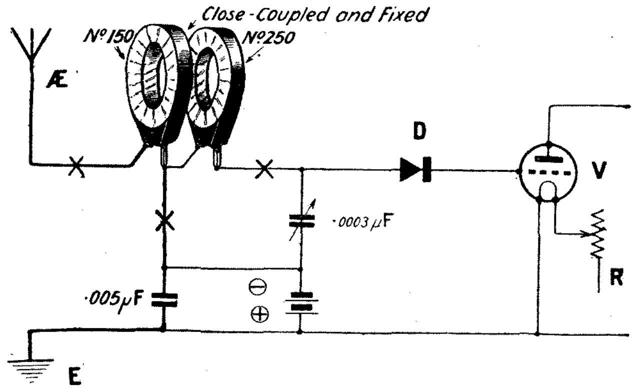
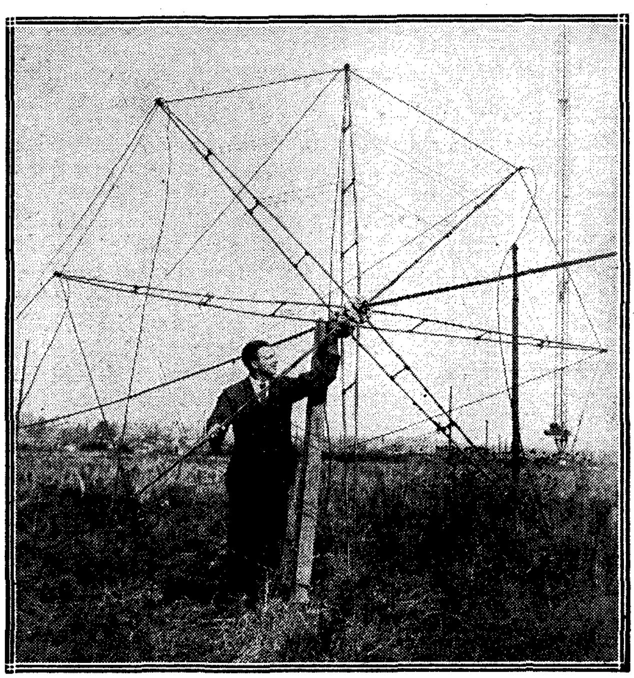


Fig. 3.—The arrangement of coils recommended by the author for the reception of Daventry. Switches for changing over may be inserted at the points marked X.

in that case). The main criticism called for was that there was a slight general lowering of "pitch," but sibilants were much clearer than usual, and speech very natural. This was with a Marconi Ideal 4:1 transformer, Ediswan Dulcivox loud-speaker base, and Scientific Supply Stores non-resonant loud-speaker trumpet, with a Grafton Electric Co.'s audio-choke and H.T. accumulator battery. A low single-wire aerial,



The spreaders for the aerial at the Government Wireless Station at Hillmorton, near Rugby, are of imposing size.

or an indoor attic aerial, at 12 miles, gave with a D.E.5B valve (1.4 volts grid bias) and a single power valve following it moderate loud-speaking of great purity, which would suffice in intensity for an intimate audience.

Constructional Notes

The aerial coupler is of the "semi-aperiodic" type, with a simple tapped solenoid coil of mediocre design (to correspond with the fairly high damping present). Five alternative tappings are provided for the aerial connection, the optimum being found by simple experiment; excess turns can be removed later. The grid-coil has 80 turns of No. 22 d.c.c. wire close-wound, on a *dry* cardboard (or low-loss) former about 3 in. in diameter. This will tune over the usual short-wave broadcast belt with a .0003 μF parallel tuning condenser. The 50-turn tapped primary coil is wound on the same former continuously with the secondary, as shown in Fig. 2.

Crystal Detector

The crystal detector should be of the two-crystal or perikon type, and should be connected the right way round. An excellent stable combination is that of tellurium-synthetic zincite (*i.e.*, fused zinc oxide); one of the modern semi-permanent detectors with a certain degree of adjustability should be used here. A "Maxtone" Auto-Detector operated well in the circuit, and the "R.M.C." is also very suitable. The tellurium (or bornite) crystal should be next to the grid; if a galena combination is used—at some sacrifice of stability—the whisker should be on the aerial side and the galena next to the grid.

A grid-bias battery of 1.4 to 4 volts must be provided for the first grid, and should be bridged by a large fixed condenser of, *e.g.*, .005 μF capacity, as shown in Fig. 1. The rest of the circuit follows current power amplifier practice, and calls for no comment.

Simplicity of Operation

Once a good stable setting is found on the detector, the receiver needs no further attention other than switching on the current for use, and replenishing the batteries when required. An occasional touch to the tuning handle to follow up the vagaries of the local station's frequency standard, or the effect of sagging of the aerial, etc., may sometimes be required. This should not be entrusted to the unskilled: no daily "searching" is required.

It is obvious that the high-powered station can be provided for in the same receiver by introducing two fixed coil plugs arranged 1 in. apart, with a No. 150 aerial coil and a No. 250 secondary coil, together with a simple multiple change-over switch. This arrangement is indicated in Fig. 3.

SOME NOTES ON TUNING AND SELECTIVITY

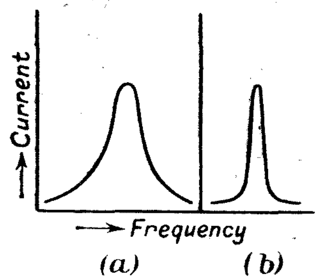
(*Continued from page 116*)

opposite of the theoretical case of a coil having no resistance, and, moreover, is rather contrary to generally accepted ideas of to-day. There is, of course, a limit to the decrease in the inductance of the coil. It is worth remembering, however, that it is comparatively easy to make a condenser having a very small loss, something less than 1 ohm, whereas the construction of a coil to have a resistance of as low as 5 ohms is a comparatively difficult matter. Low-loss coils can be wound by using special and expensive methods of construction, or they may be obtained by using only a few turns and a comparatively small inductance.

It would appear that this latter alternative is one which has not been given satisfactory trial. One disadvantage of the method lies in the fact that the voltage developed across the condenser is small. This, however, is offset to some extent by the fact that the current in the circuit is able to build up to a larger value owing to the lower resistance. There is obviously a practical compromise depending upon the type of circuit used, and it certainly seems that this method of obtaining selectivity could be explored with advantage.

Use of Reaction

With judicious application of reaction it is possible to reduce the resistance of a tuned circuit to a comparatively small value. This, of course, improves the selectivity, and sharpens the resonance curve, but the action is not always clearly understood.



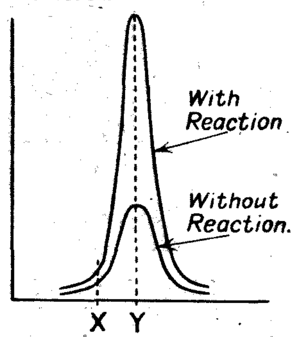


Fig. 7. *Fig. 8.*

Reaction by itself does not reduce the unwanted signal, but actually causes an increase of current at each point of the curve.

Fig. 7 (*a*) is a resonance curve of an ordinary circuit containing a fair amount of resistance. The generally accepted idea is that the application of reaction will transform this resonance curve into something of the order shown in Fig. 7 (*b*), that is to say, a very thin curve having a very sharp cut-off.

Now this is true to a certain extent only. The effect of applying the reaction is to reduce the resistance in the circuit. This, therefore, is the exact contrast of the condition of affairs shown in Fig. 4. The new resonance curve with the reduced resistance will be as shown in Fig. 8. The more the resistance is reduced, the higher becomes the peak of the resonance curve.

The point to be noted is that as long as the input remains the same, the current at all points of the curve is *increased.* Thus, if we have an interfering signal at the point X, the application of reaction will cause, if anything, a slight increase in the value of this signal. It will at the same time cause a very large increase in the strength of the wanted signal, Y, due to the sharpening of the resonance curve, and the ratio between the wanted signal and the interfering signal will be reduced.

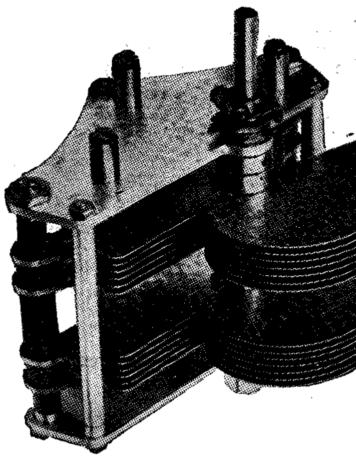
It very often happens, however, that the simple application of reaction, resulting in the increase of the wanted signals, does not give the desired effect because the interfering signal can still be heard. To obtain the resonance curve one desires, it is necessary to reduce the input of energy somewhat by loosening the aerial coupling or by making some other appropriate adjustment.

It should not be thought, however, that the application of reaction *by itself* can cause any *diminution* in the interfering signals; it can only cause an alteration of the ratio between the wanted signal and the interfering one.

The Wireless Exhibition

In our last issue we gave a
their Stand Nos. at the Wi
with a plan of the Horticul
general survey of some of t
to be seen at t

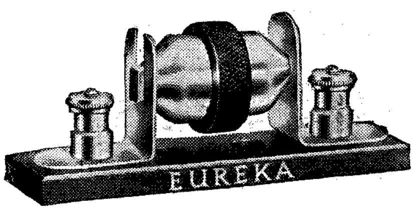
The Exhibition will be open from 11 a.m. to 10 p.m. each day until October 16.



The dual square-law low-loss condenser produced by the Igranic Electric Co., Ltd.

A GENERAL review of the exhibits at the Horticultural Hall shows that considerable progress has been made since last year, this being apparent in the appearance and finish of the components and complete receivers displayed, as well as in the design of the apparatus.

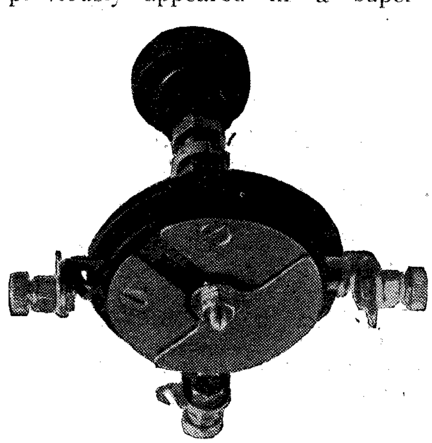
Several examples of super-heterodyne receivers are being shown, the Western Electric Co., Ltd. (Stands Nos. 37, 38 and 39) exhibiting a seven-valve set of this type. Ease of control is a feature of this



The Eureka Gravity detector being shown by Portable Utilities Co., Ltd.

receiver, while considerable selectivity and sensitiveness are claimed for it when used with the frame aerial advised. Prominent among this firm's range of products will be seen the Kone loud-speaker. It is claimed that this instrument gives extremely good quality reproduction, responding equally well to both high and low notes, and that it will handle quite a large amount of power.

An eight-valve super-heterodyne receiver is shown by Peter Curtis, Ltd. (Stands Nos. 27, 28 and 29), which is claimed to incorporate certain novel features which have not previously appeared in a super-

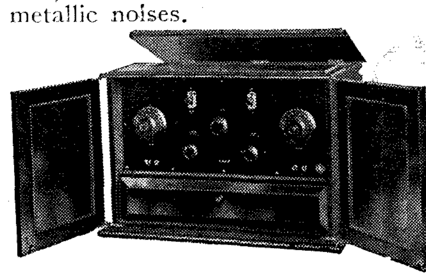


The Igranic Electric Co., Ltd., are showing a vernier balancing condenser.

heterodyne. In addition to this receiver and a wide range of receiving sets employing from two to five valves, the well-known Paragon guaranteed ebonite panels are being exhibited, together with aperiodic H.F. transformers and other components. A Duodyne receiver, made by Messrs. Peter Curtis, Ltd., is being used for the reproduction of the B.B.C. programmes during the period of the Exhibition, in association with Messrs. S. G. Brown, Ltd. (Stands Nos. 9, 10 and 11), who are exhibiting their full range of loud-speakers.

Among the complete receivers shown by the Fellows Magneto Co., Ltd. (Stands Nos. 12, 17, 18 and 23), are two of their latest models, the Two-Valve Grand and Four-Valve Grand, which are fitted in finely-finished cabinets of antique design. In addition to a display of bright- and dull-emitter valves, there are also to be seen the "Volutone" and "Junior" loud-speakers. Among the components shown on these stands notable features are a set of interchangeable coils for covering a wide range of wave-lengths, and a new accumulator charger to work from A.C. mains.

An interesting exhibit by Messrs. M.P.A. (Wireless), Ltd. (Stands Nos. 15 and 16), is a five-valve receiver, which employs the neutrodyne method of stabilising the H.F. valves. The M.P.A. "Three" is a self-contained receiver working on a frame aerial in the lid, which is said to operate a loud-speaker successfully at 15 miles from a main broadcasting station. Other exhibits include the "Celestion" hornless loud-speaker, which is claimed to give excellent reproduction, free from resonance and metallic noises.



The "Rotola III.," a 3-valve receiver shown by Rotax, Ltd.

The Radi-Arc Electrical Co., Ltd. (Stand No. 22), are also among those showing super-hetero-

at the Horticultural Hall

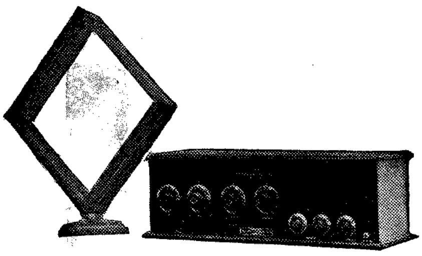
list of the exhibitors and less Exhibition, together al Hall. We give here a latest types of apparatus Exhibition.

The Horticultural Hall is easily reached from St. James' Park or Victoria Underground Stations, and is well served by 'buses.

dyne receivers, their "Liberty" sets of this class being designed to work with standard dull-emitter valves. Other features on this stand are a permanent crystal detector, and a safety wander plug incorporating a current-limiting device which is said to protect the valve filaments in case wrong connections are made, or the H.T. battery from short circuit.

The Seagull Four-Valve De Luxe Receiver, shown by Seagull, Ltd. (Stand No. 24), incorporates their low-loss tuner and choke-capacity coupling; these components are said to give a considerable measure of selectivity and freedom from distortion.

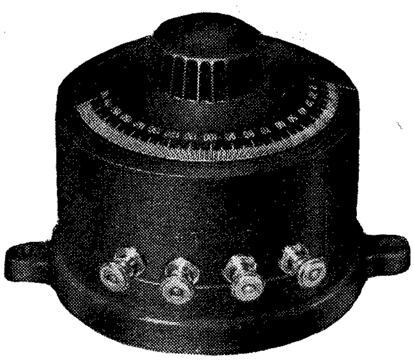
Together with standard two- and three-valve sets, the Engineering Works (Electrical and General), Ltd. (Stand No. 70), have on view their "Radiopal" four-valve receiver, which is contained in an attaché case, together with all the necessary accessories. Interchangeable frame aerials are provided, whereby reception is claimed to be possible at good loud-speaker strength from a main broadcasting station at 40 miles, or from Daventry at 120 miles, range.



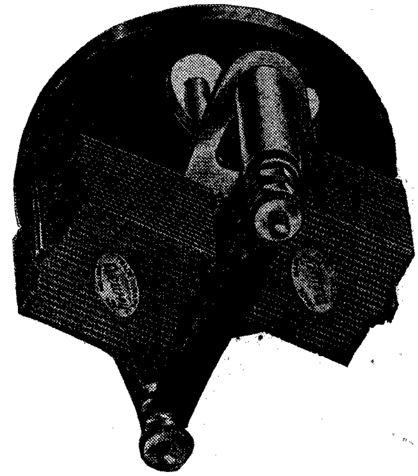
A super-heterodyne receiver shown by the Radi-Arc Electrical Co., Ltd.

Provision for using A.C. or D.C. mains for supplying their receivers is made by Read & Morris, Ltd. (Stand No. 72). In particular a four-valve set, as supplied to a London hospital, is shown with one-knob control; by means of an adapter, which may be plugged into any convenient lamp-holder, both H.T. and L.T. are drawn from the A.C. lighting mains.

The British Engineering Products Co. (Stand No. 51), suppliers of the "Tonyphone" range of receivers, are showing a number of these sets, an example being a one-valve receiver designed to operate headphones up to a distance of 500 miles from a main broadcasting station. A portable self-contained three-valve set is also shown, with which no external aerial or earth is required. Another portable set of interest is a two-valve reflex set shown by Messrs. Rotax, Ltd. (Stands Nos. 35 and 36), in which only one control knob is necessary; good stability and a headphone range of 25 to 30 miles are among the claims for this receiver. A full range of accumulators and dry batteries is also to be seen on these stands.

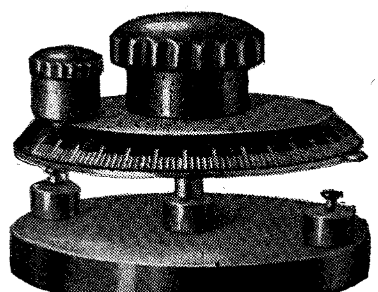


A tuned H.F. transformer exhibited by Bretwood, Ltd.



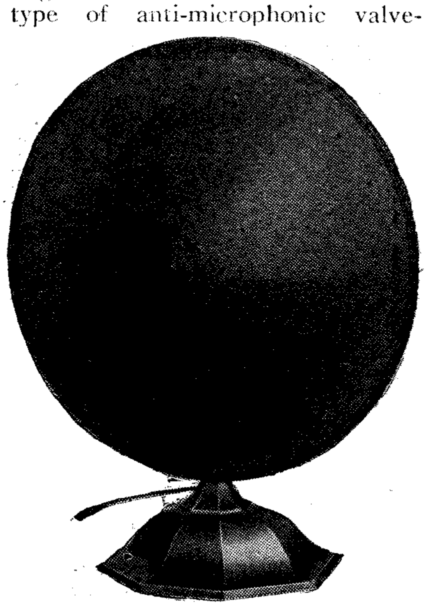
Pettigrew & Merriman, Ltd., are exhibiting their Newey 4-point square-law condenser.

The exhibits by the Silvertown Co. (Stands Nos. 46 and 47) consist of the whole of the wide range of this firm's accessories, which include the "Silvervox" loud-speaker and a number of types of L.F. and H.F. transformers, some of the former having two centre tappings, brought out for use in the "push-pull" method of amplification.



A variable condenser with mica dielectric shown by Bretwood, Ltd.

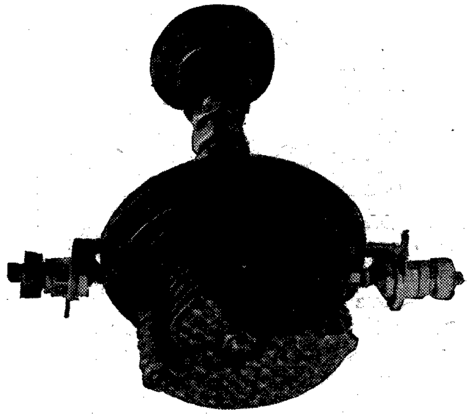
A number of new items which should prove of interest are being shown by the Igranic Electric Co., Ltd. (Stands Nos. 32 and 33). Among these items what will perhaps attract most attention is a six-valve supersonic heterodyne outfit for the home constructor, which includes a specially designed Igranic self-stabilising reactance unit. Another line of interesting exhibits comprises apparatus suitable for transmitting. This includes transmitting inductances, transmitting variable condensers and transmitting chokes. There is also a new type of anti-microphonic valve-



The Western Electric Co., Ltd., have produced a new loud-speaker, the "Kone."

holder, and other devices include a combined filament rheostat and grid-leak, and a representative exhibit of honeycomb duolateral inductance coils, intervalve transformers and filament rheostats, as well as the Igranic Electric soldering-iron.

A new fixed condenser is being shown by the Watmel Wireless Co., Ltd. (Stand No. 54). We understand that no wax whatsoever is used in the construction, the plates and mica being accurately assembled and clamped together in powerful presses, and enclosed in

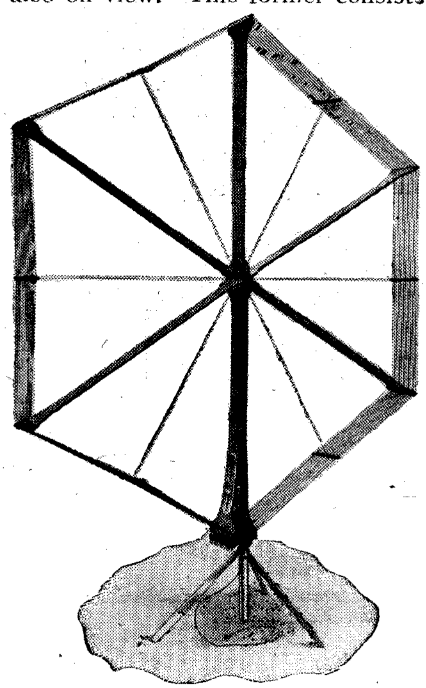


The Igranic micro condenser (Igranic Electric Co., Ltd.).

outer cases of bakelite or ebonite. Among other exhibits are displayed the Watmel variable grid-leak and anode resistances, and the anodyne radio-frequency transformer.

Messrs. Bretwood, Ltd. (Stand No. 63), in addition to other exhibits, such as their well-known variable grid-leaks, are showing for the first time some new products, including an oscillator and a tunable transformer for super-heterodyne sets, and a variable low-loss condenser with or without reduction gearing.

The products exhibited by the Collinson Precision Screw Co., Ltd. (Stand No. 62), include the Colvern selector low-loss variable condenser. This instrument is so constructed that, in addition to the fine mechanical movement obtainable by the special drive, the scale value is directly relative to the fine control, so that one-twentieth of a degree is easily readable. The Colvern former for winding low-loss coils is also on view. This former consists



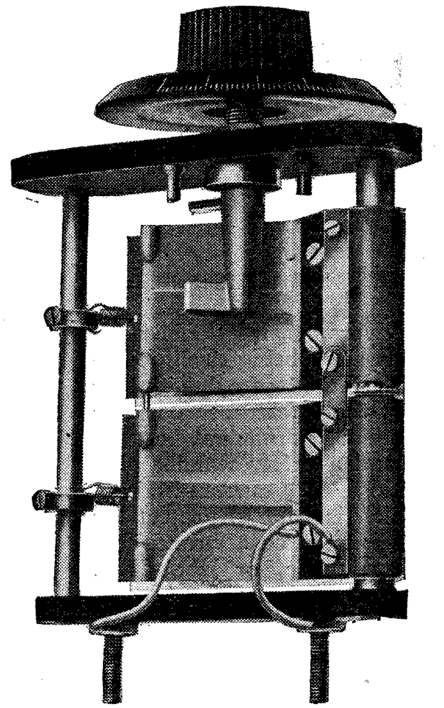
A folding frame aerial shown by Portable Utilities Co., Ltd.

of six ebonite tubes carrying a screw thread on the outside, and supported at each end by an ebonite ring.

A special self-supporting type of low-loss coil is shown by the Finston Manufacturing Co., Ltd. (Stand No. 61), together with other components. We understand that all moulded parts used on Finston components are made from a specially prepared compound, which possesses great dielectric and mechanical strength, and is non-hygroscopic.

In the "Recepco" low-loss inductance coil, shown by the Radio Reception Co. (Stand No. 56), special attention is directed towards the airspaced windings and the insulation used, which is a composition of rubber-like material holding the windings firmly in position.

An interesting exhibit by Messrs. Pettigrew & Merriman, Ltd. (Stands Nos. 67 and 68), is the



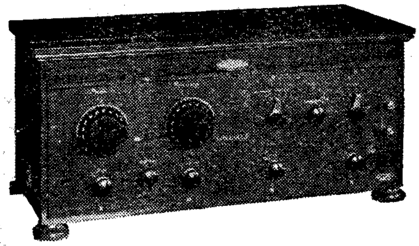
A new design of variable condenser shown by Fellows Magneto Co., Ltd.

Newey "4 point," low-loss, square-law condenser. Outstanding features of the design of this instrument are the square plates welded to the supporting pillar, and also to a bonding strip, and the employment of bakelite mouldings. Both sets of vanes move under a slow motion control, pigtail connections being provided. The Newey snap terminals and connectors are also to be seen. These are designed to provide easy and rapid connection of any number of pairs of 'phones to a receiving set, and also to allow

A fixed condenser exhibited by Watmel Wireless, Ltd.

for removal without interference or annoyance to other listeners.

The Portable Utilities Co., Ltd. Stands Nos. 42 and 43), are showing a new series of "Eureka" transformers, which are said to embody much heavier gauges of wire than have previously been practical in transformer design. In addi-



A super-heterodyne receiver produced by Peter Curtis, Ltd.

tion to the above, other lines displayed include L.F. choke units, potentiometers, frame aerials, and the Eureka rotary detector.

Two new products displayed by the Microhm Engineering Co. (Stand No. 57), are an L.F. transformer employing toroidal coils wound on a moulded former and enclosed by stalloy case plates, and a new high-tension battery in which the over-all dimensions and weight for a particular capacity are said to be considerably reduced.

The new Formo "Perfection" L.F. transformer, produced by the Formo Co. (Stand No. 71), is claimed to satisfy the needs of the most critical listener and lover of music. A 200-1 slow motion tuning dial is also manufactured, enabling delicate adjustments to be made.

Four types of valves are shown by Cleartron Radio, Ltd. (Stand

Portable Utilities Co., Ltd., are exhibiting their Eureka Baby Grand low-frequency transformer.

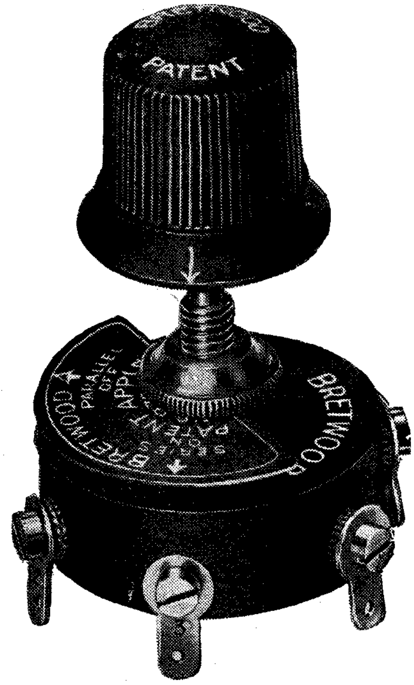
No. 44), together with a demonstration of the different stages in their manufacture.

Messrs. C. A. C., Ltd. (Stands Nos. 48 and 49), are also showing their bright- and dull-emitter valves.

This firm also gives prominence to the "Violina," a cabinet model loud-speaker, whose performance, we understand, leaves nothing to be desired in respect of quality of reproduction.

In the "Brandola" loud-speaker, exhibited by Messrs. Brandes, Ltd. (Stand No. 34), a large diaphragm is employed which is claimed to improve reproduction over the range of 200 to 4,000 cycles per second.

A series of rotary rectifiers in various sizes is being shown by W. Woods (Stand No. 64), and also D.C. motor converters for stepping down the voltage of the mains to a lower value for battery



A series-parallel switch exhibited by Bretwood, Ltd.

charging. Messrs. Sparks Radio Supplies (Stand No. 55) are also exhibiting their "Radiohm" rectifier for the home charging of accumulators from A.C. mains.

All-British manufacture is a feature of the products of the Stella Works (Stand No. 8), L.F. transformers, variable condensers, headphones and loud-speakers being among the components shown.

On Stand 45 may be seen the whole of the comprehensive range of authoritative literature produced by Radio Press, Ltd.

No less than five periodicals are now published by this firm. *Modern Wireless* and *The Wireless Constructor* appear monthly, *Wireless Weekly* and *Wireless*—the "one-word" weekly — being weekly journals.

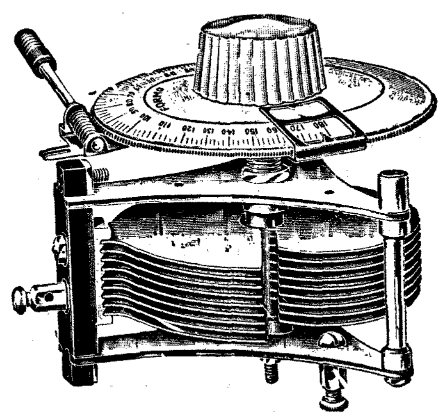
Very prominent in the display is to be seen *The Wireless Dealer*, the new monthly trade journal.

In addition to the above are

Fellows Magneto Co., Ltd., are showing their Volutone loud-speaker.

shown the series of Radio Press books, dealing with both the theoretical and practical sides of the subject, and the envelopes, panel cards, simplex radio charts and Radio Press panel transfers, all for the use of the constructor.

Radio Press, Ltd., meets the needs and requirements of all wireless amateurs and experimenters; whatever their skill or knowledge,



The Formo variable condenser with worm gear incorporated for vernier control (The Formo Company).

in these books they will find sound guidance, useful information and up-to-date reports of progress made in the science of radio-communication.

Wireless News in Brief.

Amateur's Success with Short Wavelengths. Another wireless record has been set up by Mr. Gerald Marcuse (G2NM), of Caterham, in establishing two-way communication with a station at Kohat on the North-Western Frontier of India. The station in India was using continuous wave telegraphy, but Mr. Marcuse was transmitting speech and gramophone records. The operator of the station at Kohat states that he has been regularly receiving speech from Mr. Marcuse, and that he can receive his Morse signals at any time. This two-way communication was effected on a wavelength of 45 metres, Mr. Marcuse using Marconi Type T250 valves with 600 watts.

* * *

Wireless Control. During recent exercises of the Mediterranean Fleet, a wireless controlled target ship, the *Agamemnon,* was employed. Without a man on board, the *Agamemnon* can manœuvre, change course, increase or decrease speed, and send up a smoke screen.

* * *

Experiments are being made by engineers of the British Broadcasting Company, in connection with a "Round the Continent" programme, which is shortly to be broadcast from 2LO. For an hour listeners will get the pick of the best Continental programmes.

* * *

Broadcasting in India. We understand that in the Indian Parliament it was stated, in reply to a question, that the administration of broadcasting in India will be in the hands of the Post and Telegraph Department. The establishment of an advisory board was under consideration. Toll broadcasting will not be allowed at the commencement of the broadcasting service. If a demand for it arises subsequently, the matter will receive attention.

* * *

Daventry Heard in India. A reader of the *Times of India,* of Bombay, reported the reception of Daventry, the new 5XX, and said that the piano came through exceptionally well on the headphones and was just audible on the loud-speaker.

* * *

Wireless for Lightships. Wireless installations have been fixed on several of the lightships marking the Goodwin Sands, and Trinity House proposes to deal similarly with other ships round the coast. The work will be proceeded with as funds and opportunity allow.

The primary object of the equipment is to maintain communication with shore stations, but as far as the exigencies of the service permit the apparatus will enable the crews to enjoy broadcast programmes.

* * *

B.B.C. Land Lines. From the beginning of November all stations north of Leeds will be linked up by land-line to Leeds instead of to London, thus eliminating several hundred miles of land-lines hitherto used. Between London and Leeds four special lines have been set apart for the use of the B.B.C. The arrangements at Leeds to send out the programmes or items to northern stations will be much more automatic than they have been from London. Instead of the engineers in the London control room feeding other stations, the stations depending on Leeds will help themselves. The distant station will make its own connection with Leeds by the manipulation of a single plug, which will also control the necessary amplifying apparatus.

The chief function of Leeds as a pivotal point will be to improve the quality of all items which it receives from London to the same excellence as when they left the Metropolis. Distortion and other faults will be corrected and weak signals amplified before they are passed on, so that listeners should get improved reception from many local stations, as well as a general speeding up in the S.B. part of the programme. The policy is to develop land-line communication to the highest efficiency, and, in the near future, another pivot, similar to that at Leeds, will be installed to facilitate simultaneous broadcast arrangements between London and the West Country.

* * *

We are informed that entertainments from the saloons of two aeroplanes of the Imperial Airways, Limited, will be broadcast from 2LO on November 10, as the aeroplanes are flying over London.

* * *

Brazil: New Radio Station. A wireless telegraph station, employing the Telefunken system, has been opened at Salinas, 70 miles east of Para, under the supervision of the Brazilian Telegraph Department.

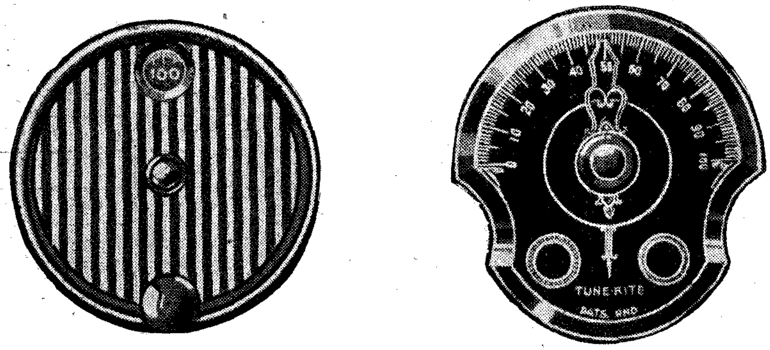
* * *

Ships' Wireless. By agreement between the British, Canadian, and United States Governments, merchant ships after October will cease operating their wireless apparatus on a wavelength of 300 to 450 metres when within 250 miles of the coasts of the three countries. The object is to prevent wireless broadcast programmes from being interfered with by Morse.

Straight-Line Frequency Dials

By SYLVAN HARRIS

In previous issues of "Wireless Weekly" articles by Sylvan Harris have appeared on Straight-Line Frequency Condensers. In this article Mr. Harris describes in detail a further development in connection with these instruments.



Two examples of straight-line frequency dials of the type described in the accompanying article.

THIS season brings two great developments in wireless receiver design, not in the fundamentals, but in the technique. These two developments are in the tuned circuits of the receiver, and are a result of the desire of the users, and the ambitions of the designers, to produce receivers that are more convenient to operate and less difficult to adjust.

The first of these developments, as everyone knows by this time, is the straight-line frequency condenser. This condenser has been studied in detail in Vol. 6, No. 16, of *Wireless Weekly,* and in subsequent issues. It will not be necessary, therefore, to review here the desirability and convenience of the straight-line frequency characteristic, although it may pay the reader to re-read those articles and refresh his memory on the subject.

New Developments

The next development -- the straight-line frequency dial—is a result of recognition received by the straight-line frequency condenser, and the desire of the radio user to obtain the benefits of the straight-line frequency idea without going to the considerable expense of replacing the semi-circular condensers which he already had in his set, with the newer type. The straight-line frequency dials are designed to rotate the plates of the semi-circular condenser in such a way that a given speed of rotation for the dial moves the condenser more swiftly on one end and more slowly on the other, so that the S.L.F. characteristic is attained.

Linear Calibration

In the previous articles I have written on the subject of straight-line frequency condensers, I have shown that, in order to obtain such a linear calibration, the capacity of the condenser must vary inversely as the square of the dial setting. In other words, if the capacity of the condenser at 100 on the dial is 0.0005 μF, then at 10 on the dial the capacity of the condenser should be $(10 \div 100)^2 \times 500$, or 5 $\mu\mu$F. At this point it must be remembered that the dial should read 100 when the condenser plates are all the way out, and zero when they are all the way in mesh.

Law of the Straight-Line Frequency Dial

This is the law of the straight-line frequency condenser, and the same law holds true for the straight-line frequency dial. For a semi-circular plate condenser, the capacity of the condenser is directly proportional to the angle through which the plates are turned.

Now, if the straight-line frequency law is to hold, it is necessary that the capacity C be inversely proportional to the square of the angle of the dial, which, combined with the above relation, requires that the angular setting of the plates be inversely proportional to the square of the dial setting. This, then, is the required law of the straight-line frequency dial. It will be noted that this is the same law as applies to the straight-line frequency condenser.

Theoretical Design

It is a rather difficult matter to deduce mathematically the shape of a cam or groove which will furnish motion to the condenser plates in accordance with the above law, as the motions in such apparatus involve both rotation and slipping, the combination of which makes the kinematical analysis difficult. Furthermore, the shape of the curve and the premises of the case depend upon the particular mechanical arrangement which is used, and obviously will be different for every individual case. There are a number of mechanical arrangements which may be used to obtain the motion required, a few of which are described in this article.

Types of Dials

There are two particular cases in connection with the dials which are being introduced which must be carefully distinguished from one another. The reason for this is that all of them, or nearly all, will probably be called "straight-line

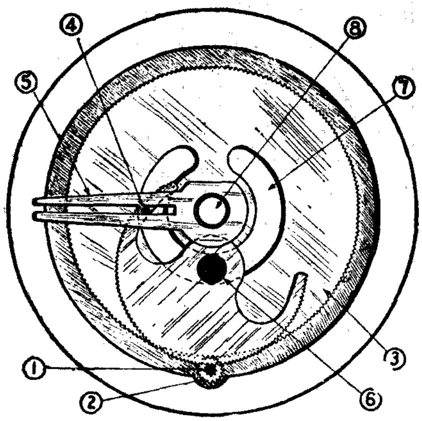


Fig. 1.—In this dial pinion 2 rotates plate 3, which carries the calibration scale. Pinion 1 moves the sector about the centre 6. Pin 4, fastened on sector, thus changes its radius in arm 5. The smaller the radius the faster arm 5 revolves about 8, which carries the condenser spindle.

frequency" or "S.L.F." dials. Some of the dials will be designed to furnish exactly linear calibrations (of course, forgetting the effect of circuit capacities for the moment), and others will be designed to furnish only approximately linear calibrations. This will be brought out more thoroughly as we proceed.

The Condenser Motion

The particular motion which is given to the condenser plates as the dial is turned is as follows :—

Starting at a dial setting of 100, when the plates are entirely out of mesh, as the dial is slowly turned, say, from 100 to 90, the plates slowly move into mesh. As the dial is turned around further and further, all the time at the same rate, the condenser plates rotate into mesh at a greater and greater rate.

Graphical Determination

The motion of the plates with respect to the motion of the dial may be studied from the curves of Figs. 3 and 4. In Fig. 3 the axis at the bottom represents the setting of the plates of the condenser, that is, as if an ordinary dial were used. In other words, the bottom axis may be taken as representing the angle of motion of the condenser plates. The axis at the left (vertical) represents the capacity of the condenser at any setting of the plates.

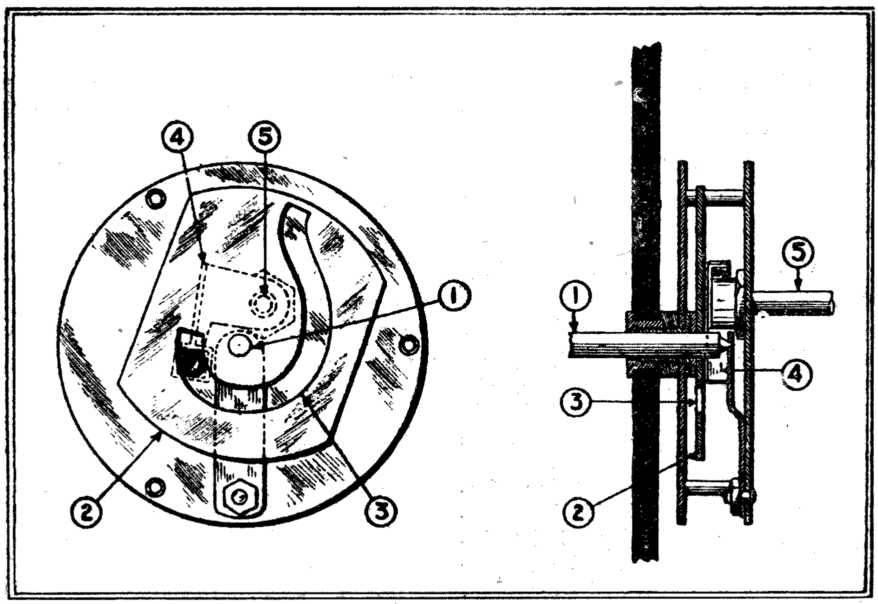


Fig. 2.—Another form of dial mechanism, in which shaft 5 turns plate 2, which carries a pin travelling in slot 3. This rotates arm 4 and condenser spindle 1. The distance between the centre 1 and the pin thus continually changes.

Curve of S.L.F. Condenser

On this graph the curve AB is the usual straight-line graph of capacity against the angular setting of the plates. Everyone is familiar with this curve; because it is linear, the condenser is called a straight-line capacity condenser. The curve BC, on the other hand, gives the values of capacity that *are required* to make the condenser give a straight-line (or linear) calibration of *frequency* against dial setting. This has been computed from the inverse square law, which applies to S.L.F. condensers. The first ten divisions on the dial have been neglected, since, if D is zero, C becomes infinite. This matter has been explained in detail in *Wireless Weekly*, Vol. 6, No. 16, in my first article on the straight-line condensers.

Plotting Dial Settings

It is easy to determine from these two curves the relation between the angular setting of the condenser plates and the dial reading of the S.L.F. dial. Simply follow the path indicated by the broken lines and the arrows. For instance, if Dp, the setting of the plates, is 20, the setting of the S.L.F. dial will have to be 57, as indicated on the horizontal axis at the top of the graph. If this procedure is followed out point for point, a curve, as shown in Fig. 4, will result. The horizontal axis gives the angular settings of the condenser plates, and the vertical axis gives the dial settings.

This curve is very close to the inverse square-law curve, which was deduced above. The only variations are near the ends of the curve, which are caused by the curved portions of the curve AB in Fig. 3.

The Purpose of the S.L.F. Dial

Before going into the various mechanisms that will give the required motion of the plates, it may

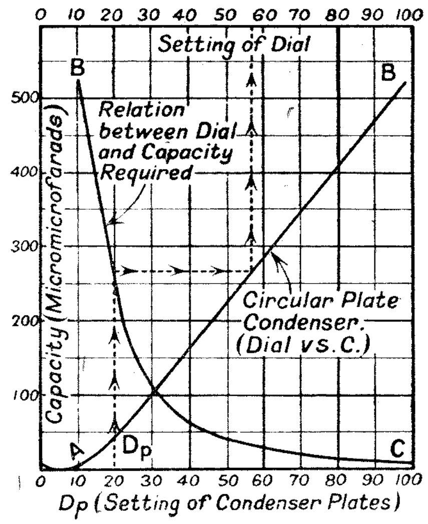


Fig. 3.—The curve shown in Fig. 4 is obtained from the capacity and frequency calibrations above by following the path of the dotted line.

be well to clear up a little misunderstanding that has come to my notice. A correspondent belittled the S.L.F. dial on the score that near one end of the motion the effect was merely the same as could be obtained with any so-called vernier dial, and for that reason he might just as well use the vernier dial. What he says is true as far as concerns the separating of stations on the dial, but the same thing is true of the S.L.F. condensers with the specially-shaped plates.

Vernier Effect

As the plates are turned out further and further, their area becomes smaller and smaller, and the effect is the same as could be obtained by using a so-called vernier condenser, that is, a small condenser of two or three plates. The reader must bear in mind that the S.L.F. condenser and the S.L.F. dial fulfil two requirements : they not only furnish a linear calibration between the frequency of the tuned circuit and the dial setting, but act as verniers at the same time. Furthermore, if there were no crowding of stations on certain parts of the dial there would hardly be any need for vernier adjustments.

Mechanical Principle

In the construction of the S.L.F. dial the mechanical principle employed is always that of the lever, as applied to a varying radius of the path of motion of a point fastened to the movable plates. For instance, imagine a plate which can be rotated about its centre. This plate has a groove in it, in which travels a pin at the end of an arm. The arm has likewise a slot in it, so that the pin can travel up and down the length of the arm.

Cam Action

As the plate is rotated, the pin moves outward from the centre. The greater the distance the pin is from the centre the faster will it move around the centre. The actual law of motion of the pin depends upon the shape of the groove, and can be made to vary within wide limits. The pin is fastened at the end of an arm, which rotates the condenser plates.

Various Types

Many variations of this principle are possible, as can be seen in the various illustrations on these pages. Sometimes ring-gears and pinions are used, but the design is greatly restricted by these, as the motions are, in turn, restricted by the possible ways of designing gears.

Methods of Construction

Other ways of constructing variable motion dials employ gears of special design; such as elliptical or hyperbolic shapes. The use of such

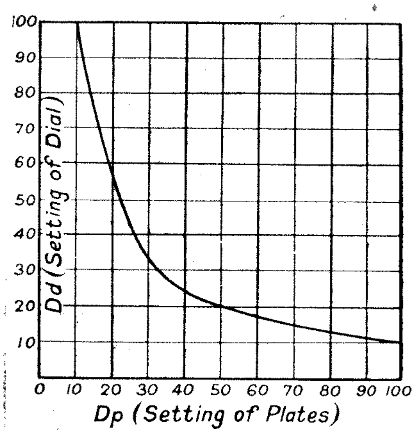


Fig. 4.—The angular setting of the condenser plates varies with the angle of the dial in accordance with the curve shown.

elliptical gears is, however, not altogether satisfactory, since this type of gear does not allow linear calibration, but only an approximation to the linear. Hyperbolic gears are difficult to use, because of their tendency to jam, and because they require a lot of room in which to operate. They have not been used as yet in a commercial product.

Advantages of S.L.F. Dials

The fact that only an approximation to the linear can be obtained in calibration with one of these dials should not deter the radio enthusiast from using them. The principal reason why these dials are manufactured is not necessarily to furnish linear calibration but to enable us to avoid crowding of stations on the dial. However, if the calibration can be made linear at the same time that the stations are separated, so much the better.

Minimum Capacity

Before closing this article we must not forget the necessity of having the proper minimum capacity in the condenser. The dial should be constructed (if linear calibration is desired) so that the plates of the condenser are partly in mesh when the dial reads 100, so as to furnish the proper minimum capacity. Or, if not designed to take care of the minimum, a small variable condenser should be shunted across the main condenser, adjusted to the proper value, and let alone. If the minimum capacity is not of the proper value, the calibration curve will depart from the linear. This, however, will not interfere materially with our ability to separate the stations when tuning.

OBITUARY

We regret to announce that Captain M. H. P. Riall Sankey, C.B., C.B.E., R.E. (retired), died suddenly of heart failure on Saturday, at his

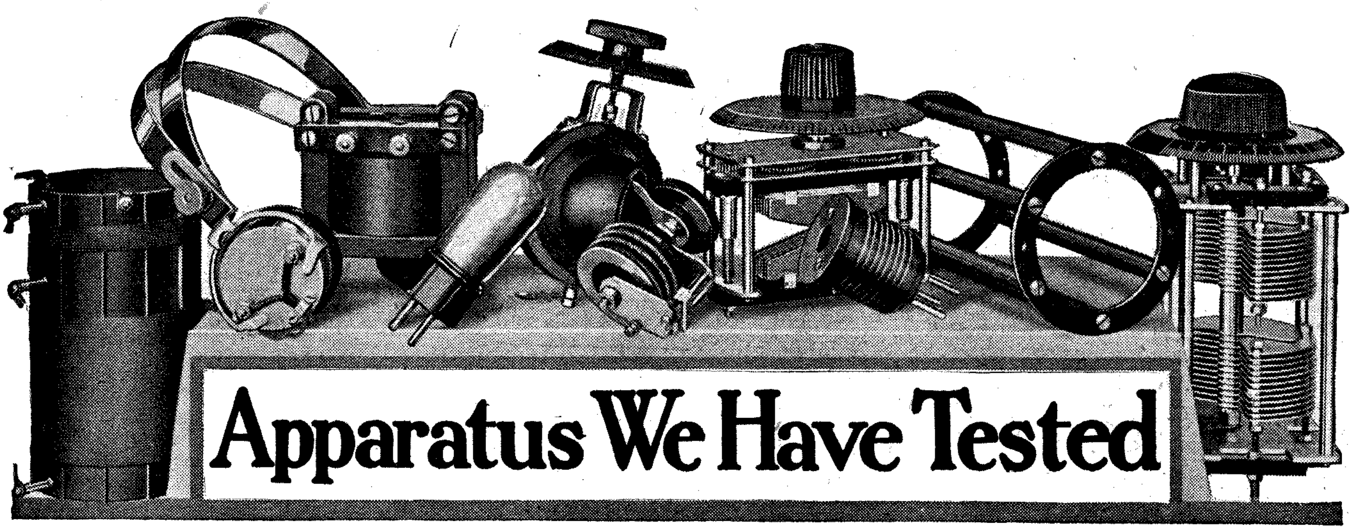
Captain M. H. P. Riall Sankey.

residence at Ealing, at the age of 71. Born at Nenagh, Ireland, on November 9, 1853, the son of General W. Sankey, C.B., he was educated in Switzerland and at Mr. Rippin's school at Woolwich, passing in due course through the Royal Military Academy and obtaining his commission in the Royal Engineers in 1873. He also passed through the School of Military Engineering at Chatham. In 1876 he entered the "Barracks Branch" of the War Office, and was engaged in architectural design, but shortly afterwards was placed in charge of the Royal Engineers' Drawing Office at Manchester. In 1878 he was ordered to Gibraltar in charge of the Military Telegraphs and Signal Station. The next year he was appointed Instructor in Fortification at the Royal Military College, Kingston, in Canada. Three years later he was placed in charge of the Trigonometrical Division of the Ordnance Survey at Southampton, where he made various improvements in the system of lithographic and copperplate printing. He was the first to apply dynamos to the process of copperplate reproduction for map printing.

In 1889 Captain Sankey retired from the Army and joined the board of Messrs. Willans and Robinson, Ltd. Later, he took an important part in designing the Victoria Works, Rugby, and he was designer of the steam turbines which were afterwards manufactured by the firm.

In 1905 Captain Sankey severed his connection with Messrs. Willans and Robinson to take up work as a consulting engineer, and some years later became director and consulting engineer of Marconi's Wireless Telegraph Company, Limited, the Marconi International Marine Communication Company, Limited, and other companies.

Wireless Weekly Small Advertisements.



Conducted by A. D. COWPER, M.Sc., Staff Editor.

Combined Valve-Holder and Rheostat

A combined valve-holder and filament rheostat of particularly neat design is that sent for our comment by Messrs. the London & Provincial Radio Co., Ltd. This resembles in some particulars a type of filament rheostat already commented upon in these columns, but has on the top of the frame (which is mounted by the same type of one-hole-fixing device) a low capacity type of valve-holder, with externally insulated valve-leg sockets, the anode socket being distinguished by being of a red colour. The contact fingers or brushes in this new type are long springs of phosphor-bronze, and were found to make good contact with the sliding resistance solenoid. Control by a small knob and sliding spindle is provided, similar to that in the older pattern. The high-resistance D.E. and the .75 ampere type of resistor are interchangeable, a matter of some convenience when changing over valves. The valve-holder part can be removed at will by withdrawing two small screws. Terminals are provided on the rheostat portion, and soldering tags for the remaining connections.

Practical trial showed that care had to be taken when soldering connections to these tags to avoid softening the ebonite holder-base and so loosening the sockets. The unit was found to be easy to mount, and to give a neat and compact instrument when arranged according to the popular vertical panel and base-board style of receiver, the wiring being appreciably simplified. The same smooth and convenient control of filament temperature as noticed in connection with the earlier pattern was obtained on trial, and the resistors proved of suitable value for their purpose.

Panel Selector Switch

A particularly neat type of multi-point selector-switch for mounting on the panel front is that submitted by Messrs. Burne-Jones & Co., Ltd. The sample, which was a 10-way switch with two extra stop points, occupied a circle of $1\frac{1}{2}$-in. diameter only, when duly mounted on a small panel. A centre screw-bush is provided, which proved to be easy to apply, and the switch arm was free from shake and operated smoothly. The stop points were favourably commented on, and appeared neater and more stable than the customary small stop-pins. Finish and workmanship were of a high order.

Insulated Wires and Cables

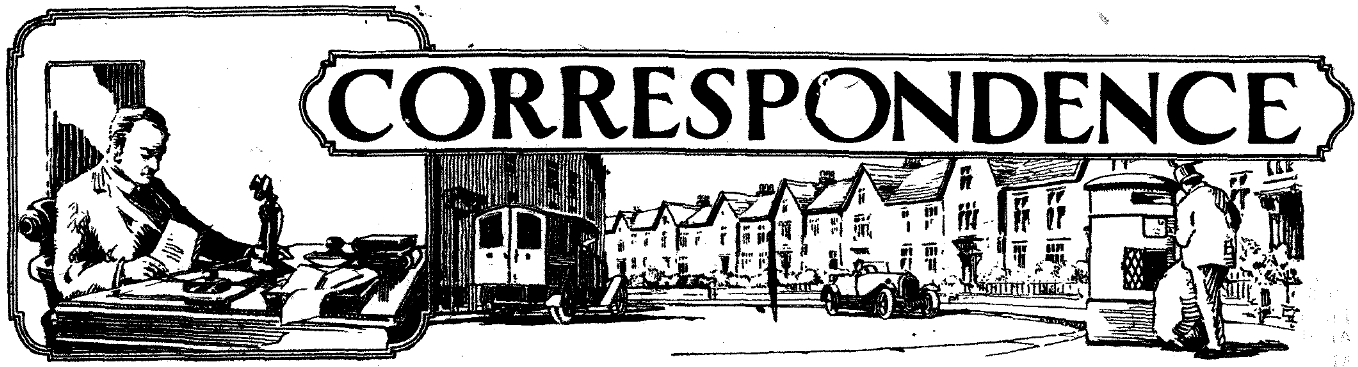
From Messrs. Ripaults, Ltd., have arrived a number of samples of insulated wires and cables particularly suited for radio purposes. These appear to be of high quality, the appearance of the silk-covered twin flex (for battery and long 'phone leads, etc.) being particularly pleasing. The twin flex samples were of the 14/36 type, and in various colours; single insulated wire with rubber insulation, suitable for low-frequency circuits in a receiver, was shown in Nos. 16, 18 and 20; ordinary cable suitable for earth-leads and aerial lead-in, with thin rubber insulation, in 2 and 3 millimetre sizes, and a specially high-class and heavily insulated cable with three-ply covering of 4, 5 and 7 millimetre size. The latter would be suitable for specially heavy service, and was of the most substantial build. It is evident that Messrs. Ripaults, Ltd., have effectively met a demand for high-class radio cables with the types submitted for our inspection.

Gecophone Geared Condenser

Messrs. the General Electric Co., Ltd., have submitted a sample, of nominal .0005 μF capacity, of their new friction-geared variable condenser, of square-law type. This is of the single-hole-fixing variety, and the fine adjustment feature is carried out by a train of friction wheels, a small bevel-edged wheel engaging between the edges of the spring discs of a larger double wheel at each of two stages of gearing, giving a peculiarly smooth motion and freedom from back-lash. The fixing device has a range to accommodate panels from $\frac{1}{4}$in. to $\frac{3}{8}$in. thick; it is decidedly complex in operation, and great care should be taken by the amateur constructor in dismantling this part for mounting the instrument.

It was further noticed, on practical test, that it was not difficult to twist the mounting bush in the frame, so that further means of fastening the condenser were required if calibrations were to be retained. A heavy brass frame is provided in the instrument, and the fixed plate assembly is mounted in this by very small insulating bushes, with a screw adjustment which appears to be called for by the very narrow spacing of the plates, the .0005 μF size being unusually compact. The insulating resistance, under normal conditions, appeared satisfactory, in spite of these tiny bushes; on testing the H.F. resistance under operating conditions, the condenser appeared to be of favourable character in this respect, though a little short of a standard pattern with ample ebonite insulation in the form of wide end-plates. No terminals are provided, but small soldering tags are supplied. The maximum capacity was around .00054 μF, the minimum being the satisfactorily low figure of $9\frac{1}{2}$ $\mu\mu$F.

The gearing ratio appeared to be about 13 to 1, sufficiently fine for separating stations below 1,000 kc. frequency, but hardly giving fine enough adjustment, in this size, for close work between 1,500 and 1,000 kc. in conjunction with a suitable inductance, the stations being very crowded here. The fine, smooth action of the friction gear and the decreased hand-capacity effects as a result of the large knob fitted, and of the grounding of the rotor and frame made possible in this instrument, were conspicuous in an extended test around the stations. The smaller sizes in particular should be very useful in fine work in the latter two-thirds of their scale.



AERIALS AND LIGHTNING

From Prof. C. L. Fortescue, M.A., M.I.E.E., Advisory Editor to Radio Press, Ltd.

SIR,—A few instances have been reported during the past summer of wireless apparatus being destroyed by lightning, but considering the number of aerials now in use the damage has been unexpectedly small. The extent to which aerials are affected by lightning discharge and the results likely to arise therefrom are questions of practical importance to all users of wireless apparatus, and an attempt is being made to collect information relative to actual cases in which aerials and apparatus have suffered in this way. I should be glad if I may use the publicity of your columns to ask anyone, and everyone, whose apparatus has been damaged to forward full information to me at the address given below. The data particularly required are :—

(*a*) The date and time of the occurrence.

(*b*) The position and approximate dimensions of the aerial.

(*c*) The nature and position of the earth connection.

(*d*) A brief description of surroundings, *i.e.*, position of adjacent houses, trees, telephone wires, etc.

(*e*) Whether the aerial was directly earthed or whether either receiving or transmitting apparatus was in circuit.

(*f*) The fullest possible description of the incident and the nature of the damage done.—Yours faithfully,

CECIL L. FORTESCUE.

City and Guilds (Engineering) College, Exhibition Road, S.W.7.

"A NEW LOUD-SPEAKER CIRCUIT"

SIR,—Re *Wireless Weekly*, issue September 16, "A New Loud-Speaker Circuit," I am happy to inform you that, unlike many freak circuits which I have set up, my efforts with the above have not been wasted.

The circuit, as Fig. 1 in the article quoted, is most satisfactory, giving powerful loud-speaking on 2ZY, which is some five miles away. Not only is it loud, but its purity is, as stated, superior to a crystal and L.F. amplifier; in fact, for anyone content with quality on their home station I know of nothing to equal it, and my experience is not small, as I have made up all sorts of circuits from crystals to 10 valves, but the best resistance-coupled set with wire wound resistances and expensive mica coupling condensers in no way approaches your design for purity and volume. Perhaps the following details may interest you :—

V1, a D.E.5.B.; battery B, 12 volts; resistance R, 80,000 ohms; V2, a B4 with 60 volts H.T. through primary of transformer; V3, a D.E.5.A. 120 volts H.T., with 12 volts negative bias; transformer, ratio 6/1, 2 μF Mansbridge condensers between L.T. negative and each H.T. tapping. A.T.I. composed of 60 turns No. 16 s.w.g. d.c.c. 3in. dia. self-supporting, "higgledy piggledy," with tap 10 from E end, Lissen X fashion. Capacity earth, consisting of length Electron buried under aerial 6 in. in ground. Aerial 7/22, 40 ft. high, 60 ft. long.—Yours faithfully,

H. S. COPPOCK.

Didsbury.

THE "OMNI" RECEIVER

SIR,—About three months ago I purchased Radio Press Envelope No. 5, the Omni Receiver, and completed same. I am very pleased with results obtained, having had every station in the British Isles during the experimenters' half-hour on Monday evenings and at least eight Continental stations up to the present. The only alterations in the set are a .001 μF variable condenser instead of .0005 μF for aerial tuning.

Mr. Clark's Omni receiver as described in Radio Press Envelope No. 5.

I have found Fig. 15 in the instructions an excellent circuit for loud-speaker work, reception being very clear with grid bias. I am using three valves at present. I am now making a wave-trap from instructions in *The Wireless Constructor* to use with the set.—Yours faithfully,

S. E. CLARK.

Bow, E.3.

"A CHOKE-COUPLED 3-VALVE" RECEIVER

SIR,—In your "Unit Choke Amplifier" in *The Wireless Constructor* for April you invite those who make one of these units to write and tell you what they think of it. Though you did not give the same invitation regarding your "Choke-Coupled Three-Valve Receiver" in *Wireless Weekly*, date May 27, 1925, you may care to hear my experience with this set.

Early in June, having decided to acquire a wireless set and having been told that reception of stations north of Worthing was poor owing to screening by the Downs, I took 2s. 6d. worth of advice from the Radio Press, Ltd. I stated that I wanted the purest reception possible from the nearest station and that I had no particular wish for long range. I added that I had thought either of getting the "Choke-Coupled Three-Valve Receiver" made up for me or of buying some standard set, and asked that one likely to suit my requirements might be named. In reply I was told that if I intended to use a loud-speaker I had better get the "Family Four-Valve" Receiver described in one of the Radio Press Envelopes, but that for 'phones the three-valve set would be quite suitable, particularly as it was simple for a beginner to work. Your insistence on the exceptional purity of reproduction of the three-valve set, however, carried the day, and I had one made up for me. The valves I am using are R.5.V., D.E.5.B. and D.E.5. Daventry *without* reaction has to be detuned somewhat. Bournemouth and London are also regularly received with good volume on the loud-speaker, but a fair amount of reaction is required. A local "radio engineer" tells me that the quality is better than any he has heard, and that he would like to know how much of this is due to the set and how much to the loud-speaker. Probably it is a case of fifty fifty!

I do not often attempt to receive other stations than the three named, but have had many Continental stations on the 'phones, though no others of the B.B.C. Recently Radio-Paris was received quite satisfactorily on the loud-speaker.

The components are those specified by you. The only difference from the set as illustrated is that the wiring has been made more rectangular.—Yours faithfully,

W. B. RICHARDS.

Worthing.

A "POWERFUL 3-VALVE" SET

SIR,—After having built a few of your sets from *The Wireless Constructor* I have built "A Powerful Three-Valve Set," described in the April issue, by Percy W. Harris, M.I.R.E. I have given it a good test for about a month, and I am more than delighted with the results. I am sure it is the set many of us have been waiting for. I am using a B.T.H. B4 valve in the first L.F. stage, and a B.T.H. B7 in the second, and using a grid-bias on each valve of about three volts; music and speech come through very sweet and clear. I found the loud-speaker was much better with a .002 μF condenser across the terminals.

I have no difficulty in picking up Manchester, although Leeds is only seven miles away, and Daventry is almost too loud even when reaction is uncoupled. Bournemouth comes in at good loud-speaker strength. I think this is one of the best three-valvers you have published, and if more generally used it would reduce the number of oscillators who try to get three-valve results out of two.—Yours faithfully,

ARTHUR DALEY.

Birstall.

SHORT WAVE TRANSMISSION

SIR,—We would be obliged if you will publish the present schedule of our telephony tests.

We will call: "Here Radiogiornale 1RG."

We send every Sunday exactly at 15.00 G.M.T. on 18 metres and at 06.00 G.M.T. on 38 metres. Input 150 watts in each case.—Yours faithfully,

ERNESTO MONTÙ (Operator), I1RG.

Bellagio Lake, Como, Italy.

CORROSION OF EARTH LEAD

SIR,—Here is something to warn your readers of. Last year I made an "earth" by burying a lead plate 3ft. down, plus the usual layer of coke, etc. To enable the earth to be kept damp a galvanised iron pipe was put down to the plate and so that its end was a few inches above ground and water could be poured right down to the plate. The earth wire was 7/22 enamelled copper stranded wire. This wire ran down to the plate alongside the galvanised iron pipe for some way. Using a powerful supersonic heterodyne set, reception on distant stations fell off unaccountably, but was cured by transferring the earth lead to a nearby radiator. Investigation of the lead plate earth showed that electrolytic action had taken place between the 7/22 copper wire and the galvanised iron pipe. The wire wherever it touched the pipe had become friable and brittle and some of the strands had completely disappeared. The result appears to be similar to that sometimes experienced on board ship between the ship's plates and the copper or bronze of the propeller.—Yours faithfully,

C. R. BATES.

Market Harborough.

ENVELOPE No. 4

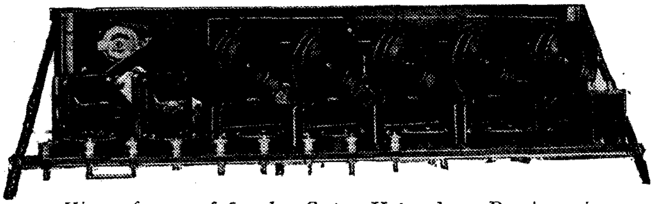
SIR,—My set is Mr. Harris' three-valve "All-Concert" circuit (Radio Press Envelope No. 4), but with an extra valve added with resistance coupling, separate H.T. + connections to each valve, power valves in both L.F. stages, with grid-bias to both. All Ediswan valves, lit by a 2-volt accumulator, and following H.T.: H.F. 60v., Detector 36v., first L.F. 80v., second L.F. 120v.

Quite accidentally I made a discovery a few days ago which may be of interest to readers of *Wireless Weekly*. I found that an ordinary wrought-iron standard lamp provided an efficient aerial for 5XX. It was necessary to alter tuning on the aerial condenser slightly, but when properly tuned the result was surprising. The volume was quite equal to that obtained from the outdoor aerial. The latter, however, was far more efficient for the reception of broadcasting on the shorter wavelengths.

The standard lamp aerial works two loud-speakers in parallel with extraordinary volume.—Yours faithfully,

S. A. BLACKALL.

Neath, South Wales.



View of rear of 6-valve Super-Heterodyne Receiver, incorporating the essential units and parts contained in the IGRANIC Outfit.

A message to Super-Het. Constructors

See the greatest advance in Supersonic-Heterodyne design yet made——on

STANDS 30 & 33

at the

Wireless Exhibition and Radio Convention, Royal Horticultural Hall, Westminster, S.W.1.

Here you will see THE ALL-IGRANIC RECEIVER EMBODYING the

Igranic Supersonic-Heterodyne Outfit.

It contains novel reactance capacity coupling units obviating the deliberate introduction of losses as a means of suppressing undesirable oscillation, such as by potentiometer control, and any tendency of the intermediate frequency amplifier to oscillate is cut off at its source.

The special method of securing stability employed in the self-stabilised reactance units enables a far higher degree of amplification to be obtained than would otherwise be possible.

Oscillator Units can be obtained in three sizes giving wave-length ranges of from 215 to 4,500 metres.

If you cannot visit the Exhibition send for the IGRANIC Instructional Envelope.

The IGRANIC INSTRUCTIONAL ENVELOPE for constructing a Six-valve Super-Heterodyne Receiver according to the Igranic system, complete with full-sized general arrangement drawing, wiring and drilling diagrams, and fully illustrated descriptive booklet can also be obtained from your dealer. Price 2/6.

If you want to see the very latest components for all circuits you will find all the new

RADIO IGRANIC ELECTRIC Co. Ltd. DEVICES

on the same stands at the

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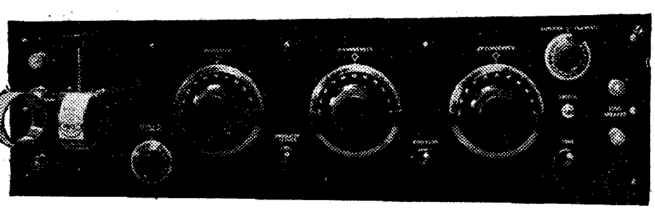


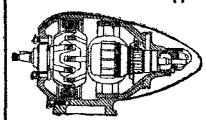
ELECTRADIX RADIOS

YOU would not use an axe to wind a watch nor a pocket compass and a school atlas to pilot a ship in strange waters. A pocket voltmeter is equally inadequate for Radio Research experiments.

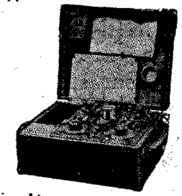
You want an "ELECTRADIX GALVO," the bargain of 1925.

The new July edition of our famous **Catalogue of Radio Bargains** now contains 500 Illustrations of electrical instruments, radio sets and components of great interest. Many of these are unobtainable elsewhere and our prices are the very lowest.

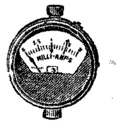
The experimenter on short waves, the expert transmitter, or the crystal novice will all find it advantageous to have a copy of



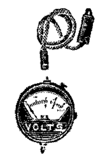
200 WATT, 500 CYCLE ALTERNATOR and EXCITER.



CRYSTAL SETS. Mark III Tuners.



MIDGET M.C. 0·10 m/a. 22/6



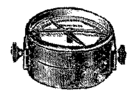
MIDGET M.C. CELL TESTER, 2 range.

"THE CATALOGUE THAT SAVES YOU POUNDS"

Its scope ranges from a 5/- pair of British Headphones or a 12/6 Milliammeter to a 30,000 volt Generator and covers all requirements.

If you cannot call and inspect goods in our showrooms between 9 a.m. and 6 p.m., it will pay you to send 4d. for our Catalogue at once. Goods promptly despatched all over the world.

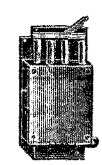
Colonial Avenue is the first on left down the Minories from Fenchurch St., or Aldgate Underground Station.



TESTING SILVERTOWN GALVOS.

EDISWAN VALVES, R.A.F. "C" Type.

H.T. VOLTMETERS, G.E.C., 2-range 1,000 and 2,000 volts.

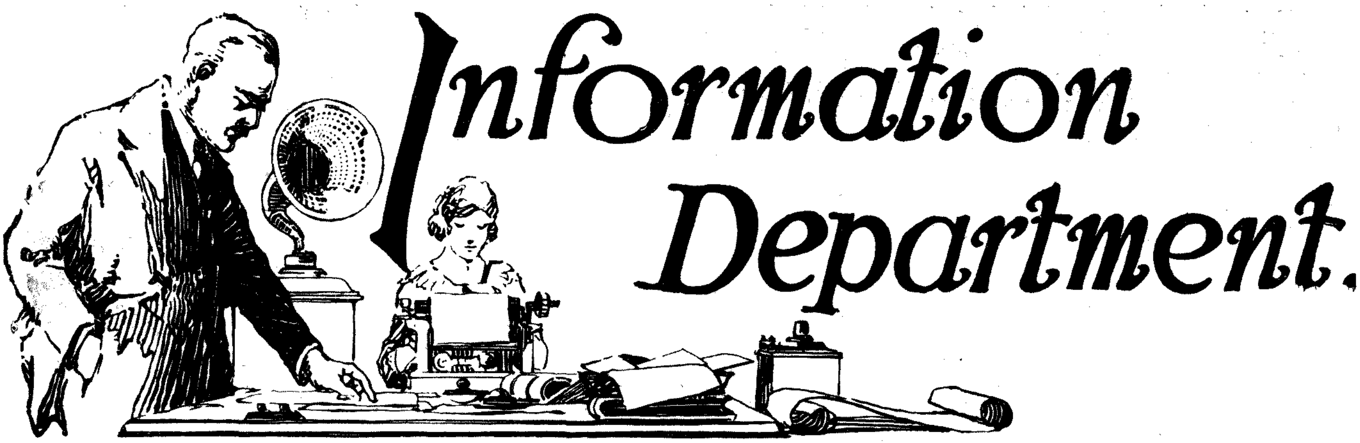


DISTANT SWITCHES.

LESLIE DIXON & CO.

9, COLONIAL AVENUE, MINORIES, E.1

and 218, UPPER THAMES STREET, E.C.4.



Information Department.

F. C. (FRANT) has constructed the Transformer Coupled 3-Valve Receiver described by Mr. Rattee in "Wireless Weekly," Vol. 5, No. 4. He states that results are extremely disappointing, signal strength being only approximately half that which he can obtain with a detector and one low-frequency amplifier on the same aerial and earth system. He asks us what is wrong.

Examination of our correspondent's letter shows him to be a victim of the lack of standardisation in H.F. transformer connections. He is employing a mushroom type, in which the primary and secondary windings are wound in one slot. In Mr. Rattee's set the wiring is suitable for one type of H.F. transformer, but not for the kind employed by our correspondent. The effect of reversing the leads to the secondary winding should be tried, when we think the set will be found to function in a satisfactory manner. If in any doubt as to the correct connections for a mushroom type of H.F. transformer such as that employed by our correspondent, we would advise him to refer to *Wireless Weekly* for September 17, 1924, in which a design is given incorporating a mushroom type H.F. transformer.

J. O. C. (BELFAST) states that he obtains excellent signal strength on telephones employing the first three valves of his Transatlantic 5-valve Receiver, but that the reception on the loud-speaker is poor and spasmodic. He also asks us how to introduce a switch to cut the two high-frequency valves out of circuit when listening to his local station.

The spasmodic reception of which our correspondent complains appears to be such that good volume is obtained on the loud-speaker when the set is first switched on, but signals fade rapidly until almost inaudible, and then again increase in volume, after a short while. We would advise our correspondent to pay attention to the two grid-leaks R8 and R9; that is, the two associated with the two resistance capacity coupled amplifying valves. Should these components develop high resistances, the grids of the amplifying valves would become choked and account for spasmodic reception on the loud-speaker. We would suggest that both grid-leaks be changed for ones of low value, such as .5 to 1 megohm, or even if necessary down to .25 megohm for the latter, R9. This should result in the set functioning in the normal manner.

With reference to the subject of the introduction of a switch to cut both high-frequency valves out of circuit we strongly advise our correspondent not to attempt this, as difficulty is usually experienced before a set with two high-frequency amplifiers is made to work satisfactorily, and once a good arrangement of layout and wiring is obtained it should be adhered to. The incorporation of complicated switching would probably completely upset the balance of the receiver, and is, therefore best omitted. The two H.F. valves can quite easily be cut out of circuit by removing the first two valves and the two H.F. transformers, and by plugging, by means of a flex lead, from the grid socket of the first valve to the socket of the second H.F. transformer which is connected to one side of the detector grid condenser.

S. D. (CAMBERWELL) employs a detector valve followed by two resistance capacity coupled amplifiers, and complains that although he gets London at excellent strength, he is never able to obtain the more distant stations, although he feels a set of this type should be capable of giving him telephone reception from other stations than London. He submits a diagram of his aerial system.

We are by no means surprised at our correspondent's lack of results on the more distant stations, for although the aerial is 40 ft. above the ground, the diagram shows it to be suspended between two chimneys at a distance of only 5 ft. above the roof. The lead-in is also brought down close to the roof and very close to a wall before entering the window of the room in which the set is worked.

From the letter it would appear that suitable precautions have been taken in insulating the aerial at the various points where it goes over the roof and is led in, but we would state that insulation is not the only consideration our correspondent should study, but that "isolation" is equally important. Where an aerial is very close to the roof of a building certain unwanted losses are bound to be introduced, and we think a much better arrangement would be to take the aerial from one chimney to a pole situated at the end of the garden. By this means isolation would be considerably improved, and losses due to absorption reduced to a certain extent, so that there would be a much better chance of distant stations being heard.

R. J. J. (SWANSEA) asks why a large number of modern valves appear to be mirrored with silver internally.

The silver mirror-like appearance of a number of modern valves is due to a particular process employed to remove the last traces of gas occluded in the metal electrodes and the glass of valves. The particular process responsible for the mirror-like effect is known as the "Getter" process. Usually metallic magnesium is employed, a small piece of this metal being fixed to the anode of the valve during construction. Valves to be "gettered" are exhausted in the normal manner and are then heated, either by the eddy-current method or by lighting the filament and applying a high potential to the plate and grid, when the magnesium volatilises, combining with the last traces of gas, thus giving very high vacuum, which is essential with certain types of dull-emitter valves.

Our correspondent is further referred to *Wireless Weekly*, Vol. 7, No. 1, for a fuller explanation of the process involved.

Erratum

We regret that a slight error was present in the theoretical circuit shown on page 66 of *Wireless Weekly* for September 30. In this the third contact from the left of the first double filament jack is shown connected to the third contact from the left of the second double filament jack. The former contact should be joined to the second contact of the latter jack and not to the third contact.

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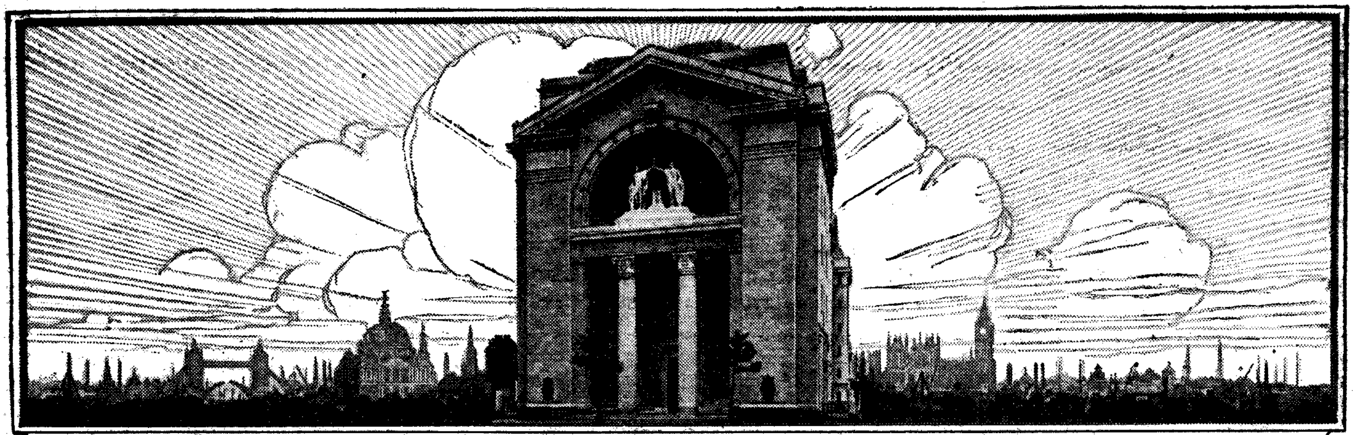

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ANOTHER STEP FORWARD

Radio Press American House

READERS of *Wireless Weekly* will be interested to hear that following upon the visit of Mr. Percy W. Harris to the United States to investigate the radio position there, Radio Press Limited, have now decided to open an American house, with offices in the heart of New York, thus enabling readers of our publications in this country to keep right up to date with all developments taking place in America.

The importance of this step to the British experimenter, and, indeed, to the whole art in this country, can scarcely be over-estimated. No longer will it be necessary for the British enthusiast to view new experiments in America through American eyes. New apparatus, new circuits, new valves, and, what may be still more important, new tendencies which are showing themselves in radio design and developments, will all be reported upon immediately, if necessary, by cable, by a competent radio expert, fully acquainted with radio matters on both sides of the Atlantic.

The manager of the new American house is Mr. A. H. Morse, A.M.I.E.E., M.I.R.E., who has held many important positions in radio both in England and America, and whose practical acquaintance with the art dates back to the very earliest days. Fuller details of Mr. Morse's career are given on another page, and his standing in the world of wireless may be gauged from the fact that for some time he held the position of Managing Director of Marconi's Wireless Telegraph Co., Ltd., of Canada.

It will be seen that Mr. Morse not only has considerable experience of administrative matters, but he has also a wide technical experience of the art. This combination of administrative experience and technical knowledge is of no little importance, since the task of obtaining full information on technical matters is not easily performed. Mr. Morse's standing assures for him the entry into many places which are normally difficult of access, and his personal acquaintance and friendship with some of the greatest men in American radio will be of inestimable value to him.

The offices of Radio Press in America will be situated in the Bush Building, West 42nd Street, New York City, one of the finest office buildings in America, and we have no doubt that before long Radio Press, Bush Building, New York, will become as well known as Radio Press, Bush House, London.

CONTENTS.

Edited by
JOHN SCOTT-TAGGART,
F. Inst. P., A.M.I.E.E.
October 21, Vol. 7, No. 5.

Some Methods of Connecting Valves in Circuit

By Captain H. J. ROUND, M.C., M.I.E.E., Chief of the Research Department of the Marconi Co., Ltd.

This article, which is the first of a series to be contributed to "Wireless Weekly" by Capt. Round, discusses the relative merits of the various methods of connecting valves in circuit for reception.

IN both transmitting and receiving circuits we use a number of alternative ways of connecting, which give equivalent results, but each of which is more convenient or more economical in a particular case. Two of the best examples of this equivalence are the so-called "top and bottom" feeds to a circuit. Both produce exactly the same result except for minor effects, but sometimes one way is more desirable than the other for purely practical reasons.

The Simplest Methods

Let us examine a very simple case where several arrangements can be used to arrive at the same result. An aerial is required to be connected to a valve, and grid bias is required on the first grid.

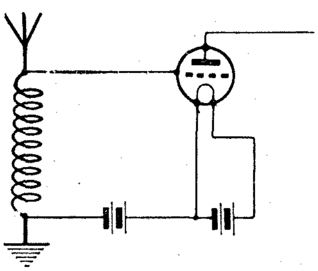


Fig. 1.—Careful insulation of the filament battery is required with this circuit.

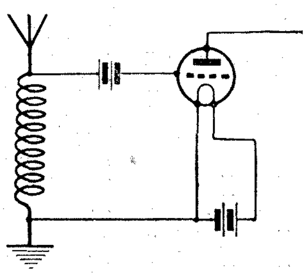


Fig. 2.—Here the grid bias battery is at H.F. potential to earth.

Fig. 1 represents a way of doing this, but we have run into an objectionable feature in that the negative terminal of our low-tension battery is no longer at earth potential; not, perhaps, a very serious error in a simple one-valve circuit if care is taken to insulate the battery, but this is not always easy to do, and a battery leaky to earth would be liable to give noises and incidentally to run down the grid bias battery. Figs. 2, 3, and 4 represent other ways of doing this. Fig. 2 is quite a possibility, but not good practice—batteries at high H.F. potential are a nuisance. Fig. 3 is also not too good, because it necessitates shunting the battery with a low-loss condenser of large value. Fig. 4 is really the best practice. X in the figure is either a leak or a choke, and the condenser wants to be large enough not to have much potential drop across it, and, of course, if amplitudes are large, reconsideration on account of grid current is necessary.

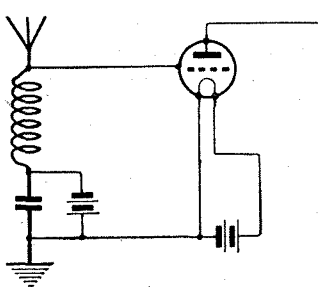


Fig. 3.—With this arrangement the grid bias cells must be shunted with a condenser.

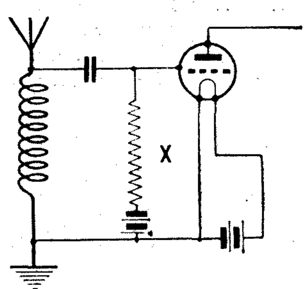
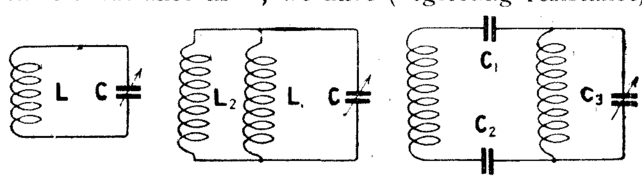


Fig. 4.—X in this circuit may be either a leak or a choke coil.

The Use of Choke Coils

In the circuits mentioned, losses of battery energy do not enter, so that there is really nothing to choose between a choke and a leak, if the leak is of high value, but we shall meet many other cases where the use of a choke is essential, and a little careful consideration of its working will be necessary.

In Fig. 5 we have an inductance L in series with a condenser C, an ordinary resonant circuit. If we build Fig. 6, so that L1 and L2 in parallel have the same inductance as L, we have (neglecting resistance) an equivalent circuit. The sum of the currents through L1 and L2 is equal to that in L, and they are divided inversely as the inductances L1 and L2. If we make L2 very large it will take negligible current compared with L1, but it will still be part of the circuit. Incidentally trouble may occur due to capacity effects in L2 if the inductance is made too large, but this is a practical affair.



Figs. 5, 6 and 7.—These diagrams may be compared with Figs. 8 and 9 below.

Modifications

We may now put blocking condensers in at C1 and C2 (Fig. 7). If these condensers are so large that the potential across them is small compared with that across the tuning condenser (or inductance)—we have as far as the high-frequency current is concerned still not altered the circuit, and we can use this arrangement to give us apparently a quite different valve connection.

Fig. 8 is the normal bottom plate feed and Fig. 9

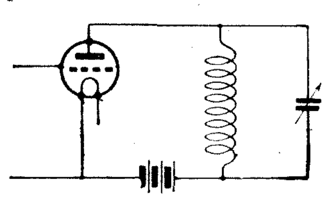


Fig. 8.—The normal "bottom feed" circuit.

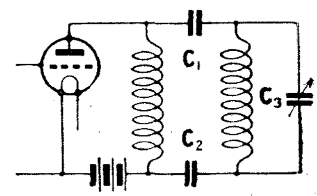


Fig. 9.—A similar method modified so that the H.T. battery is removed from the main oscillatory circuit.

the modified high-frequency circuit similarly fed; the actions will be very obviously the same, but we have removed the H.T. from the main oscillating circuit. Re-draw Fig. 9 and shift the condenser C2, and we get the very well-known choke-fed plate circuit.

Fine Wire Choke Coils

This little bit of diagram reasoning shows that the choke carries high-frequency current, and losses in it must be avoided, but as its currents are very small it can naturally be made of fine wire.

But why all this twisting and contorting of circuits?

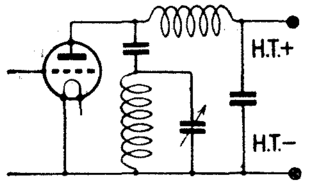


Fig. 10.—The circuit of Fig. 9 in a better known form.

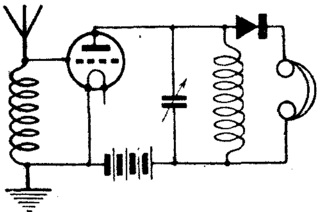


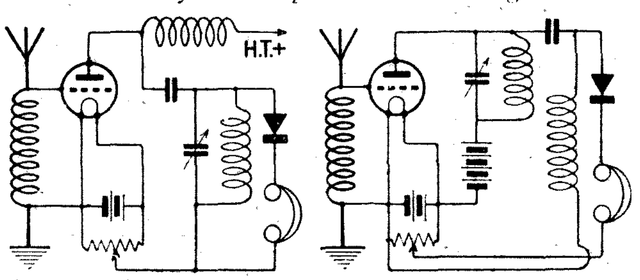
Fig. 11.—This simple tuned anode circuit with crystal detector has certain disadvantages.

Because Fig. 10 is very often more convenient than Fig. 8, in that we can tap off our main inductance with the grid of another valve without having to worry about H.T. potentials getting at our grid, or in a transmitter we can remove dangerous H.T. from the oscillatory coils.

Tuned Anode Circuits

Of course, there are other methods still, such as secondary windings round our oscillating inductances, very often used, in fact, in both receiving and transmitting transformers.

We will, however, take up a case where this information regarding top and bottom feed is useful. A single-valve tuned anode circuit without, and then with, reflex. Suppose we want to set up a simple tuned anode with crystal rectifier. The circuit of Fig. 11 is O.K. unless we want to put in a potentiometer on to the crystal, when we shall find we cannot use the valve battery for the potentiometer. Figs. 12 and



Figs. 12 and 13.—Showing two methods of using a choke coil which give more satisfactory circuits than that of Fig. 11.

13 show two ways of using the choke to get a much nicer circuit.

In both cases the H.T. gets removed from the telephones, where it is always a possible source of shock or trouble.

Reflex Circuits

Suppose we wish to reflex the circuit, Fig. 14 will be the first method we shall think of.

This will be objectionable, because any leakage of either the low-tension or the high-tension battery will tend to short the transformer secondary T2.

Fig. 15 gets over this difficulty, and is similar to Fig. 3 in principle, but has the very obvious objection that the aerial capacity and the blocking condenser are across the transformer secondary—a place where the minimum capacity is desirable, and, secondly, the aerial system and the transformer form a resonant circuit capable of receiving (because of the aerial) low-frequency currents such as from A.C. mains. The circuit can apply these unwanted potentials to the grid, and the valve will then amplify them to the phones.

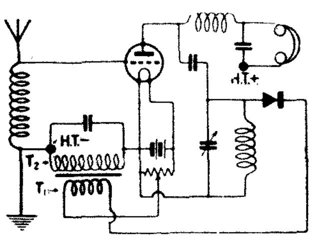


Fig. 14.—Leakage of the L.T. or H.T. battery will tend to short circuit the secondary (T2) of the L.F. transformer.

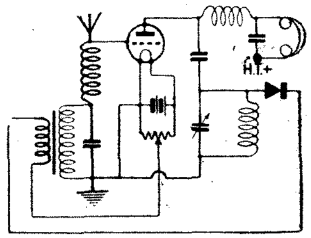


Fig. 15.—This shows some improvement over Fig. 14, but interference from A.C. mains may be troublesome.

In some houses the trouble will not be serious, but, of course, there is no need to ask for trouble.

Low-frequency Chokes

Fig. 16 carries out the top-feed idea completely, and seems to be the best general arrangement; it has the least number of faults.

Its only serious fault is that it has left our telephones at high potential, a fault common to most receivers and not really good practice, but here again an iron core choke and a condenser will remove that trouble if necessary. The design of the high-frequency chokes has to be carefully considered, and the best form seems to be to wind them of fine wire in one layer of a value

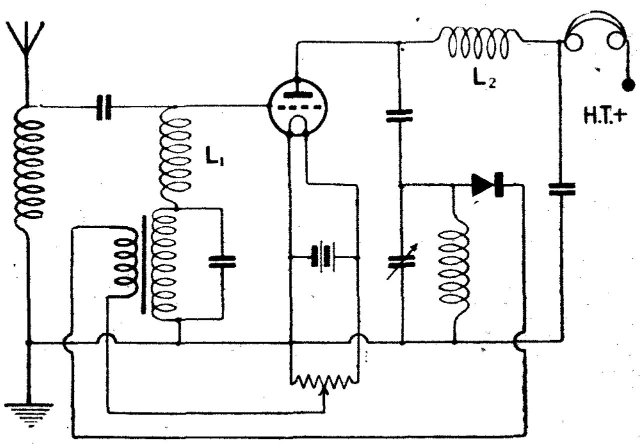


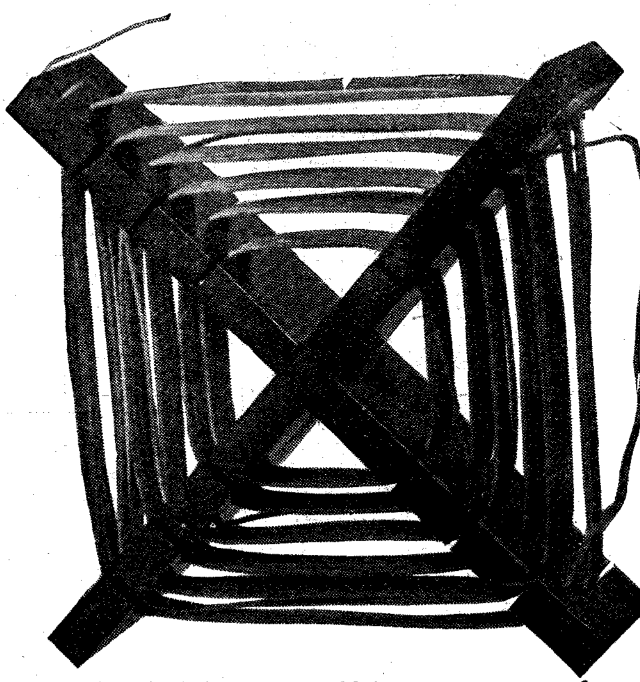
Fig. 16.—The only serious objection to this circuit is that the telephones are at H.F. potential to earth.

of inductance five or six times the main inductance. If layer-wound chokes of large value are used, there is a danger of forming wave-traps at certain frequencies.

Transformer Circuits

The greatest difficulties arise when chokes have to be made to handle a big range of wavelengths. A bold alternative to all these simple circuits is the transformer circuit, but as this introduces at once ideas of ratios of transformation, with all its complications, I will leave it till later.

DISTORTION IN TUNING CIRCUITS



A coil of this type would have a resistance of between 5 and 10 ohms at high frequencies.

By J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., Staff Editor.

In this article, the second of his series on the theoretical principles underlying selectivity, Mr. Reyner discusses the limitations of selectivity when telephony is the main objective of reception.

IN my article in this series last week I discussed the question of tuned circuits and the effect of resistance upon the resonance curve. At first sight it would appear that the problem of selectivity is simply that of making the resonance curve of the particular circuit chosen so sharp, that is to say having so narrow a band width, that the undesired stations may be eliminated and the wanted station brought in by a suitable adjustment of the tuning controls.

The problem, however, is not quite so simple as this, owing to the fact that telephony is not confined to an isolated frequency, but requires a considerable band of frequencies for the satisfactory transmission of speech or music.

Frequency Bands Required for Telephony

It is a little difficult at first sight to appreciate, without recourse to mathematics, why telephony should require a band of frequencies. A physical interpretation, however, may be obtained by considering the problem as the reverse of a well-known problem in receiving. If a high-frequency oscillation is modulated with a second high-frequency oscillation of a slightly different frequency, the well-known heterodyne note is obtained. This heterodyne note is produced by the alternate addition and subtraction of the currents in the two oscillations. Due to the slight difference in frequency, the currents alternately come in and out of step, so producing a variation of the resultant amplitude which gives the heterodyne "beat" note.

Modulated C.W.

This principle is illustrated in Fig. 1. Now the process in a telephone transmitter is the exact reverse of this. We have here a continuous wave which is modulated at a low frequency, that is to say, if the high-frequency wave were modulated with a pure note of a definite frequency, the modulated wave would be as seen in Fig. 1. This same type of wave, however, we have just seen to be capable of being produced by two waves of constant amplitude, but having different (high) frequencies. Thus it will be seen that the modulation of the original carrier wave gives rise to two additional high frequencies, which are known as side frequencies or side tones.

Side Bands

The frequencies of these side tones are constant for a given note, but in the case of speech or music where the low-frequency vibrations impressed upon the microphone are of all frequencies ranging from 50 up to 5,000 or more, it is obvious that there will be two side tones for each particular frequency, so that waves radiated will consist of the carrier wave and a fairly broad band of side tones. This side band extends, as we have seen, to plus or minus 5,000 cycles on each side of the carrier wave, and if satisfactory and distortionless speech or music is to be received, then it is essential that not only the carrier wave, but the whole of this side band also, shall be satisfactorily received.

Flat-Topped Resonance Curves

Now consider the ordinary resonance curve. It will be seen that the current has a maximum at one frequency, and as the frequency varies on either side, so the current gradually falls off. The sharper the resonance curve, that is to say, the greater the selectivity of the circuit, the more rapid will be the falling away. Thus with the ordinary resonance curve the higher side band frequencies will not produce the same currents in the tuned circuit as the carrier wave will.

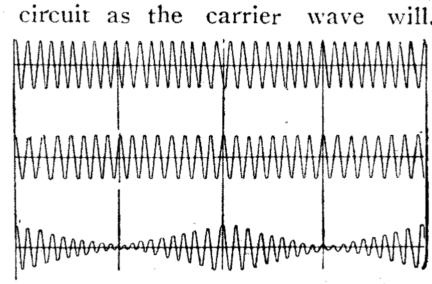


Fig. 1.—The combination of two high frequencies produces a third high frequency modulated at a lower frequency.

That is to say, if the circuit is at all selective, it will tend to cut off some of these side frequencies instead of receiving them, and the result will be distorted telephony.

The ideal resonance curve for this type of work would be one as shown in Fig. 2, having a flat top, so that it amplifies all the frequencies equally well within the band, and a sharp vertical cut-off.

An absolutely square-topped resonance curve is, of course, not a practical proposition, but fortunately we can obtain a very close approximation to this ideal condition.

Use of Band Filters

The only effect of varying the resistance in a single tuned circuit is to alter the scale of the resonance curve. This point was made clear in my last week's article, and it will shortly be seen that no matter what resistance we choose, we cannot obtain a satisfactory solution of the difficulty. It is found that if good speech is to be received, then the amplitude of the oscillation at a frequency 4,000 cycles different from resonance must not be less than one-half the resonant value. If this limit is exceeded, then the side bands will be cut off too much and distortion will result.

Selectivity Impossible with a Single Circuit

Fig. 3 shows the curve in which this condition of affairs is fulfilled, and it will be seen that at a frequency 10 kilocycles away from resonance the current is still appreciable. Now 10 kilocycles is the closest spacing which can exist between broadcasting stations without serious difficulties. The majority of broadcasting stations are spaced a little farther apart than this, but there are stations working with a frequency difference of only 12 to 14 kilocycles. Thus if a station was being received with a frequency difference of, say, 14 kilocycles from a local station which,

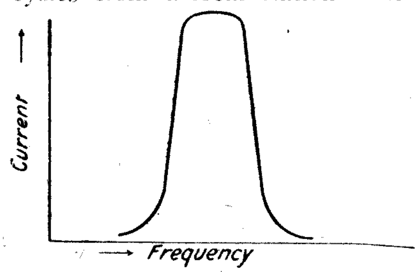


Fig. 2.—A flat-topped resonance curve is required for telephony.

by virtue of its proximity, was supplying 100 times the amount of energy or more, the selectivity of such a circuit would be totally inadequate.

Coupled Circuits

The solution of the difficulty lies in the use of a series of coupled circuits. If the first resonant circuit is coupled to a second tuned circuit, either directly with a loose coupling, or through a valve, in order to make up for any loss of signal strength in the transfer of energy from one circuit to the other, then the resultant resonance curve is found to be somewhat more flat-topped and also steeper-sided. It can be shown that the resonance curve obtained with two similar coupled circuits is obtained by squaring the ordinates of the resonance curve obtained for a single circuit. This has been done in Fig. 4, from which it will be seen that a considerably steeper cut-off is obtained giving a curve having a fairly uniform band width towards the peak.

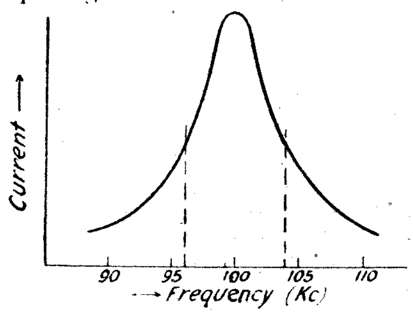


Fig. 3.—A resonance curve for a single circuit complying with the condition for good quality.

Increase of Resistance Necessary

This second resonance curve, however, would produce too sharp a cut-off on the higher side bands, and it is necessary therefore to increase the band width of the resonance curve. This is done by increasing the resistance in the circuit, the effect of which is to increase the band width, and this results in a resonance curve as shown in Fig. 5. It will be seen that this curve is not only wider at the top than that of Fig. 3, but has a much sharper cut-off towards the bottom. This means to say that the various side band frequencies will all be received perfectly satisfactorily, but that interfering stations at a greater frequency difference from the resonant value than 4 kilocycles will be cut off to a greater extent than with the single circuit.

The principle can be extended to comprise a whole chain of filters, and as more and more tuned circuits are incorporated, so the curve gets more and more flat topped and steeper and steeper sided.

Band Filters

Professor G. W. O. Howe has recently worked out some actual figures for the resistances necessary in the various filters in order to comply with the conditions. He takes as his criterion of selectivity that a 10 per cent. departure from the resonant frequency should reduce the currents to 1/10,000 of the resonance value. A 10 per cent. departure from resonance at the ordinary broadcasting frequencies employed would mean a difference of from 70 to 80 kilocycles. Such a circuit would at a frequency difference of 10 kilocycles only give a current equal to .0008 of the resonant value, which will be seen to be satisfactory for ordinary wireless reception.

Distortion Due to Reaction

Now with a single circuit having an inductance of 80 μH and a capacity of 500 $\mu\mu$F, the effective resistance to obtain a resonance curve as sharp as this would have to be .008 ohms. It is possible by using suitable reaction circuits to obtain such a very low resistance, but if this were done the telephony would be horribly distorted. This would be due to the fact that the cut-off would be too sharp, and only a very small percentage of the side bands would be satisfactorily reproduced. The problem may be studied from another angle, which serves to render the importance of the side bands a little clearer.

Another Point of View

The growth or decay of current in a circuit depends on the resistance thereof. In a circuit having extraordinarily low resistance, such as that which we have just considered, the building up and dying away of the oscillation would be so slow that it would be unable to follow the variations of current sent out by the transmitting station. Consequently, instead of the received currents varying according to the modulation impressed on the transmitter by the microphone, they would lag hopelessly and would be totally unable to follow the very rapid variations, and the result would be chaos.

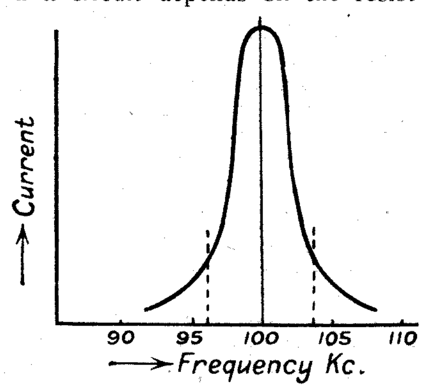


Fig. 4.—This curve has a flatter top, but the cut-off is too sharp for good quality.

Values of Resistance Required

We have just seen, however, that in the case of a chain of tuned circuits coupled to each other, the desired sharpness of cut-off may be obtained while the top of the resonance curve still remains fairly broad and flat-topped if suitable resistance

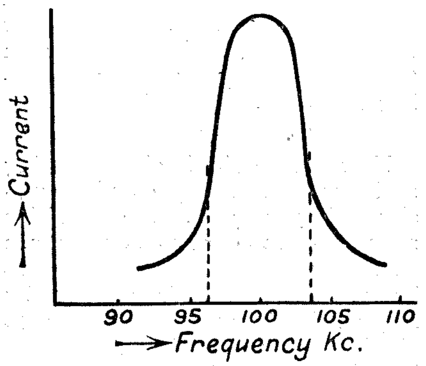


Fig. 5.—By inserting resistance the sharp cut-off is still maintained, but the band width is made larger.

is inserted. Professor Howe has worked out the resistance required in the circuit previously mentioned in order that the telephony shall be satisfactory. The criterion for this, it will be remembered, is that the current, at a frequency of 4,000 cycles removed from the resonant frequency, shall not be less than one-half. For this condition to be fulfilled, the resistance required in each circuit is

2.31 ohms for the single circuit,
3.97 ohms for two circuits,
5.2 ohms for three circuits,
6.1 ohms for four circuits.

Three Circuits Essential

If a single circuit, however, were made with such a high resistance as 2.31 ohms, then at a frequency difference of 80 kilocycles (10 per cent.) the current would only be 1/33 what it is at resonance, which, of course, is nothing like selective enough. The ratio of the currents at resonance to the currents at a frequency 10 per cent. away, is given by Professor Howe for the particular values of resistance just quoted. For a single circuit this ratio is 33.

For two circuits 337.
For three circuits 4,060.
For four circuits 24,300.

It will be remembered that the criterion laid down was that the currents at 10 per cent. detuning should be 1/10,000 of the resonant value, and it will be seen that this condition is obtained somewhere in between 3 and 4 circuits. It is therefore necessary to use four tuned circuits, if adequate selectivity is to be obtained with perfect reproduction; but if a certain quality can be sacrificed, then three circuits only may be employed.

Practical Application

We now come to consider what these results mean when interpreted into terms of practical conditions in a receiver. The problem really depends upon how much selectivity one is prepared to allow for. It is undesirable to multiply the number of tuning circuits more than is absolutely necessary. If we have two tuned circuits, each having a resistance at high frequency of 4 ohms, a condition which is by no means easy to comply with, then we shall get satisfactory quality, but we shall not get particularly selective results. Reaction could, of course, be introduced on to one of these tuned circuits, which would have the effect of improving the selectivity to a considerable extent. It would, however, cause a very noticeable alteration to the quality of the telephony.

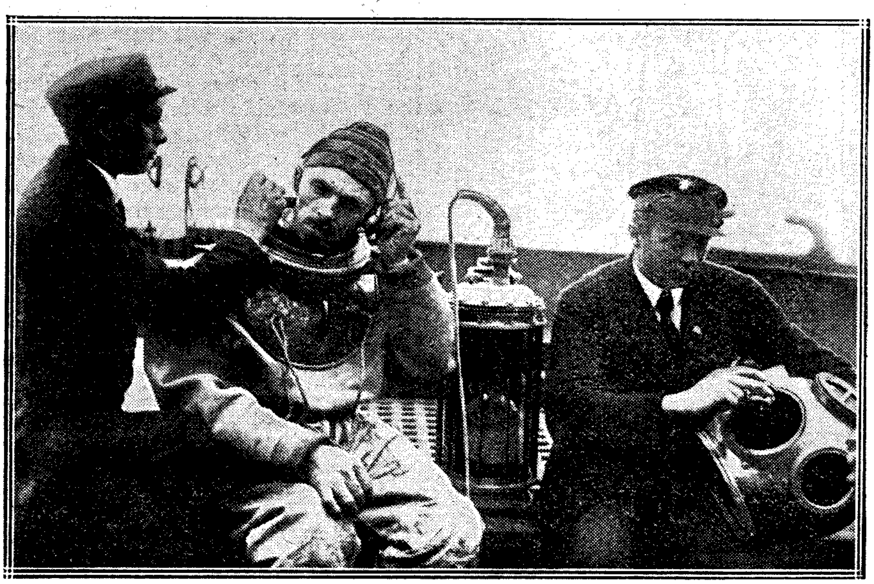
Four-Circuit Tuning

The problem is a little better if three circuits are employed. Here we may arrange for the circuit to have a resistance of 5 ohms, and the speech will then be perfectly satisfactory. The selectivity will be good in the majority of cases, but in the case where the set is to be worked within one or two miles only of the local station, then a higher order of selectivity will be required for receiving those stations which are close (in frequency) to the local station.

If, as a practical compromise, one is prepared to sacrifice a certain amount of quality in receiving these stations, which after all are only a few out of the whole broadcast band, then the application of reaction upon the third circuit would result in the desired selectivity at a slight sacrifice of purity. If four circuits are used, as has been seen, both selectivity and quality are absolutely satisfactory, but the difficulty of operating such a set rules it out of court for all except the more advanced experimenters.

High-Frequency Resistances

It should be remembered that these values of resistance which are given are all high-frequency resistances. Mr. Cowper and others have shown in these columns that it requires very special construction to obtain a coil suitable for tuning at broadcast frequencies, which has a resistance as low as 5 ohms. Added to this are all the resistances due to stray capacities in the circuit, due to the damping of the valves, and here again Mr. Cowper has shown that anything from 40 to 80 ohms may be introduced by the ordinary grid condenser and leak method of rectification. It will be seen, therefore, that even if one decides to use only three circuits, very particular care must be taken, in designing those circuits, to keep the resistance down as low as 5 ohms.



Herr Rarmstorf, who is seen testing the telephones while a microphone is attached to his helmet, recently successfully spoke by wireless from the bottom of the sea near Heligoland. His speech was relayed via land-lines from various German broadcasting stations.

RADIO PRESS LTD. AND THE UNITED STATES

APPOINTMENT OF MANAGER OF OUR AMERICAN HOUSE

Mr. A. H. Morse, A.M.I.E.E., M.I.R.E.

Information regarding the opening of our American House will be found on the Editorial page in this issue. We give below some account of the previous activities of Mr. A. H. Morse, A.M.I.E.E., M.I.R.E., who has been appointed manager.

WE have much pleasure in introducing to our readers Mr. A. H. Morse, A.M.I.E.E., M.I.R.E., on his appointment as Manager of the American House of Radio Press, Ltd. Mr. Morse has been actively concerned with the technical side of both wired and wireless telegraphy for some years.

Post Office Telegraphs

In 1897 he entered the Telegraph Service of the General Post Office in London, leaving this in April, 1900, when he left England to serve in the South African War, with the Telegraph Section of the Royal Engineers. On his return to England in 1902, for a short time Mr. Morse was engaged in journalistic work in Fleet Street. In 1904 he proceeded to West Africa, where he carried out the construction of the first telegraph line built to communicate with Sokoto.

Wireless in Canada

On completion of this contract in Africa he proceeded to Canada, where in 1906 he entered the service of the De Forest Wireless Corporation as consulting engineer. The following year he was appointed Superintendent of this Company. During his period of service with the De Forest Company, Mr. Morse was in charge of the complete system of wireless telegraph communications between the cities of Montreal, Ottawa and Quebec.

In 1907 he proceeded to the Pacific coast to take charge of five wireless stations for the Canadian Government, and on the completion of this contract he entered the service of the United Wireless Telegraph Company in Seattle, spending the following year in Alaska. In 1909 he was appointed superintendent of construction and maintenance for the United Wireless Telegraph Company, and early in the next year he returned to London to take charge of the technical side of this Company's European business.

With the Marconi Co.

When the Marconi Company took over the business of the Northern Wireless Telegraph Company in 1912, Mr. Morse joined the former company. Three years later he was appointed adviser in wireless matters to the Indo-European Telegraph Company. Mr. Morse returned to Canada in 1919, when he accepted the position of Managing Director of Marconi's Wireless Telegraph Co., Ltd., in Canada. This appointment he held until the beginning of 1923, when he decided to enter business on his own account, and tendered his resignation with this object in view.

Radio Press Offices

The offices of the Radio Press, Ltd., American house, will be situated in the Bush Building, 42nd Street, New York, an admirable position in one of New York's most famous thoroughfares.

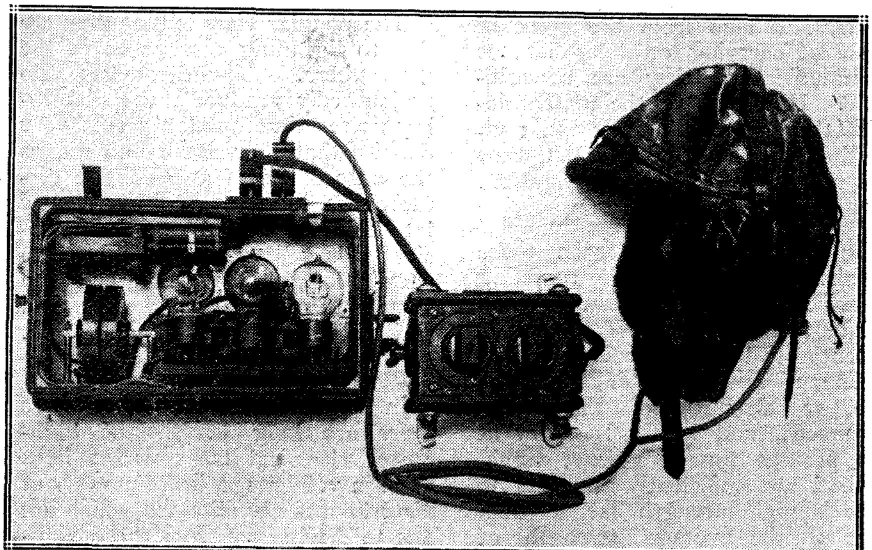
R.A.F. REUNION DINNER

The annual reunion dinner for past and present officers of No. 1 (T.) Wireless School and Squadron, Royal Air Force, will be held in London on Friday, December 4, 1925.

All officers interested should communicate with the Hon. Secretary,

Mr. J. F. Herd,
Ditton Corner,
Datchet, Windsor,

who will send full particulars.

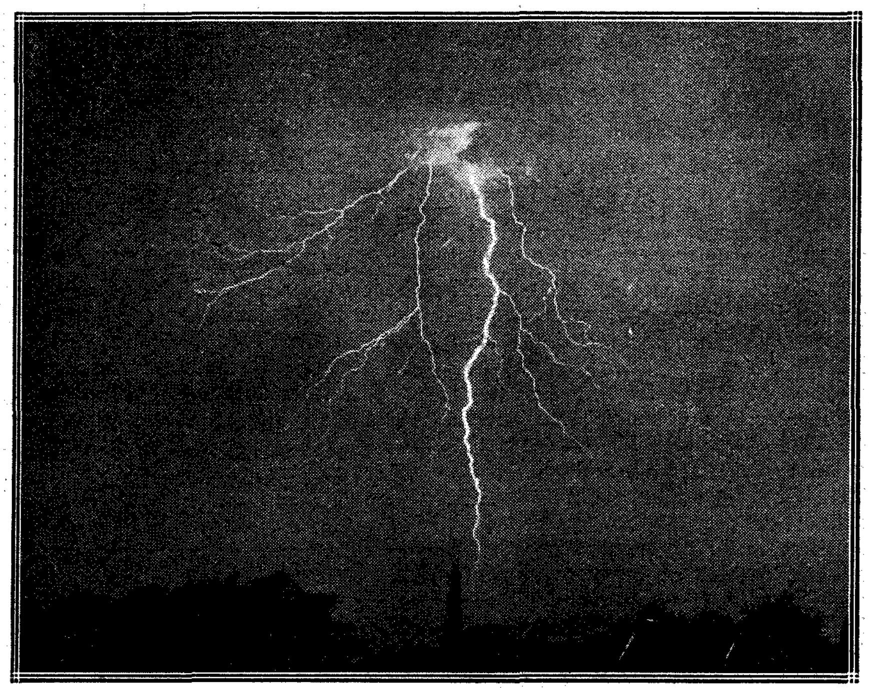


The receiving apparatus used on aircraft for the reception of telephony from ground stations. The remote control unit is seen in the centre of the photograph.

The Nature and Sources of Atmospherics

By Major JAMES ROBINSON, D.Sc., Ph.D., F.Inst.P., Director of Research to Radio Press, Ltd.

Much success in the elimination of atmospherics in reception can hardly be achieved without an appreciation of the nature of these disturbances. This discussion of the extent of our present knowledge in this direction should prove of considerable interest.



A visible lightning discharge may be regarded as one cause of atmospheric disturbances.

IN these days, with millions of people using wireless, there is no necessity to describe the crashes, clicks, and rumbling noises of atmospherics which are obtained on all wavelengths. They are a nuisance to listeners, but to some other classes of people they are extremely useful. Unfortunately from the broadcasting point of view, and also from the point of view of carrying on long-distance communication, they are unavoidable. However, to the meteorologist they are full of interest, and, further, to the pure scientist, they are a fruitful field for investigation.

Signal Strength of Disturbances

In any particular region these crashes and clicks and rumbling noises have an average strength, and for perfect broadcast reception it is essential to have the received signal strength much greater than the average strength of these disturbances, and in this country at the present time broadcast transmitters are sufficiently powerful to give signal strength larger than that of the average strength of atmospheric. This average strength of disturbance depends on geographical situation to a very large extent, some countries being very much worse than others. The crashes and clicks are usually called by the name of "Atmospherics," but they have other names, such as "Strays," "X's," "Parasitic Signals," and "Static." The most common names are Atmospherics and X's.

What Are These Disturbances?

The popular view is that they are due to lightning discharges in the atmosphere. Thunderstorms do undoubtedly produce these disturbing noises, but opinion seems very definite that they are by no means the only cause of atmospheric disturbances. Before inquiring closely into the real causes, we may consider other disturbances peculiar to certain localities, which are of the same nature as atmospherics, and which are often confused with them.

Power Lines

In Switzerland and Mexico, where there are long lengths of high-power electrical transmission lines at high voltages, a large number of disturbances are obtained which are due to discharges from these high-tension lines. Such disturbances may be easily visible or they may be more of the nature of brush discharges. Again, in large cities where there are electric trams and electric power systems on a large scale, electric discharges of this nature also take place.

Similar Disturbances

An instance is on record where observations of atmospherics were simultaneously recorded in Berlin and other places in Germany, and it was found that there were more of these disturbances in Berlin than any other place in the country. This was undoubtedly due to the large number of electrical power lines in Berlin.

Other Causes

Also the presence of long lengths of overhead wires accentuates the disturbance due to atmospherics, as they act as collectors of the waves, re-radiating them to receiving aerials. Another source of disturbance for which atmospherics are wrongly blamed is a faulty high-tension battery in one's own receiving apparatus.

Lightning Flashes

There is not any doubt that lightning flashes do produce atmospheric disturbances. Many instances are on record where observations of lightning flashes have been recorded by eye and in telephones or loud-speakers at the same instant, and it can be considered as beyond doubt that lightning discharges are one source of atmospheric disturbances. Whether they are the only sources is a very difficult question, but opinion seems to be that lightning flashes are not by any means the only cause of atmospheric disturbances. In fact, the distance over which an atmospheric which is due to a lightning discharge can be heard is usually not greater than 150 miles.

Natural Spark Transmission

It is quite easy to understand why a lightning discharge causes a disturbance in one's receiver, because lightning is really a very long spark discharge, the spark occurring between an electrified cloud and the earth or between two electrified clouds which are charged to a high electrical potential. Such a discharge is obviously of the same type as the spark discharge of a wireless transmitter. There is no transmitting aerial other than the path which the lightning happens to follow.

Highly Damped Waves

There cannot be any definite tuning of such a system, but, on the other hand, there must be tremendous power behind a lightning flash, as much mechanical damage can be done by such a flash. In spite of the bad wireless conditions as we know them, wireless waves are produced by a lightning flash, but because of the large resistance of the natural aerial of the path of the lightning, and the low inductance, the waves will be highly damped.

Types of Disturbances

A very large number of observations has been made by very many observers on the types of noises which are characterised as atmospherics, and a large number of classifications has been made from time to time. There are very many types, but I think we can be satisfied by separating them into the four classes :—

Clicks, Crashes, Grinders, and Hisses.

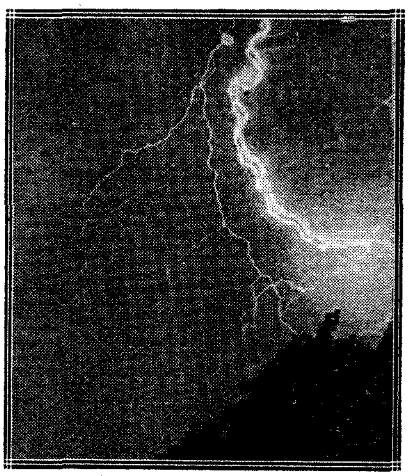
The clicks are similar to the disturbances that one obtains from single lightning discharges. Crashes usually last from half a second to five seconds. They are obtained when there appears to be no thunder about, but when the weather is squally, and when there appear to be sudden violent changes of temperature. Grinders would seem to consist of a large number of clicks and crashes together, although there has been much difference of opinion as to the cause of grinders. Hisses can occur at various times. They are prevalent in local rain or hailstorms, and they may also occur in very dry weather.

Distribution of Atmospherics Over the Earth's Surface

A very large number of observations has been made regarding places where the atmospherics are of great intensity and frequency of occurrence, and places where few atmospherics are observed. Also a great number of general conclusions has been drawn; but in running through the literature on this subject there appears to be much contradictory evidence. It is quite easy to understand why there should be such apparent contradiction, as a large number of observers have restricted their investigations to comparatively small regions of the earth's surface. Some observers give certain regions as very bad for atmospherics, and others give quite different comments. One of the reasons for this is that atmospherics vary from time to time and there are daily variations and seasonal variations, which are by no means regular.

Observations

Out of the large mass of observations of the strength of atmospherics at different places in the world, and at different seasons and different times of day, one set of observations will be referred to. It would be very confusing to readers to give the results obtained by a number of different observers, and the particular set of observations chosen will serve as the most typical and probably the most reliable.



The disturbance due to a lightning flash is not usually audible at any great distance from its source.

The Marconi Expedition

This record of observations was made on the Marconi Expedition round the world in 1922-1923 to study the propagation of wireless waves. A large number of observations was made, since before any general deductions could be formed, such a large mass of evidence was required. The first observation is that the "click" type, due to thunderstorms, may occur anywhere and at any time of day or of the year.

Tropical Conditions

The "grinders," however, are worst over large areas of land in the tropics. Again, in different parts of the tropics they vary with the time of the year, being worst in the regions north of the Equator during the northern summer, and worst in the regions south of the Equator during the southern summer. The daily variation is fairly regular, the worst atmospherics occurring usually about 3 p.m. From then till midnight the intensity diminishes, a minimum being reached in the early hours of the morning, after which an increase in intensity commences and continues up to the maximum again in the afternoon.

Deductions

This complete series of observations is very instructive, and it can be used as a basis for a generalisation as regards the distribution of atmospherics. The tropics are not the only place where grinders are produced, but undoubtedly there we have the source of the most violent grinders.

Law of Distribution

With these observations of the Marconi Expedition, and with the most reliable observations of other investigators, a general law can be given, *that the most intense atmospherics of the grinder type have their origin over large areas of land in the tropics, and that the origin follows the sun with the seasons and with the time of day.*

Later in this article it will be shown that the grinder and crash types may also originate in other regions besides the tropics, and that in all cases mountainous regions have a large influence.

General Investigations

Having now some idea as to the distribution of atmospherics geographically and with the seasons and the time of day, we must consider other investigations which have been made regarding the influence on meteorology, and also how wireless reception is affected. Such problems as the frequency or the wavelength of the disturbance, the wave form, the direction from which the atmospherics come, and how to make use of the observations for enabling weather forecasts to be made, have all received much attention.

Forecasting of Thunderstorms

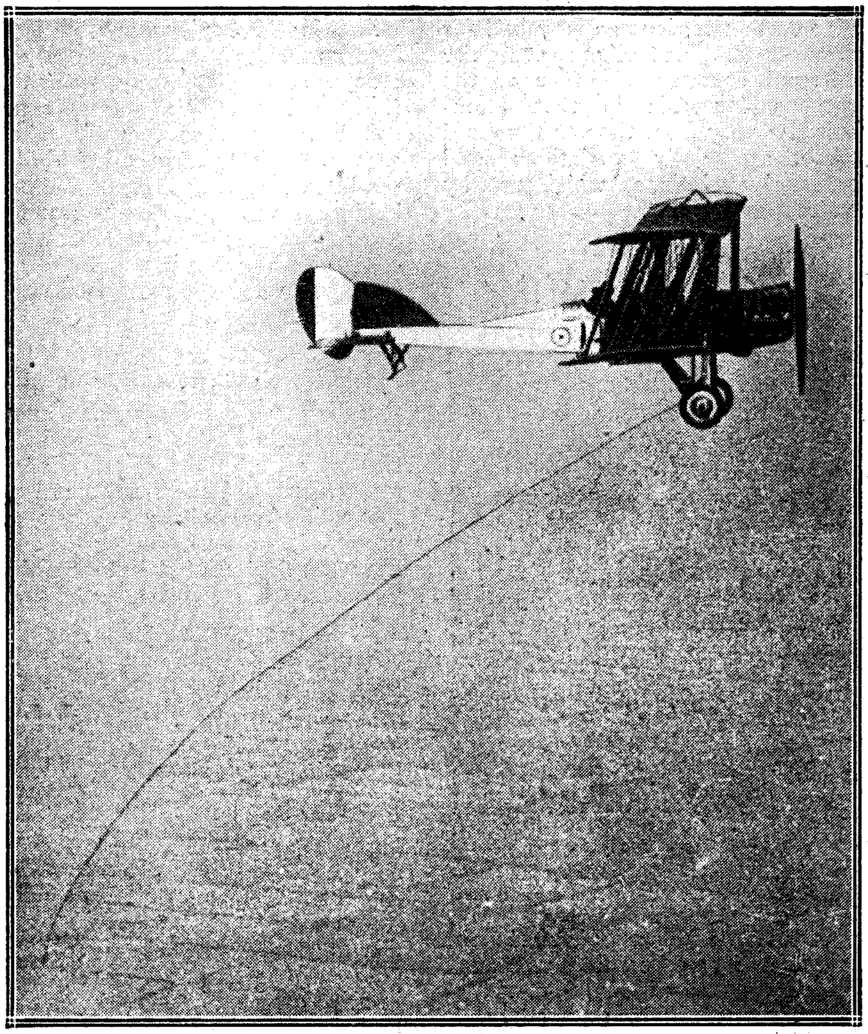
Even before the days of wireless it had been discovered that thunderstorms can be recorded by a vertical wire and a coherer. The first records were made in the year 1895 by the well-known scientist Popoff. His observations were found to be very useful from the meteorological point of view, and were repeated and used to a considerable extent.

Observations from Aircraft

When the War started, and when aircraft began to come into their own, it was found that exceedingly useful information could be obtained by such observations of atmospherics, which by that time were made by more modern wireless apparatus. This was principally with a view to determining when thunderstorms were coming. It was the click type of atmospheric which was observed, and observers soon began to know when a thunderstorm was approaching. Thus it was possible to warn aircraft in advance of the approach of a thunderstorm.

Directional Observations

Later attempts were even made to give more information, and to indicate from what direction the thunderstorms were approaching. Such information is, of course, extremely useful, as aircraft, particularly airships, with such information, could avoid the area of the thunderstorm without having to descend.



During the Great War much useful work was done with aircraft in the detecting of the approach of thunderstorms.

Dr. Watson Watts

This work was started about 1917 under the control of Dr. Watson Watts, who contributed very considerably to our knowledge of atmospherics as a result of this work. He has used various methods for recording the direction of thunderstorms, changing his apparatus with the advance of the technique of wireless. In the early days he used the Bellini Tosi system, with an arrangement for making unidirectional observations. The moving coil of the radiogoniometer was moved to various directions, and the number of atmospherics counted for a definite time interval for each position. Later he made these observations more automatic by using a large rotating coil and recording photographically.

Sources of Atmospherics

A number of stations made simultaneous observations round the British coast, so that the origin of the atmospherics could be plotted. The general result of his observations was that the prevalent source of atmospherics was on a bearing 150 degrees from true north, actually in a south-south-east direction, thus pointing towards the Alps or to a position in Northern Africa. He further found that the maximum appeared to vary somewhat with the time of day, and also with the time of the year, practically varying over an angle of 30 degrees from the mean.

Further Investigations

In addition to determining these very general results of the most prevalent direction, he was able to forecast the approach of thunderstorms at any particular time, and also the direction of approach. His observations were of such importance that they have been repeated by various people in other countries. One typical example was in Berlin, where a slightly different direction for the prevalent atmospherics was obtained, pointing in the magnetic meridian. However, this direction again pointed towards the mountainous regions in Central Europe or to some spot in Northern Africa. As a result of these variations, the German observers are of the opinion that the source of atmospherics appears to follow the sun.

The atmospherics appear also to come from a vertical direction, and some observers consider that these are the most intense, though those from horizontal directions are most frequent.

Frequency of Oscillations

This subject has been much discussed for many years, but it can now be considered to be decided. Without definite information it was impossible to state whether an atmospheric discharge was oscillatory at all, and if so what frequency it had. Observations were, of course, made on the influence of tuning wireless aerials to different wavelengths, and recording on which wavelength the atmospherics were most intense.

Long Wavelengths

The conclusion reached is that atmospherics are worst on the longest wavelengths. This result is undoubtedly correct, for on short wavelengths of the order of 100 metres, although atmospherics still appear, they are not nearly so bad as on a wavelength of 20,000 metres. In fact, a very recent observation by G. Marcuse, who has been operating on 40 metres with Australia, states that during this recent summer he was not worried by atmospherics at all. Thus the tendency was to assume that if atmospherics were oscillatory at all they would have a very low frequency, lower than 15,000 per second.

Wave Form

In the last two or three years observations have actually been made to determine what wave form an atmospheric has. This brilliant piece of work was done by Dr. Watson Watts and Professor Appleton. They used a cathode ray oscillograph to investigate the wave form of an atmospheric, and they found that, as a general rule, atmospherics are not oscillatory, although in some cases a highly-damped oscillation was recorded.

Examples

Some typical examples of the wave form are given in Fig. 1, A, B, C, D. Fig. 1A shows the most prevalent type, where it is seen that the atmospheric is merely a pulse in one direction, the voltage produced in the aerial rising very suddenly to a maximum and dying away very suddenly. Another type is shown in Fig. 1B, this again being non-oscillatory. Fig. 1C shows a form of semi-oscillatory discharge, this being very highly damped. Fig. 1D shows a form that was obtained on a number of occasions where comparatively high-frequency oscillations were superimposed on the type of pulse discharge shown in Fig. 1A.

Characteristics

The duration of these discharges was about 1/500th of a second. The electrical potential produced in the aerial corresponds to an electrostatic field of 1/10th of a volt. This corresponds to a very loud signal, as a usual wireless signal for good communication is 1/10th of a millivolt, which is a thousand times smaller. It is thus seen that there is some tremendous power behind a single atmospheric discharge, corresponding to 1,000 times that required for good communication.

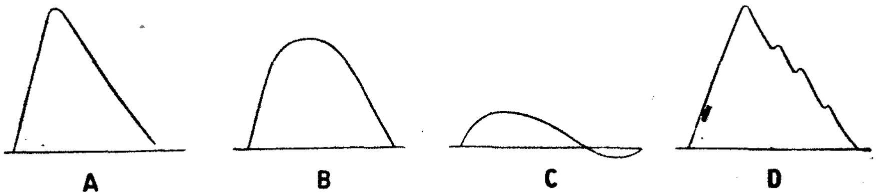
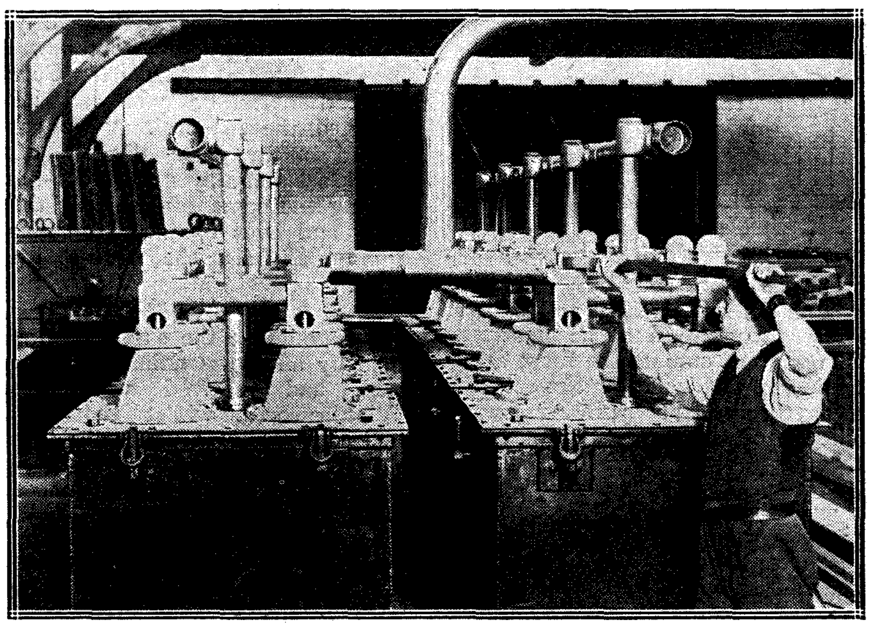


Fig. 1.—Some typical examples of the wave forms of atmospherics.

Why Atmospherics Appear on all Wavelengths

It now appears fairly obvious why atmospherics appear on all wavelengths. Referring to Fig. 1A, there is a sudden rush of potential which is of very large amplitude. This will excite an aerial in such a way that it will make the aerial commence to oscillate at its own natural frequency, and thus we get shock excitation of aerials no matter what the tuning of the aerial may be. Obviously the shock effect will be worse the longer the wavelength, and again it appears obvious that it will be worse the greater the damping of the aerial.



A bank of condensers at the Government Wireless Station at Hillmorton, near Rugby.

Meteorological Investigations

Atmospherics are of very great importance for the study of meteorology. We have already referred to the use of atmospherics received by wireless to forecast the approach of thunderstorms. Much work has been done recently with a view to extending the means of atmospheric observations towards the forecasting of weather generally, and not merely in the case of thunderstorms.

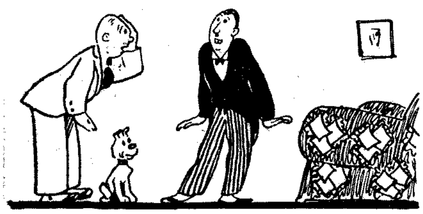
Weather Charts and Atmospherics

For this work it is necessary to study the weather charts very carefully in connection with the recorded atmospherics at certain receiving stations. A considerable amount of work has been done on this subject during the last few years, and special attention has been given to it in France, particularly by Malgorn and by de Bellescize. Malgorn has come to the conclusion that the prevalent type of atmospheric as distinct from the thunderstorm type, is dependent upon temperature

(*Continued on page* 160)

Surprising

I SHOULD never have thought it of Winklesworth, nor would you if you knew him. He is, in fact, just about the last fellow on earth from whom anyone would have expected any such thing. Never to my mind has a man been more obviously cut out for a life of bachelor freedom than Winklesworth. That is why you could have knocked me down with a fender



. . Announced he was engaged to be married . . .

when he came round one day and announced with a silly simper that he was engaged to be married. She was, of course, the most beautiful, and wonderful, and sweet, and altogether perfect girl in every way. They always are until you marry them.

A Hopeless Case

The fellow simply bored me stiff. He wanted to go on telling me all this kind of thing with a far-away look in his eyes, whilst I wanted to talk about wireless. The result was that conversation became a little difficult.

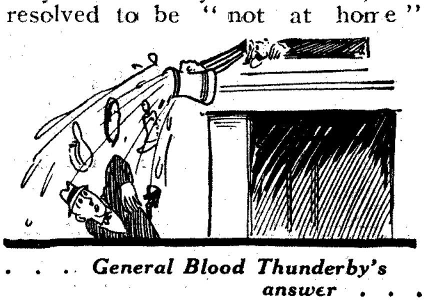
The fellow would not talk sense, though I tried and tried. He just went on talking, till I began to fear that I should never get rid of him at all. I do not think that I would have, if it had not occurred to me to suggest that he should go and break the good news to Poddleby. It was then half-past eleven at night, but Winklesworth was in a state in which time seems nothing at all, and he promptly dashed off to give Poddleby all the details. Early the next morning, when Poddleby pushed him out in the same way in the small hours, he went on to General Blood Thunderby, but the only answer that he got to his ring was a volley of boots and hairbrushes and a jug of cold water from the General's bedroom window, which happens to be just over the front door.

The Club Hears It

At the wireless club on the following evening I found that nearly everyone was there, though luckily he was not. "Have you heard Winklesworth's good news?" I asked Admiral Whiskerton Cuttle. "Good news, do you call it?" shouted the Admiral. "He came round to my place directly after breakfast and stayed till lunch-time, saying the same sort of silly thing over and over again. The man's gone mad, sir, the man's gone mad."

Indefatigable

I found that the same view was held by all the remaining members who had received visits from Winklesworth, whilst those who had not yet done so realised that they were shortly to be for it, and resolved to be "not at home"

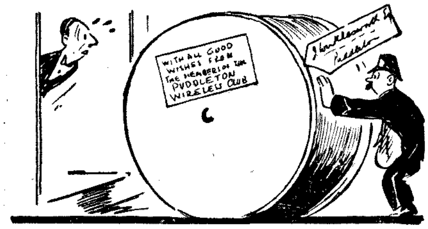


. . . . General Blood Thunderby's answer . . .

when he called. "I tried that dodge on," said Bumpleby Brown, who came in just at this moment. "The fellow called to see me after lunch to-day, and as I had got wind of the affair from Gubbsworthy, I told the maid to say that I was engaged on very important business. Do you think that that choked him off? In less than ten minutes I was rung up on the telephone by Winklesworth, who proceeded to tell me all about it.

Forewarned is . . .

The General now took the chair, and the meeting got down to business. At the end of the ordinary cut-and-dried stuff, the Chairman asked if any member had any private business to bring before the house, and, thinking that I had better say a word in season, I rose



. . . A 10-mile drum of No. 18 cotton-covered wire . . .

with my usual grace to my feet. "Many of us," I said, "have heard from Winklesworth an account of the charms of the lady who is shortly to blight her young life by marrying him. Those of us who have not so far heard will very shortly do so. Winklesworth, who should know, assures us that she is an angel and all sorts of other things. It is obviously not right that this sweet young thing should be allowed to ally herself to Winklesworth, without being properly warned beforehand. As fellow members of the wireless club, it is, I think, our duty to write her a letter telling her something about her future worse half."

None so Deaf . . .

After some discussion my proposal was carried, and the letter was drafted by Poddleby for despatch to the damsel. In it we told her that Winklesworth was a wireless fan, and we explained as carefully as we could just what that meant. Did she wish to have her drawing-room filled with accumulators, and high-tension batteries, and condensers and wire? Did she want to have an aerial mast planted in the midst of her favourite bed of begonias? Did she desire to have a silent husband who would sit evening after evening with the 'phones upon his head, glaring at her and bidding her in terse words to make less noise if she dropped so much as a stitch? Did she wish to have the whole house flooded because her husband had been endeavouring to solder an earth lead to an ascending water main? And so on and so on. If she wished for these things, of course, she had only to marry Winklesworth. If she married Winklesworth she could not say that we had not told her what to expect. In conclusion, we bade her think matters over very carefully, and not to come to any rash decision. The letter was signed by all the members of the club and sent off. The next day the reply came. It said just this:—

"Dear Sirs,

"Thank you for your *sweet* letter, which will have the attention that it deserves. Please do not send me a wastepaper basket for a wedding present, for I already have a very nice one.

"Yours faithfully,
"ANNE NODE."

Clear Consciences

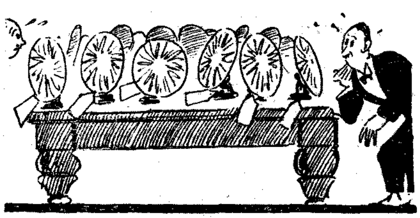
"An excellent wireless name, anyhow," I said, on reading it through, "and, when you come to think of it, they are pretty rare. You might, of course, have Constance (abbreviated to Con) Densor, and one could think of others, but at the present time, they are not very frequent. In years to come things will be better. I have a friend who has christened his twins Resistance and Capacity, and doubtless most of you know of similar cases. As regards the letter, it is obvious that the young woman is just as mad as Winklesworth, and it is not of the slightest use for us to take any further steps. We have warned her, and if she likes to pay no heed to our words there is no more to be said about it. It is sad though to think that Winklesworth, one of our most promising young experimenters, will probably find his style sadly cramped, for I deduce from her letter that she is a lady of some character, who will probably object strongly to serious wireless being carried on in her drawing-room."

The Club's Present

Everyone agreed that I was quite right, and we could only sit down, leaving Miss Anne Node to grin and bear it. It was Poddleby who suggested that the club must subscribe for a suitable wedding present, since Winklesworth is one of our original members. Naturally we all agreed to this at once, and I headed the list of subscribers, after borrowing five bob from Bumpleby Brown. Subscriptions simply rolled in, and before the list closed we found it to be quite a respectable sum. Then came the problem of deciding what to give Winklesworth. All kinds of silly suggestions were made. One fellow actually wanted to give him a complete five-valve receiving set. Just as if a fellow like Winklesworth would use for one moment a set made by anybody else! When they had all done talking I made my suggestion, which was that our present should take the form of a ten-mile drum of No. 18 cotton-covered wire. This, I explained, would probably last Winklesworth for the best part of a year, and what more appropriate present could there be for a wireless enthusiast than wire? Nobody had a word to say against my suggestion, which was carried unanimously, Poddleby being instructed to arrange for a special polished reel suitable for drawing-room purposes, with a silver plate upon it suitably engraved.

My Own Choice

"And what are you going to give him yourself?" I asked General Blood Thunderby. "I am keeping my present secret," said the General shortly. "There is no fun at all if everybody knows what everyone else is giving." It was agreed that the nature of the private presents should be kept secret. We decided that each of us should buy his independently, and that all should be delivered on the day before the wedding. For a long time I simply could not decide what form my own should take. But two days before the wedding, whilst I was in the train going up to London, an inspiration came to me. Luckily Winklesworth was travelling in the same compartment, for, on examining my note-case, I found that it was empty, and I was able to borrow a fiver from him. Arrived in London, I made my way to my favourite wireless shop, where I selected with great care a loud-speaker of the most modern type, guaranteed to be completely distortionless. Having heard a good deal of Winklesworth's loud-speaker reception, I thought that this would be the most appropriate present that could possibly be given. The loud-speaker was of the well-known Boojum make.



. . . *16 "Boojums" upon Winklesworth's table* . . .

And the Others

On the following morning I resolved to carry my present with my own hands round to Winklesworth's abode. As I was standing on the doorstep waiting to be admitted I heard a crunch on the gravel behind me, and turning round I observed General Blood Thunderby walking up the path bearing an enormous parcel. Just then I heard the gate click, and behind the General I saw Snaggsby bearing a similar parcel. The General's I put down as a cake-stand, and Snaggsby's as a coal-scuttle. Just then the door opened, and the maid admitted us. She took us along to Winklesworth's den, where we found him profusely thanking Poddleby, Bumpleby Brown, Tippleston and Admiral Whiskerton Cuttle for their kind offerings. On the table were four large parcels. The General, Snaggsby and I placed ours beside them. We begged Winklesworth not to cut the strings, until all the members of the wireless club should have turned up. They came in one by one at intervals of a few minutes, each with his large parcel. When all were assembled, and when all the parcels had been placed upon the table, Winklesworth seized a pair of scissors and undid Poddleby's parcel. To my horror a Boojum was disclosed. Another Boojum emerged from the Admiral's, a third from Bumpleby Brown's, and, to cut short my tale of horror, when all the strings had been cut and all the paper undone, sixteen Boojums stood side by side upon Winklesworth's table. . . . "Anyhow," said the General, talking about it afterwards at the wireless club, "we said it was going to be a surprise, and I am blowed if you can think of a much greater surprise than that."

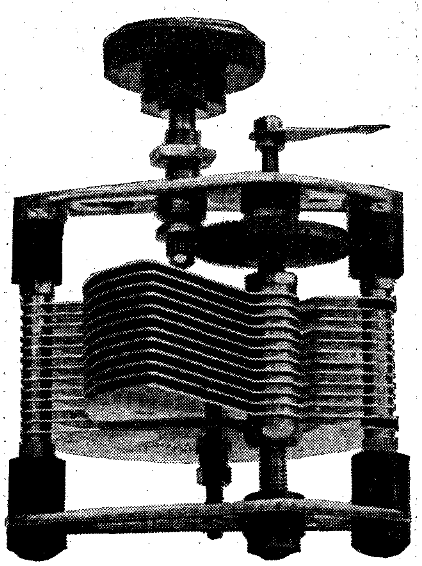
WIRELESS WAYFARER.

Some Impressions of the Wireless Exhibition

In last week's issue we published details of some of the more interesting exhibits at the Wireless Exhibition, held in the Horticultural Hall from October 10 to 16. The accompanying survey is intended to provide an impression of the chief features of the Exhibition, which should prove of interest to those who were unable to be present.

An attractive model of the "Celestion" loud-speaker, exhibited by M.P.A. (Wireless), Ltd.

THE Wireless Exhibition at the Horticultural Hall has been a most successful affair, proving a centre of attraction for large crowds, among which the home-constructor element was present in large numbers. The impression one gained from mixing with the crowd was that here were no dilettanti, few of the people had come out of mere curiosity or to stroll around and look at things, but rather almost every individual was keenly interested in the subject.



A low-loss variable condenser with reduction gearing, shown by the Penton Engineering Co.

Some of the questions overheard, addressed to salesmen on the stands, indicated clearly that the greater part of the enquirers had a definite knowledge of wireless, and that each knew what he wanted and was out to get that which would most nearly supply his needs.

Complete Receivers

A large proportion of the exhibits were of components and accessories such as are dear to the heart of a constructor, and a comparatively small number only of complete sets were shown. The greater part of these were either portable sets or super-heterodynes, and several novel receivers of these types were being exhibited. One very effective display which attracted a lot of attention was in black and white, in which the black of the ebonite and white of the nickelled metal parts matched very well. Low-loss condensers were well in evidence, and many of these were provided with some form of geared control, in many cases as ingenious as they were effective, while some of the stands specialised in the production of low-loss tuners, in which inductances of special design were used.

Facilities for Customers

There were no restrictions on the sale of components at the stands, and business was quite brisk, many of the public buying freely. The whole atmosphere of the Exhibition was far more intimate than that of its predecessor at the Albert Hall, and although considerations of space forbade the provision of comfortable lounges and armchairs on the stands, this did not hamper the carrying on of business.

Broadcast Music

Music was broadcast by means of one of the new Western Electric Kone loud-speakers, a special model being made for the purpose, which was close on 5 ft. in diameter. Except for slight resonance noticeable on one or two notes, the purity of reproduction was exceptionally good, while the volume was not so great as to interfere with the conversation.

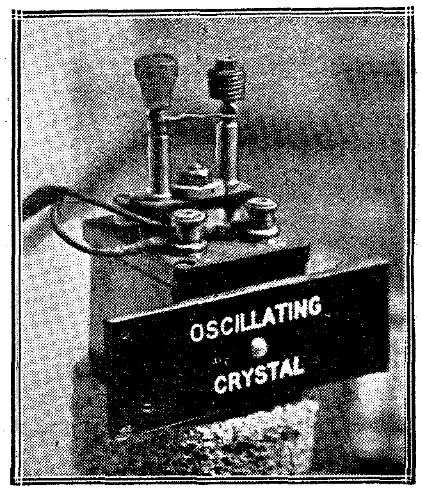
Many hours could be spent at the Horticultural Hall very profitably, for there was hardly a stand which did not show many little gadgets and accessories both novel, ingenious and useful.

Design of Apparatus

The workmanship of the components and accessories shown was of a high order, and it is obvious that great progress has been made since this time last year, not only on the technical but also on the production side. Actually there was nothing shown that was revolutionary in design, although many of the exhibits showed distinct originality in their conception.

Special Features

A display that attracted a great deal of attention was the machine used for winding transformers demonstrated on one of the stands. This was shown in actual operation, and invariably attracted a large crowd. Another item of particular interest was one of the super-heterodyne kits being displayed on one of the stands, for which many inquiries were received. We understand that a different method from that usually employed is used for the intermediate-frequency amplifier.

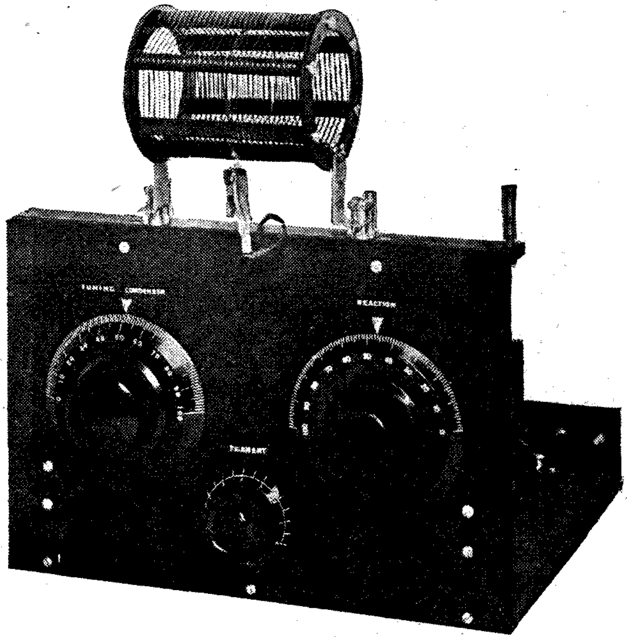


A specimen of oscillating zincite was shown by A. Hinderlich.

SOME FURTHER NOTES ON SHORT-WAVE CALIBRATION

By D. J. S. HARTT, B.Sc.

In an article in our October 7th issue Mr. Hartt described a Lecher wire method of calibrating a short-wave absorption wavemeter. Practical details of the harmonic method of calibration are given here, this being more suitable for use at lower frequencies than those dealt with in the previous article.



The short-wave receiver used in the experiments described.

IN *Wireless Weekly*, Vol. 7, No. 3, I gave some details for a simple method of calibrating a short-wave absorption wavemeter involving the Lecher wire method. This method is extremely suitable for calibrations on frequencies over 12,000 kc. (25 metres), but practical difficulties limit its usefulness for frequencies much lower than this, and we therefore have to seek other methods to enable us to calibrate a wavemeter or receiver for frequencies lower than 12,000 kc. (25 metres).

Calibration by Harmonics

One of the easiest available methods consists in detecting the harmonics of some transmitting station which is operating on a known frequency. Here, however, one has to proceed carefully, for there are several sources of error which may render such a calibration inaccurate.

First, let us examine the question of the production of harmonics. The top line in Fig. 1 shows the conventional way of illustrating a pure sine wave. In this case we have oscillations of one fundamental frequency only, and there are no harmonics, that is to say, there is nothing analogous to the overtones of a piano note or waves having frequencies which are exact multiples of the frequency of the fundamental.

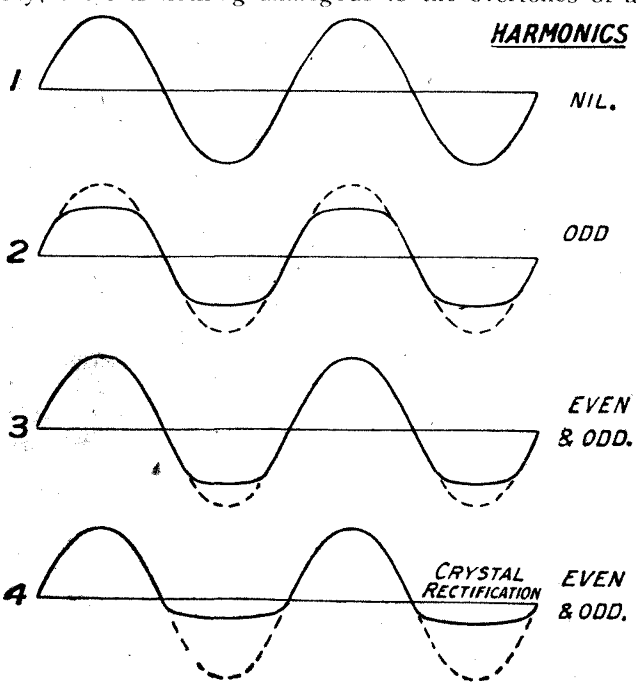


Fig. 1.—Illustrating the wave forms (2, 3 and 4) incidental to the production of harmonics, compared with a pure sine wave form (1).

Production of Harmonics

In practice it is a little difficult to obtain high-frequency oscillations which are strictly of *pure* sine wave form, so that even under the best conditions there are a few faint harmonics present. Now, when the wave is distorted, as shown in the second line, where both the positive and the negative half-cycles are flattened similarly (the pure sine wave is shown dotted), stronger harmonics are produced; under these conditions we get only the *odd* harmonics, which are those having frequencies three, five, seven, etc., times that of the fundamental.

Where, however, only the negative half-cycles are distorted, as in the third line, both the even and the odd harmonics are produced. These have frequencies two, three, four, five, etc., times that of the fundamental. Both these conditions can be produced with an oscillating valve with suitable adjustment of the filament temperature, H.T. voltage and grid bias. The condition for the production of both the even and the odd harmonics is that positive and the negative half-cycles shall be distorted to a different extent.

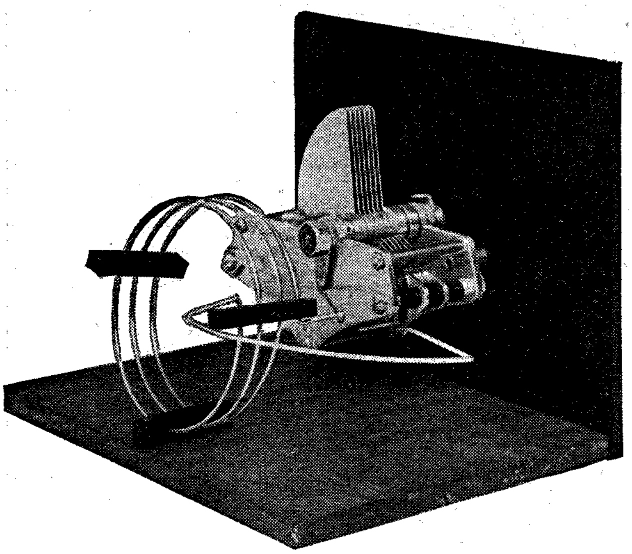
Reception of Harmonics

Now we can detect these harmonics from a nearby transmitting station by listening direct on a short-wave set by merely connecting the set up, setting it into a gently oscillating condition, and listening for the beat notes formed between the oscillations of the set and the harmonics of the transmitting station. This, however, does not lead us very far, for these harmonics are weak, and only the first few can be detected.

At about ten miles from a main broadcasting station only the first two or three harmonics can usually be detected.

Possible Errors

Other difficulties arise when we have an oscillating valve tuned to a known frequency, and arranged to



The absorption wavemeter which it is desired to calibrate.

generate strong harmonics, and in this case we must be careful to avoid confusing the harmonics with the beat notes produced by the heterodyning between them and the harmonics of the oscillations of the short-wave set. The strength of such beat notes will, it is true, be small, but where we are dealing with weak harmonics only, it is often difficult to distinguish them, particularly when we are trying to select the higher harmonics, which, of course, get nearer together in wavelength.

A Satisfactory Method

I have, however, found that the following method works well and leaves little room for any serious discrepancies to occur.

The scheme is to tune an ordinary crystal receiver to your local station and couple it to the coils of your short-wave set. Only a loose coupling is necessary, but by this means I have found it possible to detect up to the fifteenth harmonic of 2LO with comparative ease. This gives us a calibration up to about 12,500 kc. (24 metres), so that with the aid of this method and that using the Lecher wire principle we can get a complete calibration of any short-wave set or wavemeter over the whole of the useful short-wave range.

Crystal Rectifier

Reference to Fig. 1 will show that with crystal rectification we have the right condition for the production of both the even and the odd harmonics. The operation of detecting these harmonics and calibrating both a short-wave set and an absorption wavemeter, is as follows, and is illustrated diagrammatically in Figs. 2 and 3 :—

Practical Calibration

The crystal set is connected to the aerial and the earth and tuned to the local station working on a known frequency. It is not essential to tune it accurately, but the higher harmonics will be stronger if the tuning is done so that maximum signal strength is obtained. The crystal set is then brought near to the short-wave receiver, so that there is a fairly loose coupling between the coils of each set. Then, while maintaining the short-wave set in a *gently* oscillating condition, just past the oscillation point, rotate the tuning condenser slowly, starting from the full-in position, until the first chirp is heard. The coils in the short-wave set should, of course, be chosen so that the second harmonic comes at the upper end of the wavelength range.

The Absorption Wavemeter

Then the beat note is adjusted down to the silent point (if this is possible, otherwise get as near as you can). Finally, take the reading on the tuning dial and transfer this calibration to the absorption wavemeter. This is done by bringing the latter about a foot or nine inches from the oscillating short-wave set left adjusted in its previous condition.

Resonance Indication

When the wavemeter is tuned to the same frequency, the short-wave set will stop oscillating. When this happens a click (or pair of clicks; see *Wireless Weekly*, Vol. 7, No. 3) will be heard in the 'phones in the plate circuit of the short-wave set. If a milliameter is available, this may be used instead of the 'phones, and a *sudden* change in plate current will indicate when oscillation ceases.

Precautions

Proceeding in this way we can go higher in frequency and obtain a calibration point from each harmonic. Care should be taken to rotate the tuning condenser of the short-wave set very slowly (some reduction gearing is almost essential), so as not to miss one of the harmonics. After about the tenth harmonic is passed, it will be advisable to tighten the coupling between the coils of the crystal set and the short-wave receiver, since the harmonics get very weak

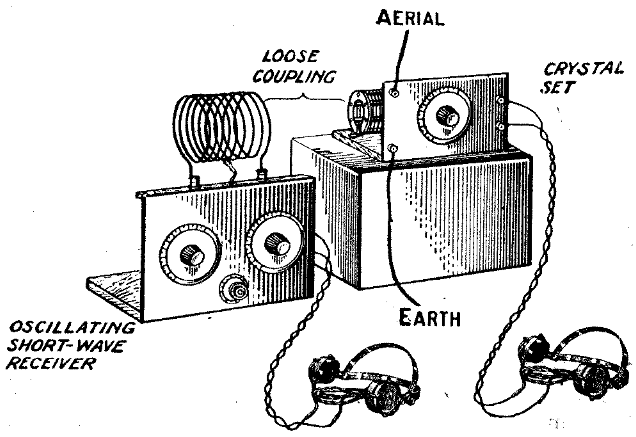


Fig. 2.—The coil of the crystal set is placed in a position of loose coupling with the valve set coil, the circuit of the former being tuned to the frequency of the local broadcasting station.

here. In my case I could only just detect the fifteenth harmonic by listening very carefully.

Different Frequency Ranges

During some part of the range it will be necessary to change coils in the short-wave set, and caution must be exercised here. It is possible to cover the range from 15,000 kc. to 1,500 kc. (20 to 200 metres), using only two coils with a .0003 μF tuning condenser, and for the purpose of these calibrations this is quite satisfactory if the tuning ranges of these coils overlap slightly, so that one particular harmonic occurs in both ranges.

Eliminating Overlap of Ranges

The best way, of course, is to "hold" the harmonic, which occurs just before the change-over, with the aid of a separate oscillator tuned to the same frequency, and then no confusion can occur. If this is not possible owing to lack of apparatus, you must choose your coils so that one particular harmonic occurs in the end of one range and the next harmonic at the beginning of the other. That is, there should be no harmonics common to both ranges.

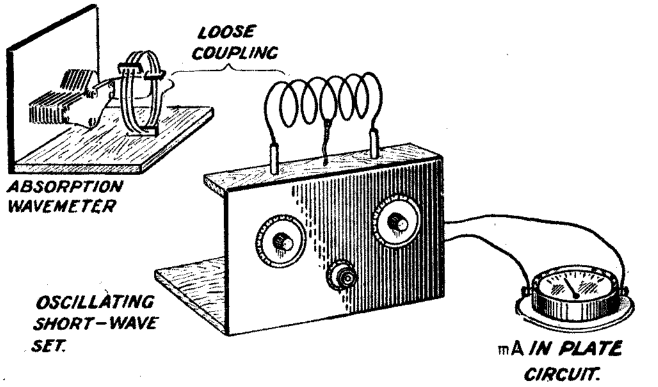


***Fig. 3.**—When transferring the calibration to the absorption wavemeter quite loose coupling is desirable in order to ensure accuracy.*

Coils

The short-wave coils I used were as follows:—Thirty turns No. 20 enamelled wire wound double-spaced on a 3½-in. diameter Collinson low-loss former, 4 in. long, with a tap on the fifteenth turn; ten turns No. 12 bare copper wire, 4 in. diameter, and sprung out so as to be 5 in. long.

The Short-Wave Set

The usual modified Reinartz circuit was used with half of the coil for the grid turns and half for reaction, the centre tap being connected to the local earth (L.T. +). The usual leaky grid condenser rectification was used, with a V24 valve, and special attention was paid to reducing casual wiring capacities, etc. This single valve short-wave set is shown in one of the accompanying photographs.

Tuning Range

With this arrangement the tuning range, using the 30-turn coil, was from just above 5,455 kc. (55 metres) to over 1,500 kc. (200 metres), and about 5,555 kc. (54 metres) to over 15,000 kc. (20 metres) for the 10-turn coil. These coils were chosen to give a continuous range, so that they would be a guide to those who could not employ another oscillator during the change-over.

Harmonics of 2LO Station

The following is a list of the frequencies of the first sixteen harmonics of 2LO, based on a frequency of 824.6 kc. (363.8 metres), which is the latest figure supplied by our Elstree laboratories before going to press. The nomenclature adopted is that the *second* harmonic is *double* the frequency, and so on.

(Metres correct to 0.1 metre)

1st harmonic	824.6 kc.	(363.8 metres)
2nd ,,	1,649.3 ,,	(181.9 ,,)
3rd ,,	2,473.9 ,,	(121.3 ,,)
4th ,,	3,298.5 ,,	(90.9 ,,)
5th ,,	4,123.1 ,,	(72.8 ,,)
6th ,,	4,947.7 ,,	(60.6 ,,)
7th ,,	5,772.4 ,,	(52.0 ,,)
8th ,,	6,597.0 ,,	(45.5 ,,)
9th ,,	7,421.7 ,,	(40.4 ,,)
10th ,,	8,246.3 ,,	(36.4 ,,)
11th ,,	9,070.9 ,,	(33.1 ,,)
12th ,,	9,895.6 ,,	(30.3 ,,)
13th ,,	10,720.2 ,,	(28.0 ,,)
14th ,,	11,544.8 ,,	(26.0 ,,)
15th ,,	12,369.5 ,,	(24.3 ,,)
16th ,,	13,194.1 ,,	(22.7 ,,)

Faint Harmonics

Using this method one could detect the first ten harmonics at good strength, but the higher ones were fairly faint. (I am about 10 miles from 2LO.) The addition of a note magnifier to the single-valve short-wave set will enable the higher harmonics to be found with greater ease.

Results Obtained

By means of these two methods I have calibrated the short-wave set shown in the accompanying photograph from 15,000 kc. (20 metres) to about 1,667 kc. (180 metres). It is sometimes convenient to have a short-wave set calibrated, but it is better to calibrate at the same time an absorption wavemeter such as I described in Vol. 7, No. 3. This particular instrument has been calibrated, by the methods we have discussed, from 15,000 kc. (20 metres) to below 8,570 kc. (35 metres); there was a slight discrepancy between the Lecher wire calibration and that obtained by harmonics, due probably to slight experimental errors in each, but the agreement was sufficiently good for ordinary purposes.

Wavemeter Tuning Range

By making further suitable coils for the absorption wavemeter (say, of 6 turns for the range down to 5,000 kc. (60 metres), and so on) on the same lines as those indicated for the absorption wavemeter in my previous article, it will be possible to calibrate the wavemeter for the same range as is covered by the short-wave set. If only one wavemeter is to be used for the whole range the coils will have to be made interchangeable in such a way that constancy is assured.

By this means, then, you will be able to tell where you are working on your short-wave set with a fair degree of accuracy throughout the range, simply by bringing your wavemeter near to the short-wave set which is just past the oscillation point, and then determining the point of resonance on the wavemeter. A reference to your curves will then give you the frequency.

Other Possible Methods

There are other methods available for such calibrations; but those outlined in this and in the previous article are perhaps the simplest for the amateur to carry out. Among other methods, that involving the use of the Abraham Multivibrateur, may be mentioned; this is a device using valves with which it is possible to produce oscillations very rich in harmonics, so that many harmonics, even up to the 150th, can be detected.

Inventions and Developments

UNDER THIS HEADING MR. J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., OF THE RADIO PRESS LABORATORIES, WILL REVIEW FROM TIME TO TIME THE LATEST DEVELOPMENTS IN THE RADIO WORLD.

Further Developments in Gas-Filled Rectifiers

SOME time ago I described a new form of neon-filled rectifier (*Wireless Weekly*, Vol. 6, No. 21), in which the electrodes consisted of a plate and a rod enclosed in a bulb filled with neon, at a fairly low pressure.

Another form of rectifier tube has been designed recently, known as the Raytheon tube, which possesses several advantages over the neon tube.

For one thing the gas employed in this device is helium, and this enables conduction to take place at much lower potentials, of the order of 30 to 40 volts.

The rectifying properties are obtained by the usual method of making one electrode very much larger than the other, in which case the conductivity is found to be good when the large electrode is *negative*,

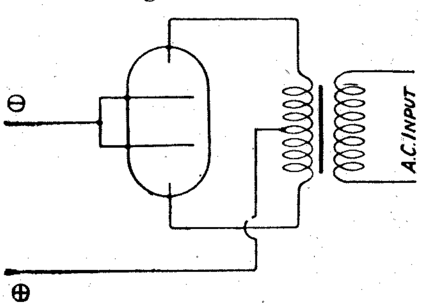


***Fig. 1.**—The one tube gives double-wave rectification, the circuit being as shown above.*

but almost negligible when the polarity is reversed.

The tube does not commence to conduct until the voltage applied across it is of the order of 150 volts, but, as has been indicated, it will remain conducting down to comparatively low values.

Double-Wave Rectification

The device is arranged to give double-wave rectification in the one tube, the circuit being as shown in Fig. 1. The actual mechanical construction of the tube, however,

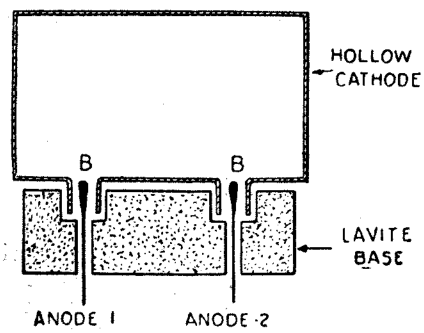


***Fig. 2.**—Showing the construction of the rectifier.*

has a good deal to do with the results obtained.

The two small electrodes are in the form of thin rods, which are mounted in insulating material, while the two large electrodes, which are shown connected together in Fig. 1, are combined into a single casing which completely encloses the small electrodes. The construction is illustrated in Fig. 2.

Mean Free Path

The whole is mounted in a glass bulb which is filled with helium at a pressure of a few millimetres of mercury.

The thickness of the insulation round the small electrodes is so designed as to be less than the mean free path of an electron in helium at the pressure employed. Thus the discharge cannot take place across this short circuit path, which would conduct in both directions, but must spread out into the main body of the device, so obtaining the rectifying properties.

The current carried by the particular valve described is about 300 mA, so that the application of these valves is limited at present to use with small outputs, or for employment in place of a high-tension battery, working from A.C. mains. There can be little doubt, however, that further developments will follow fairly rapidly, and that rectifiers capable of handling greater currents will soon be produced.

The chief advantage of this form of rectifier lies in the absence of

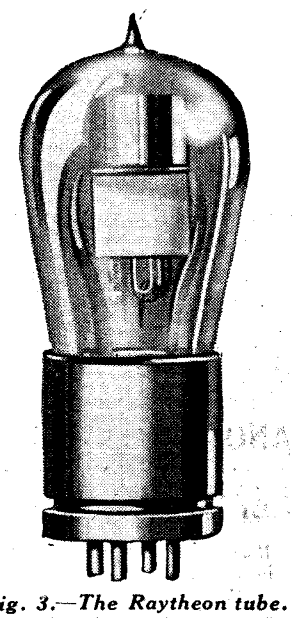


***Fig. 3.**—The Raytheon tube.*

any hot cathode requiring a heating battery. Such a battery, of course, reduces the efficiency of thermionic rectifiers very seriously, particularly with small powers, and any satisfactory device in which the battery is eliminated will be watched with interest.

Wireless News in Brief.

Another B.B.C High-Power Station? Crystal users in the South-Eastern counties will no doubt be glad to learn that the B.B.C. have recently been carrying out test transmissions, with a view to the possible establishment of a second high-power station to serve this area. Many listeners will have heard transmissions from a station giving 5GB as its call-sign. This is the experimental station of the B.B.C. at Chelmsford, which uses a power of 10 kilowatts and is working at a frequency between 714 and 750 kc. (400 and 420 metres). The general purpose of these preliminary tests is to discover how much interference, if any, occurs with Government stations.

* * *

Exhibition in Manchester. A Wireless Exhibition is being organised in Manchester by the *Manchester Evening Chronicle,* to open on October 27, the closing date being November 7.

* * *

We hear that Mr. N. G. Baguley, of Castle Gate, Newark, Nottinghamshire, has succeeded in communicating with Bermuda, which is about 670 miles distant from New York. The two stations were able to maintain communication for over two hours.

* * *

Broadcasting in the Free State. The first two broadcasting stations to be put into operation in the Irish Free State are expected to begin transmitting before Christmas, and Irish and British listeners will therefore have two more stations within easy range.

These stations are situated at Dublin and Cork. Each will have a power of approximately 1½ kilowatts, but the wavelengths have not yet been fixed.

So far listeners in Southern Ireland, of which it is estimated that there are about 10,000, have had to be content with listening either to Belfast or to one of the other B.B.C. stations in Great Britain.

The Dublin and Cork stations will both be under the control of the Irish Post Office, and announcements will be made in English and Erse.

* * *

Wireless in the Far East. In both China and Japan there is not only keen appreciation, but an active forward movement in wireless matters. Japan is already provided with an imposing technical literature on wireless, and it appears that young Japan is so absorbed in the new pastime that wireless is interfering with ordinary education plans.

The Shanghai station includes in its daily programme two hours of jazz music. The transmissions commence at 9.45 a.m. and conclude at 11 p.m. At Tientsin gramophone records are broadcast daily by a Japanese firm.

* * *

Owing to the fact that Yokohama has now been successful in picking up KDKA, East Pittsburgh, Pennsylvania, on its lower wavelength, the Yokohama broadcasting station will shortly attempt to re-broadcast transmissions from the American station.

* * *

Meteorological Forecasts from Daventry. The high-power station at Daventry is being utilised in many ways other than that of broadcasting programmes. One of its most useful functions is to send out the meteorological forecasts every day at 9.30 a.m. (G.M.T.), and any vessel within the vicinity of the British Isles may receive forecasts for the succeeding twelve hours if fitted with a suitable receiver. Local forecasts are also sent out from Newcastle, Bournemouth and Liverpool between 9.20 and 9.35 p.m.

* * *

Armistice Day Programme. A special Armistice Day programme is in course of preparation. The arrangements will probably include the placing of a microphone in some public thoroughfare for reproducing the sounds of the throng of mourners, a performance of suitable music under the baton of a well-known conductor, and a patriotic play specially written for the occasion.

* * *

Wireless on Ships. We now understand that the agreement recently entered into by the British, Canadian and United States Governments to prevent the use by ships of wavelengths of 300 and 450 metres when within 250 miles of the coast only applies to the coasts of Canada, Newfoundland and the United States. There is no such restriction in the case of ships within 250 miles of our own coasts.

Radio Press Measurements of Frequencies of B.B.C. Main Stations.

5.30 p.m., October 13.

	KC.	METRES.
Cardiff	852.8	351.8
London	824.6	363.8
Manchester	799.4	375.3
Bournemouth ...	780.0	384.6
Newcastle	744.2	403.1
Glasgow	711.6	421.6
Belfast	685.6	437.6
Birmingham ...	632.9	474.0
Aberdeen	601.6	498.7

LAYING OUT A

By G. P. KENDA

Not the least important c short-wave receiver is the components. Mr. Kenda details which should pro are confronted with

PROBABLY the wisest plan for the beginner in short-wave reception to adopt is to decide upon the two-valve circuit which we considered last week, and which is reproduced again upon these pages for reference. Such a receiver is extremely simple to build, easy to operate, and the design need present little difficulty if due attention is paid to certain well-understood points.

A Short-Wave Advantage

One of the attractions of short-wave work is to be found in the fact that the apparatus is so simple that a reader with quite moderate technical knowledge can actually design his own instrument and build it, instead of being compelled to follow some published design, with a corresponding gain in the pleasure derived from the use of the finished instrument.

I think that most readers who are making use of this series of articles will be able with the directions which I shall give, to lay out and build a successful short-wave set, using the circuit which we have been discussing, but I should like to add that any who feel doubt as to their ability to do this would be well advised to choose one of the recent designs for a short-wave receiver, such as that published recently under the name of Mr. Allinson, and to follow this carefully.

Importance of Stray Capacities

The circuit which we are to adopt is so simple and the necessary components are so few in number that there are very few pitfalls for the unwary in laying out the receiver, provided that certain points are given due attention. First and foremost, the reader must realise that the tuning range upon the higher frequencies is very considerably affected by stray capacities, therefore very special pains must be taken to minimise all such additions to the circuit capacity. For example, a pair of wires running to a variable condenser should be given more than the usual separation, and so it should be throughout the set.

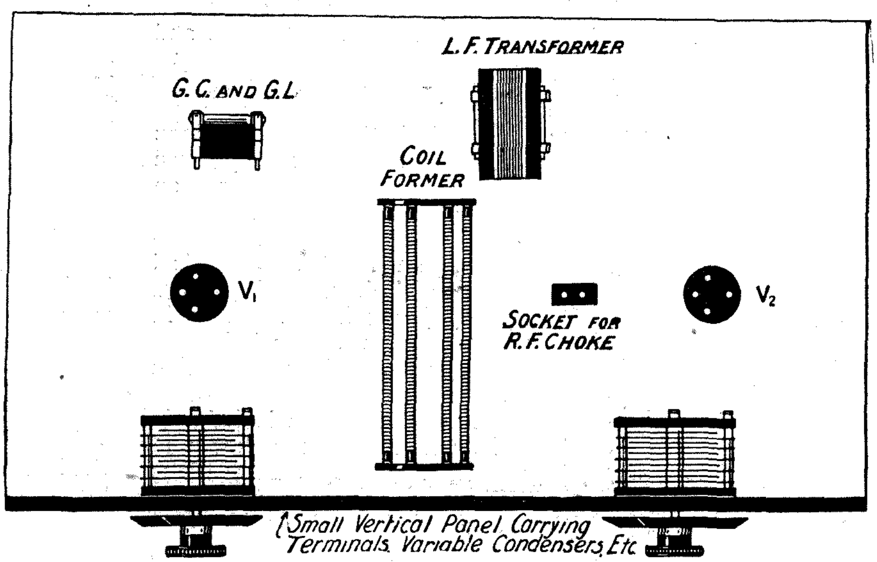


Fig. 1.—A lay-out of the principal components of a set which would prove unsatisfactory in practice. This position of the L.F. transformer relative to the coil would markedly reduce efficiency.

Spacing Essential

Long leads (within reason, of course) are not nearly so much to be feared upon moderately short wavelengths, say, below 15,000 kilocycles (20 metres), as leads which run close to others at differing potentials. It should therefore be decided that the set will cover a considerable amount of space, and that no special attempt should be made to secure compactness. The spacing-out of components is undoubtedly more important than securing short leads, unless those short leads can also be well separated from all other leads, and unless, furthermore, the components are so far from one another that the stray capacities from one to another are not serious.

The "Bread-Board"

The general plan to adopt will naturally vary with the taste of the constructor, but since most short-wave receivers are very definitely experimental in their character, and undergo frequent alterations, I would strongly urge the use of what our American friends call a "bread-board." This simply means the use of a wooden baseboard, sometimes with a narrow vertical ebonite panel attached to its front edge, to carry the variable condensers and terminals, and possibly the filament rheostats.

Special Points

Having accepted, then, the general rule that the set shall be well spaced out, one or two of the components call for mention in regard to their placing. Let us first consider the tuning coil or coils, since their position is undoubtedly of considerable importance with regard to the working of the set. Take the greatest possible pains to ensure that the tuning coil is well away

SHORT-WAVE SET

, B.Sc., Staff Editor.

sideration in the design of a st method of arranging the gives here some interesting of assistance to those who iculties in this respect.

from all metallic objects, and on no account let any object of this nature come within the stronger part of the field of the coil.

A Common Mistake

For example, do not on any account make the common mistake of using a cylindrical coil, and pointing it at one of the variable condensers which is situated only a few inches away. To do so is simply to invite trouble in eddy current losses. On the contrary, take care the coil is well away from all the condensers and other objects, even though you may have to use leads up to 6 or 8 inches long for the connections from the coil itself.

Achieving a Compromise

A little thought devoted to the arrangement of the parts will show how the coil may be placed in such a position that it is well isolated, and the leads to it are no longer than absolutely necessary. At the same time, consideration should be given to the question of the placing of the socket for the detector valve, in such a way that the lead from its grid to the grid condenser and from the grid condenser to one end of the tuning coil, or to one of the wires which join one end of the tuning coil to the tuning condenser may be reasonably short, and, above all, well separated from other leads.

The placing of the choke coil is a matter which calls for a little consideration, since it is most desirable that this component should be well separated from others at earth potential, and it is also desirable that the lead from the one side of the coil to the plate of the valve and also the lead from the plate of the valve to one side of the reaction condenser should be reasonably short, as well as well separated from other leads.

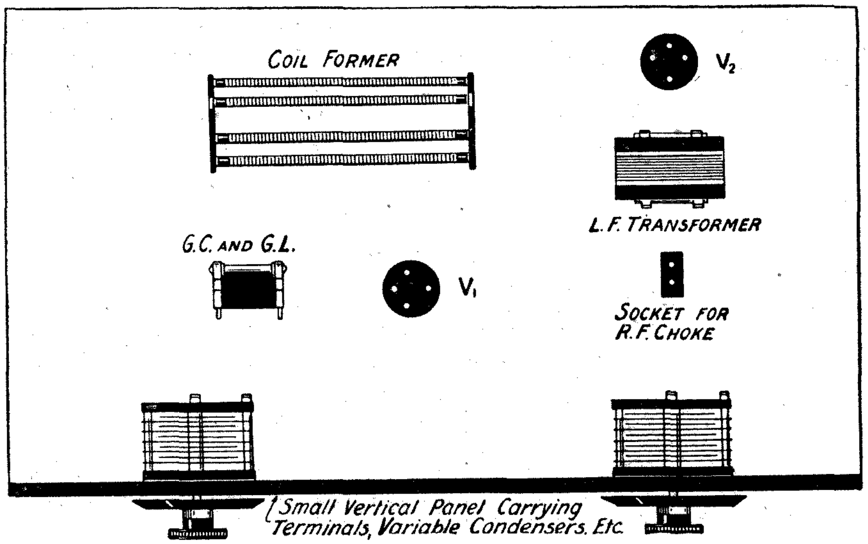


Fig. 2.—This represents an improvement on the lay-out of Fig. 1, though it would be better to place the variable condensers closer together and alter the position of the R.F. choke.

Two Examples

With these points in mind, it will probably be useful to discuss next the two alternative lay-outs for the circuit which we are considering, which are illustrated upon the first two pages of this article. On the left will be seen an example of a thoroughly bad lay-out, and we will first examine some of the reasons for describing it in this way. First observe the position of the coil former, which, for the purposes of these notes, is assumed to be a standard one of the skeleton type. As this former is placed, it will be observed that the low-frequency transformer is placed right in the field of the coil, also that the R.F. choke is very much too close to it, and finally that the placing of the coil is such that some portion of its field cuts across both the variable condensers. These latter, however, are so far from the coil that the last point is not a very serious one.

A Better Lay-out

In the second lay-out it will be observed that the coil is well isolated, and that although the low-frequency transformer is still in such a position that some portion of the field cuts through it, yet it is so far from the coil that probably little harm would result. The second position for the coil which is illustrated also has the advantages that the wiring is straightened out and simplified, and further that one end of the coil is exposed in such a manner that it would be easy to couple to it a small coil in the aerial circuit, without the necessity for the aerial and earth leads passing through the other wiring of the set.

Improvements

A careful examination of the left-hand lay-out will show that it violates several of the rules which have been laid down, and we will next see how these points have been improved upon in the second lay-out. The position of the coil we have already discussed, and it will next be seen that the socket for the R.F. choke is now reasonably well isolated, and this can be counted an improvement. It is still, however, not in an ideal position, since it is so placed that certain of the leads connecting the choke to the anode of the valve V1

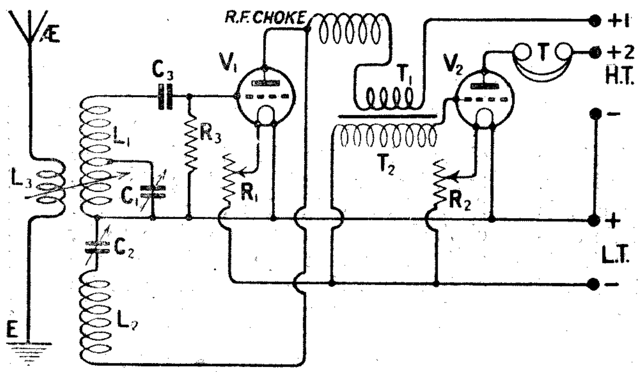


Fig. 3.—A circuit of this type employing a detector and one stage of L.F. amplification was discussed in Mr. Kendall's previous article in this series.

and to the reaction condenser will be unnecessarily long. If it were moved to the left so as to be considerably nearer to the socket of V1, say, as far as would bring it immediately beneath the "L" in "L.F. Transformer," the lay-out would be further improved.

From this it follows that the position of the right-hand variable condenser, which we will assume is a reaction condenser, might also be improved upon by moving the component bodily to the left until it was separated by only about its own width from the other condenser, which performs the functions of tuning. In its first position the idea of spacing out the components had been carried so far that much of the wiring would be unnecessarily long.

The Grid Condenser

Another point which might be improved upon in this lay-out is concerned with the relative positions of the grid condenser and leak and the socket for the detector valve, V1. Upon both the lay-outs shown these are too far apart, since the ideal arrangement is to solder the tag on the grid condenser directly to the grid pin of the valve socket. When a suitable board-mounting valve-holder is employed, this, of course, is quite easy.

These examples should, I think, make sufficiently clear the considerations which are involved to enable the reader to carry out for himself the operations of laying out the set, since a little consideration of the two lay-outs which I have given, and the criticisms which I have made of them, should serve to make clear the factors involved.

In the actual construction of the set there still remains the question of the coils, their construction and mounting in the instrument, but this is too large a subject to be dealt with in this instalment.

□

The Nature and Sources of Atmospherics

(Continued from page 149)

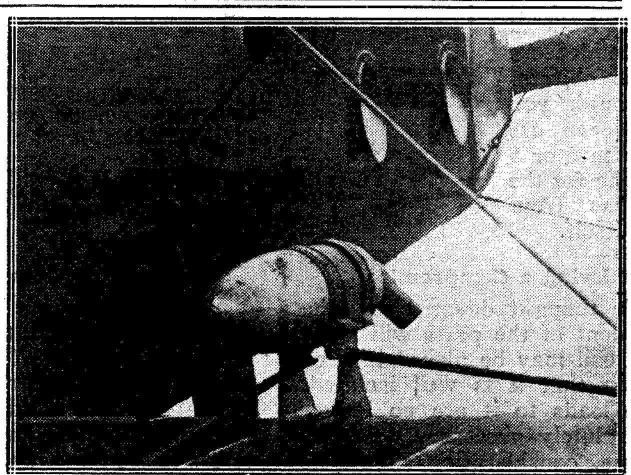
changes of the atmosphere. Whenever there is an approach of a cold layer of air from the Polar regions, there is an increase in the number of the grinder type of atmospherics.

"Cold Fronts"

The march of cold air from the poles is usually referred to as a "Cold front," and the conclusion is that, as this Cold front marches forward so the source of atmospherics marches with it. Whenever the Cold front reaches a mountainous region the atmospherics reach their maximum intensity. This again is obviously due to the fact that the temperature changes must be more violent in a mountainous region. Thus the general conclusion appears to be bearing out that of the directional observations of Watson Watt and others, including those in Germany, who have traced the most prevalent atmospherics to the mountainous regions of Europe or Northern Africa.

Malgorn's observations were also conducted over the Atlantic and Pacific Oceans, where again the observations were verified that the atmospherics follow the march of the Cold fronts. Another general conclusion was verified by him, that the worst atmospherics are not produced over the ocean, but over large areas of land, and particularly near mountainous regions.

Regarding the Crash types of atmospherics, which sometimes last from half a second to five seconds, a view has recently been expressed in France as to their origin. The reason for this will be given in a subsequent article.



The generator for supplying power to the wireless transmitting sets on aircraft is sometimes fixed on the lower plane, as shown. The propeller on its shaft is rotated by the blast of air from the main airscrew.

Typhoons

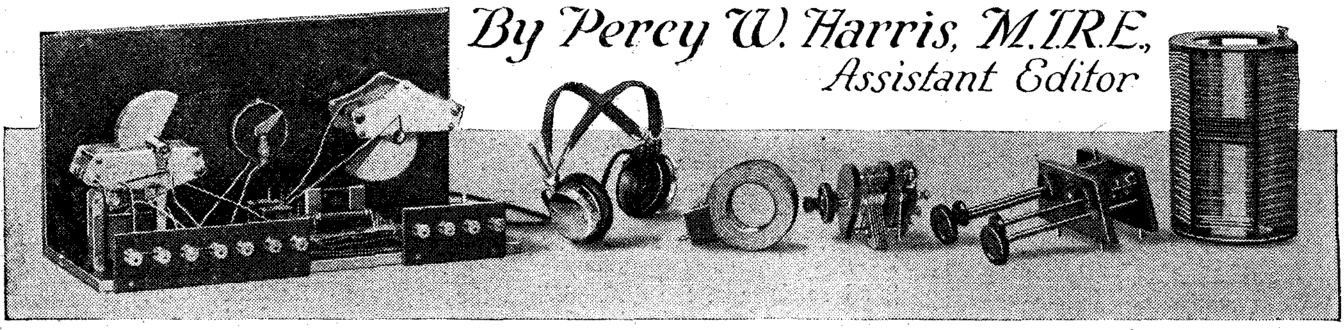
Attempts have been made in China to follow the approach of typhoons, but so far without success, although directional observations have also been made. This seems somewhat peculiar in view of the success which has resulted from the forecasting of the approach of thunderstorms and cyclonic disturbances. The reason appears to be that cyclones and thunderstorms are associated with the advance of a Cold front which comes from the poles, whereas typhoons are produced by the advance of hot air from the tropics. Thus the typhoon area does not appear to reach very high altitudes, nor to produce violent atmospherics.

The results of further observations will be given in a subsequent article in this series.

(To be continued)

Random Technicalities

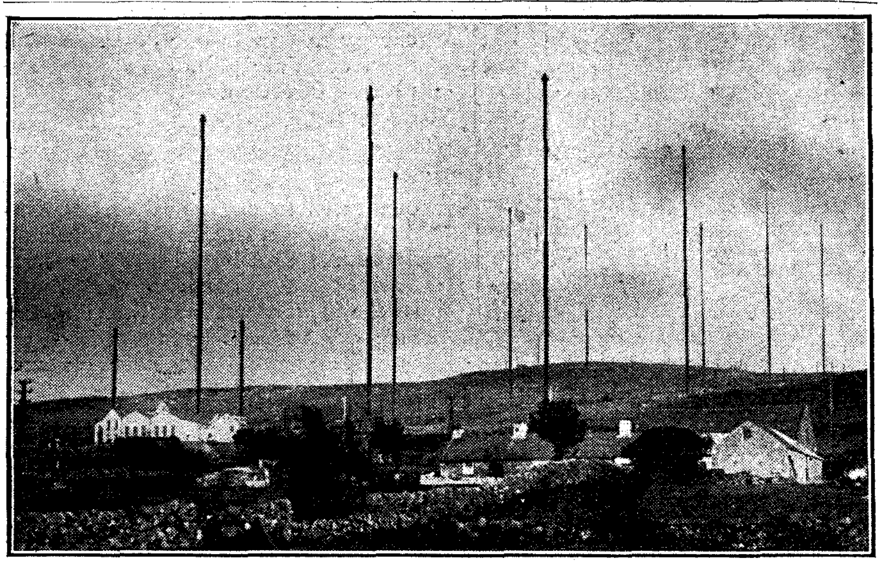
By Percy W. Harris, M.I.R.E., Assistant Editor



EXPERIMENTERS might quite profitably give more attention and thought than they do to the question of filament voltage, or rather filament current. Frequent warnings are given to valve users not to place the high-tension leads across the low-tension terminals, and several excellent protective devices are now on sale to prevent the early decease of precious valves from accidents of this kind. Rarely, however, do we see warnings regarding the abuse of filament resistances. I am sure that thousands of valves are consigned to the scrap-box each year for no other reason than that the user has been unable to repress his desire to fiddle with the rheostat knob. I am afraid many advertisements give the impression, when describing the virtues of the sweetly running and quiet contacts, that adjustment of the filament current is something which goes on continuously during reception. On my own sets at home I do not touch the filament resistances from one week end to another, except when trying different valves or other special components.

A Suggestion

Personally I should like to see the valve-makers marketing valves to run with filament voltages of 6, 4 and 2 volts respectively, so that they could be run direct from accumulators without filament resistances of any kind. If a valve is designed to run at a particular filament voltage and current, this current should be maintained constant throughout the life of the valve, and not be varied in order to obtain other adjustments in the set. For this reason I am not in favour of using filament resistances for fine tuning. In the great majority of cases even with the valves such as we have at present, which are designed to operate at voltages different from those given by an accumulator direct, I think a permanently set resistance will, in a very large number of cases, give us all we require.



The aerial masts at the Carnarvon wireless station are situated on a hill 1,800 feet above sea level, so that some of them are almost constantly in the clouds.

Damage Done to Cells

"But," you will say, "we must have a variable filament resistance to allow for the drop in voltage of the battery." This adjustment to compensate for the drop in voltage of the accumulator has done more to ruin these excellent accessories than any other one factor. Any accumulator manufacturer will tell you with great emphasis that it is madness to attempt to get the last ampere of current out of a cell, and particularly careful instructions are always given not to let the voltage drop below 1.7 or 1.8 per cell. In spite of this, thousands of users continue to discharge their accumulator on the principle that there is "still something in it," even though the voltage has dropped far below the safe figure indicated by the makers.

Regular Charging

If you examine the discharge curve of an accumulator you will find that the voltage is maintained at 2 until practically the end of its useful discharge, when there is a fairly rapid drop. My own method is to recharge the accumulator immediately there is any sign of the voltage dropping below 2, and I never, in any circumstances, try to bring signal strength back again by readjustment of filament resistance knobs.

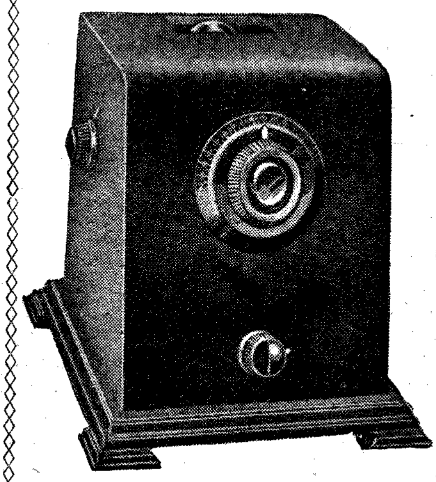
American Practice

In America practically all modern receivers have one filament resistance knob only for all the valves. Of course, when we use dry cells the discharge curve of which is a steady slope, filament resistances of the adjustable type are desirable.

An H.F. Selector and Radiation Preventer

By B. B. MINNIUM.

The problem of the oscillation nuisance is still sufficiently serious to arouse interest in any apparatus designed to prevent receivers from re-radiating energy. The instrument described in these pages is claimed to be satisfactory in this respect, and at the same time to provide a good measure of selectivity.



The Penetrola, a commercial form of the apparatus described in the accompanying article.

ONE of the greatest problems with which radio engineers are confronted in the design of apparatus is the prevention of radiation, or feeding oscillations back into the aerial system. Research workers have been experimenting for many months endeavouring to find a device that will prevent radiation and at the same time not interfere with the proper functioning of the receiver. There have been circuits published heretofore that will not radiate, but there are certain types of sets that will break into oscillation at the slightest excuse, and it is with the latter that engineers have concerned themselves.

"All-Capacity" Bridge

It is easily seen that a device which will stop a regenerative set from radiating annoying squeals and at the same time will not lessen the efficiency of the set is more or less a pretty stiff problem. Yet such a device has been developed in the form of a stage of high-frequency amplification, which is connected between the aerial and the input side of the receiver itself. This circuit makes the valve act as a one-way relay, so that energy can pass from the aerial, or other energy collector, such as a loop, to the succeeding valves, but cannot flow in the opposite direction. This property is due to the balance obtainable through the all-capacity bridge that is incorporated in the circuit—which balance remains constant for all settings of the dial. When the filament of the valve is cold, energy cannot pass in either direction through the valve; when the filament is heated and is emitting electrons, an amplified copy of the signal flows in the plate circuit through the agency of this electron stream.

No Oscillation Nuisance

Thus energy can pass from the aerial to the output of this new device, but cannot pass in the opposite direction. And also when such a stage of perfectly balanced H.F. amplification is interposed between the aerial and the receiving set any squealing originating in the receiver is isolated from the aerial and cannot interfere with the reception of other receivers in the vicinity.

Previous Fallacies

The property of radiation-prevention has wrongfully been claimed for most forms of high-frequency amplifiers connected between aerial

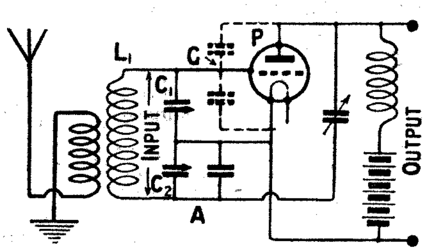


Fig. 1.—The fundamental principle of the system may be easily understood with the aid of this circuit diagram.

and receiving set, the idea being set forth that, as long as the H.F. stage itself does not oscillate, it will prevent oscillations set up in succeeding stages of the receiver (or in the detector) from reaching the aerial. Some writers have even gone so far as to state that a loosely-coupled regenerative receiver will not radiate and that the single-circuit receiver is the only transgressor in that direction.

Radiating Circuits

As a matter of fact, conclusive tests made show that all four types (oscillating H.F. amplifier, oscillating detector preceded by one or more stages of imperfectly balanced but non-oscillating H.F. amplification, single-circuit regenerative, and loosely-coupled regenerative receivers) radiate strongly and that

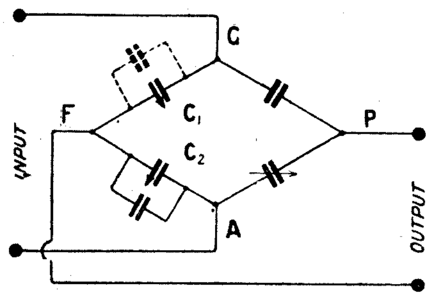


Fig. 2.—The operation of the circuit depends on the action of the bridge connection shown here, which should be compared with Fig. 1.

the so-called loosely-coupled three-circuit regenerator is capable of causing most annoying radiation. In fact, it is obvious that any method of coupling which will allow energy to flow in one direction will most certainly permit a flow in the reverse direction.

Tests with the Selector

Radiation tests were made by setting up an oscillating receiver connected to one aerial and a non-oscillating set connected to a second aerial running parallel to the first. When the two receivers were tuned to the same distant station and the first was made to oscillate, howling in the second receiver (which originated in the first) completely drowned out reception. When, however, this new device was connected between the oscillating receiver and its aerial, no interference in the second receiver resulted.

A Conclusive Test

It was found that, when the two receivers were placed side by side, enough energy was radiated from the coils and wiring of the regenerator itself to cause mild interference with the second receiver, but when they were placed about fifteen feet apart (in adjoining rooms), no interference could be heard, although the two receivers

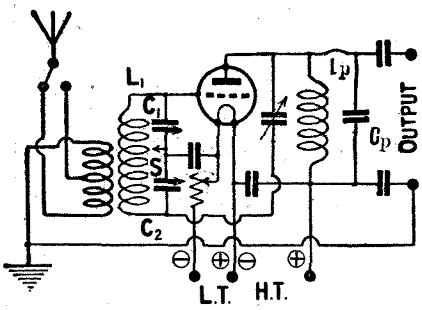


Fig. 3.—This diagram shows the arrangement of the tapped primary and the condensers.

were still connected to parallel aerials. It was also found feasible to operate two radiating-type receivers on parallel aerials without mutual interference between them, when each had been provided with the new device.

Metal Screening

In the development of this instrument, it was noticed that the output coil of the unit was capable of radiating howls originating in the oscillating receiver. For this reason the device has been completely enclosed in a sheet metal case.

Stability

Ordinarily it is impossible to add a further stage of H.F. amplification to receivers using two such stages because the addition of the third stage causes the combination to become unstable, resulting in locally-sustained oscillations and howling. This instrument is so perfectly stable that it may be added to any receiver without increasing the tendency toward oscillation.

Selectivity and Amplification

The new instrument differs from such devices as the wave-trap, in that a wave-trap admits all except a narrow band of frequencies, at the same time reducing the strength of the desired signal, while this device admits and amplifies only the desired narrow band of frequencies.

Furthermore, such a decided increase in the strength of the desired signal is obtained that, in most cases, a station which is inaudible with the receiver alone will, with the assistance of this instrument, give loud-speaker volume.

Circuit Employed

Fig. 1 shows the fundamental circuit and Fig. 2 is the all-capacity bridge involved. The same lettering is used in both figures. Thus the capacity between grid and plate is indicated by the condenser between points G and P, the grid and plate respectively, of the valve; and the balancing condenser from plate to the point A is shown connected between points P and A of the bridge. This latter condenser is adjustable, but when once set at the point at which the bridge is balanced, it does not require further adjustment at any frequency unless a valve having a different value of grid-to-plate capacity is substituted for the valve for which balance was obtained.

Constructional Details

In Fig. 3, the input inductance L_1 is more than twice the value ordinarily employed, resulting in a very high signal voltage across its terminals—and therefore increased signal strength over that ordinarily obtained. The primary inductance is tapped as shown to allow a choice in selectivity for varying conditions of operation. Fig. 3 is the actual circuit diagram for the type used with sets employing an outside aerial. It will be noticed that the shield, marked S, is not connected directly to the earth, but through a by-pass condenser. While this earths the shield and the rotor of the twin variable condensers to

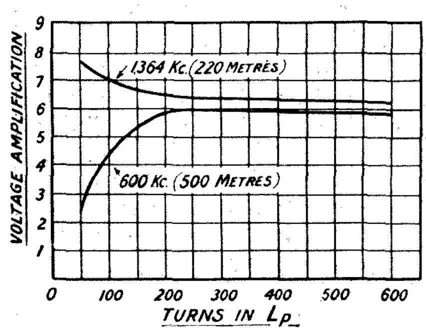


Fig. 4.—Showing how the voltage amplification varies with the number of turns on the anode inductance.

alternating currents, it removes the possibility of burning out a valve by having the positive high-tension battery lead accidentally come in contact with the shield.

The matter of which filament lead is earthed and which is connected to high-tension minus lead is determined by the wiring of the receiver itself. Thus this device will function, without change in its own wiring or that of the receiver, with any set, no matter which battery lead is grounded or which is connected to the high-tension minus terminal.

Special Features

The special output circuit shown in Fig. 3 allows the unit to amplify

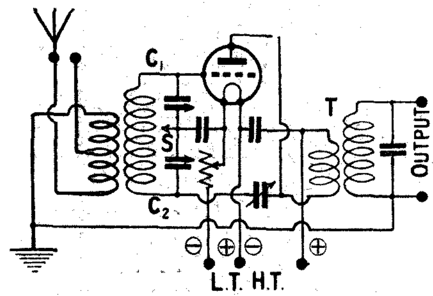


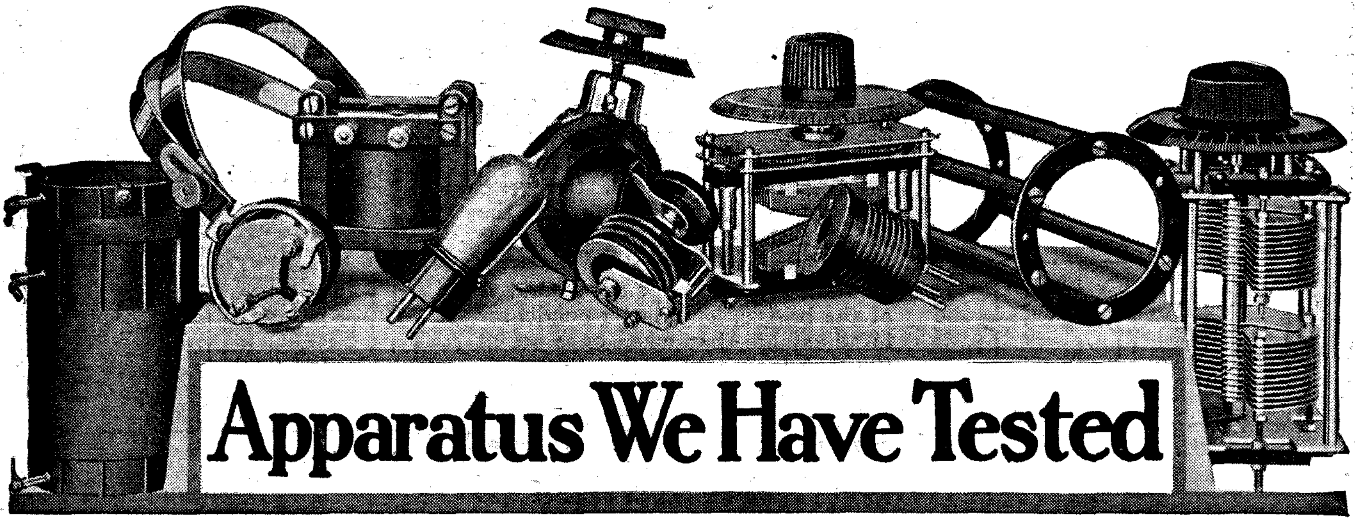
Fig. 5.—The complete wiring diagram of the instrument illustrated at the beginning of this article

the incoming signal when feeding into any type of receiver, whether it be of the fixed-tuned primary type (as in the neutrodyne) or a single circuit or loosely-coupled type, tuned either with a series or parallel condenser. C_p is so proportioned that, with the rest of the output circuit, it simulates the conditions of the average-sized aerial. This causes the tuning of the first dial of the receiver to be altered but very little—if at all.

The output inductance L_p has been chosen to give the highest possible average gain with various types of receivers. Fig. 4 shows two amplification curves run at 1,364 and 600 kc. (220 and 500 metres) and the inductance of L_p was chosen from the results of a series of such curves to give the maximum amplification possible.

For Loop Reception

For use with a set designed for loop reception, type CL has been developed. The circuit of Fig. 5 is employed. Here the loop is replaced by a very short aerial (20-50 feet long), which, it has been found by experiment, gives a better combination of selectivity and signal intensity and less static. The earth connection may be used as shown, or may be replaced by a short length of wire thrown on the floor or running under the carpet. T is a small high-frequency transformer, across the secondary of which a condenser is shunted in order to compensate for the difference between the distributed capacity of the secondary of T and that of the loop, thus preventing any marked disturbance in the reading of the first dial of the receiver.



Apparatus We Have Tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

Benjamin Valve-Holders

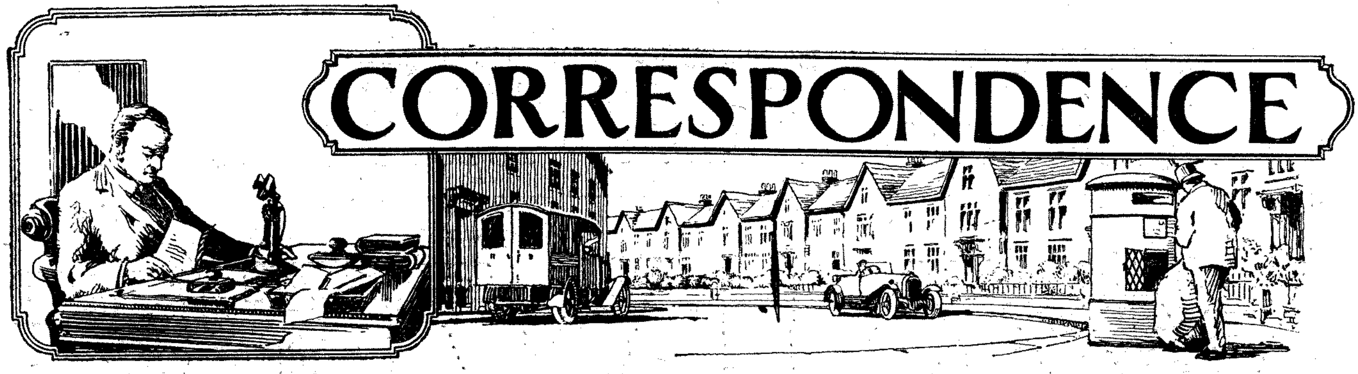
An interesting type of anti-microphonic valve-holder, and one which lends itself particularly well to the modern base-board and vertical panel type of receiver, with valves arranged behind the panel, is the Benjamin Clearer Tone Valve-Holder, samples of which have been sent to us by Messrs. the Benjamin Electric Co., Ltd., for practical test. These have a hollow rectangular bakelite base, with drilled fixing lugs for fastening down on a base-board or panel, and with four convenient terminals at the corners as well as small soldering tags at the lower corners. An ordinary type of four-pin valve-holder is suspended within this hollow base, with the upper portion projecting through a circular aperture in the top, by four spring arms (formed into close spiral springs at the inner ends), which actually provide the valve-leg sockets at one end and the soldering tags at the other end of one continuous piece of metal. Actual trial showed that a good measure of insulation from the effects of vibration and shocks had been achieved. We are glad to note that the price asked for these well-finished and neat-looking holders is very reasonable indeed; they can certainly be recommended with every confidence. Insulation resistance, on test, proved unexceptionable.

"Soldo" Tinning Compound

A soldering compound which is rather more than a flux is "Soldo," a sample of which has recently been sent for our comment by Messrs. the Soldo Co. This material, which has been commented upon previously in these reports, consists of a greyish material, with metallic specks visible in it, packed in a small tin with a tight lid. If some of this is placed on a piece of most ordinary metals, heated to above the melting-point of solder, the metal becomes tinned at once, both the solder and the fluxing material necessary to clean the object to be tinned being present in the flux. The makers claim that an ordinary poker can be pressed into service to act as a soldering-iron, and that there is no necessity to clean the metal in the usual manner by scraping, filing or acids. We have had this flux in almost daily use, in experimental work, for a considerable period, and can endorse the claim that the tinning of not over-clean metal is very greatly facilitated by its use. But we do not consider that it is advisable to emphasise unduly the fact that there is no need to clean metals before commencing soldering operations, particularly in radio constructional work. One application in which we have found both earlier samples and the latest product invaluable is in the repeated cleaning and retinning needed by an ordinary soldering-iron, even a gas-heated one, from day to day and during constructional work. Practical trial shows that by momentarily placing the tarnished point of the iron in this "Soldo" compound in its tin, the dirt vanishes and the iron is ready tinned for use. Similarly for tinning obstinately-resistant small brass parts and wire ends good use can be made of it, and where a large surface has to be tinned, as in sweating brass plates together, etc., the compound saves a large amount of time and wasted effort. The report from the N.P.L. quoted by the makers gives evidence of the soundness of resulting joints.

National Tapped Tuner

Messrs. National Wireless and Electric Co. have submitted for test an example of their tapped tuner, with ball reaction-rotor and with nine tapping points, which is claimed to cover from approximately 1,000 to 100 kc. (300 to 3,000 metres wavelength), with the aid of a .0005 μF tuning-condenser in series-parallel connection. It consists of a composition tube, about 6 in. long and 3 in. in diameter, wound closely with a large number of turns of very fine silk-covered wire, except for a narrow gap just over the centre of the vario-coupler rotor. The latter has also a large number of turns of fine wire on a moulded spherical former; it is arranged transversely in bearings towards one end of the stator tube, and is intended to be controlled by a knob (with bevel scale) projecting through the front of the panel. Two fixing screws, with suitable spacing bushes, are provided. Terminals on the tube itself, on heavy copper straps, give means of electrical connection to the rotor winding, whilst small terminal bolts and soldering tags are provided for the grid-circuit connections and for wiring up to the selector switch. The tappings are made in a very neat manner with connections inside the stator tube. On practical trial on a small P.M.G. aerial with a .0005 μF tuning-condenser, the requisite overlap of tuning ranges was found wanting between 630 and 612 kc. with parallel tuning-condenser; the tuner should be used with series condenser in the lower ranges. Otherwise the range from about 869 to 110 kc. was readily available, free oscillation resulting at all points. The local station, 2LO, jammed everything else up to about Belfast's wave, only Birmingham being obtained fairly clear of London (at 12 miles from the latter); on the No. 6 tapping point 5XX came in at moderate loud-speaker strength on the one valve in London, sensibly free from 2LO; on the ninth point Eiffel telephony came in weakly, and not entirely free from London, whilst Radio-Paris in the lower range was jammed by both 5XX and London. On measuring by the Moullin voltmeter method the resulting signal-voltage from the local station, without reaction, the figure recorded was lower than that for any but the least commendable of plug-in coils. The tuner can hardly be described as of a low-loss type with such high-resistance fine-wire windings and dead-end effects of a marked order. The utility of so unselective a device is somewhat hard to appreciate at a time when the problem of mutual jamming of the rapidly multiplying broadcast stations is so much to the fore.



THE "NEW LOUD-SPEAKER CIRCUIT"

SIR,—I am glad to say that favourable reports on the "New Loud-speaker Circuit," as described in *Wireless Weekly* of September 2 and September 16, 1925, are coming in from all parts of the country, and hence perhaps the following remarks may be of interest.

As explained, the action of the detector valve in any form of the trigger circuit depends upon changes of voltage first and foremost, rather than changes of current. The detector is not only a rectifier, but also a voltage amplifier, rather than a power amplifier, and therefore the greater the voltage amplification factor of the detector valve, the better.

This appears to be borne out by the recently published conclusions of Messrs. Manfred von Ardenne and Heinert; they show that in connection with those stages of resistance-capacity coupled amplifiers which act as voltage amplifiers pure and simple, anode resistances of several megohms should be used with high amplification factor valves, and that used thus the filaments of ordinary valves have to be run very dim.

Von Ardenne and Heinert hope to be able to produce special short filament valves with amplification factors as high as 70 for the benefit of their resistance amplifiers, and it is to be hoped—for the benefit of the trigger circuit—that such valves will be available also in this country.

However, one limiting factor is the natural capacity to earth of the anode circuit of the detector. In all forms of the trigger circuit used for telephony it is advisable that both the detector and the valve following it should use low-capacity sockets, and that the detector anode battery and the leads from it to the detector anode and the grid of the next valve should be kept as clear as possible from the rest of the circuit.

Finally, the merits of the trigger circuit—details of which have been divulged in *Wireless Weekly* only—are such that it is now being put on the market in the form of a cabinet receiver by Messrs. Princeps, Ltd., of 173, New Bond Street, with whom is associated Major Prince, who originated the circuit.

There is still considerable scope for experiment to find the best conditions under which particular valves will work in the circuit.—Yours faithfully,

GUY C. BEDDINGTON.

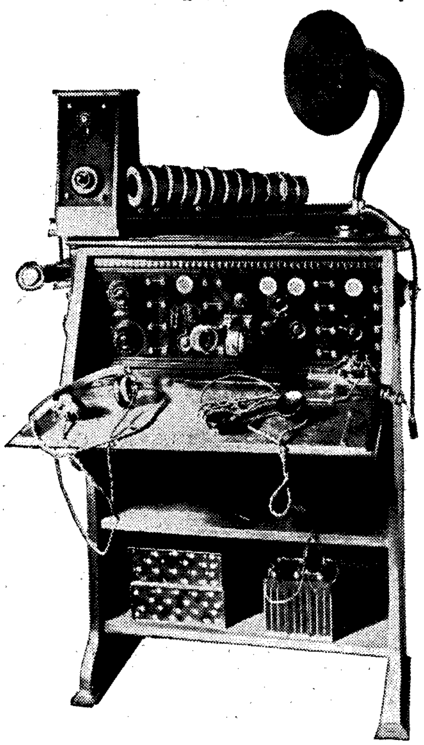
Villa Yolanda, Ospedaletti, Italy.

ENVELOPE No. 2

SIR,—I have much pleasure in enclosing a photograph of my "Family" four-valve circuit set (Radio Press Envelope No. 2, by Percy W. Harris, M.I.R.E.), which I hope will be of interest to you. I constructed this set some months ago, and have always derived the utmost satisfaction therefrom; in fact, I find it gives far better reception than any other of your many circuits which I have tried. You will notice that it is made out of experimental panels. I have made up your wave-trap, and with this in circuit I can cut London completely out and pick up any of the B.B.C. and many Continental transmissions without the slightest interference. For London I only use detector and one L.F. valve, and this gives sufficient power to work a small loud-speaker, which can be heard all over the house. I always recommend this circuit to my friends, for in my opinion it is quite the best.—Yours faithfully,

A. HAYNES.

Peckham, S.E.



The receiver employing the "Family" 4-valve circuit, as constructed by Mr. Haynes.

SIR,—I thought you might be interested in the following report of the "Family" four-valve set (Radio Press Envelope No. 2, by Percy W. Harris, M.I.R.E.), which I built some four or five months ago. I thought I would give it a good trial, all stations mentioned being tuned straight into the loud-speaker, not 'phones first. The following come in *too* loud for comfort and can be heard for hundreds of yards down avenue:—Leeds-Bradford (I am two miles from the Bradford station), Manchester, Newcastle, Aberdeen, Birmingham, Belfast, Daventry and Hamburg. In addition, the following are loud enough to be heard all over the house:—Radio-Paris, Madrid, Berlin, The Hague, Lausanne, Radio-Wien, Radiofonica and Glasgow. With a wave-trap I can get Cardiff, Bournemouth and Sheffield quite well, also Liverpool and Nottingham. All these are summer-time results, so I think the receiver good enough for anyone and a credit to Mr. Harris.—Yours faithfully,

A. TURNER.

Bradford.

A HARTLEY-REINARTZ RECEIVER

SIR,—I refer to the "Two-Valve Hartley-Reinartz Receiver," particulars of which were given by Mr. J. W. Barber in *Modern Wireless* for October, and think that you may like to know my experiences with a receiver of this kind constructed from details given by A. D. Cowper, M.Sc., in *Modern Wireless* for August ("A Selective Hartley-Reinartz Circuit for Broadcast Reception"). I followed the latter description in nearly every respect, but I utilised .0005 μF variable condensers. In spite of this, reaction and tuning is delightfully smooth. I added one transformer coupled L.F. stage, and with this combination, and using a four-electrode valve for this stage, I have to de-tune 2LO, otherwise it is too loud on L.S. Clarity is all that can be desired. Selectivity appears

too high in my set to allow of any other station being tuned in, the latter process being a two-handed affair, for every setting of one condenser the other one having to be adjusted.

I find a variable grid-leak is an advantage. All the wiring is carried out in 16 gauge square wire, and all components are well spaced, and G.B. is used for last valve. As stated before, clarity is particularly good, and with a perfectly silent background. I strongly recommend this set for the local station, and it should be ideal up to 20 miles, using a power valve in the last stage for L.S.

In conclusion, I would say that my aerial is about 18 ft. high and 80 ft. long, including lead in. The set is situated on the first floor with a double flex 60-ft. lead to loud-speaker on the ground floor. The earth is a length of ribbon aerial buried about 1 ft. in the ground, running under the aerial almost to the mast. I find that this kind of earth gives me better results than any which I have tried so far, which include water-taps, a zinc pail, wire netting and pipes, the latter three being well buried in the ground. The ribbon aerial I find particularly efficient on the shorter waves, *i.e.*, from 60 down to well below 40 metres.

Trusting the above is of interest to you and congratulating you on your always most interesting and efficient circuits. I am a constant reader.—Yours faithfully,

GEO. E. LILNS.

Harrow.

ENVELOPE No. 9

SIR,—I have constructed the "Efficient Single-Valve" set described in Envelope No. 9 (by Herbert K. Simpson), and perhaps readers would like to hear results obtained on first night.

2LO came in on loud-speaker fair, Birmingham on 'phones good strength, Newcastle on 'phones good strength; Madrid on 'phones fair, but not good volume. Several amateurs sending Morse. Glasgow fair, but 2LO difficult to cut out. Not bad for the first trial.

I have also constructed several other R.P. sets, and find them very easy to follow during construction. They get all that are claimed for them.

Wishing *Wireless Weekly* every success.—Yours faithfully,

Streatham. H. BRACEY.

SWANSEA RADIO SOCIETY

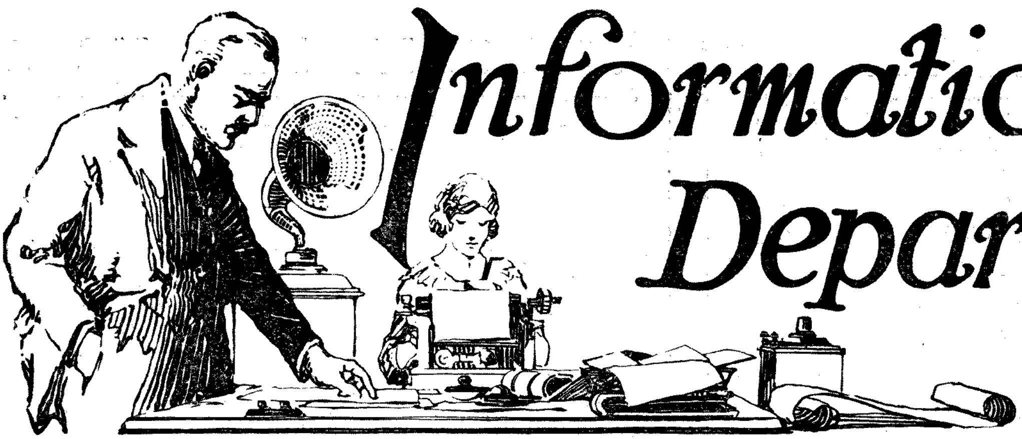
SIR,—I beg to give you a report of the Swansea Radio Society's annual general meeting. I trust that it will prove of interest to your readers.—Yours faithfully,

E. H. WHITE (Hon. Sec.).

100, Bryn Road, Swansea.

The annual general meeting of the above Society was held on Monday, October 5, at their headquarters, Y.M.C.A. This was the Society's first meeting for the new session. A very satisfactory report was given both as to the number of members and the sound financial position of the Society. The following officers were elected: President, Capt. Hugh Vivian; Vice-Presidents, Sir A. Whitton Brown, K.B.E., M.Inst.M.E.; Messrs. H. K. Benson, A.M.I.E.E., A.M.I.Mech.E.; R. G. Isaacs, M.Sc., A.M.I.E.E.; J. C. Kirkman, B.Sc., A.Inst.P., Fellow of Phy. Soc., London; Col. A. Sinclair, A.M.I.C.E., M.I.E.E.; W. Guy Hodge, D. W. Walters, A.M.I.E.E.; J. D. Williams, David Davies; Chairman, Mr. D. P. Williams; Vice-Chairman, Mr. T. S. Clark; Members of the Council, Messrs. A. E. Allsopp, A. Bates, H. K. Benson, C. Russell Peacock, H. B. G. Taylor and S. O. Wedlake; Hon. Auditors, Messrs. W. E. Wright and J. Turpee; Hon. Valuers, Messrs. A. E. Allsopp and A. Bates. A pleasant function was carried through at the close of the meeting, when the retired Secretary, Mr. H. T. Morgan, was presented with a clock. Mr. D. P. Williams, the Chairman, said, in making such a presentation the society were recognising the valuable services of Mr. Morgan. Mr. T. Macnamara thought the present satisfactory position of the Society was due to Mr. Morgan's efforts. Mr. T. Briggs also paid tribute, and the presentation was made by the Society's first lady member, Miss Hawken.

Information Department.



R. E. (HENDON) asks whether a simple scheme is possible to alter the capacity of his .0002 μF variable condenser, incorporated in his short-wave receiver, without adding parallel fixed condensers, in order to employ this on the ordinary broadcast wavelength range of 300 to 500 metres.

Since our correspondent specifies that he does not wish to use a parallel fixed condenser to increase the capacity of the one employed in his receiver, the only solution of his difficulty is to change the dielectric in order that the capacity may be increased. It is obviously not practicable to replace the air dielectric by ebonite or mica, since this proceeding would not only take too long but would require considerable skill if intended for use when a rapid change over was desired. It could be arranged, however, that the whole condenser be immersed in suitable oil when it was desired to employ it on the ordinary broadcast waves. Paraffin oil has a dielectric constant of 2, and hence if the condenser were immersed in this, its maximum capacity would be doubled. Incidentally, its minimum capacity would also be increased, and, frankly, we are not in favour of the method, which is very messy.

F.E.P. (TONBRIDGE) employs a straight four-valve receiver of the H.F., Detector and 2 L.F. type. He is troubled by a background of "mush." The house electric lighting supply is direct current, and when the main switch is open he has discovered that the "mush" almost disappears. He asks our advice on how to eliminate the interference without cutting off the electric supply.

We would advise our correspondent to get an electrician to insert a 100-turn coil in series with each side of the mains near the main switch. It should be remembered that the wire employed in their construction should be of sufficiently heavy gauge to carry the total current taken by the house lights. The coils may be wound on 4-in. or larger formers, the size of the wire being decided by the consideration mentioned above.

This procedure should allow most of the interference to be cut out, although

probably it will not be completely banished owing to the nature of its introduction. D.C. mains sometimes bring in "mush," and this is induced from the wiring of the house into the receiver. To effect a complete cure it would be necessary to introduce similar coils into the mains leading into neighbouring houses, since the tendency for these adjacent systems to cause the interference will still be present.

R. A. (Bexley Heath) wishes to measure the capacities of a number of small fixed condensers which he has purchased. He states that he has a buzzer wavemeter available and also one fixed condenser of .0003 μF capacity, which value he knows to be fairly accurate.

Given an accurate buzzer wavemeter and one condenser of known capacity, it is a very simple matter to determine experimentally the capacity of other small fixed condensers. Working from the basic formula

$$\text{Wavelength (metres)} = 1{,}885\sqrt{LC}$$

where L = inductance in μH.
C = capacity in μF, we can apply this, in practice, as follows :—

Connect the small fixed condenser of known capacity in parallel with a coil, such, for example, as a No. 50 plug-in coil and a pair of telephones in series with a crystal detector across the oscillating circuit thus formed. Now start the wavemeter buzzing with a suitable coil inserted in it, and measure the wavelength of the former circuit. Let X = the wavelength thus obtained, L = the inductance of the coil employed in parallel with the fixed condenser, which latter we will call C1. We now have

$$X = 1{,}885\sqrt{L\,C1} \quad \ldots\ldots (1)$$

Replace C1 by the condenser, of which the capacity is required, and let this be C2. With the wavemeter take a second reading of wavelength with the new fixed condenser. Let this reading be Y. We thus obtain

$$Y = 1{,}885\sqrt{L\,C2} \quad \ldots\ldots (2)$$

Since L is the same for both readings, and X, Y and C1 are known, it follows that

$$C2 = \frac{C1\ Y^2}{X^2}\ \mu F \quad \ldots\ldots (3)$$

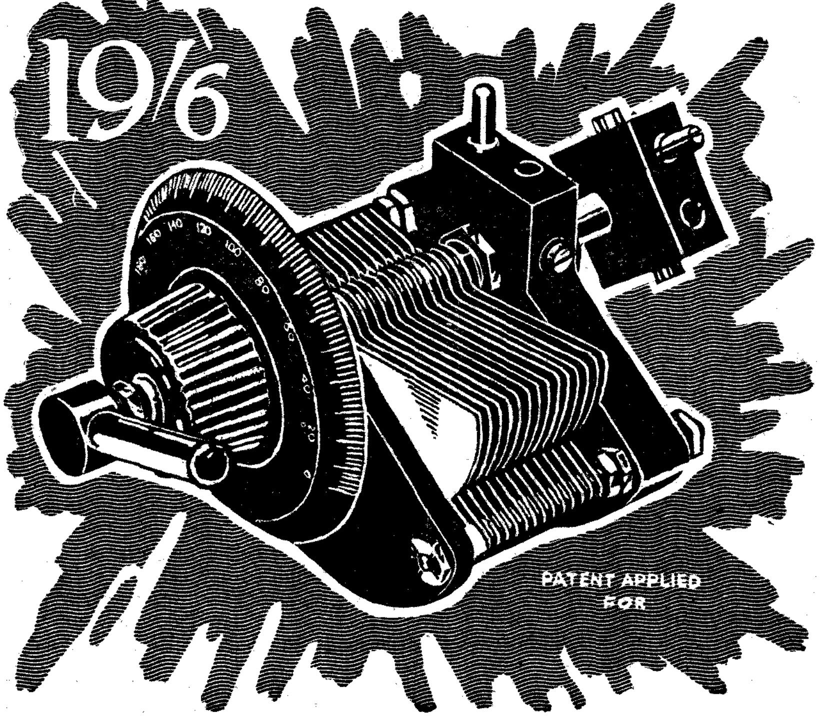
From equation (3) above, the capacities of the various small fixed condensers can be readily obtained by taking two wavelength measurements as indicated. The inductance of the coil L may be taken as constant over the band of wavelengths the experimenter is likely to employ during the measurements, and fairly accurate results will thus be obtained.

W. M. (WESTERHAM) asks whether the addition of the "2-Valve Amplifier de Luxe" to his crystal set should give him good loud-speaker results from 2LO. He states that signals on his crystal set were weak, that the addition of one valve of the Amplifier increased them to fairly comfortable telephone strength, but that the addition of both valves resulted in howling which completely drowned all signals.

In reply to our correspondent, we would state that unless good telephone strength is obtained on a crystal set alone, full loud-speaking should not be expected when a 2-valve amplifier is added. He would be well advised, therefore, to pay attention to his aerial and earth system, remembering that height and isolation from surrounding buildings of the aerial have considerable bearing on signal strength. Alternative earth connections should also be tried with a view to improving results still further. Once really good signals are obtained in the telephones it is reasonable to expect the addition of a transformer coupled 2-valve low-frequency amplifier to give fair loud-speaker results.

If on experimenting with the aerial and earth system it is found impossible to get really good signals on telephones with the unaided crystal set, we would advise that a single-valve receiver with reaction be constructed, such as that described in Radio Press Envelope No. 9.

The howling when both valves of his amplifier are in use, of which our correspondent complains, can generally be cured by the very simple expedient of connecting the negative terminal of the low-tension battery to the earth terminal of the crystal set.



This is the Seamark Connode

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Tuning your set is very much like balancing a see-saw on a trestle. By bringing up your reaction coil, the balance is upset and the receiver "howls"; then you dash across to the condenser dial and reduce its reading, thereby stopping oscillation. In this way a balance may be struck by alternate adjustments, first on one dial and then on the other.

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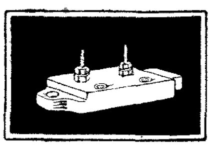

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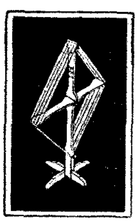

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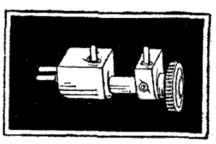

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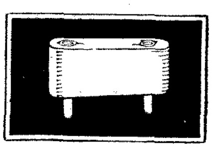

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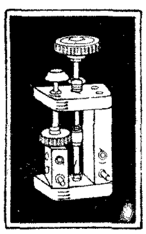

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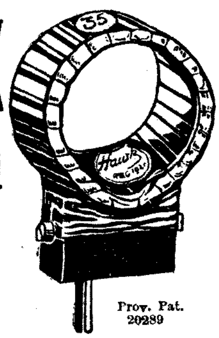

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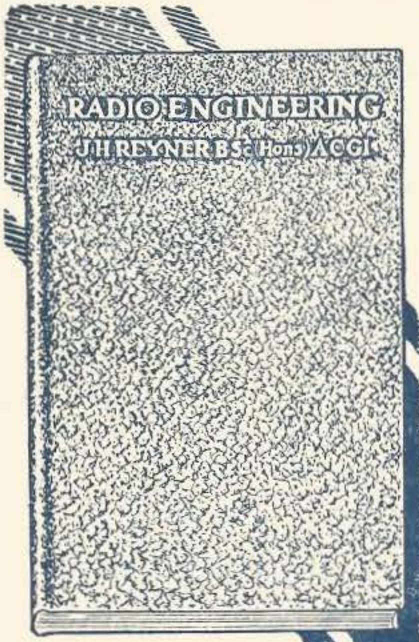

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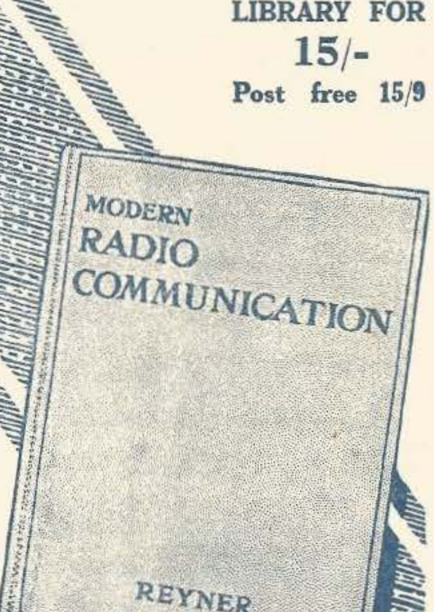

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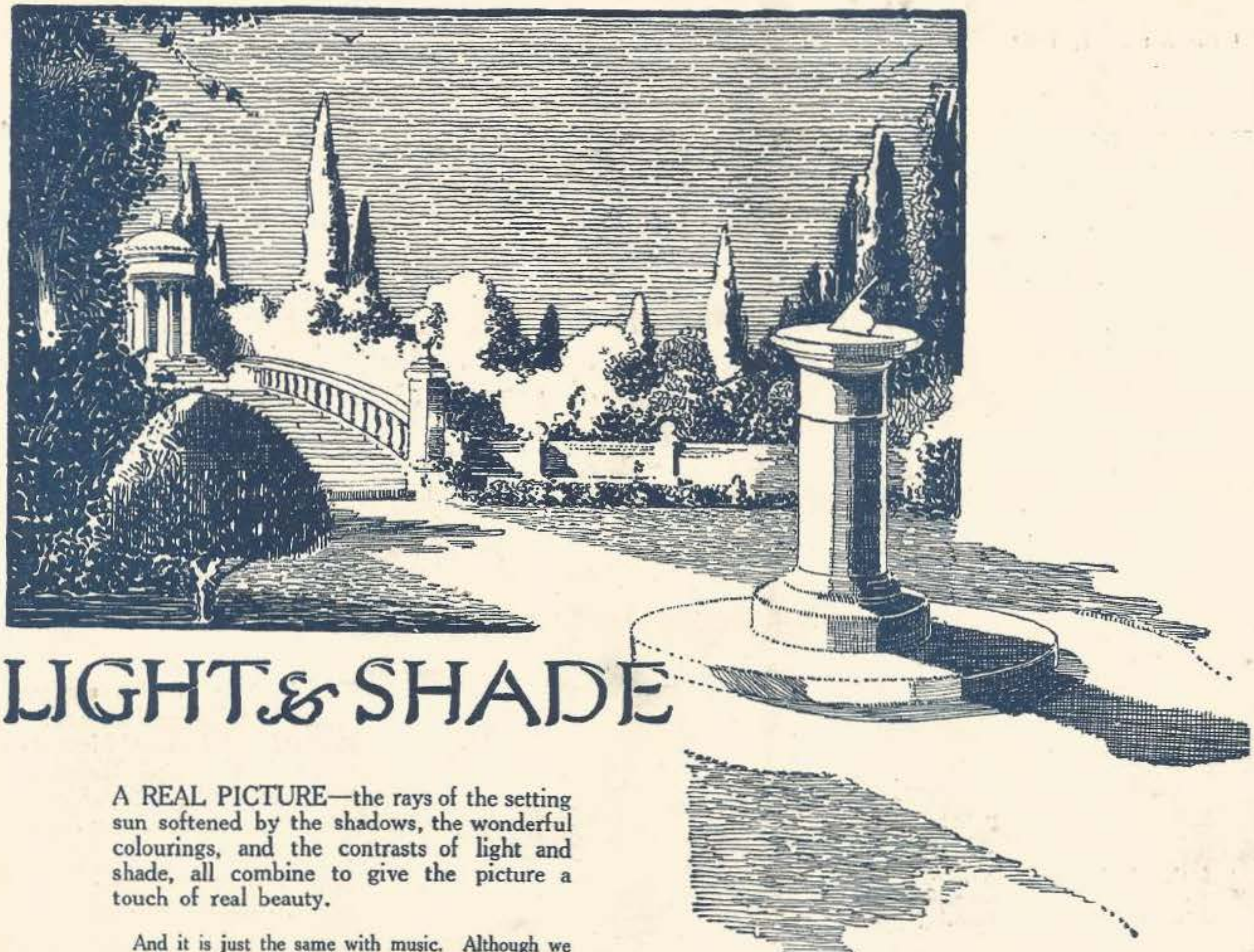

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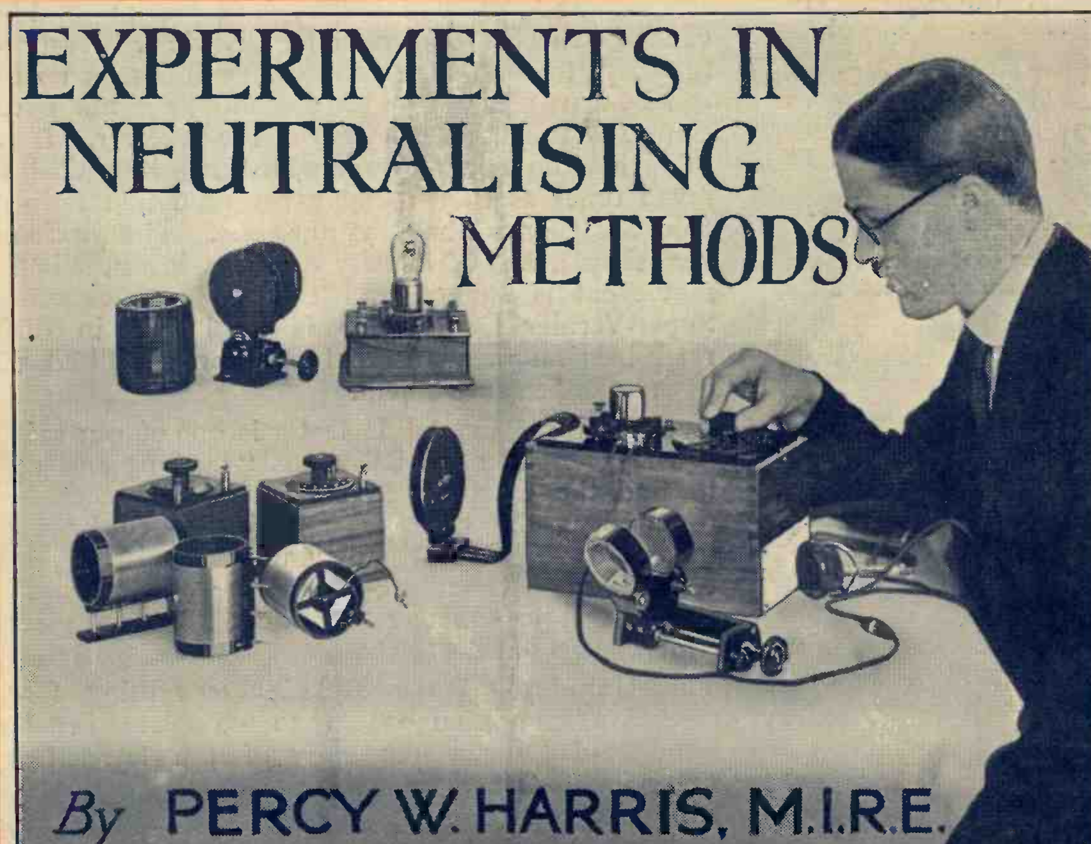

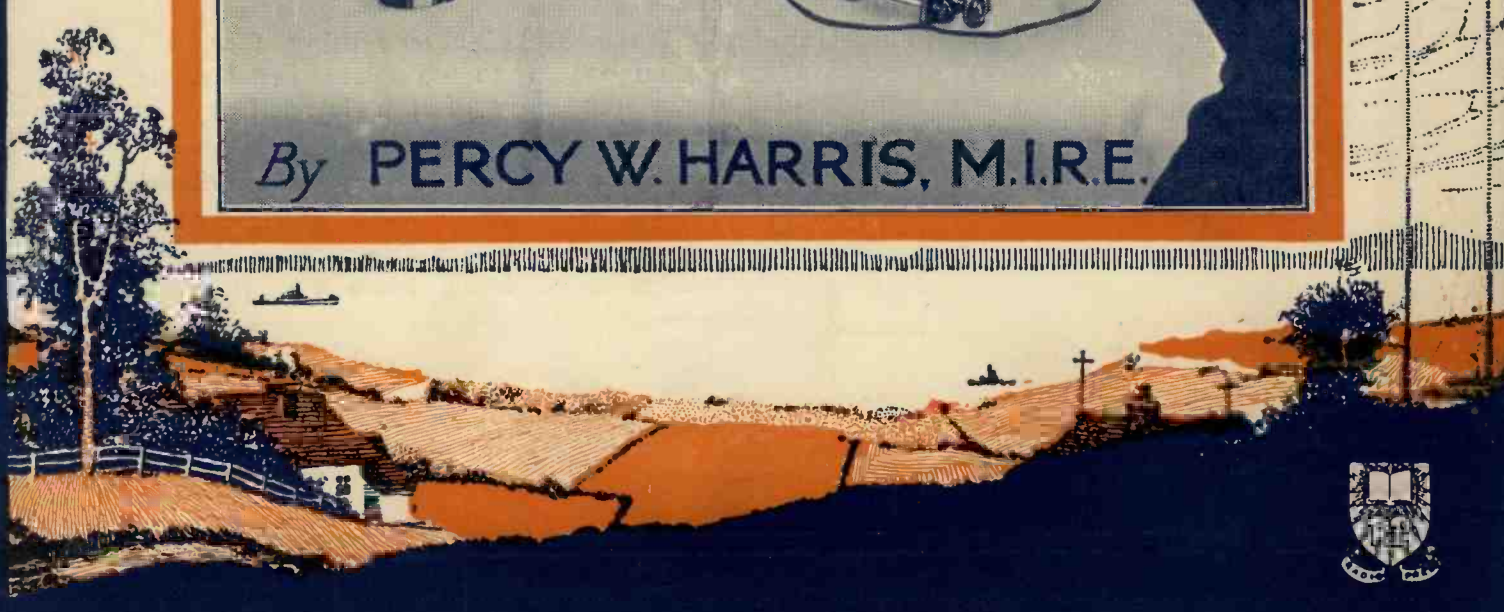

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One Exhibition Only!

RADIO PRESS, LTD., have long realised the inconvenience, disadvantage, and even harm, to the industry arising from the absence each year of a fully representative single wireless exhibition. The fact that both the Albert Hall and the Horticultural Hall Exhibitions were well patronised this year indicates how immensely successful a single exhibition would have been. On October 16 the Editor of this journal addressed the following letter to the trade :—

DEAR SIRS,—

In our issue of *Wireless Weekly* of September 16 we protested very strongly against the action of the N.A.R.M.A.T. in confining their exhibition primarily to their own members, the result being that two London exhibitions were held last year, and again this year it has not been possible through the action of the N.A.R.M.A.T. to have a single representative exhibition of the wireless industry.

As Editor of *The Wireless Dealer* I have realised still more the impossible situation which has arisen through the establishment of two exhibitions, neither of which is representative, and it is the aim of this company to alter this state of affairs.

There are innumerable disadvantages in two exhibitions, an important one of which is that the general tendency is for the public and trade not to buy at the first until they have seen the second. As there is no possibility of an immediate and direct comparison, many purchases are not made at exhibition time. Another disadvantage is that there is no single exhibition at which representatives of foreign and colonial firms can make their purchases. Moreover, exhibition publicity is duplicated, whereas, if concentrated on a single exhibition there would probably be a very much larger attendance. From the point of view of the wireless dealers, many of these cannot afford either the time or the money to visit two London exhibitions at different times. The division of energy in London tends to a multiplicity of provincial exhibitions, and in general the present position is confusing to the trade, but still more incomprehensible to the public who undoubtedly feel a natural resentment at being inconvenienced by what is really a trade difference.

I feel the time has now come when sections of the trade must get together to have a real exhibition comparable to the Motor Show which is held at Olympia. The Association which organises the Motor Show is of an entirely different character from the N.A.R.M.A.T., and sectional differences give place to a real exhibition which is in the interests of the whole trade and public alike.

The Wireless Dealer and my company in general, with its great resources and unrivalled means of obtaining direct contact with hundreds of thousands of the general public, and also its great influence with the trade, proposes to establish a single exhibition next year. If, by its influence, it is possible to persuade the exhibitors at both exhibitions to come together under a single roof of their own accord, so much the better. Preparations, however, are going forward and a company is being formed to run a single exhibition so that, if it becomes necessary, an organisation will exist to provide the public and the trade with what it wants.

Such an exhibition conducted by ourselves would be run without profit, and would be on a co-operative basis, and planned by a committee of exhibitors.

(*Continued on p. 202.*)

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Director of Research:
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October 28, Vol. 7, No. 6.

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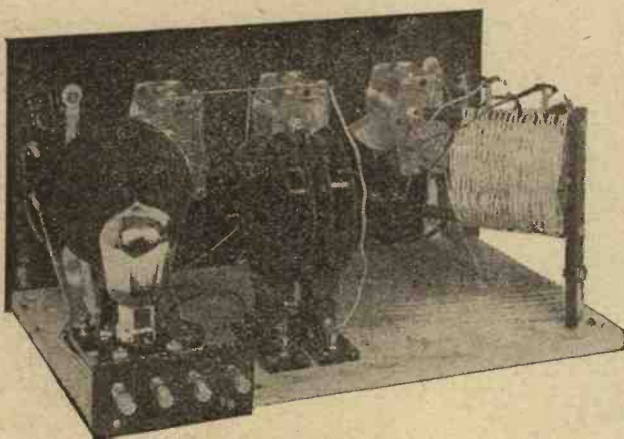
A METHOD OF OBTAINING EXTREME SELECTIVITY

By C. P. ALLINSON (6YF).

The problem of obtaining good selectivity in a single-valve receiver is probably of no little interest to many experimenters. The apparatus described in this article offers a possible solution, and suggests a line for further experiments.



The relative positions of the aerial and grid coils can be seen in this photograph, the aerial coil being that on the right.

THE problem of selectivity is most keenly felt by those who dwell within five to ten miles of a main B.B.C. station, and in the case of 2LO, with its present power of 3 kilowatts, this difficulty can easily extend to those residing up to fifteen or twenty miles away.

Wavetrap Methods

The use of a wavetrap does not always meet with success, and one frequently hears the remark, "Oh, yes, I can cut out the local station with a wavetrap all right, but it cuts everything else out as well." Actually, however, the use of a wavetrap does not render a receiver more selective in itself, it merely provides a means of eliminating an unwanted transmission, or at least reducing interference from this source.

The method to be described in this article actually gives a degree of selectivity to the receiver which is little short of amazing. Further, the use of this method actually requires one control less than that needed by a three-coil tuner in which both aerial and secondary circuits are tuned.

"Filter Coupling"

A general theoretical circuit diagram is shown in Fig. 1, and it will be seen that the aerial is coupled to the grid coil of the receiver by means of a filter circuit L1 C1. In fact, it employs what one might call a "filter coupling." The coupling between the coils L1 and L2 has to be extremely loose if the circuit is to function satisfactorily, and the coupling can, in fact, be reduced to a surprising extent without producing any appreciable loss in signal strength. It is important that the coil L1 be a low-loss coil with a minimum self-capacity, and the position of the aerial tap will vary with different aerial-earth systems. In most cases, however, if L1 be an 80-turn coil, the 20th turn will give a suitable position for the aerial tap.

Relative Positions of Coils

A single-valve receiver using this circuit is shown in the photograph, and from it will be seen the exact position and distance from L2 of the filter coil L1, and it is noticeable that not only is this coil a good distance from the grid coil, but also that its axis is not even parallel to that of this coil. It would be thought that with this exceedingly loose coupling between the two coils the signal strength would be greatly reduced, but when compared with a standard single-valve receiver it was found that no difference in signal strength actually resulted.

Elimination of "Mush"

The adjustment of the two tuning condensers C1 and C2 is exceedingly critical, and unless they are both set so that the circuits L1 C1 and L2 C2 are exactly in tune with the desired signals, nothing at all will be heard. When, however, they are both in tune, the desired station will be received at normal strength with the added advantage, however, that the background will be exceedingly good. In practice this receiver has been found to help to eliminate mush and spark signals to an extraordinary degree, and a direct comparison with the receiver which was used in the signal strength test showed that this was actually the case.

Selectivity

When the set was tested on an aerial less than three miles from 2LO, it was possible to receive Bournemouth at good strength in the headphones without any interference at all from the former station. A test was carried out on an aerial about ten miles from this station, and Manchester, and also Cardiff, could be received without any interference at all.

Experiments

There is a great deal of scope for experimental work in building a receiver on the lines indicated. There is first of all the question as to whether the aerial and earth connections should be as shown in Fig. 1, the earth going to the end of L1, marked B, or whether it should go to the end of the coil marked A. There is also the position of the aerial tap which needs to be determined for maximum signal strength on stations whose wavelength is considerably different from that of the local interfering station. For maximum selectivity it is, of course, necessary to use as few turns as possible between the aerial and earth taps consistent with satisfactory signal strength. It is also necessary to try the effect of reversing the connections going to the coil L2, as this has a bearing not only on the signal strength but also on the selectivity.

Aerial and Earth Connections

Other methods of connecting aerial and earth to the filter coupling circuit are shown in Fig. 2. At (*a*) the aerial and earth taps are taken to points equidistant from the centre of the coil L1, while at (*b*) a small coil L of 10 or 15 turns is wound closely over the centre of the filter coupling coil L1, or it may, if desired, be placed inside.

Coils

Although it is so important that L1 be a low-loss coil, an efficient plug-in coil will be quite satisfactory to use as L2. Various coils were tried by the author in the grid circuit, one of which was an air-spaced low-loss coil of length about 2½ times the diameter. This, however, did not appear to be very satisfactory. Whether this was due to direct pick-up by the coil owing to its size, or due in some way to its distributed field, it is difficult to say. Much can be done, however, by trying out different coils for the grid coil, such as single-layer solenoids, wound either on solid or skeleton formers, more or less self-supporting basket weave coils, spider web coils, pancake coils, etc.

Reaction Control

It will be found an advantage to employ some method of reaction by which the tuning of the grid circuit is not altered with the reaction control. If this is not done it will be found that the receiver becomes very difficult to handle when tuning in distant stations. When working with this circuit the use of a variable grid-leak for R2 (Fig. 1) is almost a necessity, and this is critical within a turn, or even half a turn, in order to get maximum signal strength. This will depend, of course, to a certain extent upon the valve that is being used, but, in any case, it is a refinement extremely desirable in a receiver of this nature.

Layout of Components

In laying out this receiver it is essential that ample space be given to all components, and the one illus-

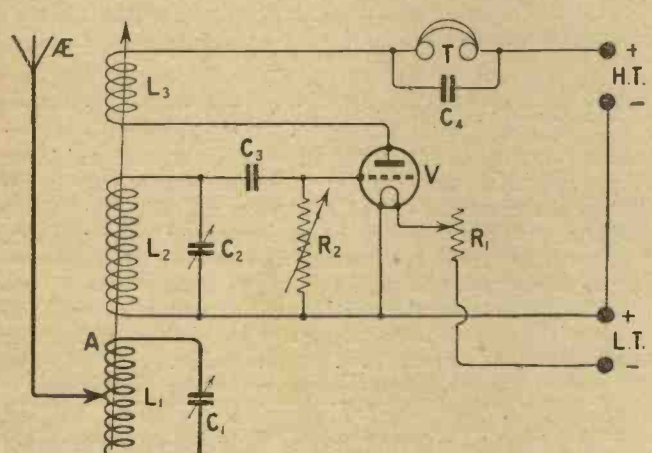
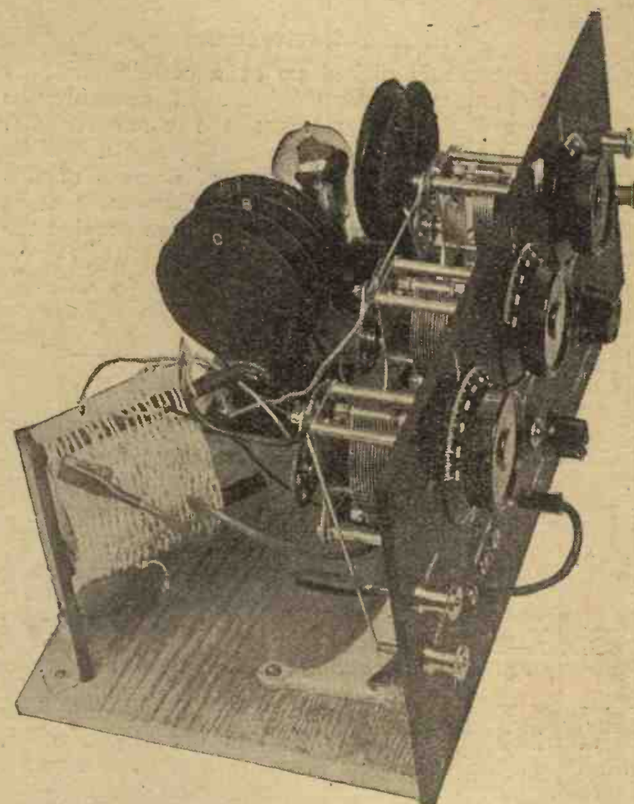


Fig. 1.—The use of a variable grid-leak for R2, as shown here, is to be recommended in order to obtain the maximum signal strength with the circuit.

trated has been constructed on a 16 in. x 8 in. panel. This may seem somewhat bulky for a single-valve receiver, but it was not possible, on a smaller baseboard, to get a sufficiently loose coupling between the aerial and grid coils. Geared condensers will be found a *sine qua non,* for even with these there may be a certain difficulty at times in tuning in weak distant transmissions.

Hand Capacity

Notwithstanding the critical adjustments required in tuning in, quality is exceptionally good, and the way in which Morse and interference from mush are



The actual set used in the experiments described employs a modified form of Reinartz circuit, though the circuit shown in Fig. 1 may prove equally effective.

eliminated is quite a revelation. In the receiver constructed by the writer no trouble with hand capacity effects was experienced at all, but this, of course, is merely a matter of careful lay-out and seeing that the correct connections to the variable condensers are made. In the case of the condensers used by the writer in this receiver, these were of the earthed rotor pattern, and the moving plates were therefore in each case connected to the side of the coil at or nearest to earth potential. In the case of the filter coupling coil L1, the moving plates of the condenser C1 were connected to earth, while the moving plates of C2 were connected to low-tension positive. It was found in this particular receiver that earthing the low-tension battery did not help in any way, either in facilitating reaction control of the receiver (as a matter of fact it did the reverse), or increasing signal strength or selectivity.

Operation

As the receiver made on these lines will be found somewhat peculiar to handle until experience has been gained on it, a few notes with regard to this may be of help. The first point is, of course, to tune in the local station with minimum reaction. Having got this in at its loudest strength by adjusting condensers C1 and C2, reaction may gradually be increased. To tune in another station, increase or decrease (as may be required) the grid tuning condenser C2. It will possibly be found that as this is done the set will go into oscillation, but in view of the extremely loose coupling between the two coils L1 and L2, and the fact that the circuit L1 C1 will now be out of tune with the grid circuit, little fear need be entertained of causing serious interference to near-by listeners.

Final Adjustments

A carrier-wave is picked up at a certain point by suitable adjustment of C2, and it will probably be extremely weak. Now readjust the condenser C1, turning it in the same direction as C2, and it will be found that over a certain number of degrees of this condenser the set will go out of oscillation, that is providing the reaction coil L3 has not been coupled too

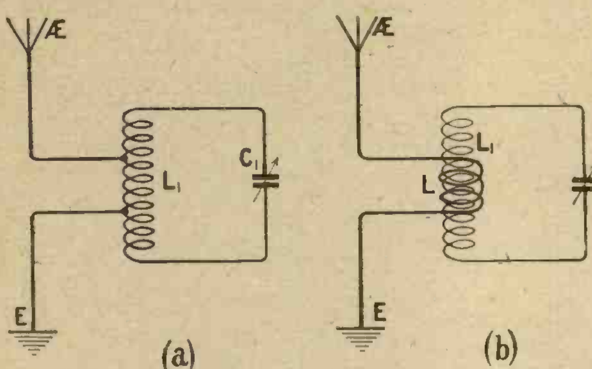


Fig. 2.—Two methods of aerial coupling which may be tried in place of that shown in Fig. 1.

tightly. Note carefully the points on the condenser C1 at which the set goes into and out of oscillation, and set the dial exactly in between these two readings. Reaction may now gradually be increased, and C2 adjusted until the station is heard. A very slight increase of reaction and a slight readjustment of C2 will now bring the station up in strength very rapidly, and perhaps a finishing touch to the condenser C1 will be required to bring it in at its full strength.

Loose Coupling

If the coupling between L1 and L2 is too tight it will be found that, when the circuit L1 C1 is brought into resonance with L2 C2, there will be a click in the telephones and also the tuning of these two circuits will react on each other, thus making it very difficult indeed to receive distant stations. The coupling should therefore be reduced till the click disappears and the interaction between the two circuits when tuned independently is at a minimum. It will be found that at a certain position of the two coils signal strength will be excellent with comparatively easy control and no oscillation backlash.

Aerial Tappings

It will probably be convenient to take three tappings from the aerial coil L1, one for extreme selectivity, which will contain the fewest number of turns between the aerial and earth taps, one for maximum signal strength on the higher band of B.B.C. frequencies—say, above about 789 kc. (380 metres)—and a third tap for maximum signal strength for the lower B.B.C. frequencies below the 789 kc. (380 metre) mark. All wiring should be carefully spaced out and leads should be made as rigid as possible, for even a slight amount of vibration in one of the wires will be sufficient to cause the signal from the station being received to swing.

Practical Tests

The receiver illustrated was tested one evening on an aerial about 20 feet long, less than three miles from 2LO, and brought Manchester and Cardiff in at equal strength without interference from this station. Stations below Cardiff and above Manchester were, of course, received without interference from London, and in one evening when reception conditions did not appear to be at all favourable, over twenty stations were brought in and logged without difficulty. During a test on a much larger aerial within 10 miles of 2LO, Manchester and Cardiff were both received at good strength in the headphones without interference from London, in daylight as well as by night, while most other B.B.C. stations were tuned in at varying strengths.

Conclusions

The experimenter with this circuit must not be discouraged if at first he has little luck with it, for it requires quite a considerable time to get the knack of handling it, but once this is achieved no difficulty need be experienced in tuning in any desired transmission, providing, of course, that it is within range, and it will be found that remarkable freedom from interference from ship and shore spark stations and mush is experienced.

Long Distance Amateur Communication

Mr. D. Kruse (SMTN), of Djursholm, a prominent Swedish amateur, has succeeded in establishing communication with Australian 2BK with an input of only 4.5 watts D.C. The Australian claims this to be a reception record, and it must certainly be a transmission record for SMTN.

* * *

SHORT-WAVE PROGRAMME FROM WGY

Short-wave enthusiasts may be interested to learn that programmes of music and speech are now being broadcast from WGY, the General Electric Co.'s station at Schenectady, at a frequency of 7,160 kc. (41.9 metres). This transmission is carried out every night except Sundays, from about 0100 G.M.T. onwards. The reception of these programmes has been effected at good telephone strength using a detector valve and a stage of L.F. amplification.

Extension of the Radio Press Guarantee

In this and future issues of *Wireless Weekly* readers will find a postcard for their use on purchasing goods made by manufacturers advertising in Radio Press publications. When goods have been bought from a local retailer, this card should be filled up and posted to the actual manufacturer of the goods. In the event of complaints arising over defective or faulty apparatus, if the manufacturer wrongly declines to put matters right, Radio Press, Ltd., will then use every endeavour to obtain satisfaction for the customer. Full details of the guarantee will be found on the postcard itself.

The B.B.C. Wavelengths—Some More Figures

In "Wireless Weekly," Vol. 7, No. 1, we pointed out inconsistencies in the published and actual wavelengths of the B.B.C. stations. In view of recent occurrences in this connection, we here comment further on certain apparent anomalies.

We recently had occasion to draw the attention of our readers to certain discrepancies between the wavelengths of broadcasting stations, as published by the B.B.C., and the actual wavelengths, as measured by ourselves.

Allotment of Wavelengths

It is generally understood at the present time that, as a result of the Geneva Conference and the recent wavelength tests by the European broadcasting stations, the allocation of wavelengths is not yet settled, pending a general rearrangement affecting a large number of stations. In the meantime, however, it seems desirable that more definite information should be published about what is actually being done at the moment.

In the *Radio Times* of October 16 the B.B.C. made reference to the misgiving caused in certain areas by the prospect of alterations. They stated, too, that the prospective changes have not yet been determined in detail, and that ample notice would be given, in order to avoid prejudicing the interests of listeners.

Changes Published

A table of new wavelengths allotted to certain B.B.C. stations, mostly relays, on October 13, was published in a daily paper on October 14. In this connection, however, we are given to understand that the information about these changes was only supplied at the request of the journal concerned.

In the *Radio Times* of October 16 these alterations were printed. In the same issue of the *Radio Times*, however, the published wavelengths of the main B.B.C. stations are as shown in the accompanying table, the approximate kilocycle equivalents being added in accordance with our usual practice.

"Official" Wavelengths

If the "official" figures given here are compared with those given as the "official" wavelengths in the article on this subject in *Wireless Weekly*, Vol. 7, No. 1, it will be seen that "officially" practically no changes have been made. The alteration in the wavelength of Newcastle, the one exception, was announced, as mentioned above, on October 14, and subsequently in the *Radio Times*. On the other hand, an announcement was made from the microphone that the wavelength of 2LO would be raised, the actual alteration being from 838.7 kc. (357.7 metres) to 824.6 kc. (363.8 metres). No figures were given by the announcer, however, and listeners, seeing the wavelength of 2LO given as 365 metres in the *Radio Times*, might reasonably conclude that the new wavelength was to be raised above this latter figure.

For purposes of comparison, we give in the third column the table of measurements taken by us at 5.30 p.m. on October 13, and published in our last week's issue.

It will be seen that, while the "official" figures given by the B.B.C. have remained substantially the same, the actual wavelengths have been appreciably altered.

	Official. October 16.		Actual. (*Wireless Weekly*, September 23.)		Actual. October 13.	
	Kc.	Metres.	Kc.	Metres.	Kc.	Meters.
Cardiff ..	849.9	353	852.8	351.8	852.8	351.8
London ..	821.9	365	838.7	357.7	824.6	363.8
Manchester ..	793.7	378	806.2	372.1	799.4	375.3
Bournemouth	772.2	386	782.1	383.6	780.0	384.6
Newcastle ..	742.6	404	747.2	401.5	744.2	403.1
Glasgow ..	710.9	422	706.5	424.6	711.6	421.6
Belfast ..	681.8	440	—	—	685.6	437.6
Birmingham ..	626.3	479	628.1	477.6	632.9	474.0
Aberdeen ..	606.1	495	—	—	601.6	498.7

Monsieur Stephan, who has lately been broadcasting lessons in French from the London Station.

Are Low-Resistance Coils Practicable?

By J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., Staff Editor.

In this article, the third of his series, Mr. Reyner discusses some of the factors affecting the resistance of coils, and describes some preliminary experiments on the actual measurement of high-frequency resistance.

IN my last two articles I have discussed the general principles of selectivity, and have shown the effect of resistance upon the shape of the resonance curve which is obtained in any given circuit. I also pointed out last week that, in order to obtain distortionless telephony, it was necessary to use a chain of more or less loosely-coupled filter circuits in order to obtain the requisite selectivity without too sharp a cut-off.

Conditions for Distortionless Reception

Moreover, in order that the resonance curve of a filter so designed should have a fairly flat top, it is necessary for each individual circuit in the filter to have a definite resistance, and some examples were given showing the exact values of resistance necessary in each of the filters in order to comply with the conditions for distortionless reception. These values, however, probably convey very little to the average experimenter, because the present state of the art is such that we know very little about the actual high-frequency resistance of coils.

The "Skin Effect"

The problem is one which is almost incalculable from the theoretical point of view. We know that at radio frequencies the current does not flow uniformly throughout the particular conductor, but tends to crowd towards the outside of the wire. This is known as the "skin effect," and is due to the fact that at these very high frequencies the effect of the magnetic field produced by the current *inside the wire itself* becomes appreciable, and tends to drive the current towards the outside. Now this effect can be calculated with a reasonable degree of certainty, that is, say, within about 1 per cent., for straight conductors isolated from all other parts of the circuit.

Diameter of Wire

Such calculations are valuable because they indicate that the variation of resistance with frequency decreases as the diameter of the wire decreases.

The majority of the current flows in a thin skin on the outside of the conductor, and theory shows that

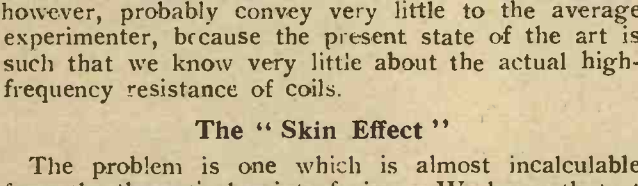


Fig. 1.—Illustrating how the percentage of the whole wire usefully employed at high frequencies is greater with smaller gauges of wire, owing to the "skin effect."

the thickness of this skin is approximately constant whatever the size of wire. It follows, therefore, that the effective area of the conductor is a greater percentage of the whole in the case of a thin wire than in a wire of larger diameter. This effect is illustrated in Fig. 1.

It will be obvious from this reasoning that at a certain limiting gauge of wire the high-frequency

Maximum diameter (cm.) of isolated wires having a ratio of $\frac{\text{H.F. resistance}}{\text{D.C. resistance}}$ of 1·01.

Frequency (kc).	100	200	600	1,000	2,000
Copper	.0356	.0251	.0145	.0112	.0079
German Silver ..	.194	.137	.079	.061	.043
Iron at low permeabilities ($\mu = 100$)	.008	.006	.0034	.0026	.0019

30 s.w.g. = .0315 cm. 43 s.w.g. = .0091 cm.
40 s.w.g. = .0122 cm. 47 s.w.g. = .0051 cm.

This table gives the limiting diameter for various metals, to indicate the skin effect in different materials.

resistance becomes nearly the same as the D.C. resistance, that is to say, the resistance measured with ordinary direct current.

The above table gives the limiting diameter for one or two various metals, which will serve to indicate the skin effect in different materials. The higher the resistivity of the material, the less is the skin effect. Thus the limiting diameter for German silver is greater than for copper.

Skin Effect in Coils

Now, as soon as we start to wind the wire into a coil, or make it up into a circuit, complications are immediately introduced. There is the mutual inductance of one part of a circuit on another, which causes an alteration of the distribution of the magnetic field. Since the skin effect itself is primarily dependent upon the magnetic field inside the wire, it follows that any alteration of the distribution of the field in general will cause an alteration of the skin effect. This is particularly the case if the wire is wound into a coil. Here we have a large number of wires all in close proximity to one another, and the effect of the magnetic fields of the various wires is very considerable.

Theory and Practice

Mathematicians have certainly tackled the problem, and formulæ have been devised which apply to single-layer solenoids under certain conditions, giving an accuracy of about 10 or 12 per cent. Very little real success, however, has attended the efforts of the theorists in this direction. Probably because of this difficulty, and the uncertainty surrounding the whole subject, very little is known generally about the actual values of high-frequency resistance. The only satisfactory method of obtaining any guide whatever is by means of actual measurement, and, of course, the particular measurements must be carried out at the frequency at which the coil is to be used.

D.C. and High Frequency A.C.

There would certainly seem, however, to be a need for more definite information on the subject. Very little is known even as to the order of resistance which may be expected. For example, a cylindrical coil,

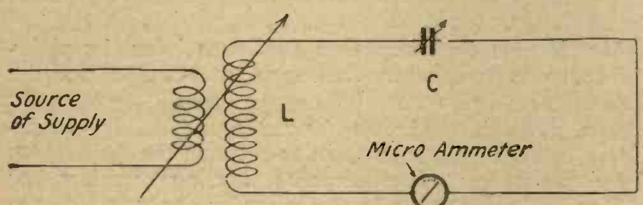


Fig. 2.—Detuning the circuit LC from resonance with the source of supply will cause a drop in the current flowing through the micro-ammeter.

wound on a 3-in. former, with 90 turns of No. 22 gauge wire, would have a resistance of about 0.9 ohm to direct current. How many people can say off-hand what order of resistance may be expected from a coil of that type at a high frequency of, say, 800 kilocycles? As a matter of fact, even with a " low-loss " winding the H.F. resistance of such a coil would be more than 10 ohms.

Actual Measurements

In order, therefore, to clear up this very undesirable state of affairs, and also to give a certain amount of definite meaning to my last two theoretical articles, I propose to give details of some actual coils of which the high-frequency resistance has been measured. At the same time, there must be many experimenters who would like to obtain for themselves direct measurements of the high-frequency resistance, and to this end I have developed a method which is within the reach of the serious experimenter.

Method Employed

The method is one which is capable, with suitable apparatus, of giving very accurate results, and even with the comparatively simple apparatus which I have employed, it will give results within the limits of accuracy required by the average experimenter and designer. It consists simply in measuring the current in a tuned circuit including the coil under test. This current, of course, is a maximum when the circuit is in tune with the frequency of the supply, and falls off more or less rapidly as the circuit is mistuned. Fig. 2 illustrates the principle of the method.

A Theoretical Example

Assume that we have the circuit LC tuned to the frequency of the incoming supply. If now we vary the capacity C by a small amount, then the current will be reduced. Let I be the current in the circuit when in tune—that is, at resonance—and let I_1 be the current when the circuit is mistuned. Let C be the capacity of the condenser at resonance, and let C_1 be the capacity when the circuit is mistuned. Then it can be shown that the actual high-frequency resistance of the circuit is given by the expression,

$$R = \frac{C - C_1}{\omega C C_1} \sqrt{\frac{I_1^2}{I^2 - I_1^2}}$$

where $\omega = 2\pi \times$ frequency.

This expression involves the knowledge of:—

1. The current in the circuit, or the ratio of the resonant current to the " mistuned " current.
2. The capacity of the condenser at resonance and in the mistuned condition.
3. The frequency of the supply.

A Simple Method

All these quantities can be measured fairly simply, and with reasonable accuracy, by using apparatus well within the means of the serious experimenter. I propose next week to give details of a simple set whereby the resistance of a given coil may be obtained in less than five minutes. Such an instrument will be of considerable service in crystallising one's ideas on the subject of resistance.

Low-resistance Filter Circuits

Let us consider now the question of the building of low-resistance filter circuits. My previous articles have indicated the necessity for resistances of the order of 5 ohms in the various tuning circuits. This value must appear to many a comparatively high resistance, since the D.C. resistance of the majority of coils used on the broadcast band is below 1 ohm.

In practice, however, as was mentioned earlier in this article, the high-frequency resistance of the common " low-loss " type of coil wound with 20 or 22 S.W.G. is of the order of 10 ohms.

Reducing Resistance

How then are we to reduce the resistance? The obvious method is the use of thicker wire, but this

Professor J. A. Fleming, F.R.S., experimenting with special apparatus in his laboratory.

does not produce the desired results, for several reasons.

In the first case, as was shown earlier in this article, the effective area of conductor is less with thick wire than with thin. Thus, although the D.C. resistance may be considerably reduced, the H.F. resistance does not fall so rapidly.

Variation of Resistance with Gauge

Assuming the thickness of the skin to be the same in each case, we can obtain some idea of the difference in resistance caused by a variation of diameter.

The resistance of a conductor is proportional to the area thereof. The effective area of a conductor carrying high-frequency current is $\pi r^2 - \pi (r - t)^2$ where t is the thickness of the skin.

This expression is equal to $2\pi rt - \pi t^2$. If t is constant, which is approximately the case, we have the effective area directly proportional to r.

The total area, however, is proportional to r^2. Thus doubling the diameter would reduce the D.C. resistance to one-quarter, but would only halve the high-frequency resistance.

This reasoning, it must be remembered, is only approximate, but serves to indicate that the skin effect introduces complications in the design of the coil. The very fact that the wire is wound in a coil at all

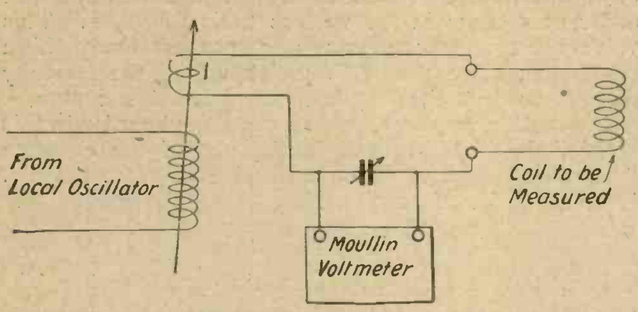


Fig. 3.—Indicating the practical method employed by the author for the measurement of H.F. resistance.

introduces further complications, which still further discount the advantage to be gained from the use of thick wire.

Inductance

Another point arises from considerations of inductance. The thicker the wire, the longer will the coil be for a given diameter and number of turns. This means that the inductance will be slightly reduced, and more turns must be wound on to bring the inductance up to the correct value. Thus the resistance is again increased.

Dielectric Loss.

Quite apart from the simple resistance of the wire itself, there is the loss caused by the dielectric loss in the insulation of the coil former and in the wire itself. This is by no means unimportant, and in some cases may even exceed the actual ohmic resistance of the winding. It is for this reason that low-loss coils are wound with spaced windings and with enamelled or bare wire to reduce the amount of dielectric in the magnetic field.

Conclusions

I shall have more to say about this next week, when I propose to develop the theory from practical measurements. It will be obvious from these remarks that purely theoretical ideas are of little value, and that the design of a really low-loss coil is a matter of some difficulty.

RADIO PRESS, LTD. *v.* THE RADIO PRESS SYNDICATE

In the case of Radio Press, Ltd., *v.* The Radio Press Syndicate, before Mr. Justice Astbury, in the Chancery Division of the High Court of Justice, on Friday, October 16, 1925,

Mr. Robert Peel appeared as Counsel for the plaintiff company, while Mr. Armitage was Counsel for the Radio Press Syndicate.

The main issue involved was a motion by Radio Press, Ltd., for an injunction to restrain the defendants from publishing advertisements, issuing circulars, or otherwise carrying on business under the name of the Radio Press Syndicate, or any other name likely to lead the public to believe that the business of the defendants was the same as or had any connection with the business of the plaintiffs.

The facts of the case were stated in the affidavit of Mr. Robert A. Lodge, Associate Member of the Society of Incorporated Accountants and Auditors, and secretary and chief accountant to Radio Press, Ltd.

The following are extracts from the affidavit :—

The company's objects are these : To carry on business as proprietors and publishers of newspapers, journals, magazines, books, and other literary work and undertakings dealing in whole or in part with matters relating to radio telegraphy, radio telephony, etc., and to equip, maintain, and manage laboratories and experimental stations for purposes of research and other experimental work in connection with telegraphy, telephony, and other methods of intercommunication or with any other matter connected with the business of the company.

We are the publishers and proprietors of *Modern Wireless*, which is a monthly publication, and *four* other papers, and their circulation runs into many hundreds of thousands of copies. We also publish handbooks connected with the construction of wireless apparatus of all types, and we publish numerous types of working drawings and charts to enable home constructors to construct their own radio apparatus.

It is our practice to carry out tests by our experts upon any apparatus submitted to us by manufacturers and to publish an editorial report of the result of such tests in one or other of our various wireless publications. Most of our advertisers, whose advertisements appear regularly in our various publications, take advantage of these tests, and also many manufacturers who never advertise in our publications receive the same impartial treatment, and the tests of this apparatus have from time to time been published in our periodicals without any fee being charged.

The result of the case was, of course, a foregone conclusion, the actual wording of the judgment being :

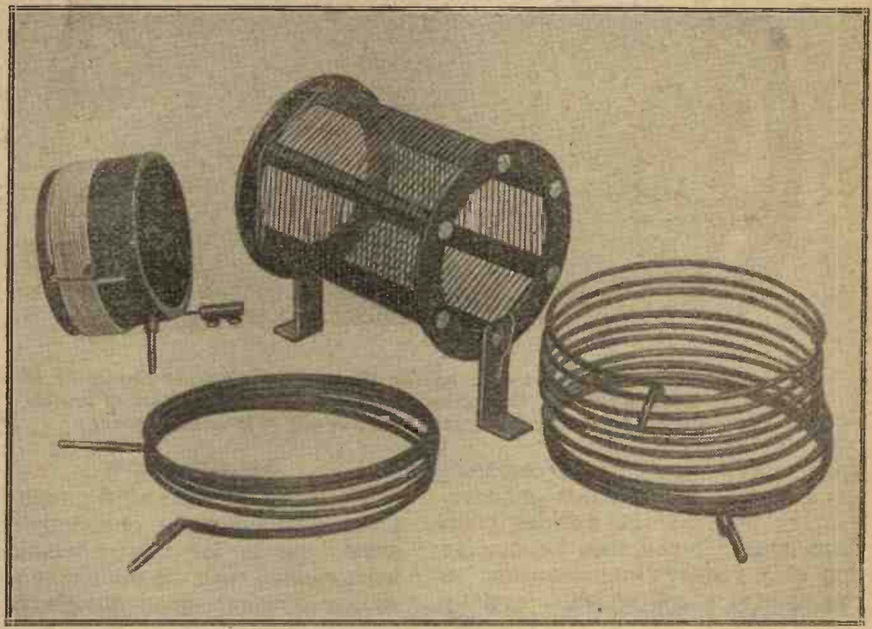
"This court doth order that the defendants, their servants and agents, be perpetually restrained from publishing advertisements or issuing circulars or otherwise carrying on business under their present name of the Radio Press Syndicate or under any name calculated to lead the public in any way to believe that the business of the defendants is the same as or is in any way connected with the business of the plaintiffs.

"And it is ordered that the defendants do pay to the plaintiffs their costs of this action, to be taxed by the Taxing Master."

Designing Coils for a Short-Wave Receiver

By G. P. KENDALL, B.Sc., Staff Editor.

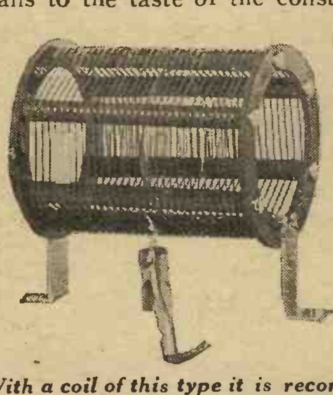
Having dealt with the choice of a circuit and the lay-out of components for short-wave reception, Mr. Kendall here continues his series of practical articles with a discussion of the best methods of mounting various types of coils, together with full data for constructing a set of coils with which to make a start.



Some typical forms of coils designed for short-wave reception. The self-supporting coils in the foreground will be found the more efficient, though the other types shown are recommended by the author for preliminary experiments.

IT will be remembered that last week in considering the actual layout and construction of a short-wave receiver, I deferred to a later occasion the consideration of the actual coils used, since this is a detail whose importance calls for careful consideration in a separate article.

One of the great difficulties in designing a short-wave receiver of universal usefulness lies in the fact that an extremely wide band of frequencies must be covered. For example, there are in common use bands of frequencies equivalent to wavelengths 20 metres (15,000 kc.), 40-45 metres (7,500-6,500 kc.), 70 to 120 metres (4,286-2,500 kc.), and 150 to 200 metres (2,000-1,500 kc.). It is not practicable to cover the whole range with a single coil, and therefore one is compelled to devise some scheme of interchangeable units. This I propose to leave in its details to the taste of the constructor, after outlining the desirable features of such a system of interchangeability.



With a coil of this type it is recommended that the ends of the winding be brought out to plugs, while a clip is provided for the centre tapping.

An Essential

First and foremost, thoroughly good and sound connections must be made if any plug-in or pin and socket arrangement is used, since nothing is more distressing in a short-wave set than an uncertain contact. This desirable end may best be achieved by only a small number of plug and socket connections, say, one at each end of the coil, connections at other points along the coil being made by soldering to the desired turn a short length of bare copper wire, and gripping this with a tapping clip (similar to those supplied by Messrs. Burndept, Ltd.), to which is soldered a length of flex. This scheme is thoroughly to be recommended, since these clips make a good and sound connection by virtue of their sharp teeth and strong springs.

Importance of Spacing

Whatever plug and socket arrangement is used, it should be regarded as essential that the various electrodes thereof should be well separated from each other, and on no account should the ordinary coil plug and socket be used with its poor spacing and large amount of dielectric material between the elements. Such an arrangement is quite unsuited to reception of the really high frequencies.

Constructional Details

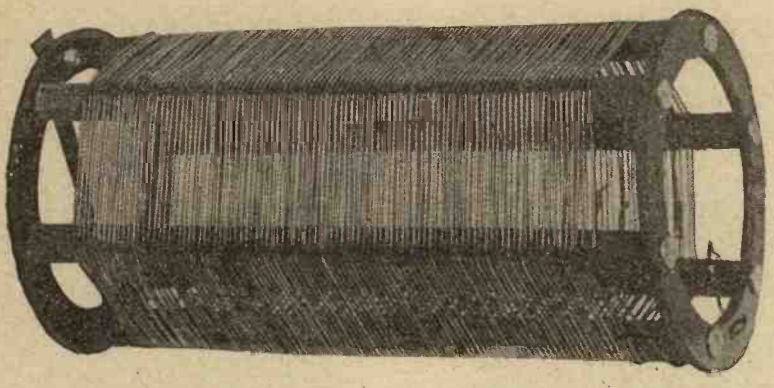
For the actual construction of the coil I would strongly advise the reader to make his first attempt with an inductance wound upon one of the skeleton formers which are now obtainable from many firms, among others Messrs. Collinson Precision Screw Co., Ltd., and Messrs. Peto Scott, Ltd., using No. 22 or 20 enamelled wire, spaced in the ordinary manner in the threads cut in the side rods of the former.

Use of a Standard Former

A standard length former should be chosen for all the coils, so that two valve pins can be attached to the ends of the skeleton former by means of *small* brass brackets or any other mechanical arrangement which the reader prefers. These pins can then be pushed into valve sockets (the separate leg type) which can be mounted upon the baseboard of the receiver in pieces of ebonite, thus making connection to the two ends of the coil. The other connection upon the grid coil L, called for in the circuit which we have chosen as our standard, will then be made by means of a clip.

I would advise that quite long formers be chosen, in order that the windings can be isolated from the end rings and their fixing screws by being placed in the middle of the former. This arrangement is of greater importance than one might at first think.

The beginner in short-wave work will be well advised to adopt a coil of this kind for his first venture, since it will certainly give good re-



When a former of this type is used for short-wave work, it should be of something like the full length employed for coils for the reception of broadcasting, the winding being located centrally between the ends.

sults and is very easy to construct in a reasonably efficient manner. Having got the set working with such a coil, it will then be time to consider further improvements in the way of a coil which is entirely air supported, wound with possibly a thicker gauge of wire, and so on. Quite good results are obtainable with the coils I have specified, and it certainly renders the construction of the set very much easier than attempting, at first, to design an ultra low-loss inductance.

Turn Numbers

The question of turn numbers is also rendered easier of decision when a former of standard diameter is used for all the coils, and the following data will serve as a guide on first assembling the set and making a set of coils. For the range of frequencies in the neighbourhood of 15,000 kilocycles (20 metres) four turns, each spaced two grooves from its neighbour on the threaded rods of the former, will be correct, a tuning condenser of .0003 μF being assumed throughout. For the next band of frequencies around 7,500 kilocycles (40 metres) six turns will suffice, and will enable the user to get well above the frequency corresponding to the 40-metre wave in order to take in a number of transmissions which may be heard on 8,500 kilocycles (35 metres).

To cover the band of frequencies between 4,250 kc. and 2,500 kc. (corresponding to wavelengths between 70 and 120 metres), a third coil will be required, whose windings should consist of 12 turns, again double spaced upon the threaded side rods of the former. A fourth coil carrying 20 turns will complete the set, this covering the lowest band of frequencies concerned.

Reaction Turns

The reaction winding for each of these coils should be of exactly the same type as the tuning winding, being wound with the same wire and similar spacing upon the former, and in the same direction, that is to say, as though it were a continuation of the previous winding. Leave a space of about ¼-in. between the ends of the tuning winding (L_1 in the circuit of Fig. 3 shown last week) and the beginning of the reaction winding (L_2).

The reaction winding should be variable as regards the number of turns in circuit, and this is easily arranged by soldering short pieces of wire to the coil every one or two turns, and making connection by means of a tapping clip. As a matter of fact, it is advisable to make connection to both ends of the winding by means of clips, in order that wider variations of coupling may be obtained. The maximum number of turns upon the winding should in general be about two-thirds of that of the grid winding L_1. The only exception to this rule is found upon the shortest coil of all where the reaction winding should be of the same size as L_1.

The Aerial Coil

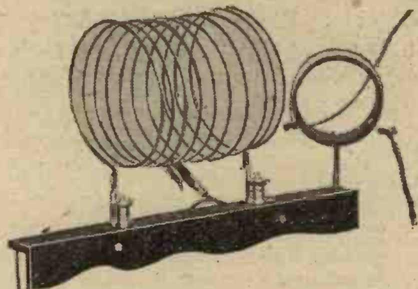
In connection with the practical arrangement of the coils there remains the question of the aerial coupling coil. This can take the shape of a coil of a very small number of turns arranged to couple quite loosely with the secondary winding L_1. At this point I think I ought to confess that in the short-wave receiver which I am at present using, and in which a coil of the type which we have been considering is incorporated, the aerial coupling coil consists merely of a length of No. 20 d.c.c. wire in which two turns are made by wrapping the wire round one hand, and this improvised hank winding of two turns is simply pushed into one end of the coil former. The ends of this wire are then connected to the aerial and earth leads, and the whole arrangement, while perhaps rather primitive, gives perfectly satisfactory results. Variations of coupling are hardly ever called for, and if desired can be obtained by pulling the coil out of the former, or pushing it a little farther in.

Mounting the Aerial Coil

No doubt a variety of better ways of achieving this end will suggest themselves to readers who like to make a more mechanical job of the arrangement, and a good example is illustrated in one of the photographs accompanying this article. It is desirable to use more than one aerial coupling coil to obtain the best results, for reasons which we shall see later when considering the practical side of operating the finished set, and I find that with an average aerial two turns are sufficient for use with the two smaller coils, whose dimensions have been given, three turns being adequate for the next size and four for the largest of all.

An Important Point

A concluding point regarding the mounting of the aerial coil: if possible let the coil consist merely of the necessary number of turns, air spaced, and supported by the stiffness of the wire itself, which may form the necessary connections to the coil. Avoid using any masses of metal or dielectric material in this coil, remembering that it is inserted possibly inside the grid winding of the set. This condition is readily complied with when it is



Showing a good method of mounting the aerial coil (seen on the right) so that a variable coupling can be readily obtained.

realised that no very elaborate mounting arrangements are needed, since variations of coupling here are not often required.

A DEVICE FOR INDOOR AERIALS

The method of erecting an indoor aerial described here will be found simple to construct, and possesses the advantage of being easily erected and dismantled in a few moments.

MOST wireless enthusiasts at some time or another desire to experiment with indoor aerials at home, or on occasions when they take their receiving gear to a friend's house or flat, wish to rig up an efficient temporary arrangement which can be erected

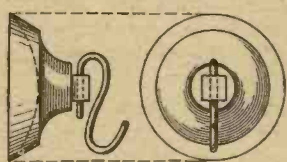


Fig. 1.—Four rubber suction discs of this type are needed.

and dismantled easily, but which will not deface furniture or other fittings.

The following is a description of how such ideas can be realised by anyone who is willing to spend a few shillings on the necessary material, and expend a little time in assembling.

Materials Required

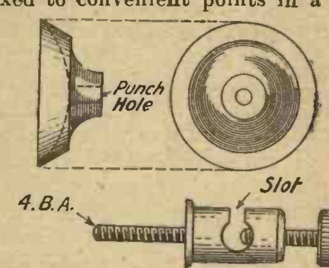
The first step is to obtain four red rubber suction discs, as shown in Fig. 1. These are familiar to most people, being affixed to shop windows for holding light articles for show purposes. They can be obtained from any shop fitter at a cost not exceeding 3d. each. With a safety-razor blade trim the top portions flat, as shown in Fig. 2, and in the exact centres punch (with a cork-borer) a hole, through which a 4B.A. screw will just pass freely. Now obtain four pieces of fibre tube 3 in. long and of a bore into which a 4 B.A. screw will cut a thread, four telephone terminals with 4B.A. stems, and four ¾ in. 4B.A. screws with countersunk heads. The next step is to take your hacksaw or a key-cutting file and slot the telephone terminals, as shown in Fig. 3. All the items are now ready for assembly, and this is done as in Fig. 4, which is self-explanatory, making up four complete articles.

Attachment to Walls

It will be found that on damping the rubber suction cap and pressing to any smooth, non-porous surface, the appliance will adhere tenaciously, and cannot be pulled free with a straight pull. As a matter of fact, the bigger the strain thus applied the tighter the grip, and the writer, when trying out the first model, succeeded in pulling an overmantel with a plate-glass mirror from its fixings, and a catastrophe was only narrowly averted! By pinching the suction cap and tilting sideways the article is easily removed, and does not mark or damage walls, picture glasses, windows, mirrors, enamel, vitreous distemper, etc.

Aerial Wire

The four completed articles can be affixed to convenient points in a room



Figs. 2 and 3.—Showing the method of preparing the suction discs and terminals.

or passage, and the aerial wire, which should be thin and flexible, laid in the slots cut in the sides of the telephone terminals, pulled taut, and the terminal heads screwed home. The slots obviate the necessity of threading the wire through the terminals, and it is only a matter of seconds to unscrew the terminal and lift the aerial out. The writer finds that thin brass stranded picture wire makes an ideal aerial for use with the appliances in question.

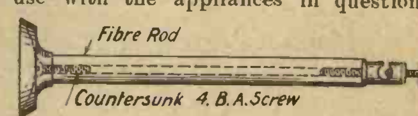


Fig. 4.—The complete assembly of one of the wall attachments.

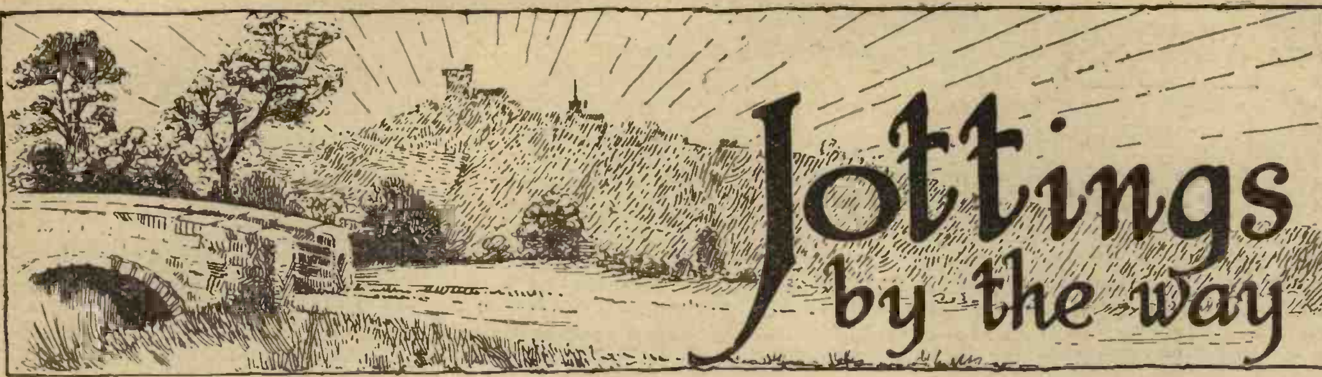
Applications

Such an aerial system is ideal for erecting temporary aerials in public halls, etc., and should prove a boon to flat-dwellers, as an outside or inside aerial can be rigged up by running the aerial wire on several of the articles described, which can be affixed to the outside or inside of the glass of several windows. From the point of view of portability, the idea leaves nothing to be desired, as four of the appliances with a coil of fine aerial wire can be carried in the pocket. The total cost of the material should not exceed 3s., and this is considerably less than the cost of a frame aerial. It is desirable to mention that the articles described above are covered by a Patent, and, whilst they can be made up by amateurs and others for personal use, they must not be manufactured for sale to the public.

E. W. H.

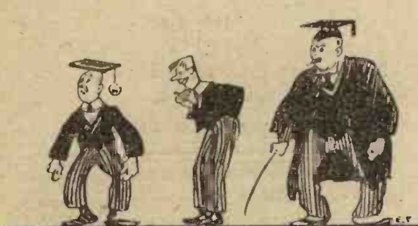
WIRELESS IN THE R.A.F.

A three-wire aerial, used in conjunction with two fixed frames, is fitted to the tenders employed by the R.A.F. for some of their mobile receiving stations.



The Sincerest Form

IMITATION, they say, is the sincerest form of flattery, though, personally, I am not convinced that this statement is universally true. I remember once as a small boy giving an imitation of my form master which my little friends assured me was absolutely life-like. It took place in the classroom whilst we were waiting for his arrival at the beginning of a lesson, and so engrossed was I in the part that I was enacting that I failed to observe his entry into the room. You may take my word for it that he was not flattered; at any rate, if he was he had a funny way of showing his appreciation of my



. . . an absolutely life-like imitation . . .

tribute. I remember that I found forms distinctly hard things to sit upon for some days after.

But in the case that I am going to tell you about, if you will allow me to do so, this week, I think that the imitation was really a very flattering one. For a long time past, as you may remember, we have had but two Philistines in Little Puddleton, two men, I mean, who did not possess wireless sets, did not talk wireless shop, and, in fact, neither knew nor cared anything about wireless. These were the editor of the *Little Puddleton Gazette* and his accomplice who fulfils the *rôle* of sub-editor, reporter, sales-manager, compositor and office boy.

The Conversion

Until quite recently they preserved their hostile attitude, but gradually we noticed that a more civilised spirit was creeping into them. The *Gazette* has, of course, published from time to time garbled reports of our meetings, but that, until a month ago, was as far as it got in the way of wireless. The first inkling of the great change that we received was when it began to publish little paragraphs, obviously snipped out of other papers, about marvellous feats of reception and transmission. These increased in number, and presently all were collected together into one column under the heading of "Radio Tit-Bits, by Our Own Wireless Expert." The *Gazette* posters also began to ask all and sundry: "Are you reading our Great New Wireless Feature?" Naturally sales simply rushed up. The paper was sold out each week, and copies changed hands at enormous prices. The editor saw that he had struck a good thing, and resolved to develop it.

The Invitation

I was singing quite happily in my bath one morning—I had risen rather early, I remember, since I was feeling blithe, and the time had barely touched double figures—I was warbling, as I have said, when there came a knock at the bathroom door. It was our handmaiden, who told me that Mr. Poddleby was downstairs, and earnestly desired speech with me. "Tell him," I said, "that I will be down in a jiffy!"

I have always been a pretty quick dresser, but Poddleby is an impatient kind of fellow, and he was manifesting distinct signs of annoyance at having been kept waiting when I came into the dining-room an hour and a quarter later. I found, however, that he had wiled away the time by eating my breakfast. After mutual recriminations he calmed down and said, "I see that you have not yet read your letters." He picked up the little pile of envelopes which lay beside the coffee-pot, and ran quickly through them. All, I may say, were of that nasty oblong shape. "Put the lot in the fire," I said. "The very look of them makes me sick." Poddleby picked out one which bore the Little Puddleton postmark, and handed it to me with a smile. "Just open that one and read it," he begged; "I'll guarantee that it is not a bill." I did as he asked. The missive ran:—

"Dear Sir,

"Could you make it convenient to call upon me at the office of the *Little Puddleton Gazette* at four o'clock this afternoon? I

. . . engulfed my breakfast before I could stop him . . .

would like to see you in connection with our wireless feature. I am asking Mr. Poddleby and Professor Goop as well.

"Yours faithfully,

"THE EDITOR."

Staggered

To say that I was staggered is to put it mildly. I was still staggering when the door opened, and the maid ushered in Professor Goop in a great state of excitement. So perturbed was the good man that, when a few moments later the damsel bore in the second attempt at my breakfast, he sat down absentmindedly and engulfed it before I could stop him. "And now that we have all fed," he said—I

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" " " " " 35 " 4/-
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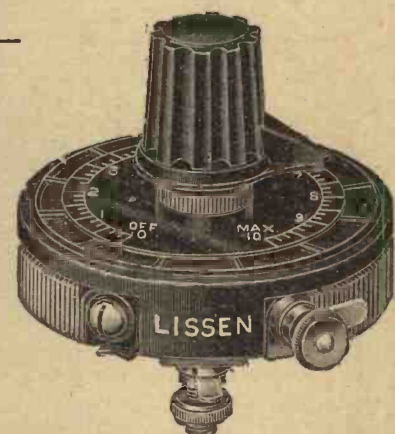

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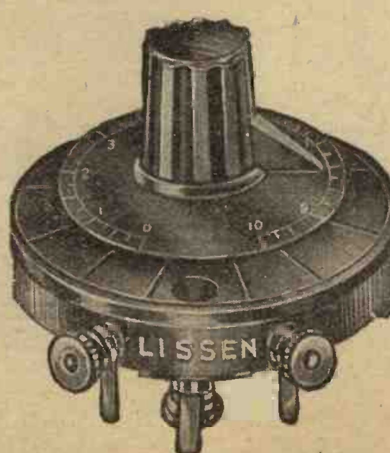

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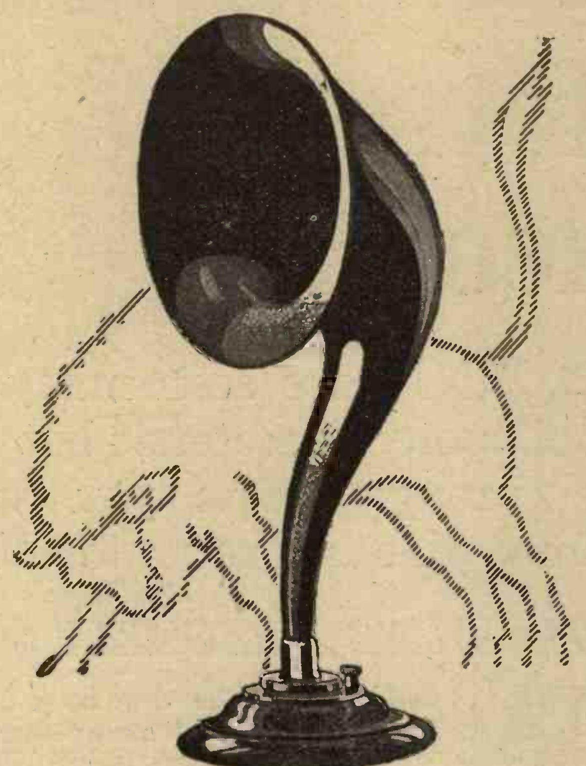

"bullying" the electrical impulse

NOTE—Acoustics: the science of sound. Radio Acoustics: transforming the electrical impulse into audible sound

Acoustics is the scientific study of the mechanics of sound. This science applied to radio means the transformation of our friend the electrical impulse into audible sound. An impulsive impulse, this electrical fellow, and one of many moods. We've been close on his heels for years, constantly improving his transformation to easy and natural sound. Never a complete mastery, but always a sufficiently friendly understanding with this elusive spirit of radio. "Bullying" perhaps, but always in a friendly spirit. Tactfully handled in the Brandes laboratories, he has revealed many helpful theories, and the value of this research shows itself in the quality of the Brandes instruments. He brings the voice and music and we get him to talk as naturally as possible.

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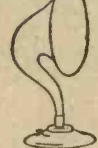
¶ *The countersunk screws in the bottom of the base are sealed. Repairs or replacements required under our guarantee will be granted free of charge provided seals are intact.*



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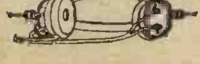

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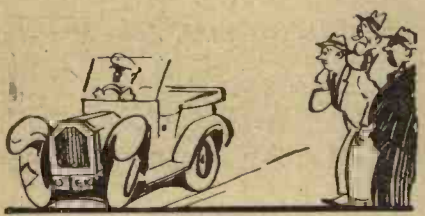
was just about to protest when he raised his hand and stopped me—"let us consider the letters that we have had from the editor of the *Gazette.*" He and Poddleby were soon hard at it, and when I had seen them well under way I crept from the room and ordered a third breakfast to be served in my study.



. . . *a very ancient Lizzie* . . .

Early rising always did give me an appetite.

The Meeting

Half an hour later I returned to the dining-room, and found that they had been so engrossed that they had failed to notice my absence. As I entered, the Professor was saying, "Very well, then, we all agree to be there at four o'clock, and to do our best to make the *Gazette* really worth reading." At the appointed hour we met at the office, and were shown in to what I believe is called the "editorial sanctum." The editor plunged at once into his subject. He explained that there was obviously a great demand for wireless literature in Little Puddleton, and that he proposed to enlarge the feature at present appearing in the *Gazette*. "Let me see," said the Professor, "the paper has eight pages, has it not? If two of these are occupied by advertisements, it leaves six. Supposing that we use five and a half of these for articles upon wireless, it will leave you half a page for news, which we consider—and we have given much thought to the subject—quite ample." The editor, it appeared, was not prepared to go quite as far as this, but in the end he promised us that one page should be devoted in future to wireless.

Research Laboratories

"And now," he said, "I want to broach to you my great scheme. I have heard that another publishing firm is starting research laboratories and a test department somewhere near London. I do not propose that the *Little Puddleton Gazette* shall lag behind. I have already arranged for the purchase of a suitable piece of ground, and research laboratories are now being erected. I have to offer to you, Professor Goop, the post of Supervisor-in-Chief of the laboratories; to Mr. Wayfarer that of Assistant Supervisor, and to Mr. Poddleby that of the Head of the Test Department. May I take it that you accept?" In a few moments the whole thing was fixed up. "If you would care to inspect the laboratories," said the editor, "I will tell the staff chauffeur to bring my car round." We jumped at the opportunity.

We Start

He blew hard down a tube, and a shrill whistle sounded in some distant room. "The car at once," he ordered. In a minute or two the noises of starting up were heard from the yard. Clank, rrrrrup, bang; clank, rrrrrup, bang. Then, after a super-explosion, the thing apparently got under way. "The car should be ready now," said the editor. We went downstairs and found awaiting us a very ancient Lizzie, in which sat the sub-editor-reporter-compositor-office boy wearing a chauffeur's coat and cap.

Mag. Trouble

"To the laboratories," ordered the editor. The driver trod hard on some things and pulled at others. There was another bang, and the engine stopped. Luckily we were at the top of a hill, and when Poddleby had given one good push to start her off down it, all was well, except for Poddleby, who had to run a bit in order to catch up. "I am afraid," said the editor, "that my car is missing on three cylinders owing to a faulty magneto."

We Inspect

We drove on in the direction of the sewage farm, and went on until the road suddenly came to an end. The editor said that we must now walk. It was only a step, he told us. Having pushed our way through a quick-set hedge, and fallen into a ditch on the far side, we crossed three of the most clinging ploughed fields that I have ever waded through. We now came to a stile, and, having climbed over it, found ourselves on (or, rather, I should say in, for we were well up to the knees) a narrow piece of land on the northern boundary of our old friend the sewage farm. At the far end was one of those funny little houses on wheels that you see lying about in fields. "The research laboratory," said the editor, with a grand wave of his hand. "Let us go and inspect it." On the way there I lost a shoe, whilst Poddleby had a narrow escape from drowning in one particularly soft place. However, we got there somehow in the end. Professor Goop was in ecstasies, which was a jolly sight more than I was. "Just the very place," he said. "Here we shall be able to work absolutely undisturbed, and before long not England alone but the world will ring with the fame of the research department of the *Little Puddleton Gazette.*"

We Forge Ahead

That was our first introduction to the laboratory. Since then the work has gone forward with a will. Duckboards have been laid down across the field, and new ones are always ready to replace them when they sink out of sight. Poddleby has been installed in a disused henhouse, the temporary test department. And we are already quite well off for instruments. We have a milliammeter, presented by the General, a most delicate and accurate instrument which only lacks a pointer. Gubbsworthy gave us a pair of kitchen scales, whilst Snaggsby weighed in with a case-opener, which he assured us was by far the best means of getting quickly at the inside of wireless sets for test purposes. We have also a home-made wavemeter of Admiral Whiskerton Cuttle's, which will be all right when we have got the buzzer to go, and a combined volt and ammeter of Winklesworth's, which is a splendid instrument if only you can remember that somebody made a slip over its scales, and that when it says volts it means amps., and *vice-versa*. We are thus, as you will see, extraordinarily

. . . *Poddleby had a narrow escape from drowning* . . .

well equipped so far as material is concerned. It is hardly necessary, I think, to refer to the giant brains that are at the head of the *Gazette's* laboratories. We are going to begin our researches any day now, and when we do you may expect to see something.

WIRELESS WAYFARER.

Inventions and Developments

UNDER THIS HEADING MR. J. H. REYNER, B.Sc. (Hons.), A.C.G.I., D.I.C., OF THE RADIO PRESS LABORATORIES, WILL REVIEW FROM TIME TO TIME THE LATEST DEVELOPMENTS IN THE RADIO WORLD.

A Real Anti-Atmospheric Device ?

ATMOSPHERICS, more particularly the variety known as "static," do not trouble broadcast reception in this country as much as in America. There are, however, cases where atmospheric interference is not only troublesome but almost entirely spoils reception. This is, of course, particularly the case on distant reception, and an otherwise perfect transmission is often completely marred by such parasitic noises.

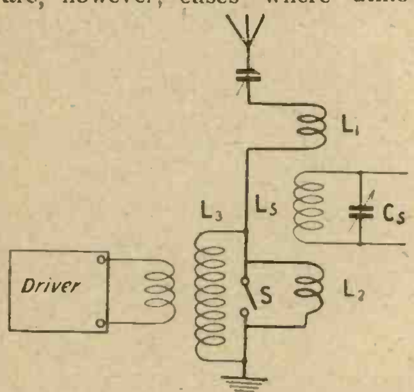


Fig. 1.—The coils L1 and L2 are so arranged that their total effect on the secondary coil Ls is nil.

Various attempts have been made from time to time to devise methods of eliminating this troublesome form of interference. Such devices, however, have hitherto met with little success. One of the principal difficulties in the matter is due to the very nature of the atmospheric disturbances. These disturbances are of comparatively low frequency and the effect on an ordinary aerial is simply to "shock" it, at whatever wavelength it happens to be tuned to. That is to say, ordinary tuning is absolutely useless as a barrier against this unpleasant interference. Further, Professor Appleton has shown that mistuning the aerial produces no material improvement, a fact which has been observed in practice, since the reduction in the signal strength is more than the reduction of the atmospheric interference.

The "McCaa Static Eliminator"

A very novel device has been invented in America, where it is finding considerable vogue in eliminating static. The device, which is known as the "McCaa Static Eliminator," is the result of many years of hard work and persistent application on the part of a well-qualified engineer. Certainly the principles which are adopted would appear to be scientific, and it is quite possible that this is no mere flash in the pan, as has often proved to be the case with other so-called interference eliminators.

Principle of Operation

The principle may be put in a nutshell as follows :—It is simply that the aerial is arranged to be tuned to a different frequency for the signal than for the static. For the reception of the signal, of course, the aerial is tuned to the frequency of the transmitting station, but as far as atmospheric interference is concerned the tuning of the aerial is totally different.

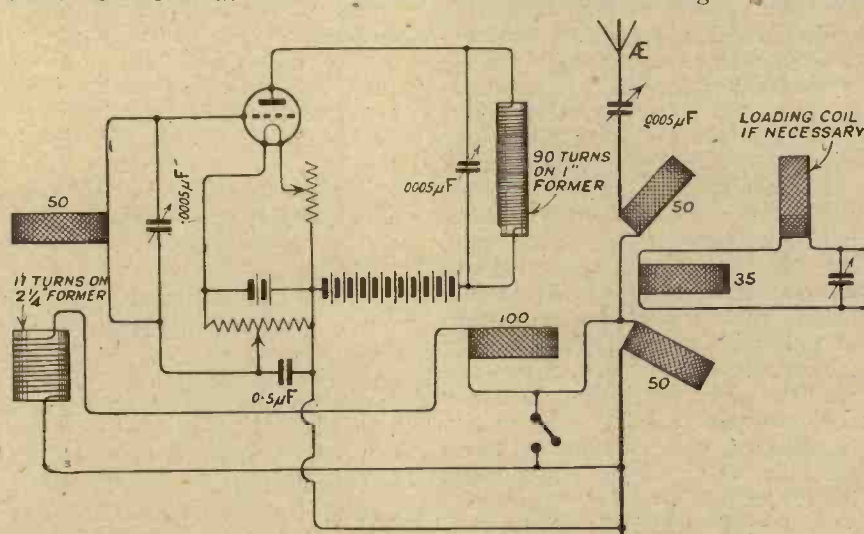


Fig. 2.—The complete circuit of the McCaa Static Eliminator. The use of a three-coil holder is suggested for the coils L1, L2 and Ls of Fig. 1, as shown here.

The circuit of Fig. 1 will make this clearer. The aerial is coupled to a secondary circuit with two coils, these coils being arranged to act in opposite directions and being so adjusted as to cancel out in their effect on the secondary. Shunted across the second of these coupling coils is

(Continued on page 203.)

Some Notes on Low-Power Transmission

By L. H. THOMAS (6QB).

Signals from G6QB have probably been picked up by many of our readers. Mr. Thomas here gives details of some of the apparatus employed at his station, and describes how good results were obtained without elaborate equipment.

MANY enthusiastic experimenters are deterred from making any attempts at transmission because they have no source of power available, or because their accumulator-charging facilities are not all that they should be. It is the object of this article to show that much useful and interesting work may be done in a situation that may at first seem hopeless.

Receiving Valves Used

The writer commenced transmission in June, 1923, at a frequency of 1,500 kc. (200 metres). A well-known British make of bright-emitter receiving valve was employed, the filament being worked at 5.5 volts. The valve then passed about 15 milliamps., with an anode potential of 200 volts (from dry cells). Chiefly for reasons of accommodation, it was undesirable to use as many dry cells as were necessary to give this input of 3 watts. When two of these valves were worked in parallel, it was found that 3 watts could be dealt with at 140 volts, but the drain on the accumulator was somewhat heavy. The solution was obviously to find a valve of much lower impedance, and yet one which did not require to be over-run too much—no valve can be expected to live very long when being over-run by some 50 per cent. Several other makes of 4-volt valves were tried, all giving precisely the same results.

A Successful Experiment

Then, more by accident (the burning-out of the last bright-emitter) than design, a D.E.R. valve was plugged in, the filament being run on about 2.8 volts. This valve was found to pass 40 milliamperes at 140 volts, giving approximately 6 watts. The aerial current was increased considerably. The anode potential was reduced to 112 volts, at which the normal 3 watts was obtained, almost half the dry cells being dispensed with, with no loss of efficiency. The filament of the valve seems similar to that of the 4-volt .75-ampere type, but thoriated, of course, and the identical valve is still in use; it has lost none of its emission, and works perfectly as a rectifier on its rated H.T. and L.T. voltages.

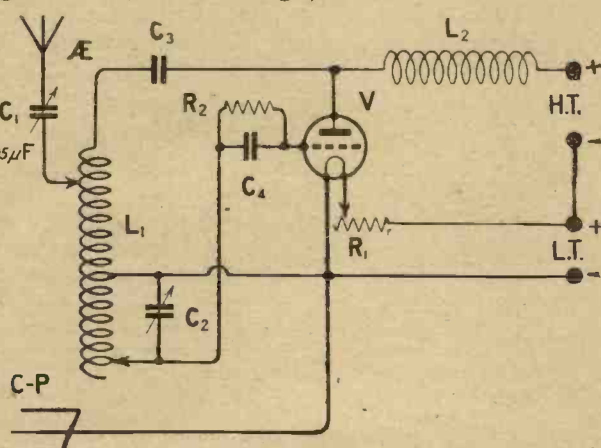
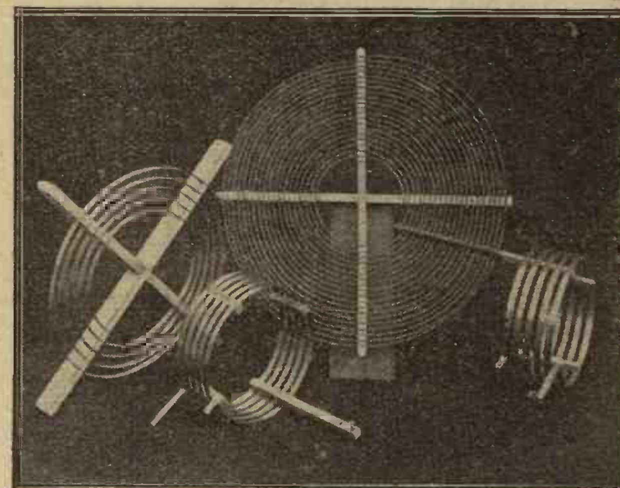


Fig. 1.—The well-known direct-coupled Hartley circuit is very suitable for a beginner at transmission on account of ease of operation.



A group of typical inductances of types commonly employed in transmission.

Increasing Efficiency

This valve solved both the H.T. problem and that of burns-out, and also made less demands on the accumulator. Two of them are now employed in parallel, and inputs up to 5 watts could be obtained with 100 volts on the anodes. The writer has not yet succeeded in finding their saturation current.

Attention was then turned to increasing the efficiency of the transmitting apparatus. It was employing the ordinary direct-coupled Hartley circuit.

New Coils

An aerial current of 0.32 amperes at 2,000 kc. (150 metres) and 0.21 amperes at 2,609 kc. (115 metres) was obtained. The coils, which were wound on cardboard formers with 7/22 aerial wire, were then replaced by "pancakes" wound with copper ribbon on ebonite cross-pieces. These were similar in construction to the coil on the left of the illustration at the head of this article. A great increase in efficiency was noted, the aerial current at 2,609 kc. (115 metres) being increased to 0.26 amperes. (The aerial at that time had a somewhat high capacity.)

The Radio-Frequency Choke

The radio-frequency choke L2 (Fig. 1), a duolateral coil of the usual type, was then replaced by one of the old inductances wound with aerial wire, and tuned by a .0005 μF variable condenser. This increased the aerial current at 2,609 kc. (115 metres) to 0.3 amps., and sharpened up the wave considerably, the input remaining as before.

A New Aerial

The old 80-ft. aerial collapsed at this stage, and the owner of the house to which the far end was attached would not allow the writer to replace it.

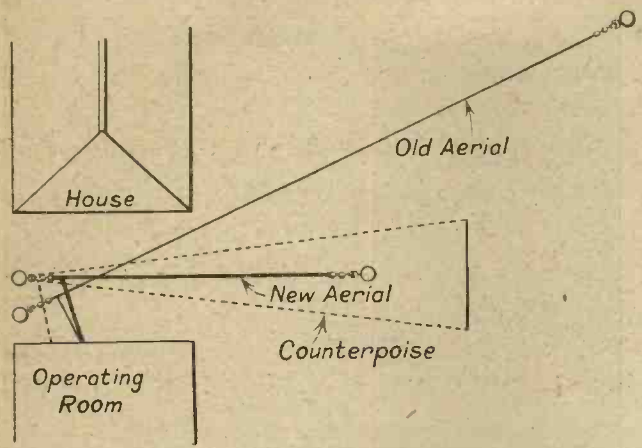


Fig. 2.—Showing the relative positions of the new and old aerials.

Accordingly a 36-ft. mast and a 30-ft. single-wire aerial were erected, the counterpoise now being under the aerial instead of making an angle of 45 deg. with it (Fig. 2).

Checking Radiation

The set was readjusted, and it was found that, in spite of the decrease in the capacity of the aerial system—the new aerial being half as high as the old—the aerial current was increased to 0.34 amperes. By this time the writer was wondering if there was any limit to the aerial currents obtainable with an input of 3 watts. Now, of course, the readings of the hot-wire meter are quite unreliable unless it is placed at an antinode of the aerial system. Accordingly, making use of a crystal receiver with a Weston galvanometer situated about 20 ft. from the transmitter, curves were plotted for measured received current against observed reading on the meter, with the latter in various positions. It was finally placed between the aerial series condenser and the inductance.

Loose Coupling

The next alteration was to employ a loose-coupled circuit, the coupled coils being about 8 in. apart. The aerial current shown on the meter with such loose coupling is practically independent of harmonics, and therefore much more reliable. Power was then increased to 5 watts (the same two D.E.R. valves being used), and a five-wire counterpoise erected in place of the previous two-wire fan.

Results Obtained

No difficulty was experienced in communicating with any active European country after 4 p.m., and two reports were received from the U.S.A. (one from 5HL, Tennessee—about 4,200 miles).

Since then two more American reports have been received, signal strength apparently varying in direct proportion with distance, since signals are never reported strong at distances less than about 60 miles!

A Satisfactory Circuit

The final arrangement of the circuit is shown in Fig. 3. The grid-leak R2 consists of two copper strips placed half an inch apart in a jar of tap-water. The inductances are of ½-in. copper ribbon, spaced ⅜ in. on ebonite cross-pieces. The arrangement at X serves to minimise "key-thumps." C7 is a Mansbridge condenser, capacity 2 μF. X is the secondary of an old L.F. transformer. When using this arrangement, pressing the key (K) causes the note to "build up" gradually, and on releasing it the note "dies out" rather than starting and finishing with heavy thuds and sparking at the key. When using receiving valves and dry batteries it is a distinct advantage to key the high-tension supply—the anodes do not get red-hot and the cells do not polarise so rapidly. The grid condenser C4 is an air dielectric fixed condenser made up out of old variable condenser plates, and all the condensers are ordinary receiving condensers.

Receiving Components

It is, of course, quite practicable to construct a low-power transmitter entirely from receiving components. Standard plug-in coils have often been used experimentally, giving quite good results. It should, however, be borne in mind that only components of reliable manufacture should be employed, and they should preferably be of the modern "low-loss" variety.

Lay-out

Even when working at such frequencies as 1,500 kc. (200 metres) care must be taken to space all parts well from one another, and to use moderately heavy wire for wiring-up. The components in the grid and anode circuits should not only be well insulated from earth, but also well spaced from any earthed conductor. Also, in this connection, great care should be taken that no leads can vibrate or move to any great extent, as nothing tries the ear of a distant operator more than trying to read a fluctuating, "bubbly" note, perhaps through severe atmospherics and interference. Remember, above all things, that a weak note which is pure and steady is infinitely easier to read than an extremely strong signal that is merely a harsh, unpleasant noise.

Difficulties Encountered

In conclusion, let it be said that no one could be in a much worse position for transmission than the writer. The Southern Railway, employing 3,000 volts 25 cycles A.C., is 30 yards distant, and the L.C.C. tramways 50 yards away, making reception extremely difficult. Lastly, there are no electric lighting mains available. If effective transmission can be carried on in the face of such difficulties, surely no one can say that he is too badly placed to attempt it. I hope at some future date to give some particulars of transmission at 6,667 kc. (45 metres).

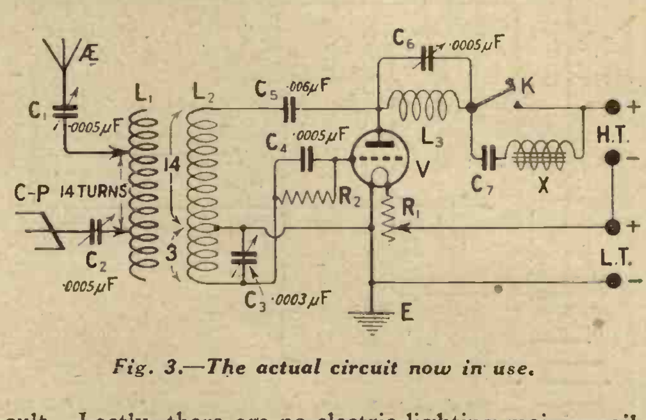


Fig. 3.—The actual circuit now in use.

SHORT-WAVE NOTES AND NEWS

We propose to devote this page to matters of interest to short-wave enthusiasts. Owing to the natural increase in this class of work at this season, and the constantly growing activities of short-wave stations, reports of this type may be expected to make a wide appeal.

WINTER, the "DX" season, is now approaching rapidly, and the band of frequencies from 20,000 to 6,000 kc. (15 to 50 metres) is rapidly filling up with strong, weak, sharp, flat, pure and raw notes. The most conspicuous fact about the 6,667-kc. (45-metre) band is the almost total fading of "local" (*i.e.*, European) stations after about 19.00 G.M.T. On listening at about 22.30 G.M.T., numerous North and South American amateur stations can be heard at good strength, while if one pauses to listen to a signal somewhat weaker than the rest, it generally is of British, French or Belgian origin.

French Amateurs

Speaking of French amateurs, the writer would very much like to know why the unlicensed transmitters (about 95 per cent. of the whole!) allot themselves such extraordinary call-signs as 8PIP, 8WAG, 8DUCK, and so on. They are all registered (unofficially) at the "Journal des 8, c/o M. Georges Veuclin, Rue du Cauche, Rugles, Eure, France," and any cards intended for them will certainly reach their destination if sent through this excellent medium. It is to be regretted that they still seem to prefer a tremendously powerful "raw A.C." note to a pure C.W. note of respectable strength, judging by the transmissions heard.

Belgium

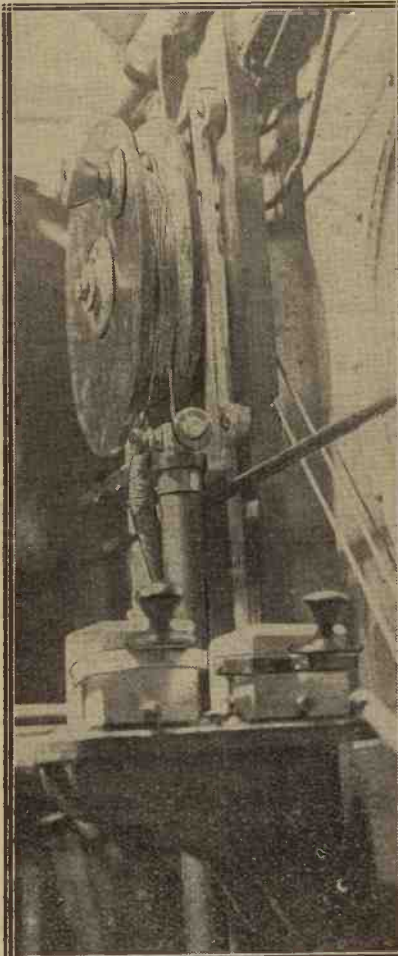
The Belgians are very active just at present, and similarly they may be reached c/o Réseau Belge, Rue du Congrès, Brussels. They all now have calls beginning with a letter and followed by a figure, which may be duplicated (*e.g.*, A2, K3, B22, etc.).

Scandinavia

Several Finnish stations may now be heard at about 7,500 kc. (40 metres), the chief being 2NM, 2ND, 2NS, 2CO, and 1NA. Their "nationality prefix" is now S, the old prefix FN having been dropped. The Swedish transmitters are also to be found at good strength, the more powerful of them often working on telephony. They all speak and send in morse in excellent English, and specialise in pure C.W. notes. They are probably, on the whole, the leading European transmitters, through their admirable practice of placing quality before quantity.

Transatlantic Working

Reverting to our friends on the other side of the Atlantic, NKF, already well known to our readers, is again working on about 7,692 kc. (39 metres), and may be heard from 9 p.m. onwards. At the writer's station his signals are almost unbearably loud with a detector and 1 L.F.—the universal "low-loss" arrangement. The numerous stations calling "ABC," which often puzzle listeners on this wave, are U.S. Government stations conducting various short-wave experiments. Among them are, in order of signal strength, WIZ, WIR, WVQ, WQO, WQN, and NEL1. We shall miss NERK, the ill-fated *Shenandoah*, this season.



The "trailing" type of aerial used on some aircraft is coiled up on a small winch in the cockpit when not in use.

Progress in America

The strongest of the amateur stations is 1PL, and others deserving honourable mention are 1CH, 1CMX, 2ZB, and 4ER, all of whom can generally be heard ten feet from the 'phones, using an ordinary two-valve receiver. The Americans certainly seem to have progressed more than the Europeans in the matter of short-wave transmission, but they have the advantages of their longer experience, the superior components at their disposal, and the tremendous influence of such stalwarts as Reinartz, whose name seems inseparable from short-wave working. In addition, they are, of course, very fortunately situated in being allowed considerable freedom in transmitting hours and so on.

The Higher Frequencies

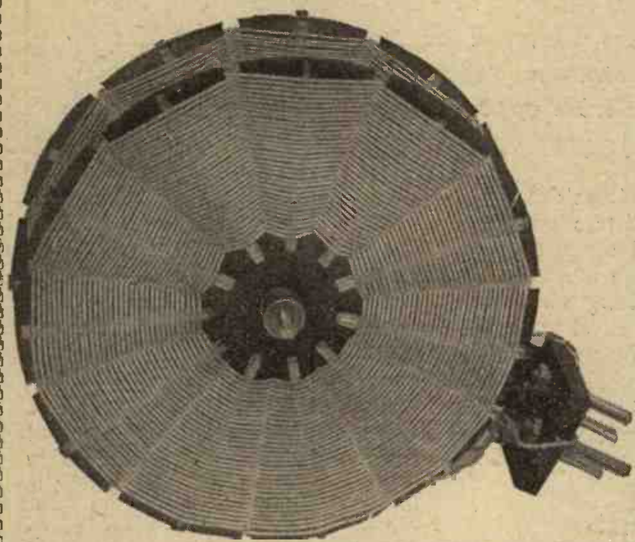
The 15,000-kc. (20-metre) band seems to be rather neglected nowadays. It certainly appears that it is less suitable for consistent long-distance C.W. transmission than the 6,667-kc. (45-metre) band; this may be on account of the fact that it is much more difficult to obtain a good, pure, steady note on the higher frequency. (In this country, too, it is more difficult to obtain a licence for the lower wave!)

[*The Editor will be glad to receive reports on matters of special interest to short-wave enthusiasts for inclusion in these columns.*]

An H.F. Transformer with Variable Coupling

By C. C. PRIOR.

High-frequency transformers of the type described here retain the advantages of the plug-in method of making connection, while they may reasonably be expected to be more efficient than many conventional transformers.



The primary and secondary windings of the transformer are wound on slotted fibre or ebonite discs.

NO interested visitor to the recent Radio Exhibitions could fail to remark that, whilst great efforts have been made to eliminate losses in tuning coils, condensers, valve-holders, and some other components, little or no attention has been paid to the H.F. transformer, which remains practically where it was two years ago.

Heavy Gauge Wire

The writer, after many experiments, has been led to the conclusion that, to obtain full efficiency, not only should the windings be made of wire of much heavier gauge than is generally the case, but provision should be made for varying the coupling between primary and secondary. The transformer about to be described is the practical result of these considerations. It consists essentially of two basket coils of a type devised by the writer, mounted in such a way that the coupling between them is capable of continuous variation between two limits.

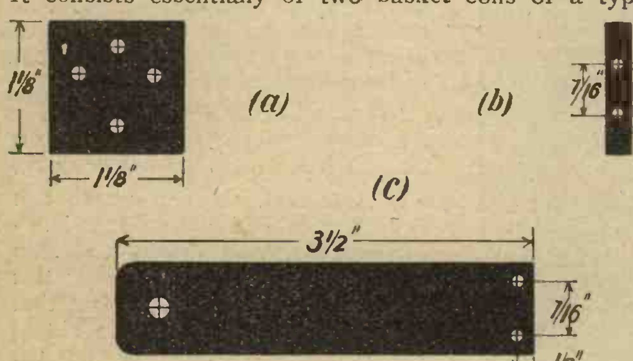


Fig. 1.—Dimensions for drilling the ebonite supports may be taken from these diagrams.

Winding the Coils

The coils are wound upon fibre or ebonite discs, 5 in. in diameter with $1\frac{1}{2}$-in. centres and 11 slots. In order to ensure good air spacing of the turns, match sticks are affixed by seccotine or similar adhesive radially along the centre line of each spoke on both sides of the coil former. This method retains all the advantages of basket winding, whilst at the same time ensuring a rigid coil.

Mounting

The mount consists of an upright piece of $\frac{3}{16}$ in. ebonite $3\frac{1}{2}$ in. long by $\frac{5}{8}$ in. in width. The base is a piece of $\frac{1}{4}$-in. ebonite $1\frac{1}{8}$ in. square (Figs. 1 (a) (b) and (c)). The base is drilled and fitted with valve pins, so that it may be plugged into the standard four-socket valve-holder. The upright is fixed to the base by two 5 B.A. bolts, which are screwed into holes drilled and tapped in one edge of the base. Fig. 2 will make the construction clear.

A short length of 2 B.A. screwed rod is passed through a clearance hole drilled $\frac{1}{4}$ in. from the top of the upright and secured by two nuts, one on each side, screwed tight. The coil intended to form the primary is now slipped on the rod and secured by a nut. It is intended that the secondary coil shall slide backwards and forwards on the rod, and for this purpose it must be fitted with a bush. Most of the bushes obtainable commercially are too long and too cumbersome, and it is best to construct one for the purpose. It is easily made by sweating together an ordinary flat 2 B.A. washer and one of the small spacing washers $\frac{1}{8}$ in. thick used for spacing the fixed plates of variable condensers.

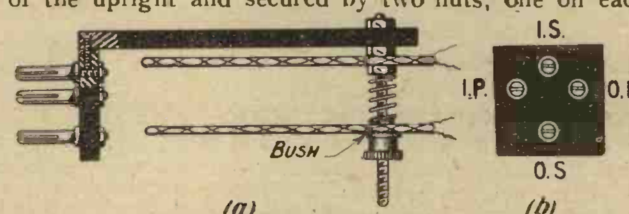


Fig. 2.—Showing (a) the method of mounting the windings, and (b) how the ends of the windings should be connected to the legs of the transformer.

Coupling Adjustment

After fixing the primary coil, a helical spring is slipped over the rod and the secondary coil, with its bush, then placed in position, the flange of the bush being on the outside. A knurled nut is then screwed on to the rod. (That used by the writer was taken from an old dry battery.) The spring should be of wide mesh, so that it may be short enough when compressed to permit of the closest coupling of the two coils. It is easily made of 20 or 22 S.W.G. brass spring wire by winding half-a-dozen turns on a 2 B.A. rod.

The writer has found the results obtained with this transformer greatly superior to those obtained with the ordinary type of instrument.

Choose the Wuncell and be money in pocket

The Wuncell Dull Emitter
Voltage 1·8 volts. Consumption ·3 amp.
W1 for Detector and L.F. **14/-**
W2 for H.F. Amplification. **14/-**

Wuncell Series WR1 & WR2
WR1 for Detector and L.F. **16/-**
WR2 for H.F. amplification **16/-**
For use with any accumulator from 2 volts to 6 volts.

The Cossor Loud Speaker Valve W3
Voltage 1·8 volts. Consumption ·5 amp.
Price **18/6**

EVERY week sees several thousand wireless enthusiasts leaving the ranks of the bright emitter valve users and changing over to Wuncells. And each month these new adherents make a practical saving of several shillings in reduced accumulator re-charging fees. But this is not the only economy effected. The new Wuncell possesses a filament having exceptional long-wearing qualities. Owing to the fact that the valve operates at its best when the filament is barely glowing, it is subjected to very few stresses.

The Wuncell filament is made under a process known only to Cossor. It is built up layer upon layer. Each layer means additional strength. This process ensures a filament wonderfully productive of electrons—and when allied to the well-known Cossor electron-retaining design of Grid and Anode, obviously an ultra-sensitive valve is the result.

Now is the time to change over to Wuncells—and start saving money. If yours is a multi-valve Set operated from a 4 or 6-volt accumulator it is unnecessary for you to discard all your valves at once, you can change over one by one as your existing valves become useless. For your convenience the W.R. series of Wuncells has been evolved. These are 1·8 volt valves with special bases which permit the Wuncells being used with 2-volt, 4-volt, or 6-volt accumulators without the slightest alteration to Set. A small in-built resistance controlled by a switch enables the valve being used on any voltage between 2 volts and 6 volts. Get acquainted with these super-economy valves without delay—your dealer can supply you with interesting descriptive folders free of charge.

Cossor

Issued by A. C. COSSOR LTD., Highbury, London, N.5

Gilbert Ad. 3817

Wireless News in Brief.

Future of Broadcasting. The first meeting of the Committee appointed by the Postmaster-General to advise as to the future policy in regard to the broadcasting service will take place on November 19, 1925, under the chairmanship of Lord Gainford.

* * *

Relaying the Continent. The recent "Round the Continent" test by the British Broadcasting Company, while not an unqualified success, certainly more than realised expectations in some directions. The scheme agreed upon was fairly closely adhered to during the tests, several well-known Continental stations being picked up and re-broadcast.

While the reception of the Paris stations was marred by interference, Brussels (Radio-Belgique) came through very well indeed. Stations in Germany, Spain, Holland, and Italy were also picked up with varying success.

October 29 is the date announced for the next Continental relay.

* * *

In order to comply with popular demands, Daventry will transmit dance music as a regular feature from November 2. This music will not be played by the Savoy and studio bands only.

* * *

The Rugby Station. Experimental work will shortly be in full swing at the Government high-power station at Rugby, which is now nearing completion. Experimental apparatus for wireless telephone work is included in the equipment.

We understand that the services of Rugby will be available to the public for communication with America early in the New Year, though not, of course, by means of telephony. It is quite possible, however, that the latter development is not very far distant, but a great deal of experimental work must be undertaken before the scheme becomes practicable.

* * *

Wireless Fog Signal. A wireless fog signal will shortly come into operation at Cape Silleiro, Spain, on the Galician coast. The warning will take the form of the letters OR broadcast on a musical note of 800 vibrations per second, during 30 seconds in every five minutes.

A wavelength of 1,000 metres will be used, and the average ship's receiver will be able to pick up the signal at a distance of 30 miles.

* * *

Armistice Day Wireless. We hear that the British Broadcasting Company has under consideration the broadcasting of a Requiem on Armistice Day, and also the noise of a busy street a short time before the striking of the hour of eleven, in order to show by contrast how thorough is the silence.

* * *

The Radio Association. The Radio Association will hold a dinner at the Hotel Cecil on November 19. The Duke of Sutherland will preside, and among those who are expected to be present are Mr. Marconi, Lord Wolmer, and Mr. J. C. W. Reith. Some of the speeches at the dinner will be broadcast from 2LO.

* * *

Foreign Progress. Hamburg, Monaco, Breslau and Frankfort, stations, which are now working on $1\frac{1}{2}$ kilowatts, are shortly to raise their power to 10 kilowatts each, thus bringing the number of high-power stations in Germany to six.

Wireless in Australia. In addition to a high-power station which is being erected at Rosenhügel, near Vienna (Austria), two relay stations will shortly be opened at Salzburg and Klagenfurt. The station at Graz, which was formerly a relay station, has now been changed to a main station, owing to the great popularity it has achieved.

* * *

Radio Wien, Vienna, has been carrying out trials on 750 kc. (400 metres) from 10 to 11 a.m., and at 6 p.m. Later on, transmission will also take place at 10 p.m. An account of their reception from anyone hearing these transmissions would be appreciated by Col. Franz Andule, Rudengasse XI, Vienna.

* * *

Wireless on Ships. Six vessels owned by the Companhia Nacional de Navegacao Costeira, of Rio de Janeiro, are to be equipped by the Marconi Co., Ltd., with wireless installations of the largest and most complete type supplied to ships.

The installation for each ship will comprise a $1\frac{1}{2}$ kw. quenched spark transmitter, a $1\frac{1}{2}$ kw. continuous wave valve transmitter, valve receivers for spark and continuous wave reception, a wireless direction finder and a broadcast receiver of the type which is designed especially for ships. Loud-speakers operated by the broadcast receiver are to be installed in the music room and in the smoking-room of each ship.

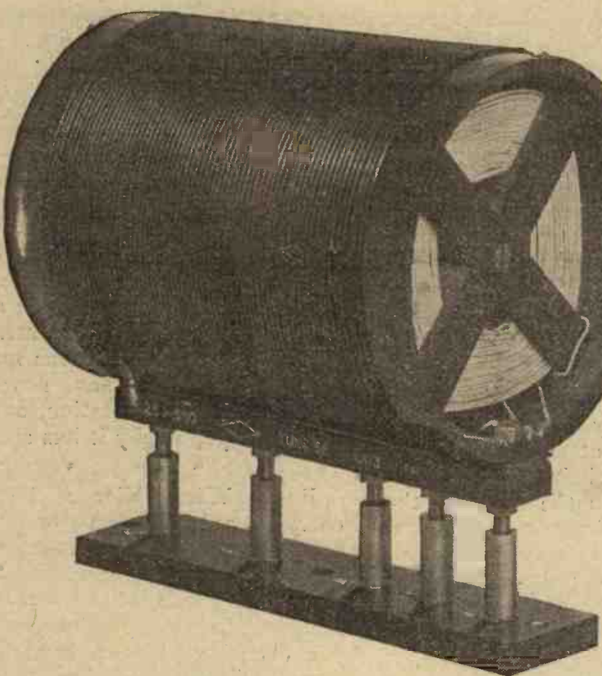
* * *

Broadcasting University Lectures. It is announced that the British Broadcasting Company will open a studio at Oxford, possibly before the end of the Michaelmas Term, in order to broadcast lectures, Union debates, and special gatherings.

EXPERIMENTS WITH N

By PERCY W. HARRIS,

A series of experiments couplings are here de much valuable and

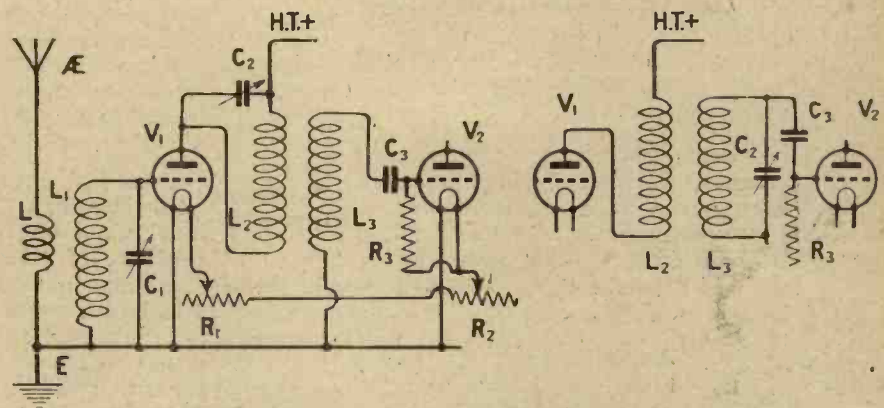


This plug-in type of H.F. transformer is incorporated in the "Special Five" Receiver, described by Mr. Harris in the November number of "Modern Wireless." It has a special neutralising tapping.

IN tackling the problem of improving the high-frequency side of our receiving apparatus, we are immediately faced with a number of difficulties. Every student of the subject is acquainted with the fact that if both the grid and anode circuits of a valve are tuned to the same wavelength and are reasonably "low-loss" in design, self-oscillation will at once occur, at least at those frequencies in which most of us are interested, namely the broadcast bands and the higher frequencies. The causes of self-oscillation have frequently been discussed in this journal, so that it is not necessary to enter into details here.

Self-Oscillation

Although the inter-electrode capacity of the valve is usually blamed for all of the trouble, the capacitative coupling between the various wires in the grid and anode circuits, as well as stray magnetic couplings, probably account for the greater portion of the effects. Stability in such circumstances can be obtained by introducing damping into either the grid or the anode circuit, or both, and as a matter of fact, in the past stability in receivers has often been the result of thoroughly bad design. For example, a high-loss coil in the grid circuit may introduce quite sufficient damping to stabilise the circuit, while a highly damped aerial, tightly coupled to what would otherwise be a low-loss grid circuit, may have a similar effect. Since my return from America I have devoted a good deal of time to studying the problems of stability and efficiency in high-frequency amplifying circuits. In the present article an attempt is made to provide data based on practical experiments conducted in my laboratory during the last few weeks.



Figs. 1 and 2.—Using the conventional barrel type of H.F. transformer, it was found that the tendency towards self-oscillation was less when the secondary was tuned (Fig. 2) than when the primary was tuned (Fig. 1).

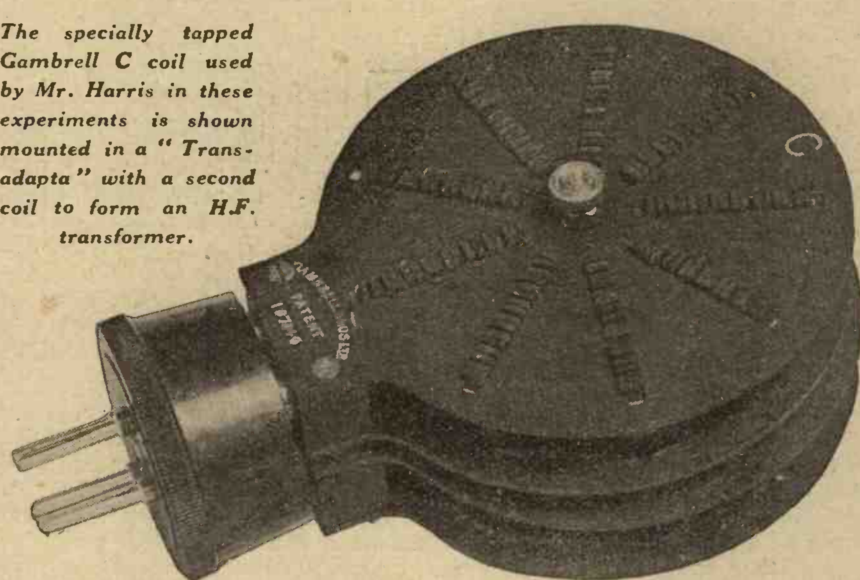
The Testing Set

In order to conduct these tests, a special testing set was constructed to enable rapid changes in circuit arrangement to be made with a minimum of trouble. For practically all the experiments three valves were used (high-frequency, detector, and one note magnifier). The tests are not claimed to be quantitative, but I hope they will give sufficient information to indicate lines of research which many of our readers may follow.

EUTRALISING METHODS

M.I.R.E., Assistant Editor.

vith various forms of H.F. -ibed in detail, supplying nteresting information.



The specially tapped Gambrell C coil used by Mr. Harris in these experiments is shown mounted in a "Trans-adapta" with a second coil to form an H.F. transformer.

Note Magnification

In the first experiment the instrument was arranged to have a reasonably low-loss grid circuit loosely-coupled to an aerial. The coupling between the high-frequency and the detector valves was provided by the well-known barrel type of high-frequency transformer. The detector was coupled to the note-magnifying valve by a transformer of good make, a suitable valve for note magnification being used. It is not necessary to give any details of the audio-frequency side, as this was quite conventional, the object of using the amplifier being to provide good clear signals and to avoid the necessity of wearing headphones during most of the experiments.

Oscillation Tendencies

To test the general tendency of such a set to oscillate, a bright emitter high-frequency amplifying valve was placed in the first circuit, this being followed by a good general-purpose valve for the detector. The primary of the high-frequency transformer was tuned. Choosing a normal voltage for the high-frequency and the detector valves, as indicated by the makers, the set passed into oscillation when the anode circuit was brought anywhere near the tuning point of the grid circuit. Actually with a .0003 μF condenser and the high-frequency transformer designed to cover the 1,000 to 500 kc. (300 to 600 metre) band, self-oscillation occurred over about 20 degrees of the condenser.

Tuning the secondary instead of the primary of this high-frequency transformer, leaving other conditions the same, brought about an appreciable reduction of the tendency to self-oscillation, for it was now found that this occurred over a band of only about 10 degrees. The next step was to substitute for the barrel type of high-frequency transformer a Gambrell "Trans-adapta," which enabled plug-in coils to be used as primary and secondary respectively. With a suitable Gambrell coil tuned to approximate to the values, for primary and secondary respectively, of the barrel type of transformer, and tuning the primary, oscillation took place over a much wider band than was the case with the barrel type of transformer. This was to be expected, as windings of this type are of lower resistance. On changing over to the tuned secondary, the tendency to self-oscillation was considerably reduced. Reversing the direction of one of the windings checked self-oscillation altogether.

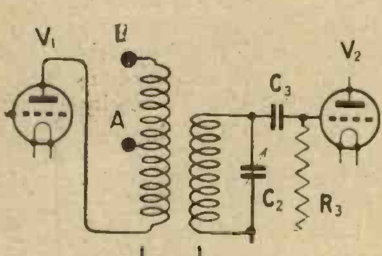


Fig. 3.—Showing one circuit arrangement using the special tapped coil as the primary of the transformer.

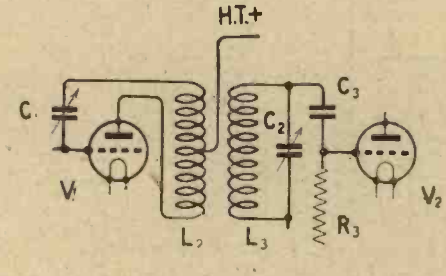


Fig. 4.—Here half the winding of a tapped C coil is used as the transformer primary, the other half serving as a neutralising winding.

Small Primary

Using two Gambrell C coils in the Transadapta as the high-frequency transformer and tuning the secondary, still using the valves above-mentioned, self-oscillation occurred over a band of about 10 or 15 degrees. Messrs. Gambrell recently prepared for me a number of C coils with tappings at the electrical centre, and I now used one of these tapped C coils as a primary, using only half of the winding (between one end and the centre tap of the primary winding itself). This, of course, had the effect of considerably reducing the coupling between primary and secondary, and I soon found that half the C coil loosened the couplings to such an extent that the tendency to self-oscillation was completely removed. A considerable increase in high-tension voltage still failed to set up oscillation, and it was not until I substituted, for the valves mentioned, two D.E.5 valves (which oscillate very freely) that oscillations were set up again. With suitably adjusted voltages, using these valves, there was sufficient feed-back, using half of the C coil, to give oscillation over a band of 6 to 10 degrees.

Reception Test

The next step was to wire up the circuit shown in Fig. 4, in which one-half of the C coil was used as the primary of the high-frequency transformer, the secondary of which was tuned, and the other half was used as a neutralising winding connected to a small neutralising condenser, joined to the grid of the high-frequency valve. This is the method used in the Grebe Synchrophase receiver, which I have found gives such excellent results. The method is quite old and was given in *Q.S.T.* in January, 1924. I soon found that the circuit neutralised admirably, and proved to be highly efficient when tested on signals, a number of the Continental stations working the loud-speaker at full strength. When testing on signals an A coil, untuned, was used as a semi-aperiodic aerial coupling to a C coil in the grid circuit. The tapped C coil was used as a primary, and a further C for the secondary.

High-Tension Voltages

Before the neutralising circuit was connected up, using only

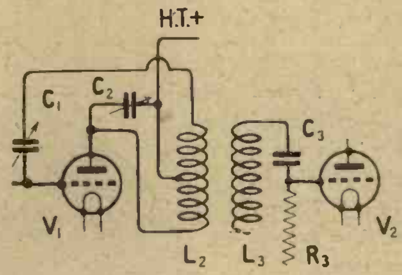
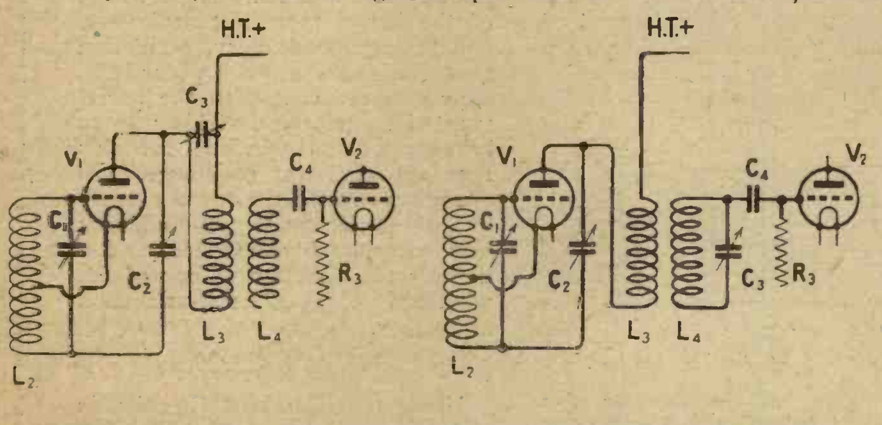


Fig. 5.—Tuning the primary of the transformer in this circuit showed an improvement over the results obtained with the Fig. 4 circuit.

half of the C coil as a primary, it was found that with D.E.5 valves, 42 volts high tension was sufficient to produce oscillation. On a reduction to 36 volts the set was stabilised but possessed no great amplification properties. With the neutralising circuit, as shown, joined up, any voltage desired could be used and the set could be stabilised by adjusting the neutralising condenser.

Tuned Primary

The next experiment was to tune the primary instead of the secondary, as shown in Fig. 5. On all tests on signals and without quantitative measurement, this seemed to give better results than was the case when the secondary was tuned. The adjustment of the neutralising condenser was found much more critical, however. Excellent signal strength was obtained as before.



Figs. 7 and 8.—Two forms of the American "Rice Circuit," with tuning of the primary and secondary of the H.F. transformer respectively.

A Stable Circuit

The next circuit (Fig. 6) was particularly interesting, as the neutralising winding was in the grid circuit of the valve, leaving the anode circuit quite free of any

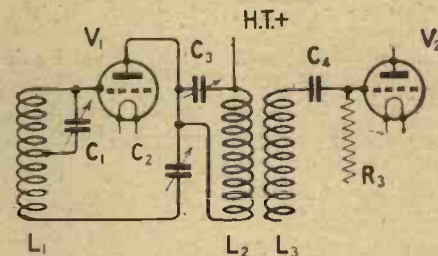


Fig. 6.—A form of circuit which was found capable of being stabilised with little difficulty.

special winding, thus enabling the barrel type of high-frequency transformer, as well as the Transadapta, to be tried. This circuit neutralised easily, and once the setting had been found, it "stayed put" over the whole band of wavelengths covered by the .0003 μF condenser. The tuning of both primary and secondary of various makes of barrel transformers and Transadapta was tried. The Transadapta transformer proved, as would be expected, the more efficient arrangement, although all the well-known makes of barrel-type transformers showed up well.

Filament Protection

The next experiment was with the circuit known in America as the Rice Circuit, shown in Figs. 7 and 8. Here it will be seen that the whole of the grid circuit inductance is tuned by the variable condenser, while the filament is taken to the centre tapping. In all these experiments the same neutralising condenser was used (that made by Messrs. Gambrell), but as in this type of condenser it is very easy to short-circuit the plates, it is advisable to place in series with it a .01 μF or larger value condenser, to prevent accidental damage to the valves. This procedure is strongly recommended to those who may repeat these experiments, for examination of a number of circuits given will show that contact between the plates on the neutralising condenser will cause an immediate burn-out of the valves.

The Rice Circuit

The Rice Circuit, tried with tuned primary and tuned secondary, neutralised easily and kept its adjustment over a wide band of wavelengths. The next experiment consisted in substituting for the transformer a tuned anode coupling, as shown in Fig. 9. This

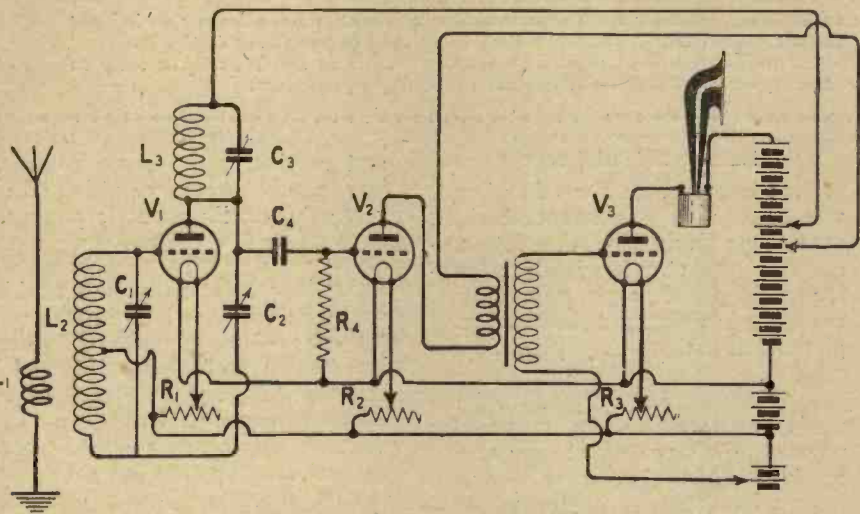


Fig. 9.—This modification of the Rice Circuit, employing tuned anode coupling, was found to be distinctly better than the circuits employing conventional H.F. transformers.

again was easily stabilised, and seemed to give distinctly better signals than the transformer method, either with a tuned primary or a tuned secondary.

Suitable Coils

All the experiments above described can be performed with any reasonably efficient inductance which has a central tapping. Messrs. Gambrell will supply the tapped C coil upon request at a very small extra charge, or single-layer solenoids with a central tap can be used. Two low-loss inductances, for example, will work admirably in the Rice Circuit, the coil used in the grid circuit having the central tap as indicated.

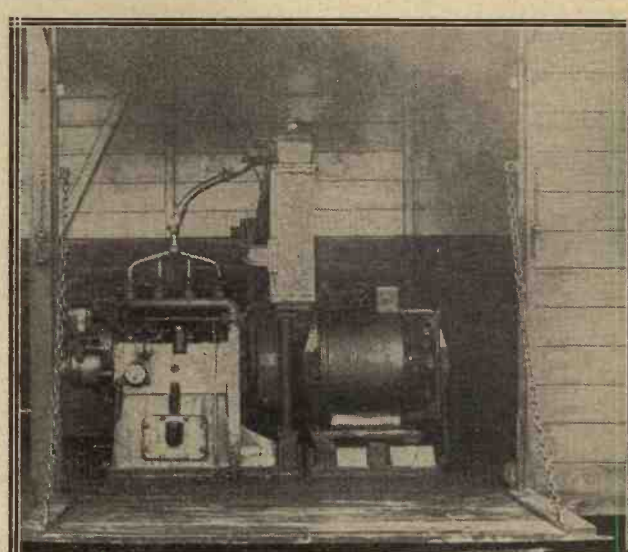
Selectivity

So far as selectivity is concerned, none of the arrangements given above was at all brilliant, even when, as in the case of the Transadapta, the coupling was made very loose, with a small coil for the primary. Real selectivity, however, was obtained by using a high-frequency transformer recently placed on the market by Messrs. Peto Scott; the secondary of this consists of a single-layer coil of fairly heavy wire, spaced, while the primary consists of a fine wire winding on a small X former, placed inside one end of the ebonite tube carrying the secondary. Messrs. Peto Scott kindly made up for me a number of transformers with double-sized primaries. I then tapped these in the middle and tried them with the circuit indicated in Fig. 4. Quite good results were obtained with this high-frequency transformer, and the coupling between primary and secondary was sufficiently weak to prevent sufficient feed-back to set up self-oscillation. Selectivity was far greater than with either the barrel type or the Transadapta type of transformer. It was found possible to use a real low-loss grid circuit, and to tune the secondary of this transformer, getting quite good signals without any self-oscillation occurring at all, even when the grid of the first valve was made negative. It must not be forgotten that the detector valve introduced quite considerable damping in all the experiments described so far, so that the problem of stabilising one stage of high frequency is not anything like so difficult as stabilising two.

An Additional Stage

The results with this type of transformer were so promising that I set up a circuit to use two stages of high-frequency amplification, both coupled with this type of transformer. With two stages, self-oscillation occurred over a considerable band, when using them as plain high-frequency transformers. By utilising the central tapping, as in the circuit shown in Fig. 4, stability was readily obtained with high efficiency and considerable selectivity. At my suggestion Messrs. Peto Scott have now made these transformers with the tapping brought out to an extra pin, so that there are now five pins, instead of four as in the original instrument. As a result of the experiments described, I have now constructed a complete five-valve receiver of very high selectivity, using two stages of high-frequency amplification, coupled with the new transformers, neutralised by the circuit given in Fig. 4. A full description of the instrument will be given in the November issue of *Modern Wireless.*

A car-type petrol engine is used to drive the generator fitted on R.A.F. lorries for the power supply to the transmitters of ground stations.



A further article by Mr. Harris, on this subject, will appear at an early date.

"Plastic" Radio by the Kluth System

By Dr. ALFRED GRADENWITZ.

Experiments in "Stereoscopic Broadcasting" mainly with transmitting apparatus have been carried out in this country by Capt. H. J. Round, M.C., M.I.E.E., and others, as described in the issue of "Wireless" for September 26. The present article gives details of experimental work done in Berlin, with a view to obtaining similar stereophonic effects with special receiving equipment.

OUR readers have possibly wondered why even the most perfect broadcasting of music fails to convey an enjoyment comparable to that of direct listening. Is it possibly because our most important sense organ, the eye, is excluded from co-operation, or is it due to slight defects inseparable from even the best reproduction? The true cause has lately been found to be a defect similar to that of one-eyed vision.

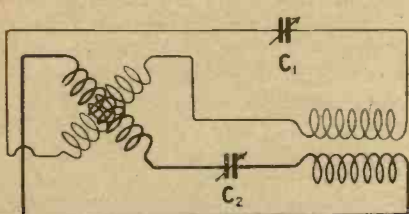


Fig. 1.—Illustrating an arrangement using a vario-coupler for setting up a phase displacement from 0 to 360 degrees.

A conception of space, in fact, is known to be due mainly to the cooperation of the two eyes, each of which, on account of their not inconsiderable distance apart, receives a slightly different visual picture of its surroundings.

Binaural Hearing

That even our sense of hearing is connected with conceptions of space has so far been mostly left out of account, though the mutual distance of the two ears, which is about 8¼ in., is bound to bring a sound coming from the left, for instance, a little later to the right than to the left ear, so that the acoustic perceptions corresponding to the two ears, in spite of our remaining unconscious of the slight difference in time, are bound to differ from one another. Just as our sense of vison fuses the left and right eye impressions into a single plastic picture, hearing amalgamates the acoustic perceptions corresponding to the left and right ears respectively into a single plastic conception, which is further accentuated by individual sound differences.

Effect of Headphones

Broadcasting, on the other hand, will convey to our left and right ears respectively (by the intermediary of the two headphones) perfectly identical oral impressions, resulting in a flat and shallow sound picture devoid of any plastic perception.

Endeavours have therefore been made to devise some means by which the left and right ears might receive slightly different acoustic impressions, just as in direct listening, the right ear, in accordance with the distance separating the two ears, receives a slightly different impression from the left ear.

Two Microphones

If two microphones separated by a corresponding distance were used as sound recorders, two separate lines of conductors being relied upon to lead the microphone currents to the left and right headphones respectively, a sound would be heard in exactly the same manner as though the two ears were substituted for the microphones; *i.e.*, this arrangement would convey a perfectly natural, plastic (that is to say, three-dimensional) impression. If, on the other hand, the two lines of conductors between the microphones and telephones respectively are replaced by two radio transmitters and receivers, the same phenomenon would occur, resulting in a perfectly plastic acoustic picture.

An Alternative Method

Another solution of the problem could be conceived of in theory as follows :—Microphone vibrations are known to be superimposed on electric waves. Inasmuch as two microphones installed at a short distance apart are able to record the phase difference required for a plastic acoustic picture, the vibrations recorded by the two microphones could be superimposed on a single train of electric waves. The waves issuing from the radio transmitter would then carry the phase difference and the radio receiver would receive it.

An Incomplete System

However, inasmuch as this phase difference is communicated simultaneously to both head-phones, both ears are bound to receive the same acoustic picture, thus excluding any actual plasticity. In fact, the electric waves generated by the two microphones respectively, and carried by the same train of broadcast waves, would have to be disentangled so as to cause those corresponding to the first microphone to be received by one and those recorded by the second microphone by the other head-phone. While this process in theory would seem

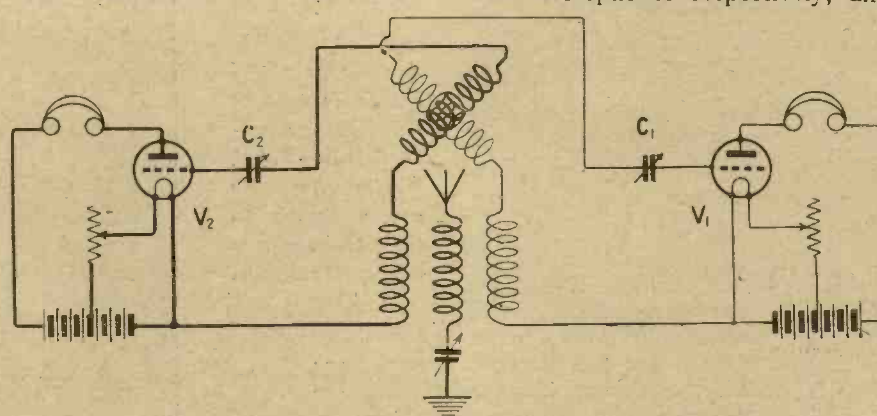


Fig. 2.—A circuit which may be used for producing phase displacement in high-frequency currents.

to be quite feasible, it has not yet been carried out in actual practice.

The Kluth Method

A German radio engineer, Dr. H. Kluth, of Nauen, has devised a new process based on a phase displacement of the waves striking the broadcast receiver, the transmitting station being, as usual, operated with a single microphone.

A shifting in phase of high frequency vibrations as obtaining in a radio receiver could, with relative ease, be obtained with the aid of a variometer free to rotate through 360 degrees. The circuit of Fig. 1 illustrates a simple arrangement enabling a phase displacement from zero to 360 degrees to be obtained in accordance with the actual position of the variometer.

No Stereophonic Effect

If this arrangement were used with the radio receiver it would entail the use of two valves

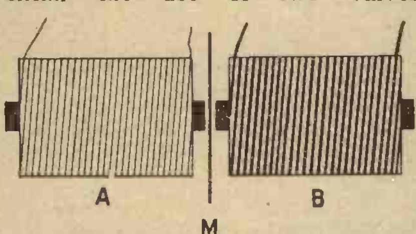


Fig. 3.—The membrane M, vibrating between two electro-magnets, A and B, produces a phase displacement of 180 degs. in a telephone circuit.

(Fig. 2), causing the original high-frequency current and that shifted by a fraction of a phase to be supplied to head-phones 1 and 2 respectively. This arrangement has much to commend it, and has been found to work without any hitch, but the setting up of a phase difference has proved to be utterly unable to convey an impression of plastic hearing. The following instance will serve to make this clear:—

If the transmitter be operated, say, at a frequency of 600 kc. (500 metres), there would be as many as 600,000 vibrations per second, corresponding to a relatively small number of acoustic vibrations, so that each high-frequency vibration would carry only a minute portion of a sound vibration. The arrangement above described will accordingly enable a sound vibration to be shifted at most by a few thousandths of its length.

Phase Displacement in Telephone Current

This failure to obtain an adequate phase-shifting by acting on the high-frequency current leads up to the actual solution of the problem as devised by Dr. Kluth, *i.e., a phase displacement in the telephone current.* Telephone currents, of course, have the same frequency as the sounds they set up in a telephone receiver; for the note A, for instance, it is 435. This sound could accordingly be shifted through one half vibration by a 180-degree phase shifting. However, a shifting of about 100 degrees is quite sufficient to obtain an impression of plastic hearing.

A Practical Example

The acoustic vibration corresponding to note A is about 29½ in. in length, and a sound coming, say, from the left would have to travel through a distance about 8¼ in. longer (corresponding to the mutual distance of the two ears) from the left ear to the right, thus undergoing a lag of 21/75 vibrations. Inasmuch as a lag of 29½ in. would correspond to a phase displacement by 360 degrees, a 8¼-in. lag would correspond to a 100-degree phase displacement. If on the phase of the telephone current could be impressed a lag of about 100 degrees, this deferred current being supplied to the second head-phone, the impression of a plastic acoustic picture would be produced by artificial means.

Use of Separate Induction Current

As regards, next, the means to be adopted in producing a phase displacement in a low-frequency current constituting a telephone current, the most obvious would be the insertion of a resistance. This, though reducing the current intensity, would, however, be unable to act on the rate of current flow. If, on the other hand, so far from

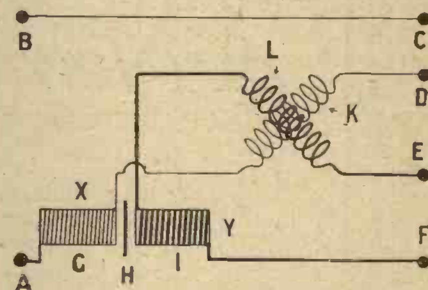


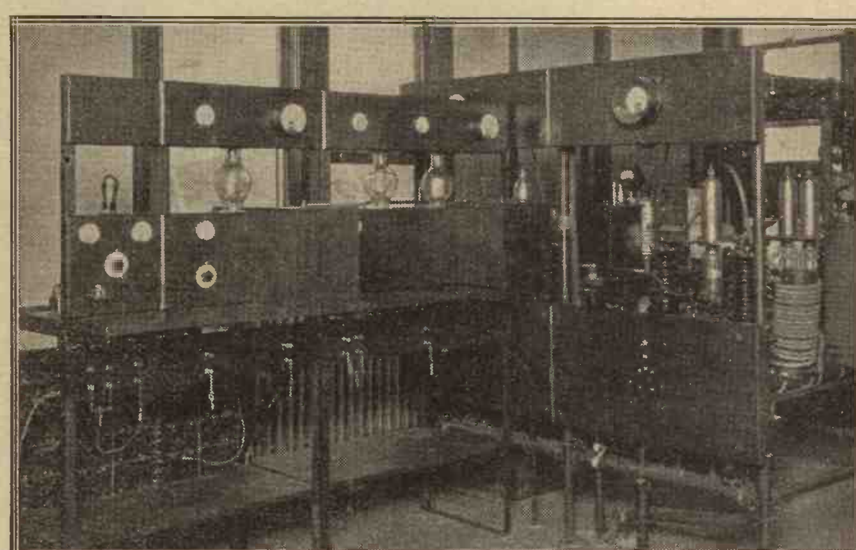
Fig. 4.—The circuit diagram of the stereophone developed by Dr. Kluth.

altering the original telephone current, means were devised for setting up a separate induction current for the second telephone, an approach to the ideal solution could be obtained, while a fully satisfactory solution will be found to result from a very simple additional arrangement.

Electro-magnets in Opposition

A transformer traversed in its secondary winding by the same current as in the primary winding could be used in this connection, though a more suitable alternative is the use of a combination of two electro-magnets between which a membrane is free to vibrate (Fig. 3). As the current in magnet A is

(*Continued on page 207.*)



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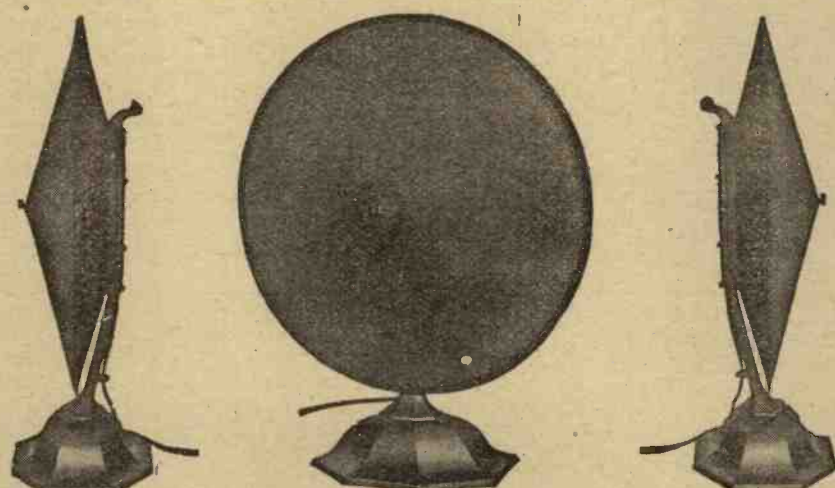

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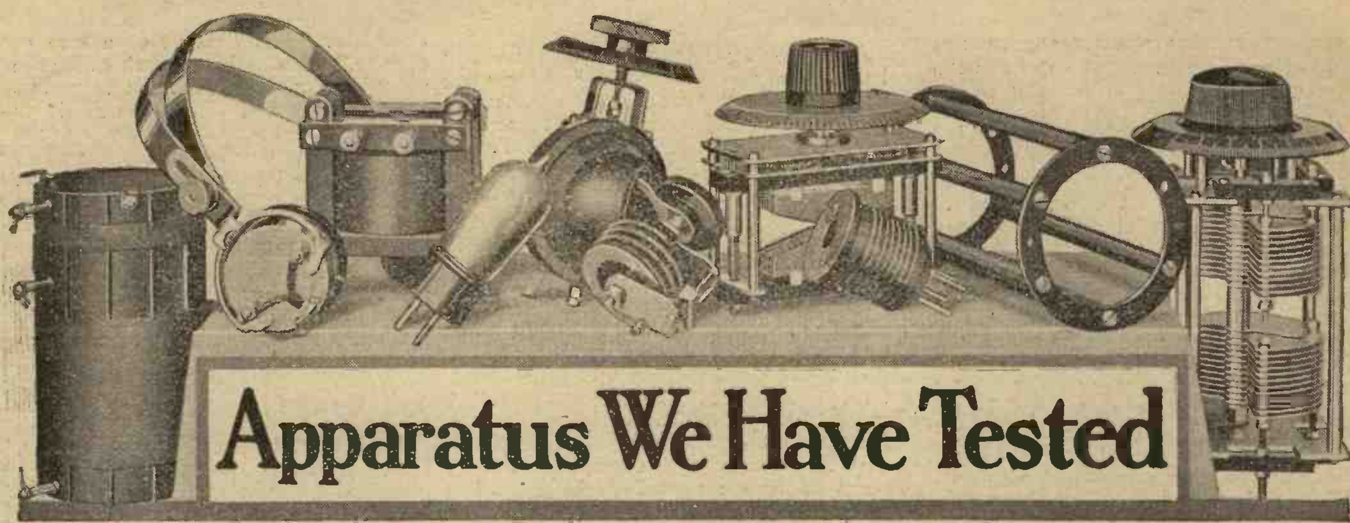


Apparatus We Have Tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

Panel-mounting Vanicon Variable Condenser with "Vernier"

Messrs. Dubilier Condenser Co. (1925), Ltd., have submitted an example of their panel-mounting "Vanicon" square-law condenser equipped with a single-plate "Vernier," operated by a concentric spindle and small co-axial knob above the main one. This has the familiar features of the "Vanicon" series, which have been reviewed from time to time in these columns; the false-panel mounting, substantial pig-tail connector to the rotor plates and large terminals, etc.; in addition a single plate is carried on the "vernier" spindle below the main condenser for fine adjustment. Measurement of the maximum capacity showed a value rather above the nominal of .0005 μF, a rather high minimum for a "square-law" type of 16 $\mu\mu$F, and a fine adjustment range of 27 $\mu\mu$F. The insulation resistance, however, on moderate D.C. voltage was but 50 megohms, and on trial in a sensitive oscillating valve circuit a decided increase of resistance was noticed. We cannot but think this is not representative of the usual high standard of Messrs. Dubilier, and must be due to some chance defect. Careful removal of dust from between plates and adjustment of the air-gaps produced no change.

"National" L.F. Transformer

A sample of their "National" L.F. intervalve transformer has been submitted by Messrs. National Wireless and Electric Co. This instrument is a small hedgehog type of transformer sealed into a polished metal case of rectangular form with a pitch-like substance, the leads to the terminals arranged on the insulating cover of the case being protected by lengths of insulating sleeving where they pass through. On test, the insulation-resistance between windings and from the primary to the casing was fair (120 megohms); the secondary winding was found to be short-circuited to the case. The D.C. resistance of both primary and secondary was normal, though the latter was not of a high order. In practical trial in comparison with our standards and with optimum conditions as to power-valves, ample H.T. and grid-bias, and with good loud-speaker equipment, the amplification was found to be poor and the tone decidedly thin and tinny, indicating a deficiency of impedance in the primary. We cannot, therefore, recommend this transformer in its present form.

"Ifix" Connector

An exceedingly useful little component, which will appeal particularly to the amateur who dislikes soldering and to the inveterate experimenter who wishes to change his behind-panel wiring half-a-dozen times during a session, is the "Ifix" connector, samples of which have reached us from W. E. Bottom. These are intended for application to the back stud of terminal screws, etc., on a panel, and are, we understand, to be supplied in Nos. 2, 4, 5 and 6 B.A. sizes; those submitted for test were of the No. 4 B.A. size.

The device consists essentially of a back nut, into a recess in the end of which is held a short slotted sleeve, which can rotate in the nut. When the nut is screwed up on the back stud the end of the latter enters this sleeve, and will evidently hold securely the end of the bus-bar or wire inserted in the slot in the sleeve by pinching it against the end of the slot. The latter is long enough to accommodate two bus-bar wires, and since the sleeve can swivel in the nut the wire can approach the terminal at any convenient angle. By applying the device to a plain screw passing through the panel, a long bus-wire can be anchored at its middle, for extra security in complex wiring schemes. Practical trial showed also that a very neat low-capacity valve-holder could be built up on the panel with four valve-leg-sockets and four of these connectors behind, the connecting wires being thus well spaced.

On trial it was found also that for temporary wiring these devices gave a secure connection, holding one or two wires firmly, but allowing of immediate changes. It is one of the few connector devices which will hold the end of 7-22's aerial wire really securely. We can certainly recommend these connectors for the purposes indicated; on the score of neat appearance alone we imagine that they will prove very popular amongst home constructors.

"Five-point" Crystal

A number of samples of their new "Five-Point" crystal have been submitted for test by Messrs. Mikro, Ltd. These were of two types: a hard, yellowish mineral with broad, highly-polished facets, recalling pyrites, and cubical masses with an almost satin-like sheen, which appeared to be of the same material in a very fine state of sub-division, and extremely hard. When tested on powerful local broadcast signals, with an ordinary cat-whisker, there were only slight signs of rectifying properties, and at isolated spots hard to find; the best gave some 10 microamperes only, and in the reverse direction, in comparison with ordinary galena that registered 28 microamperes in the same circuit.

Tested in conjunction with zincite, bornite and tellurium, there was no improvement, and the metal used for a whisker appeared not to affect the result sensibly. It is quite probable that so insensitive a crystal would stand up to the use of reaction in a dual-amplification circuit, as the makers claim, but it is evident that greater sensitiveness than that which these samples showed in our tests is desirable even in a dual circuit.

"Aermonic" Back-of-panel Coil-holder

A two-coil-holder, for mounting by the popular one-hole-fixing device behind a vertical panel, has been submitted for our inspection by Messrs. V. R. Pleasance, Sheffield. This has the stationary coil arranged right up against the back of the panel; the moving coil is pivoted and swings through an angle of 90 degrees at a distance of about 1¼ in. away from the first, giving a good range of coupling. A neat handle and black graduated scale are provided outside the panel to control and indicate the degree of coupling in use. We were glad to notice the substantial plain shaft and locking-screw to fasten this handle securely on the shaft. The movement of the spindle is frictionally controlled, an adjusting screw being provided to regulate the friction; as a result, the larger sizes of coils can be handled successfully and smooth control over reaction-coupling is possible. Large soldering tags are provided for flex connections to the coil-plugs. On test, the insulation resistance was excellent. The finish and the workmanship appeared to be high-class. The controlling handle might, with advantage, be made somewhat longer if for use in critically-tuned circuits.

"Foote Variotector" and Pyrite Crystal

Messrs. Sanders Bros. & Co., Ltd., have submitted for test examples of the "Foote Variotector," an enclosed crystal-detector with a semi-automatic crystal setting device of a curiously primitive type; and of a "Pyrite" crystal refill for the same. The crystal in each case showed a large, flat and highly-polished surface; the direction of rectification was the reverse of that with ordinary galena, to which this crystal bears no resemblance, though a cat-whisker is used in conjunction with it. As submitted, the whisker consisted simply of a coil of springy wire with a rounded end, *i.e.*, no sharp point or projecting single wire end. The setting was by simply screwing the small spindle on which the whisker was mounted down towards the surface of the crystal within the opaque case until signals were heard. Set in this way, when tested on local broadcasting, the microammeter registered a mean of 11 microamperes in six consecutive blind settings of the whisker, no setting being really poor, as against some 28 microamperes for a carefully hand-set galena crystal. By slightly bending the end of the coiled whisker so that a point became available, the average for six settings rose to 15 microamperes, with fairly consistent readings, only one poor setting being obtained in six. As a "fool-proof" device in cases where some sacrifice of signal-strength can be made for the sake of easy setting of the crystal, this simple device has evident merits. The mounting is neat and compact; one-hole-fixing is provided, and a small terminal and soldering tag respectively for connections. The body of the instrument is but 1 in. long and ¾ in. in diameter, with a small knob only visible above the panel. It is neatly finished in nickel-plate, and a plated knurled nut is provided for fixing the whisker-holder when a good setting has been found.

"Yesly" Filament Rheostat

Messrs. Engineering Supplies, Ltd., have submitted for test a sample of their "Yesly" Soft Tread Filament Control for D.E. valves. This is mounted in a circular bakelite and polished nickel case 1¾ in. in diameter, with the customary one-hole-fixing device and with two small terminal screws, provided with soldering tags at the back of the case. A large knob of good appearance, provided with a substantial set-screw for fixing it on the ¼-in. plain shaft and with an unusually clear indicator, is all that is visible outside the panel when in position. A special design of spring contact-brush operates on the inside of a flat spiral of resistance wire within the dustproof case. On test, the maximum resistance proved to be around 30 ohms, and the instrument controlled an ordinary .06 type of D.E. valve well and smoothly when used in conjunction with a 6-volt accumulator. The adjustment was unusually smooth and silent. The appearance, finish and workmanship in this rheostat are of the highest class. Although not a low-priced component, it can be confidently recommended for the most exacting work.

"Yesly" Combined Grid-Leak and Condenser

From Messrs. Engineering Supplies, Ltd., comes a sample of a combined grid-condenser and grid-leak, mounted on a small insulating base measuring about 2⅝ in. by 1 in., both the grid-leak (of customary external form) and the tubular condenser being held between spring clips which permit of instant replacement when required. The nominal values of condenser and leak were marked .0003 μF and 2 megohms respectively. On measurement, the first was found to be much nearer to .0001 μF than to the nominal value, and the leak-value was also found to be decidedly on the low side. The discrepancy was rather far from the usual commercial standard in the first instance, though on actual trial in the reception of the local broadcasting the instrument operated satisfactorily. The H.F. resistance of the condenser, when used as the main tuning capacity in an oscillating circuit, was found to be quite appreciable, so that a valve would only oscillate with powerful reaction in use; the D.C. insulation-resistance of this condenser was adequate, though not as high as one might expect in such an instrument. With rather greater accuracy of rating, this compact arrangement of grid-leak and condenser on the same base may find many uses. Rather larger and more convenient terminals would be preferable.

Barrie's Antiphonic Valve-Holder

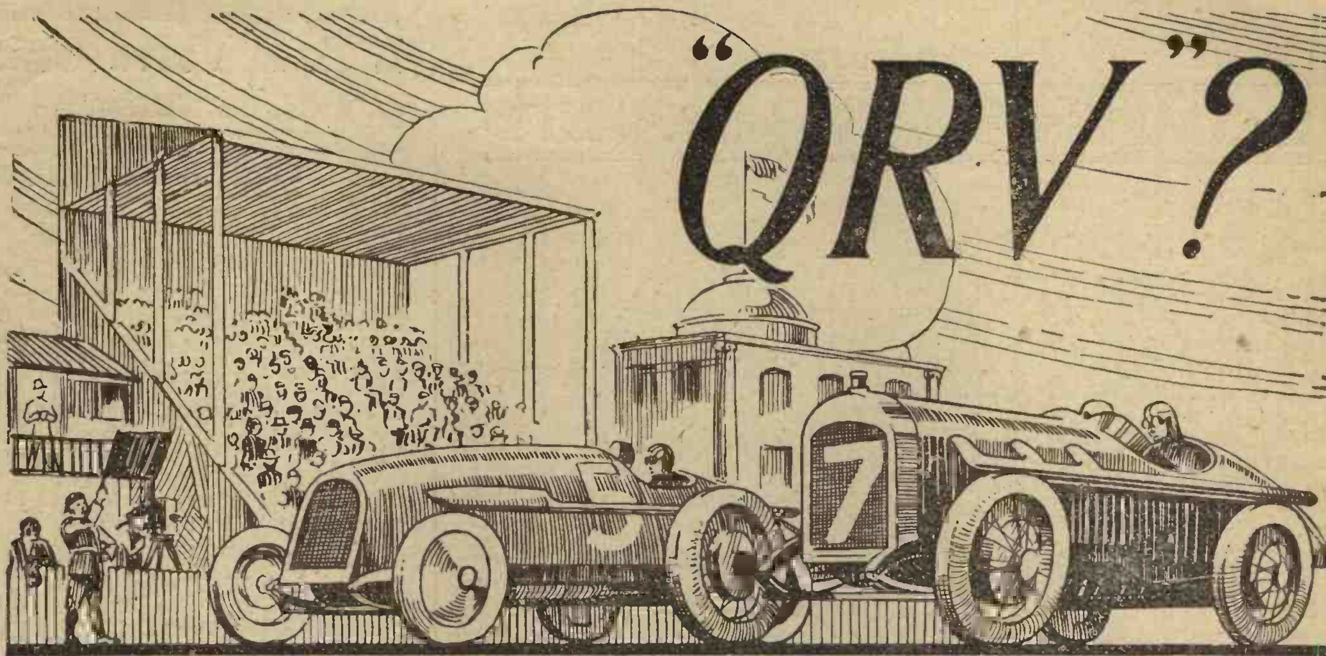
A moderate priced valve-holder for which antiphonic properties are claimed is the "Barrie's" holder, samples of which have been submitted by Messrs. Enterprise Manufacturing Co., Ltd. This consists of a disc of ebonite, with small inset sockets for the valve-legs and with soldering tags affixed by small side screws; it is adapted for fastening down on the panel on a cushion-disc of spongy rubber material by a central screw. As the latter, however, must necessarily be secured firmly in the panel, it is difficult to see how the valve is isolated from the effects of mechanical shocks by this device, especially when, in addition, the four leads are soldered firmly to the connecting tags.

Watmel Fixed Condenser

A compact type of fixed condenser, for general use in reception circuits, has been brought to our attention by Messrs. Watmel Wireless Co., Ltd. This is contained in a circular bakelite case 1⅛ in. diameter and about ½ in. deep, with two large soldering tags projecting out through the sides. A tubular rivet through the centre provides accommodation for a fixing bolt. The condenser is made up of alternate ring-shaped leaves of thin mica and copper foil, with stouter end-plates, the whole being held together by the central tubular rivet. No wax is used in its construction; the nominal capacity is plainly stamped on the front of the case in white figures. The .001 μF nominal size submitted for test showed, on measurement, an actual capacity extremely close to the nominal, and there were no signs of unusual H.F. resistance when tested in an oscillating circuit. The condenser is of sound design and evidently carefully assembled; it can be recommended to home constructors, though some might prefer to see adequate terminals in place of soldering tags alone.

"Pinorspade" Terminals

Samples of their "Pinorspade" terminals have been submitted for test by the Turner Tool Manufacturing Co. As the trade name of these terminals implies, they are constructed in such a way as to permit of ready connections being made to them by means of leads with either pin or spade end tags. A milled sleeve is normally pressed firmly against the top of the terminal by means of a strong spring. The sleeve and the top of the terminal are both furnished with grooves, which provide a good grip for a spade tag when it is inserted between them, the sleeve being pressed down against the spring for this purpose. Holes are also drilled through the sleeve and the terminal shank. To secure the pin-shaped telephone tags or plain wire ends the sleeve is pressed down and rotated till the holes in it register with the hole in the shank. The pin or wire is then inserted, and, when the sleeve is released, the pressure of the spring ensures a firm connection. These terminals can be supplied either nickel plated or gold lacquered, the finish of them being good.



Are you ready?

In radio communication, the letters "QRV" followed by an interrogation mark mean "Are you ready?" The station in reply sends "QRV," "I am ready" (no interrogation mark) and the interchange of messages begins. Are you ready for the long winter evenings when you will spend a good deal more time with your radio?

Whether you intend to build a new receiver or re-design your old set, choose your components wisely. MH Components are, in every detail, reliability itself. Forethought and care in design and construction makes them so. Specify MH Components and assure yourself of better radio reception at all times.

MH Filament Rheostats

A distinctive type made for use with all types of valves.

	Prices, each
Bright Emitter Filament Rheostat	5/6
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MH Mica Fixed Condensers

Are of the permanent capacity engraved thereon. Are instantly interchangeable.

PRICES	each
0·0001 μF to 0·001 μF (030)	1/9
0·0015 μF to 0·01 μF (031)	2/3
0·015 μF to 0·03 μF (034)	2/6

(Two clips are supplied with each condenser)

Above, mounted on ebonite base, with terminals, any value, 1/- extra.

MH H.F. Transformers

"The Transformer that made H.F. amplification popular."

Supplied in six ranges of wave-lengths, covering 80 to 7,000 metres Price 10/- each.

Special MH Neutrodyne Units and Superheterodyne Couplers also supplied.

No extra charge for matching, if requested when ordering.

MH H.F. Damper, Price 2/-

With H.F. Transformer, Price 12/-

The H.F. Damper is a device which, when inserted in the central hole of the H.F. Transformer, stabilises a circuit which otherwise could oscillate.

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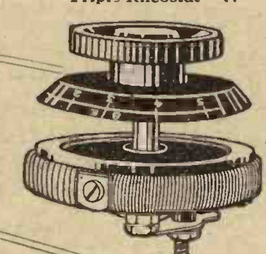

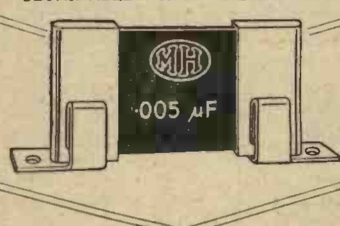

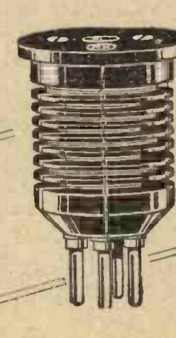

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THE S.T.100

SIR,—You will, no doubt, be interested to know that with your S.T.100 (Radio Press Envelope No. 1, by John Scott-Taggart, F.Inst.P, A.M.I.E.E.), I have received about a dozen American and Canadian stations. I have constructed my set exactly to your Radio Press Envelope instructions, the valves used being Cossor P2 and Mullard ORA. There are many S.T.100 sets round here, and I have known cases of Madrid and Breslau being received and confirmed.

Best wishes to your excellent publications.—Yours faithfully,

WM. H. RENNIE.

Kilmarnock.

P.S.—Needless to say, of course, all British stations are easily received.

SIR,—I am writing to thank you for the information given to me by a member of your staff.

As mentioned to him, I have just made up an S.T.100 set from the instructions given in your Radio Press Envelope No. 1, by John Scott-Taggart, F.Inst.P., A.M.I.E.E. I am an amateur, and have only been interested in wireless for a matter of a few months. I had the pleasure of trying out the set recently, and got very good results indeed at loud-speaker strength on an indoor aerial.

I got this result at the first attempt at tuning the set, and without any alterations being made whatsoever, using the terminal " C " for the aerial connection with a fixed 75 coil and a 50 movable. I had no assistance whatever in making up the set, but just closely followed the instructions given. Total time taken in making up the set—one afternoon and two evenings.

I used one or two different components from those given in the list, but, of course, bought all the components ready made. I am giving you this information, as it may be encouraging to other amateurs.—Yours faithfully,

H. O. EDWARDS.

London, S.W.1.

ENVELOPE NO. 4.

SIR,—I have constructed a four-valve set, which I have designed myself, using your " Family " Four-Valve Circuit (Radio Press Envelope No. 2, by Percy W. Harris, M.I.R.E.).

All such unsightly things as valves, plug-in coils, are hidden within the cabinet, while a most simple movement will slide the panel and baseboard clear of the cabinet.

The top of the cabinet is hinged, so as to be convenient in changing valves or plug-in coils, or inspecting the gear within.

The results with this circuit of yours are amazing. I am chief electrical engineeer of the motor-ship mentioned below, and while crossing from New York to London, with an aerial eighty feet long, I was able to get stations such as WDAP Chicago, KSD St. Louis, WJAX Cleveland, and WSAI Cincinnati, etc., when the ship was half-way over. When 200 miles from Land's End, I was still able to get KDKA Pittsburgh, WEAF New York, WDAR Philadelphia, WGY Schenectady, and WOR Newark.

All the British stations came in soon after leaving New York.—Yours faithfully,

ROBERT N. MASON.

M.S. *Mississippi*, London.

ENVELOPE NO. 10

SIR,—I think it might interest you to know that I have made the " Twin Valve Loud-Speaker Receiver," described by John Scott-Taggart, F.Inst.P., A.M.I.E.E., in Radio Press Envelope No. 10, and that I am obtaining splendid results. I made the set chiefly for loud-speaker reception, which I get from the Daventry station with splendid volume and clarity. I get most of the main B.B.C. stations on 'phones, 2LO coming in so strong that I have to tune it down. My aerial is 70 ft. long and 30 ft. high. I am more than satisfied with the results I am getting from this set. I have also made several other Radio Press receivers, and all have been a success.

Wishing Radio Press papers every success.—Yours faithfully,

GORDON CHAPMAN.

East Dereham, Norfolk.

A lifeboat equipped with wireless, which is being exhibited at the Manchester Wireless Exhibition, set out to reach its destination via the Manchester Ship Canal.

THE " ANGLO-AMERICAN " SIX

SIR,—I notice that you ask for reports from readers building any Radio Press set. I built the " Anglo-American Six Receiver " in February last almost exactly to specifications given by Percy W. Harris, M.I.R.E., in *The Wireless Constructor* for January. I have fitted a single-coil holder between plate and transformer primary of the detector valve, and thus use magnetic reaction on waves of 5,000 to 20,000 metres. This socket is shorted below 5,000 metres. I use three Cossor P2 valves for H.F., Cossor P1 for detector and two Marconi " R " valves for L.F.

Regarding the range of the set, all the main B.B.C. stations come in on the loud-speaker, and the following relays come in well:—Edinburgh, Stoke, Nottingham, Hull and Liverpool, the latter being deafening, as the set is used in Wallasey, about three miles from Liverpool.

Foreign stations:—Eiffel Tower (telephony and spark), Radio-Paris, Berlin, Ecole Superieure, Madrid, and several unidentified. I have also received WBZ, KDKA (long wave) and WJZ on the loud-speaker.

On the long waves, 5,000-20,000 metres (with magnetic reaction), Eiffel Tower on spark and C.W., Nauen on C.W., Moscow (MSK) on spark and C.W., Eilvese (OUI), Carnarvon (MUU), Lyons (YN), Annapolis (NSS) and many others have been received.

Trusting that this letter will be of interest, as I regard this set as the " last word " in range and power.—Yours faithfully,

A. PRYOR.

Llanberis, N. Wales.

THE TRANSATLANTIC "V"

SIR,—Having built the "Transatlantic V" in accordance with instructions given by Percy W. Harris, M.I.R.E., in the June, 1924, number of *Modern Wireless*, I consider it my duty to report on the splendid results obtained with this particular receiver.

The set has to work under the most unfavourable conditions imaginable, my flat being situated on the third floor of a block of houses encircled on three sides by tram lines and quite close to several theatres and newspaper offices with dismally antiquated electrical installations. This means that I have to put up with a great deal of unwelcome noises besides the usual nuisance of atmospherics and Morse signals. The Zurich broadcasting station is only four miles distant. My earth lead has a length of nearly 90 ft., and the only possible means of putting up an outdoor aerial is to make use of a form of basket aerial. There is any amount of screening from surrounding high buildings, trees and even hillsides.

Before building the "Transatlantic V" I tried quite a number of receivers, from an 8-valve American Neutrodyne set down to the more modest 3- and 4-valve sets of different makes. The result was lamentable, and I was on the point of giving the whole thing up as utterly hopeless when my attention was drawn to the good results obtained elsewhere with the "Transatlantic" type of receiver. It was a sort of last straw, but ultimately it proved to be *the* straw to help me out of my wireless difficulties.

I may mention that with my "Transatlantic V" I cut out the local station without making use of a wave-trap whenever I want to listen-in to foreign stations. Of these latter Daventry comes in with huge volume on the loud-speaker both during the day and evening, and so do Paris and Konigswusterhausen, all of them well over 400 miles distant. On the shorter waves I get London, Bournemouth, Cardiff, Rome, Madrid, Radio Toulouse and several German stations, all on the loud-speaker and without interference from the local station.

I am using throughout "Phillips" dull-emitter valves, type A410 for the two high-frequency stages and detector, and type A406 for the two note-magnifiers. I have to make use of a No. 35 reaction coil to get best results.

I should be pleased if my report would prove helpful to other beginners in the wireless line.—Yours faithfully,

Zurich. M. A. ZUEST.

A FOUR-VALVE T.A.T. RECEIVER

SIR,—In March last I constructed this set as described in the December, 1924, number of *Modern Wireless* (by John Scott-Taggart, F.Inst.P., A.M.I.E.E.), and after nine months of constant use I desire to testify to its wonderful efficiency. I have previously constructed the "S.T.100" (Radio Press Envelope No. 1, by John Scott-Taggart, F.Inst.P., A.M.I.E.E.), and the "Family Four" (Radio Press Envelope No. 2, by Percy W. Harris, M.I.R.E.), but I consider the T.A.T. second only to the super-het.

Results, with 70-foot outside single aerial, full loud-speaker strength:—Liverpool, Chelmsford (and now Daventry), Madrid, Radio-Toulouse, Eiffel Tower, Manchester, Brussels, and Radio-Paris.

Medium loud-speaker strength (and when coupled to two-valve resistance coupled amplifier as described in March *Wireless Constructor*, by J. W. Barber, full loud-speaker strength): —Birmingham, Glasgow, Voxhaus, Hilversum, Newcastle, Ecole Superieure, Aberdeen, Leeds-Bradford, and Belfast.

These stations can all be picked up any night when conditions are favourable, and have been heard by many of my friends.

I desire to thank you for all the information on wireless which I have acquired solely from your papers. I am a regular reader of all four.

I wish you every success in your bold undertakings.—Yours faithfully,

ALFRED N. MOORE.

Liverpool.

THE ST. PANCRAS 1925 RADIO SOCIETY

SIR,—I beg to submit a notice relative to the formation of the above Society, which I hope may be of interest to your readers.—Yours faithfully,

R. JUDSON, Graduate I.E.E.
(Hon. Secretary).

The above radio society has been formed to incorporate the Kentish Town and District Radio Society on the dissolution of the original St. Pancras Society.

The headquarters are at the L.C.C. Men's Institute at Carlton Road, Kentish Town, N.W. There is a lecture hall to accommodate an audience of about 400. Lectures are given twice a week on Mondays (theory and practice of wireless transmission, and Morse) and Thursdays (electricity and magnetism, physics, elementary theory of wireless and practical work). The hours are from 7.45 p.m. to 9.45 p.m.

Practical work can also be carried out by members during the rest of the week. There are metal, woodwork and testing facilities. Material is also available for making up sets for experimental purposes.

The present membership is about 80, of which 20 are following regular lectures, and new members are cordially invited. Write for particulars to the Secretary, c/o Radio Communication Co., Ltd., 34, Norfolk Street, Strand, W.C.2.

NEW CALL SIGN

SIR,—I should be glad if you would make known, through the medium of your excellent papers, that the call sign 5XW has been allotted to me (C.W. telephony and tonic train). I am at present working on the wave band between 150 and 200 metres, my usual wavelength being 168 metres.

Wishing you all success.—Yours faithfully, C. BRYANT.

Colchester.

SOUTH AFRICAN AMATEUR TRANSMISSION

SIR,—Will you please advise your readers that any QSL cards for South African transmitters may be addressed to c/o S.A. Radio Relay League, Myrtle Grove, Irwell Street, Observatory, Cape Town.

Thanking you.—Yours faithfully,
J. S. STREETER (oA4Z).

Cape Town.

ONE EXHIBITION ONLY!

(*Continued from p. 173*)

Our sole interest is in obtaining a single exhibition, and we hope that it will not be necessary to adopt measures to overcome the present deadlock. We believe that it is the duty of the parties concerned to come together and establish a single exhibition without regard to whether or not manufacturers belong to an association.

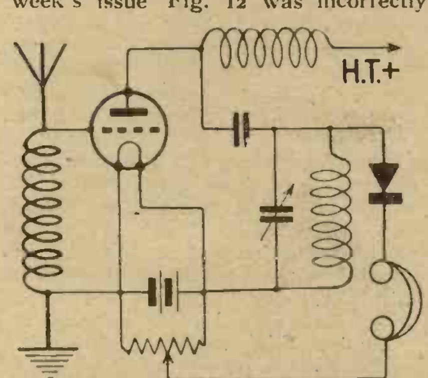
If the present narrow attitude is maintained it will be necessary for an impartial organisation to come forward and arrange for what the trade and public undeniably require.

Yours faithfully,
"THE WIRELESS DEALER,"
JOHN SCOTT-TAGGART,
Editor.

We have already received numerous letters from prominent firms expressing the heartiest support for the scheme, and showing their practical interest by indicating that they will book space in such an exhibition at the earliest opportunity. The convenience and value to the public of a unified exhibition is of great importance, and we would, therefore, welcome our readers' views on this subject.

ERRATUM

We regret that on page 141 of last week's issue Fig. 12 was incorrectly



shown. The correct form of this diagram is given herewith.

On the same page the description of Fig. 16 should read, "The only serious objection to this circuit is that the telephones are at high potential to earth."

INVENTIONS AND DEVELOPMENTS

(Continued from page 186)

a third coil having a comparatively high inductance.

Owing to the disparity in these inductances, this coil has comparatively little shunting action upon the current, most of which flows through the coil L2. Coupled to this coil L3 is what is known as a "driver," which is simply a local oscillator adjusted to supply current at a frequency near to that of the incoming signals.

Tuning

The process of tuning is as follows:—First of all, the switch S is closed, which short-circuits the coil L2, and the aerial circuit is then tuned to the incoming signal. Signals are now passed via the coupling L1-Ls into the receiver. The switch is then opened and the signal current now passes through both the coils L1 and L2, which, as we have seen, are arranged to act in opposite directions. The net result is, therefore, that the two effects of these coils tend to cancel out and the couplings are so adjusted that they actually do neutralise each other and no signal at all is received on the receiver.

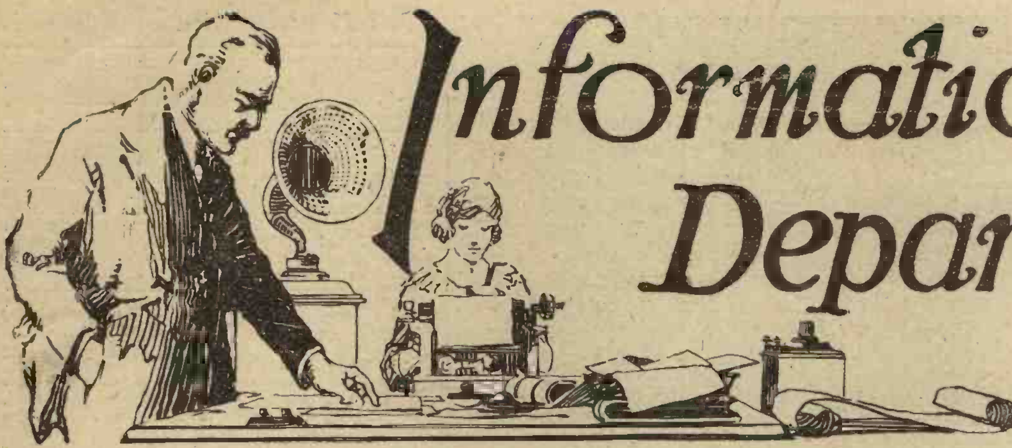
Effect of the Driver

A certain amount of the current from the aerial is now passing through the coil L3, but, as we have seen, the inductance of this coil is comparatively high, so that it does not exercise any appreciable shunting effect. The coupling from the driver, however, is so adjusted as to produce a magnetic field through this coil L3 in opposition to the field produced by the current in the aerial. Now the inductance of a coil is a property which it possesses only in virtue of its magnetic field. Consequently, if we can reduce the magnetic field to zero by some external means, then the effective inductance of the coil will be zero, and in this particular case the coil L3 will act as a dead short circuit across L2. The driver is arranged to do this—that is to say, the frequency of the current and the strength of the coupling are so arranged that at periodical intervals the magnetic field produced by the signal current is completely wiped out by the magnetic field, due to the driver, and in this case the coil L2 is short-circuited, resulting in the same position of affairs as that which originally occurred when the switch S was closed. In this case, therefore, there is only one coupling coil acting on the secondary circuit, and signals will be passed through to the receiver.

Possibilities of the Circuit

When this condition of affairs is existing, the aerial circuit as a whole is tuned to the incoming signals. The "wiping-out" effect of the inductance of L3, however, does not apply as far as static interference is concerned, because the strength of the current produced by atmospheric disturbances is much in excess of the signal current, and the result is that the magnetic fields of the coil L3 and the driver do not cancel out, and the coil L3 still possesses an appreciable inductance. Thus, as far as the atmospheric is concerned, both the coils L1 and L2 are in circuit, and the total effect on the receiver is nil.

Coupled to this is the fact that the tuning of the aerial circuit to atmospherics, including as it does coil L2, is quite different from the tuning to the signals, and it can be seen that we have here the elements of a highly scientific device having great possibilities.



Information Department.

C.B. (FALMOUTH) is experiencing trouble with his Transatlantic 5-valve receiver, which proves to be so unstable as to be unmanageable. He states that he has checked the wiring several times and finds it to agree perfectly with that given in our blue print. To prove his contention he encloses a large photograph of the wiring.

Although our correspondent's set shows admirable craftsmanship and the appearance of the set is such that he may be congratulated on his work, a close examination shows what is very likely the cause of the trouble. In place of the dual condenser employed by Mr. Harris, one of unknown make has been substituted. This has both sets of plates arranged extremely close together.

In all sets of Transatlantic type, where a dual condenser is used to tune two H.F. transformers, it is not only essential that a condenser with the two halves well matched be used, but also that a type be employed with suitable spacing between the two sets of vanes. In certain cases where this is too small the set will oscillate in an uncontrollable manner. In such cases the dual condenser should be removed and one of reliable type substituted. If this is done we think our correspondent's set will probably function correctly.

A. E. C. (BRIXTON) asks what is meant by "duplex telephony."

Ordinary wireless telephony suffers from the somewhat serious disadvantage that it is necessary to switch over from "send" to "receive" when it is desired to receive a reply to a transmitted message. Duplex telephony is a system by which the same aerial may be used for both transmitting and receiving, so that the operators at either end may break into the conversation as may be done on the ordinary land line telephone. Duplex telephony may therefore be regarded as double working, without switching over from "send" to "receive," whilst employing the same aerial.

RADIO PRESS INFORMATION DEPT.

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Vol. 7. No. 6. Oct. 28, 1925.

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"Plastic" Radio by the Kluth System

(*Continued from page 197*)

growing, membrane M will be attracted and the current in the coil of electro-magnet B will decrease. On the other hand, when the current in A is decreasing, membrane M will come close to electro-magnet B, causing the current in the latter to augment. In fact, a pulsating current of the same rhythm as the original telephone current, though with a phase displacement of about 180 degrees, is thus produced in electro-magnet B.

The Variometer

If now the current passing through A is listened to through one head-phone and the current generated in B through the other head-phone, there will still be an impression of practically one-eared hearing, a phase difference of 180 degrees being too great to produce the phenomenon of plastic hearing, while a phase displacement of only 100 degrees, in accordance with the above, is quite sufficient to produce it.

In order to effect this reduction in the phase difference of the current induced in the second head-phone, another phase shifting will be required. This, in accordance with what has been said in connection with phase shifting in the high-frequency current, can be obtained by means of an inductive variometer which, however, should be designed on somewhat different lines, its two coils being made up of a large number of windings (10,000 to 30,000) of thin wire to produce inductive coupling.

Correct Phase Displacement

The arrangement of the variometer will be seen from Fig. 4. The phase shifting is found to vary according to the angle between the two coils of the variometer, L and K. In order to supply head-phone 2 with a current of the same intensity as the current operating in head-phone 1, the coils I and L must be devised in accordance. This arrangement will result in a phase displacement of the current in head-phone 2 of just sufficient magnitude to convey the impression of a plastic acoustic picture when listening-in with both head-phones simultaneously. This effect will be further increased by acoustic differences unavoidably connected with the inductive reduction of the current in head-phone 2.

The Stereophone

This arrangement thus gives rise to an effect similar to the stereoscope in optics, and, therefore, has been fitly styled the stereophone. It is readily accommodated in a small box, only the contacts A, B, C, D, E, F, required to obtain a connection with the radio receiver (A and B) and the two head-phones (C, D, and E, F, respectively), being disengaged. The coils L and K are rigidly mounted at a suitable angle to one another.

This stereophone at the present time is the most suitable and straightforward solution of three-dimension broadcasting, entailing, as it does, no alteration of the transmitter or receiver.

IMPORTANT NOTICE

Owing to the numerous applications from our readers for back numbers of our publications, we have decided to make no extra charge on any of our periodicals for issues published within six months. The charge for back issues prior to six months will be as in the past.

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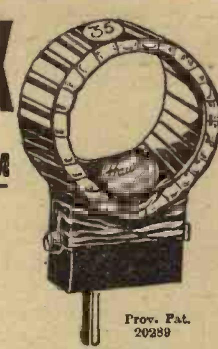

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3	How to Make Your Own Broadcast Receiver. By John Scott-Taggart, F.Inst.P., A.M.I.E.E.	1/6	1/8
4	How to Erect Your Wireless Aerial. By B. Mittell, A.M.I.E.E.	1/–	1/2
5	The Construction of Wireless Receiving Apparatus. By P. D. Tyers.	1/6	1/8
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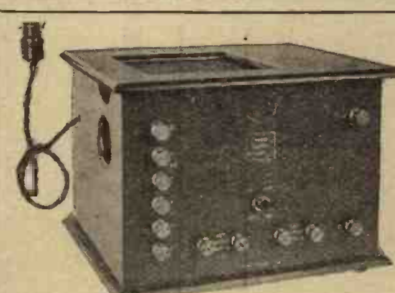

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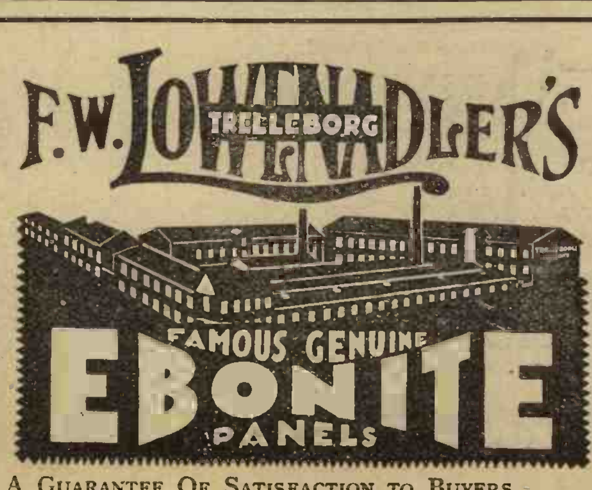

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