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TWO IMPORTANT QUESTIONS.

THE case which has just commenced in Court, in which it is stated that one neighbour, annoyed by the alleged howling of the loud speaker of the other neighbour, proceeded to disconnect the latter's aerial, raised two questions of primary importance to owners of wireless installations, especially where houses are in close proximity to one another.

It would appear that the case itself will be decided on the issue arising from the quarrel and alleged assault which is said to have followed it. But the questions in which wireless users will be interested and which are likely to be judiciously considered in any further progress of the case are: (1) what right, if any, has one person to remove or interfere with the aerial or other outside wireless property of another, and (2) what remedy, if any, has one person against another, if the former suffers substantial discomfort, annoyance, or disturbance from the use made by the latter of his loud speaker.

A few observations on the general legal aspects which have to be considered in relation to (1) may be of some service to readers of this journal, but the other subject (2), and also that of damage by lightning alleged to be attracted by the overhead wires, must be left for the future.

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OVERHANGING AERIALS.

IT is fairly clear that to run an aerial across the property of another person would give the latter a right of action for trespass, although neither he nor his property might in any real sense be injured or damaged. In such a case it will be seen that the adjoining occupier might proceed to give notice to the owner of the wire to remove it, and if not so removed to take it down himself, but without otherwise destroying it, converting it to his own use, or unreasonably injuring it. He can leave it where it fell, and if he has taken care, as he must do, to detach the portion only actually overhanging his own property, the owner of the aerial is placed in a dilemma, for he cannot step into his neighbour's garden or yard uninvited, without exposing himself to the risk of proceedings for trespass.

A person who has so taken down the aerial might be found liable to its owner, if he removed it from where it fell, and certainly if he converted it to his own use, while if he removed it out of his possession, as, for instance, by selling it, he might find himself charged with the well-known criminal offence of larceny. Once he has cut down the over-hanging and offending line he should do no more. The owner could, of course, start an action asking for an order for its delivery up.

The whole position between the parties in such circumstances as these would no doubt be regulated by the principles applied to the lopping of overhanging trees. The person aggrieved by the overhanging on his land, by a neighbour's trees, if he wishes to act sensibly gives notice to his neighbour before he proceeds to remove the branches himself. He is not entitled to take the fruit, if any, from the fallen branches, or even the branches themselves, and it would seem that the general principles of the law which have to be applied in one case would be equally applicable in the other.

CONTENTS.

FALLING MASTS OR AERIALS.

ANOTHER question, perhaps, emerges under the head of damage resulting from masts, aerials, or other wireless equipment falling upon the premises of an adjoining occupier. The whole question here must depend on the facts. There can be no doubt that where a man has erected something upon his own property which presently falls and damages the property of a neighbour, the latter, generally speaking, would not have much difficulty in recovering damage from the former on the ground of negligence.

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LEAVE OR LICENCE.

BEFORE an aerial owner takes any step which might expose him to the risks discussed, he should invariably obtain proper consent and be licensed, if necessary, from the adjoining owner who may be affected. The latter may not suffer the slightest inconvenience by what is done, but owners in particular have to remember that an uninterrupted use of their property in this way may in course of years become an acquired legal right against them.

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THE WIRELESS LEAGUE.

THE steps recently taken by the *Daily Express* in an endeavour to co-ordinate the voice of the listener by fostering the formation of a Wireless League is a matter of interest to the amateur. The objects of the League include those idealistic aims which have so frequently been put forward by other wireless organisations in the process of formation, though we would say that we consider them a little ambitious. For instance, a body that will give practical and expert advice to its members will be rendering a valuable service, whilst the provision of legal advice arising out of such questions as patent royalties is, we consider, almost as ambitious as attempting to adequately provide lecturers who will give technical talks on wireless subjects.

These services, with many others, form the objects of the League, the success of which will be entirely dependent upon the ability of those men who are elected to the general council, and we would recommend readers, before giving whole-hearted support to this new organisation, to carefully peruse the names as soon as announced, reviewing the services which these gentlemen may have been successful in rendering in the past to strengthen the position of both wireless listener and the amateur.

Without speculating on the success which is likely to be attendant upon the scheme, it might be mentioned that the insurance policy which is offered to members, and which includes third-party risk up to an amount of £100, is likely to attract many amateurs to its ranks, and we should at least describe such an arrangement as generous.

The desire on the part of the *Daily Express* is merely to take the initiative in the formation of the League, after which its management will be handed over, it is stated, to a representative council. It is refreshing to learn that such is the attitude of the organisers in these times when wireless is so often made the victim of a newspaper "stunt," and we cannot overlook that newspapers can hardly be regarded as disinterested parties in matters relating to the scope of broadcasting.

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THE SCIENCE OF LISTENING.

The systematic study of audible sounds is outlined in an interesting article by Mr. W. S. Tucker in the April number of *The Nineteenth Century and After*, in which the author shows how the scientific advancement of this subject has been promoted by the advent and application of the thermionic valve.

"In recent years," he writes, "the study of the ear as an instrument for the reception of sounds has been much advanced and the practice of conscious listening has been more developed than ever before."

After frankly admitting that little is as yet definitely known about the actual physical and physiological operation of listening, he pays a tribute to the research organisations in America, and their recent studies of the power of the ear to listen. By the aid of the thermionic valve we can now produce "pure" sounds of known intensity and increase these intensities progressively by measurable amounts, while at the same time controlling the pitch over the whole range of human audition.

The intensity ranges from barely audible sound to the point where its loudness becomes painful; the "threshold of intensity," where the ear is just dimly conscious of faint sound, varies according to the pitch of the note. The discrimination of intensity has been graduated according to a scientific scale. Discrimination of pitch has also been carefully measured, and, for normal ears, corresponds to about 0.3 per cent. change in frequency over a wide range of musical sounds. The product of these two measurements shows that the ear can distinguish about 300,000 different *pure* sounds if it is normal.

The immense number of *complex* sounds is almost infinite, but in these one tone tends to mask another. The lower tones are more persistent, being further advanced from the "threshold of intensity," hence a complex sound heard faintly at a distance becomes simpler and ultimately a purer sound; for example, the hum of a distant aeroplane persists after the non-musical rustle and rattle of the machinery have disappeared. It is partly for this reason that Trinity House employs a low-pitched siren rather than a high-pitched whistle.

The testing of deafness is another operation which recent researches are placing on a more scientific basis. The rough diagnosis hitherto obtainable by tuning forks and ticking watches is giving place to accurate measurements which enable different stages of deafness to be scientifically analysed and classified.

The author touches on the subject of reverberation and instances the different sound effects obtained in the B.B.C. studios, Covent Garden Theatre, or the services at St. Martin's Church, and the value of similar observations to the subject of architectural acoustics. The many perplexing phenomena of open-air listening are dealt with, and the article concludes with a word of warning: "some attempt should be made to protect the ear and the nervous system involved in the operation of listening from the excessive noises which modern traffic and conditions impose upon us."

COMPACT TWO VALVE SET

Detector and Low Frequency Amplifier

The Complete Receiver. The arrangement of the components gives a pleasing panel lay-out.

An inexpensive receiver of workmanlike design. The circuit principle is too well known to warrant description, and the article deals with the easy processes of home instrument making. Few tools are needed, and construction is simplified by the avoidance of tapped holes.

IT is probable that there are more valve receivers making use of a detector and note magnifier than any other circuit arrangement. It is fairly easy to reason that this circumstance arises from the fact that an oscillating detector valve gives good receiving range, and, when followed by a note magnifier, will operate a small loud-speaker when the receiver is within a radius of about eight miles from a broadcasting station. The note magnifier also renders distinct, on telephone receivers, many distant signals which need such very critical adjustment to tune in that often they are almost too feeble to be distinguishable. There are many listeners who, owing to battery charging difficulties, are compelled to limit their number of valves to two of the dull-emitter class, and it is doubtful if there is any other two-valve circuit which, in the hands of the beginner, will give such consistently good results.

As a guide to the beginner, complete practical details are given concerning the instrument work.

Panel Making.

Sheet ebonite is usually obtainable from dealers in amateur wireless materials in thicknesses of $\frac{3}{16}$in., $\frac{1}{4}$in., and $\frac{5}{16}$in. The thin $\frac{3}{16}$in. sheet is too weak for panel construction and is only used where pieces measuring not more than 2in. × 2in. are needed in building components. Panels may be made from $\frac{1}{4}$in. ebonite for use in small instruments when well supported, but it does not provide sufficient strength for carrying heavy components. When the panel is made to support the entire component apparatus, it is then advisable to use $\frac{5}{16}$in. ebonite, particularly if such heavy parts as intervalve transformers and valve platforms are to be incorporated.

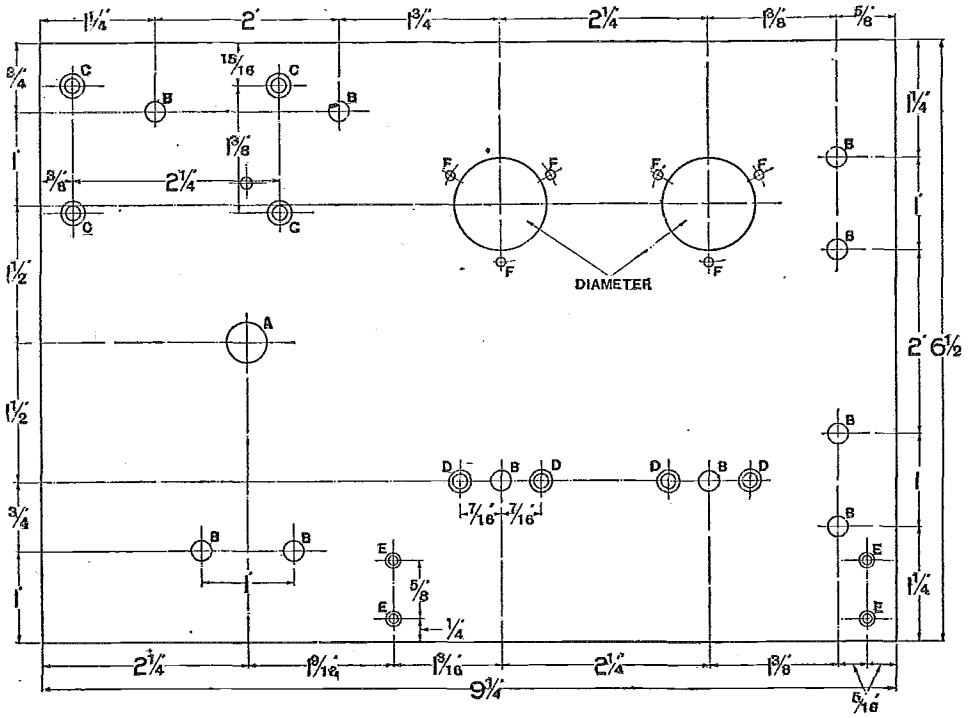
Panels are best cut to size with a small tenon saw and squared up by filing to scratch lines. The surfaces, if not already finished to a good matt, are best treated by rubbing with medium carborundum cloth in straight lines parallel to the longer sides. There is no objection to using pencil lines for setting out positions for the holes in this instance, though, in general, fine scratch lines and the use of dividers is recommended.

The positions for the holes are finally marked with a centre punch with the panel resting flat upon a firm surface. Drilling presents no difficulty, and there is very little danger of the back of the ebonite breaking away if the drills are really sharp. Avoid excessive pressure with the hand brace as the drill passes through, though a sure protection against fracturing is to clamp a piece of scrap ebonite or hard wood behind the panel. Large holes for valve windows are easily made in ebonite with a carpenter's brace and bit, though it is necessary to put a guide hole to lead the point of the bit and to bore, of course, equally from both sides of the panel. A grating of holes may be used as a substitute when a carpenter's brace and bit are not available. The positions for the small holes which pass the bolts for attaching the valve windows are best marked out, using a back plate as a template. This also applies to the holes for the screws, which attach the intervalve transformer and filament resistances, the location of the holes being marked through with the point of a drill.

The Valve Platform.

The woodwork is usually the most difficult part of instrument making, mainly because the home instrument

Compact Two Valve Set.— maker does not usually possess a good carpenter's vice, and also owing to the need to work most carefully as to squareness. The valve platform consists of three pieces of wood made up from planed $\frac{3}{8}$in. (actual thickness) mahogany. The two end pieces are made as one strip, which is sawn in half and the ends trued up by filing. The top board is mounted across the two end pieces and is attached with screws and "Seccotine." The ends are finally brought flush by filing or glass papering, after which a treatment of shellac varnish is recommended. This platform gives support to the valve holders for bringing the valves to the correct height with their filaments central in the valve windows, while sufficient space is available underneath to house both the grid condenser and leak and the H.T. battery condenser.



Dimensional drawing of the front panel. Thickness $\frac{5}{16}$in. Sizes for drilling: A, $\frac{7}{16}$in.; B, $\frac{7}{32}$in., for 2BA screws; C, $\frac{5}{32}$in., and countersunk for 4BA. D, $\frac{9}{32}$in., and countersunk for 5BA (or 6BA). E, $\frac{3}{32}$in., and countersunk for No. 2 wood screws. F, $\frac{3}{8}$in.

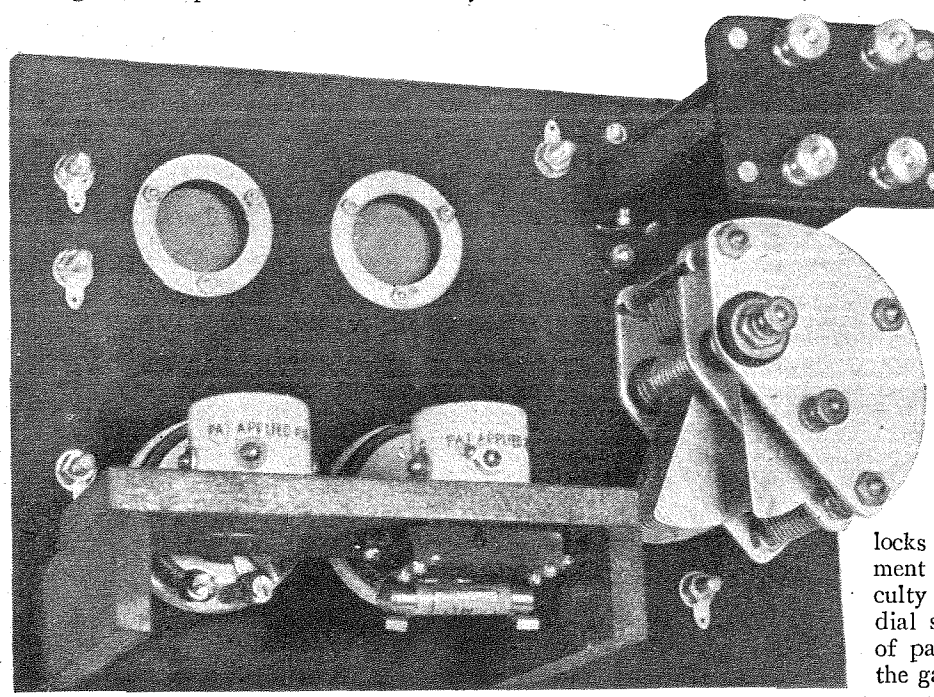
It should be noticed that the valve platform is attached to the panel, so that there is a space of about $\frac{1}{8}$in. from the edge of the panel. This is necessary to avoid the panel jamming in the box should a portion of the job be slightly out of truth.

Assembling.

Before any of the components are attached to the panel, its surface should be rubbed down with the merest trace of oil in the presence of a little turpentine, which will prevent the face from becoming smeary. This treatment will produce a thoroughly clean and dry surface which will not finger-mark.

The only difficulty which is likely to arise is the fitting of the condenser (0.0005 mfd.) dial to run truly. If a thread is not already provided in the dial, care must be taken when engaging on the threaded condenser spindle to make sure that the dial is parallel to the face of the panel. Final truing up occurs when the knob locks on to the dial, and in the instrument shown in the illustrations no difficulty was experienced in getting the dial so near to the panel that a piece of paper could scarcely be inserted in the gap, yet in no position did rubbing occur.

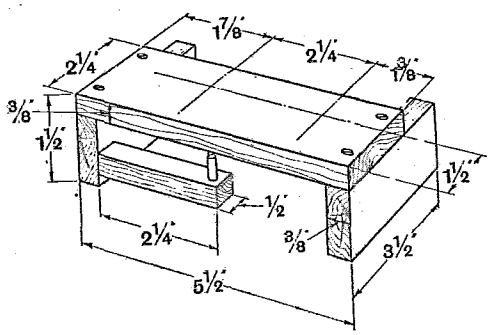
It might be mentioned that the inter-valve transformer is set up in position



Partly assembled. Tags must be inserted under all connecting screws. The valve platform is inset about $\frac{1}{8}$in. from the edge of the panel to allow for slight errors in squareness.

Compact Two Valve Set.—

before the condenser is attached, so that the heads of the screws which appear on the front of the panel can be



The valve platform. Two clamping pieces are needed to keep the H.T. battery condenser in position.

rendered inconspicuous by treatment with photographic dead black.

Tags must be inserted under all terminals and points of connection.

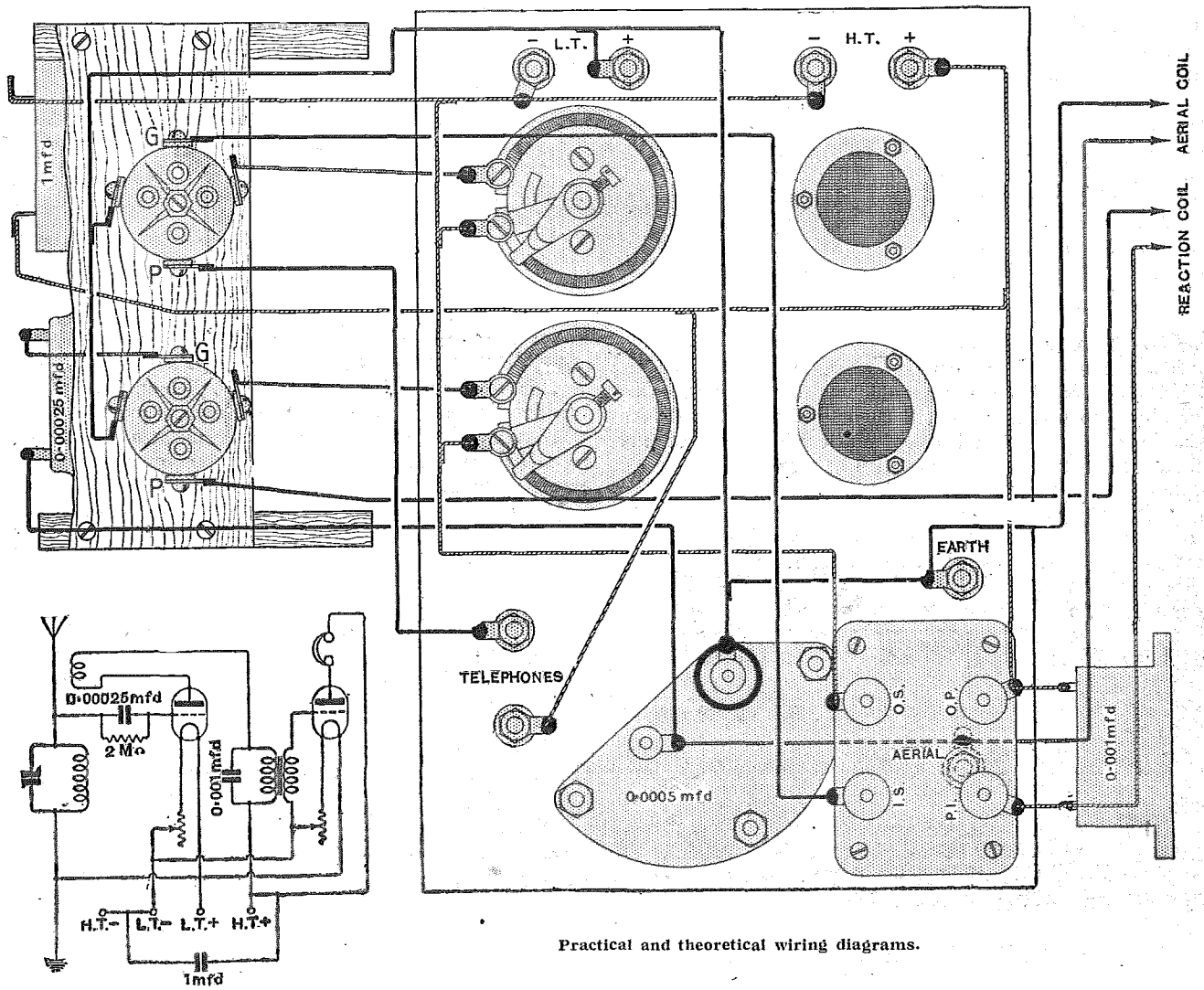
Wiring.

No. 16 tinned copper wire is used, straightened by stretching. The leads which lie near the face of the panel are put on first, and most of them run by the shortest path. Take care not to run any lead by a route which will foul the condenser as it revolves, or the valves when they are inserted. The use of resin-cored solder and a clean iron are the essentials of successful wiring up.

The four flexible leads which join to the coil holder through holes in the lid of the box should be made 1ft. in length, so that the set can be operated when withdrawn from the cabinet and the direction of reaction coupling experimented with by changing over the leads to the reaction coil.

The Cabinet.

The design adopted for the box has been arranged to be as simple as is possible. It should be made from a hard wood, such as mahogany, purchased already planed to ⅜in. in thickness. The two end pieces are made up



Practical and theoretical wiring diagrams.

Compact Two Valve Set.—

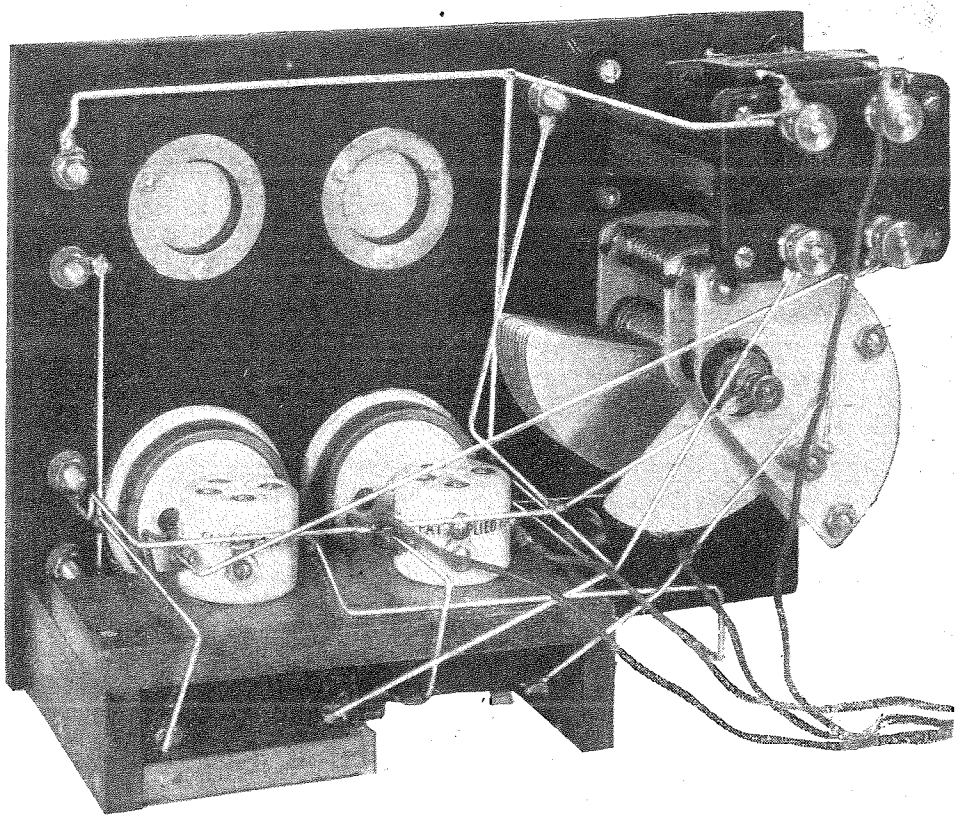
first, identical to each other and perfectly square. The top and bottom pieces are next constructed, while the back is made to fit inside in the same way as the panel fits in the front. All pieces are glued and screwed together. After well glass-papering down, an easy quick-drying polish or shellac varnish may be applied without the use of a preparation for filling the grain. A good French polish finish does, of course, add enormously to the good appearance of the instrument.

Filets are attached part of the way along top and bottom edges so that the panel when inserted projects $\frac{1}{16}$in. above the front edge of the cabinet.

Operation.

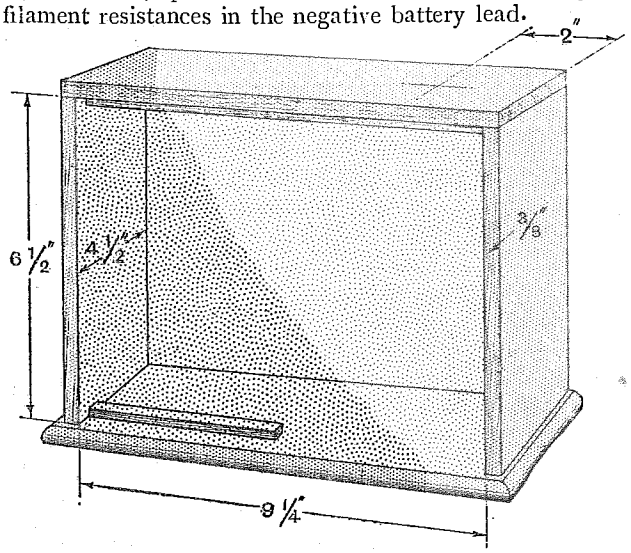
For broadcast reception on a mean wavelength of 350 metres coils usually graded as "35," "50," and "75" will be needed, or in the letter series "A," "B," and "C." The valves in this instance may be of the dull emitter 0.06 type working on two of the large glass box accumulator cells which are specially supplied for working valves of this type, or from a 4-volt battery of low ampere hour capacity. The H.T. battery should have a maximum value of about 70 volts, for it will be noticed that a grid bias is, in effect, produced as a result of connecting the filament resistances in the negative battery lead.

The direction of reaction coupling must be experimented with so that self-oscillation can be produced. The reaction adjustment will be found to be smooth owing to the damping produced in the aerial circuit by joining its lower end to the positive of the battery.



Rear view of the finished set. The leads are run by the shortest paths, taking care not to foul the moving plates of the condenser or the valves when inserted.

This receiver will bring in many distant Continental broadcasting stations, using head telephone receivers, and when connected to a good amateur aerial at a distance of 10 miles from 2LO gave loud-speaker reproduction of ample strength to fill a normal-sized room.



Constructional details of the cabinet.

LIST OF PARTS.

Ebonite from which a panel 9¼in. × 6½in. × $\frac{5}{16}$in. can be made.
$\frac{3}{8}$in. planed mahogany for box work and valve platform (Hobbies), together with quick-drying polish if required.
Ormond square law condenser, with fine adjuster and ebonite end plate (new pattern) 0.0005 mfd.
Ferranti intervalve transformer.
Igranic two-coil holder.
Two Athol valve holders.
Dubilier grid condenser and leak.
T.C.C. 1 mfd. condenser.
Two 30-ohm filament resistances.
Two valve windows with bolts long enough to pass through $\frac{5}{16}$in. panel.
Eight nickel plated terminals "Colpax" Precision Screw Company.
Four 4B.A. screws $\frac{5}{8}$in. in length, countersunk heads, and with nuts for attaching transformer.
Four 6B.A. screws and nuts $\frac{7}{8}$in. in length.
2½ dozen connecting tags.
Wood screws as required.
Dekko dial indicator.

GOOD QUALITY in LOUD SPEAKER REPRODUCTION.

It is a fairly easy matter to design and operate a set which will give really good quality in the output circuit of the detector, but difficulty is often experienced in designing a high quality amplifier. The reasons for distortion and hints on obtaining good quality are given in detail.

By N. P. VINCER-MINTER.

IN considering the question of obtaining high-quality loud-speaker reproduction, it is necessary first of all to consider briefly all the possible causes which may contribute towards the discordant sounds which, in spite of all the recent improvements in the design of amplifiers, are still unnecessarily inflicted upon us by many enthusiastic devotees of the loud-speaker. In general, the loud-speaker itself is not the offender in this respect, and the cause of the distortion must be sought elsewhere. The majority of loud-speakers sold by reputable manufacturers are capable of excellent reproduction, but it must be remembered that a loud-speaker is mainly a reproducer, and therefore if poor quality speech and music are supplied to it, it can do little to improve matters.[1] It is necessary also that care be taken not to overload the loud-speaker, and it must not be thought that an instrument of the "Junior" type can be used to fill a large dance-hall with music.

[1] Loud-speakers usually have a characteristic tone, and some are designed to emphasise low notes.

It is true that there are various forms of distortion which may be produced in the receiving circuits, but it is not the purpose of this article to discuss these, but rather to assume that high-quality reception has already been attained in the telephones, and that it is desired to amplify these signals prior to passing them on to a loud-speaker. We shall, therefore, confine our attention to an analysis of the causes of distortion in a low-frequency amplifier, and to suggesting means of remedying them.

We will first turn our attention to valves. The cause of valve distortion is twofold: first, the use of valves having unsuitable characteristics; and, secondly, in cases where the correct valves are used, distortion is caused by wrong operating conditions.

In order to understand this, it is first necessary for us to consider the operation of a valve when used as an amplifier. Briefly, a small variation of voltage on the grid is used to control a comparatively large amount of energy in the anode circuit of the valve, the source of this energy being the H.T. battery. The positive half-cycle of an incoming signal renders the grid

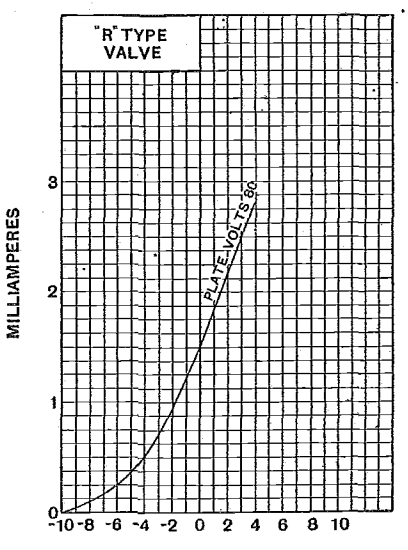


Fig. 1.—Characteristic curve of an R valve. This is a general purpose valve.

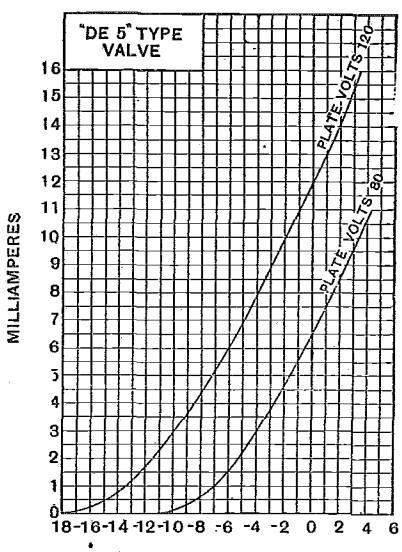


Fig. 2.—Curves of a DE5 valve, generally referred to as a power valve.

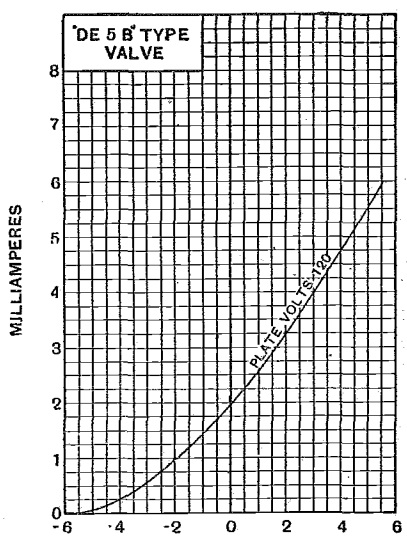


Fig. 3.—Characteristic curve of a DE5B valve, which has a high amplification factor and is suitable for choke or resistance coupled amplifiers.

less negative than normally, and this tends to increase the amount of current flowing in the anode circuit. The negative half-cycle of the signal, on the other hand, by rendering the grid more negative, causes a corresponding decrease in the anode current. Within certain limits the amount of decrease or increase in the anode current is proportionate to the variation of the grid potential—the greater the value of the negative voltage of the grid, the greater is the decrease in the anode current. If this held true for any magnitude of grid potential, there would be no need for us to use special valves for handling large power. Unfortunately, however, it is found that this only holds true up to a certain point, beyond which any further increase in the negative potential of the grid ceases to cause a proportionate decrease in the anode current. Similarly, when the incoming signal tends to make the grid less negative, a proportionate increase of anode current takes place only up to a certain point.

This may be shown by the curve of Fig. 1, which illustrates the relationship between grid voltage and anode current of an ordinary "R" valve when its anode voltage is adjusted to a valve suitable for using it as an L.F. amplifier. It will be seen that the anode current decreases steadily as the grid becomes more negative, until a negative grid voltage of 4 is attained, when the decrease in anode current ceases to be proportionate to the increase in the negative potential of the grid. The lower portion of the curve is usually referred to as the lower bend of the curve. Aural observation will readily reveal to us when the valve is being operated on this bend.

The positive half-cycle of the incoming signal, which causes the grid to become less negative, will similarly cause a steady increase in the anode current until the upper bend of the curve is reached; but there is another important factor which intervenes before this. It will be noticed that before this upper bend is reached the grid potential has passed the zero mark and has become positive. The result of this will be to permit grid current to flow, which is fatal to good reproduction. We are therefore confined to the limits between the lower bend of the curve and the point where the curve crosses the zero grid voltage line. Now the length of this portion of the characteristic curve is not very great, and therefore it will be seen that this valve is only suitable for use in cases where the incoming signals are not very strong.

Operating Characteristics of the Valve.

There is another important point which we have not yet considered, and that is the question of the adjustment of the normal grid potential; but, before considering this, it will be better if we pass on to Fig. 2, which gives two curves showing the relationship between the grid voltage and the anode current of a "power" valve, such as the DE5, with two different values of anode voltage. Taking the lower anode voltage of 80 volts first, it will be noticed that we have a greater length of straight line portion of curve to operate upon, without going outside the forbidden limits of "lower bend" and "zero grid volts line" than was the case with the "R" type valve when a similar plate voltage was used. Upon increasing the anode voltage to 120 (which is the correct anode voltage for operating this valve), we find that the length of the straight portion is considerably increased, and we can now apply a far greater voltage variation to the grid of the valve without causing distortion.

It will readily be seen from an examination of the curve that the normal voltage of the grid when no signals are being received should be made to occur midway between the lower bend and the zero grid volts line. In this case it will be seen that with an anode voltage of 120, the grid should be biased 6 volts negatively. This is usually accomplished by using dry cells. If we decide to reduce our anode voltage to 80 volts in a case where the input to the grid is small, we shall readjust the grid voltage to 3 volts negative, in order that it shall again lie midway between the points we have mentioned.

It will therefore be seen that a "power" valve is a valve designed to handle large input voltages without distortion, and is not a valve with a large amplification factor as is often thought. In fact, the actual amplification factor is less than that of an ordinary valve. In positions such as the first stage of a resistance-coupled amplifier where the input is very small, there is no need to use a valve of this type, and in point of fact a valve having a large amplification factor should be used. A special valve has been designed for this purpose by various manufacturers. This valve is capable of enormously magnifying signals of weak intesity, but is entirely unsuitable for use in positions such as the final stage of an amplifier, where of course strong signals are present. The reason for this is the shortness of the permissible working portion of the grid voltage anode current characteristic curve which we have been discussing. A glance at Fig. 3 will readily reveal this. The DE5B is representative of this type of valve.

Power Valves.

To sum up, therefore, on the question of valves, it will be seen that in order to handle the large power that is met with in a low-frequency amplifier, we must employ a valve having a long straight line portion of grid volt anode current characteristic curve, or to put it more succinctly, we may say that it is necessary to employ a valve having a large permissible grid voltage swing, and to adjust the anode voltage and mean grid potential correctly. It is also necessary to see that the filament is not run at too low a temperature, but this is a fault of which valve users are rarely guilty. It is important to mention, however, that when it is desired to reduce the volume from a loud-speaker, this must never be accomplished by reducing filament temperature or distortion will be caused. In cases where exceptional signal strength is expected at the grid of the final valve, it is necessary to employ a valve having a still larger permissible grid voltage swing, such as the LS5A.

Turning to the question of methods of coupling between valves, there are three main methods, known as transformer, choke- and resistance-coupling. All other factors being equal, the volume obtainable from them will decrease in the order named, and the purity of reproduction will increase in this order.

We will first consider the case of the low-frequency transformer, which is by far the most popular method of

Good Quality in Loud Speaker Reproduction.—

intervalve coupling, owing to the high amplification obtained. It may be said that distortion in transformer amplifiers is due to two main causes: too few turns in the primary, and incorrect design and construction of the iron core. It is necessary for the transformer primary which is connected in the anode circuit of the valve to have an impedance at least two or three times that of the valve. In considering the purchase of a transformer, therefore, it is first necessary to decide upon the valve which will precede it. If the transformer is to be used in the first stage following the detector valve, it will be necessary that the primary winding contain a large number of turns, since the impedance of the ordinary valve customarily used for rectification purposes usually lies between twenty and thirty thousand ohms. Now if the primary has a large number of turns, it is evident that the secondary must have four times this number in order to obtain the usual four to one ratio. This would render the instrument cumbersome in its physical dimensions, and might result in a poor transformer. It is therefore customary to reduce the ratio to three to one or less. This is the reason why the instruments are sold under the name of low ratio transformers, which is rather misleading, since a transformer having a low ratio between the primary and secondary turns has not necessarily a high impedance primary. To take an extreme case, a transformer having 1,000 turns on the primary and 2,000 turns on the secondary has a low ratio, but at the same time, owing to the small number of turns on the primary, it would be productive of far worse results than a very bad high ratio transformer, having a larger number of turns on the primary.

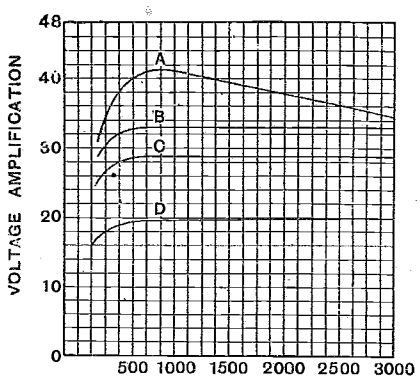


Fig. 4.—Frequency amplification curve of a single valve transformer-coupled stage of amplification. Curve A, a Marconiphone Ideal transformer, having a ratio of 4:1, with an R valve; Curve B, a 6:1 transformer, with an LS5 valve: Curve C, a 2·7:1 transformer with an R valve; Curve D, a 4:1 transformer, with a DE3 valve.

Now, if we are using a correctly designed power valve as our first L.F. amplifier, the transformer that follows it need not have so many turns on the primary, since these valves usually have an impedance of only 8,000 ohms or so. Consequently we have more space for our secondary turns, and can therefore design this transformer to have a higher ratio.

In spite of all the care and skill which goes into the design of modern transformers made by reputable manufacturers, it is not possible to obtain the same faithful reproduction with these as with the choke method of amplification. If a carefully designed transformer-coupled amplifier and a carefully designed choke-coupled amplifier are connected to a receiving set so that a rapid change can be made from one to the other by means of switching, the experimenter will probably be agreeably surprised at the increase in quality obtained with the latter method. He will probably find that he will be enabled to hear the bass instruments of an orchestra in a manner which was quite impossible with a transformer-coupled instrument. The reason for this is apparent if we study Fig. 4, which gives some amplification curves obtainable with various types of valves in conjunction with a high-class transformer. It will be noticed that in every case amplification falls off below a frequency of 400 cycles, and since bass instruments are productive of lower frequencies than this, the reason for the lower amplification of these frequencies is very evident.

Choke Coupling.

It is well known that the impedance which an inductance coil offers to an alternating current varies directly with the frequency. This is expressed by the formula $Z = 2\pi nL$, where n represents the frequency in cycles per second, and L the inductance in henries, Z being the impedance due to the inductance in the circuit. It follows, therefore, that the lower musical frequencies do not set up nearly so great a difference of potential across the coil as do the upper frequencies. We can remedy this by increasing the value of L, or in other words using a greater number of turns. For reasons of mechanical design, this cannot very well be done with a transformer, but with a choke it is possible to do this very effectively. One of the best chokes that can be used is to connect the primary and secondary windings of an intervalve transformer in series. Thus we shall not only have the inductances of the primary and secondary added together, but the total inductance will be still further increased by the mutual inductance existing between the primary and secondary windings. Care must be taken, however, to connect the two windings so that they are in the same magnetic sense, or we shall obtain a reduction instead of an increase in the total inductance. In this manner it is possible to obtain an inductance exceeding 100 henries, which will offer a high impedance to low musical frequencies which the transformer cannot reach.

The connections of a choke-coupled amplifier are given in Fig. 5. The potentials set up across the choke are

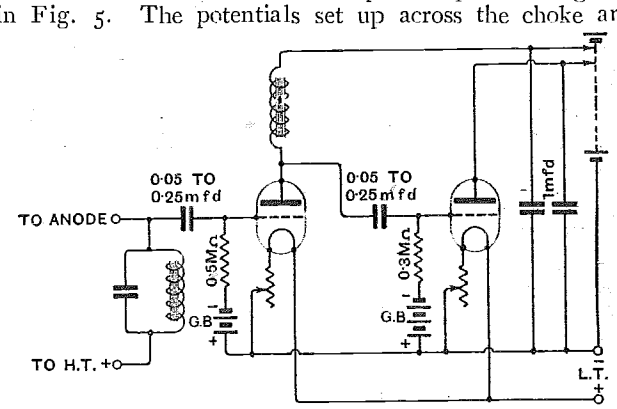


Fig. 5.—Connections of a choke-coupled amplifier.

transferred to the grid of the succeeding valve by means of a fixed condenser, this being necessary in order to insulate the grid from the high potential of the H.T. battery. Care must be taken not to make the value of

Good Quality in Loud Speaker Reproduction.—

this condenser lower than that given in the diagram, or we shall undo all the good work of the choke, since a small condenser will not transfer the lower musical frequencies so effectively as the higher ones. As the condenser has to withstand the high voltage of the H.T. battery, it is advisable that one having a mica dielectric be employed. A grid leak is of course a necessity, and a common fault is to make this value too high: 0.5 megohm will be found to be a good value, but in the final stage, where signals are very strong, it is better that this value be reduced to 0.3 megohm or lower. Grid bias is applied through the grid leak as indicated in the diagram.

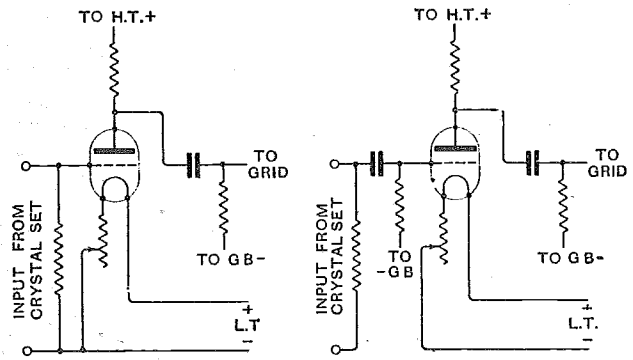


Fig. 6.—Two methods of connecting a resistance-coupled amplifier. (Left, A), for connecting to a crystal set. (Right B), for connecting to a valve or crystal set.

In spite of the high-quality rendition of a choke-coupled amplifier, there still remains a cause of distortion that we have not yet considered, which is due to the iron losses, this being a fault that will be met with in both choke and transformer-coupled amplifiers. Much can be done to eliminate this by using a carefully designed core with ample laminations, but when all has been done that *can* be done, it cannot be denied that resistance-coupling is productive of purer results than either choke- or transformer-coupling. This is partly due to the absence of an iron core, and partly due to the fact that resistance-coupling favours no particular musical frequency.

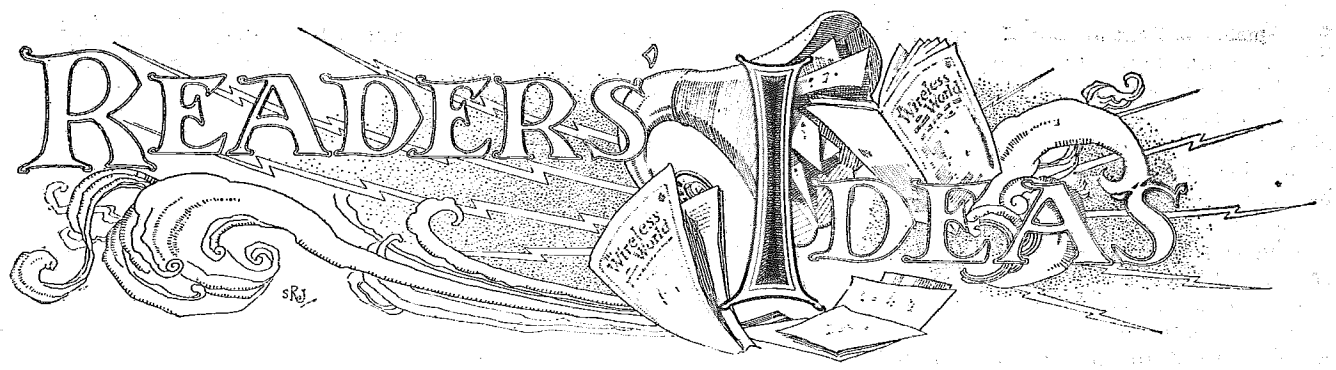
Resistance Couplings.

However, resistance-coupling is not a panacea for all evils, as many suppose, and if graphite resistances are used, or if the valves are operated at incorrect portions of their characteristic curves, it is possible to produce distortion far worse than that which is produced by a good-class transformer. It is advisable that wire-wound resistances be used. If those of the grid-leak type are employed there will usually be a background of "fizzling" noises due to small variations in their resistance. As it is now possible to obtain very excellent wire-wound resistances, this trouble need not occur. In general, it may be said that the higher the value of the resistance the greater the amplification, but it must also be remembered that an increase of H.T. battery voltage is necessary with every increase of resistance. Some very useful notes relative to this matter appeared in the January 28th issue of this journal. A useful value of resistance to employ is 100,000 ohms, but if this is used in the anode circuit of the detector valve it will be difficult to produce oscillation, and in actual practice it will be found necessary to reduce this value to about 50,000 ohms, and to shunt it with a .0001mfd. fixed condenser in order to obtain smooth reaction. Since a very great input power is not likely to be passed to the first valve of a resistance-coupled amplifier, this valve can be one of the type having a specially high amplification factor, such as the D.E.5B, but this valve must not be used in the last stage for reasons detailed previously in this article. As the connections of a resistance-coupled amplifier are precisely similar to those of a choke-coupled amplifier, a diagram of connections is not given. The same remarks made concerning grid condensers and leaks in a choke-coupled amplifier are equally applicable when resistance-coupling is used.

It is advisable here to discuss briefly the best method of adding an amplifier to a crystal set. It is not advisable to follow a crystal receiver directly by a stage of resistance-coupled amplification. Fortunately, it is not necessary to have such a high impedance in the ouput circuit of a crystal detector as in the case of the ordinary high impedance detector valve, and a transformer can be very well employed. We can then follow it with a resistance- or choke-coupled stage of amplification. If, however, it is desired to experiment with adding a stage of resistance-coupling immediately following a crystal detector, two methods of doing this are illustrated in Figs. 6A and 6B. Method B is probably the better of the two to employ, as the amplifier is then equally suitable for adding to a valve detector. The adding of a stage of resistance-coupled amplification after a crystal detector should usually not be attempted, unless the output of the crystal detector is considerable, such as would be produced by an H.F. amplifier and crystal rectifier operating at a relatively short distance from a broadcast-station. A choke-coupled amplifier is connected to a crystal detector in accordance with Fig. 6B, a choke being substituted for the resistance; but here, again, it is preferable to follow a crystal with a stage of transformer-coupling, in order to obtain an immediate step up in voltage. When adding this amplifier to a crystal set, the L.T. battery should be earthed.

In conclusion it may be said that there are various expedients which may be adopted to reduce distortion, particularly in transformer-coupled amplifiers. It is sometimes beneficial to shunt the secondary of the transformers with a resistance of 500,000 ohms or so. This will assist greatly in flattening out peaks in the amplification. It is advisable, also, to experiment with values of fixed condensers varying from .0005 mfd. to .005 mfd. across the loud-speaker windings. In this manner the tone can be adjusted.

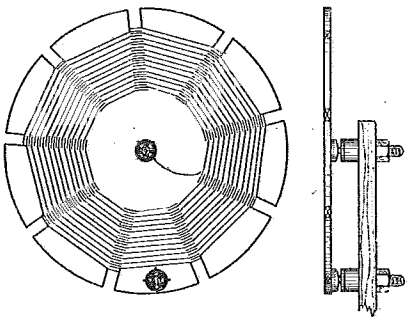
It is important to remember that a fixed condenser of large capacity should be connected across from each positive tapping of the H.T. battery to L.T. This not only serves the purpose of eliminating any extraneous noises set up by the H.T. battery, but by acting as a bye-pass for the audio-frequency variations of current prevents the amplifier being thrown into oscillation at an audible frequency by reason of the high resistance of the H.T. battery acting as a coupling between the valves. In cases where a common grid biasing battery is used for the various valves, it is advisable also that a large-capacity condenser be connected from each grid bias tapping to L.T.



A Section Devoted to Novelties and Practical Devices.

A MOUNTING FOR BASKET COILS.

The snap fasteners sold on cards in drapery establishments may be turned to useful purpose by the experimenter for mounting basket coils. Many varieties of fastener are available in japanned and plated finishes, and



Snap fasteners used as mounting terminals for basket coils.

the No. 2 size should be used if obtainable. The japanned variety should be avoided, as a certain amount of soldering is necessary in fixing the fastener. The method is best suited to basket coils wound on slotted disc formers.

The socket fasteners may be sewn into position on the former with the ends of the wire forming the coil, a touch of solder being applied at one or more points to ensure a sound electrical joint. The knob portion of the fastener may be soldered to the top of a switch contact screw which can be conveniently fixed to an ebonite holder or to the receiver panel itself if necessary. The socket portion may also be soldered to a contact stud in this way, but it is important to see that solder does not run inside the socket, as this may render the spring inoperative.

By spacing apart the ends of the coil in this way the self-capacity of the coil will be reduced.—R.B.A.E.

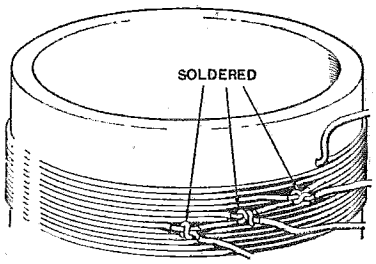
A DESIGN FOR FINE ADJUSTMENT COIL HOLDER.

A rather finer control of coupling is obtained when the tuning coils slide across one another as compared with the manner in which one moves from a parallel position to a position at right angles. The drawing is sufficiently detailed to show the precise form of construction. Worm gearing is made use of, and suitable Meccano wheels are easily obtainable.—G. R. S.

oooo

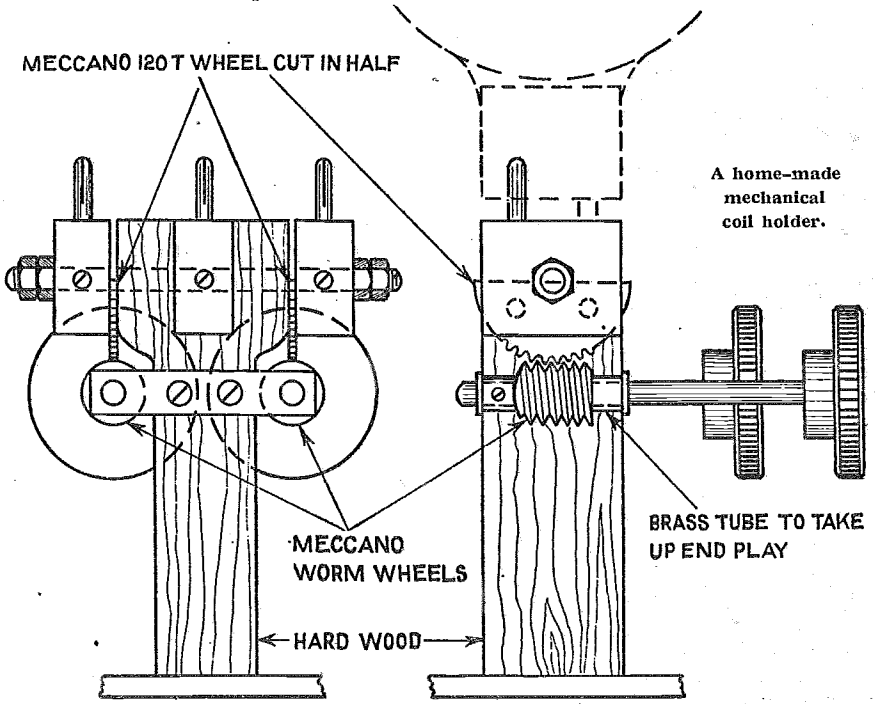
MAKING TAPPING POINTS.

In making tapping points on cylindrical inductance coils it is customary to twist a small loop at the appropriate point and to solder the switch connection to this. Unless one has some little experience of coil winding this method is apt to be troublesome, and can be avoided by winding the coil straight through



Making tapping points on a cylindrical coil after winding.

from end to end, the tappings being subsequently soldered to elevations prised up on the appropriate turns with a sharp point. The copper used for electrical conductors is very



A home-made mechanical coil holder.

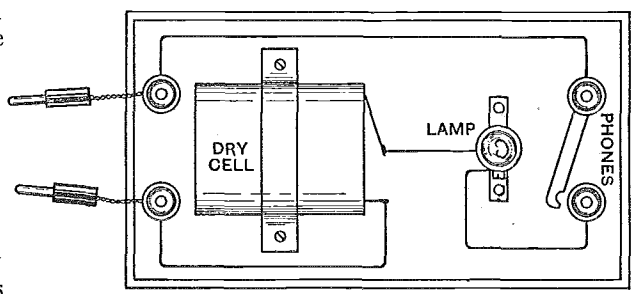
ductile, and will stretch considerably before breaking. There is little risk of breaking the wire if it is only raised a distance about equal to its own diameter. If the coil has not been treated previously with shellac varnish or paraffin wax, care must be taken that the stretching of the wire does not cause a slackening of the turns. This can be avoided in the case of untreated coils by immediately inserting a slip of insulation under the raised wire.—W. G. G.

oooo

A SIMPLE TEST BOARD.

It is very convenient to have some permanent means of testing coils for continuity and condensers for short circuits. A simple testing board may be constructed with a flash-lamp bulb and a $4\frac{1}{2}$-volt dry cell.

With the phone terminals bridged, short circuits in condensers and the continuity of low resistance circuits will be indicated by the lighting of the lamp. For transformer windings and coils of high resistance low resistance telephones should be used, when continuity will be indicated by a loud click.—G. H. C.



A simple test board for insulation and continuity tests.

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REMOTE CONTROL OF AMPLIFYING VALVES.

It often happens that one would like to use a loud-speaker in a room which is unfavourably situated for the receiver itself. The receiver should, of course, be placed as near as possible to the point where the aerial lead-in enters the house.

A journey from the listening room to the set when changing from telephones to the loud-speaker is avoided by the use of the circuit given in the accompanying diagram. The filament resistance controlling the L.F. valves is situated in the listening room, and is connected to the set by heavy leads; a cross section equivalent to No. 14 S.W.G. will be satisfactory for normal distances.

The circuit connections are changed by two relays both operated by the filament current of the amplifying valves. When telephones are in use the output terminals are connected to the detector valve, but as soon as the L.F. valves are switched on by the resistance R, the relays connect the output to the plate circuit of the last valve, and a loud-speaker may then be operated off the output terminals in the listening room.

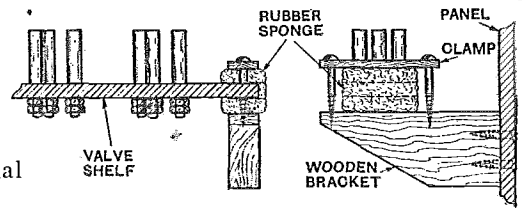
As the relay windings are excited by the filament current a fairly heavy gauge of wire should be used; and it will be found that comparatively few turns will be required to produce the force necessary to actuate the relay arms—L. H. N.

oooo

PROTECTION OF VALVES FROM VIBRATION.

Owing to the rigidity and low mechanical damping of the filaments of many dull emitter valves, it is desirable to insulate these, as far as possible, from mechanical vibrations which may cause undesirable ringing noises in the set.

A very satisfactory method of carrying this into effect is to clamp the valve panel between pieces of rubber sponge to brackets extending from the main panel. The clamping screws should on no account be allowed to touch the valve panel, and the pressure of the clamp should not be so great as to destroy the springiness of the rubber. The connections to the valve sockets should be made with flexible wire.—L. T. W.



Insulating valves from mechanical vibration.

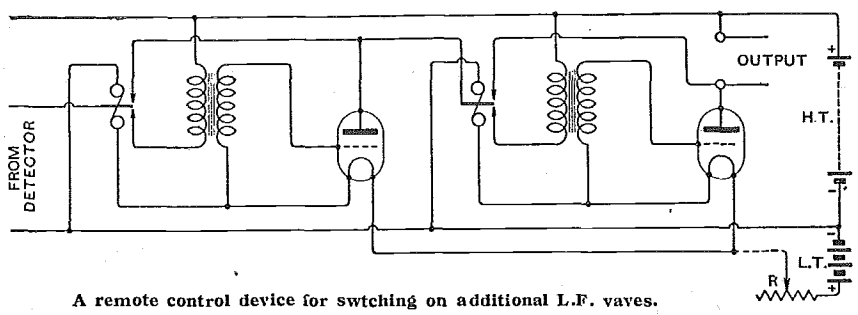
oooo

TINNING SMALL BRASS PARTS.

When the appearance of a finished set is an important consideration, it is often an advantage to be able to give small brass parts a "white" finish to correspond with other plated components on the panel. A cheap and convenient method of doing this is as follows:—

Mix together $\frac{1}{4}$ oz. of common salt and $\frac{1}{4}$ oz. of stannous chloride and dissolve in 1 gallon of water which has been raised nearly to boiling point. It is important to obtain stannous chloride, which should cost about fourpence per ounce, and not merely tin chloride, which is generally stannic chloride. As stannous chloride is readily oxidised to the stannic form, the solution should be freshly made, and it may be an advantage to use water that has been boiled to drive off dissolved oxygen.

The parts may be placed on a perforated zinc tray or suspended from a wire. They must be thoroughly clean and free from grease; absolute cleanliness is essential to the success of the process. The solution should be kept hot and the articles immersed for a period of about three hours. On removal from the solution the parts may be rubbed with a wad of soft paper and well rinsed in clean water.—J. C.



A remote control device for swtching on additional L.F. vaves.

RECORDING WIRELESS SIGNALS.

A Description of a Unit for Automatic Reception.

By CYRIL T. ATKINSON.

ALTHOUGH at the present time it is fully realised that the great bulk of experimenters confine themselves to the reception of telephony, it is felt that there are still some who take an interest in the many other applications of radio, among which can be numbered automatic reception and transmission.

Automatic reception is not as difficult as some people imagine, providing the very highest speeds are not attempted. Taking as our starting point a good 4-valve set capable of being adjusted to suitable wavelengths for the reception of powerful Morse stations, we can select one of several methods for converting the energy in the last anode circuit to a form suitable for operating a sensitive relay. The one which has given the most consistent and best results in the hands of the writer is due to F. W. Dunmore, of the American Bureau of Standards. Briefly, it consists of a suitable valve, or valves, in the plate circuit of which is placed the relay, and a negative bias applied to the grid in such a manner as to practically reduce the anode current to zero and bring the working point to the bottom bend of the characteristic curve. When a strong audio frequency signal is impressed thereon, the positive halves of the wave cause the plate current to jump from its normal exceedingly low value to something considerable, say, 1 to 2 milliamps. These pulses charge up the condenser across the relay, which in turn discharges through the windings of the relay, thus pulling it over steadily during the duration of the signal, either dot or dash. Fig. 1 is a diagram of the circuit, together with the main values

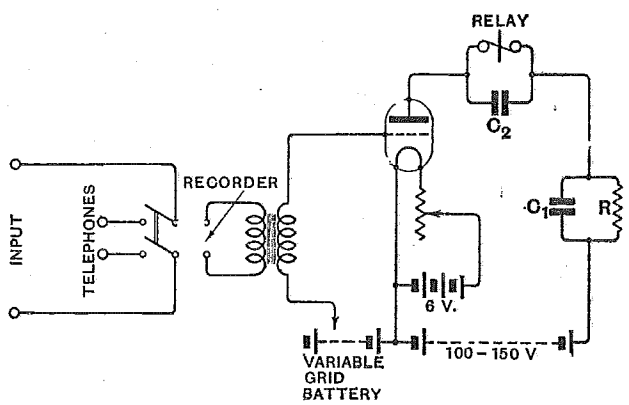
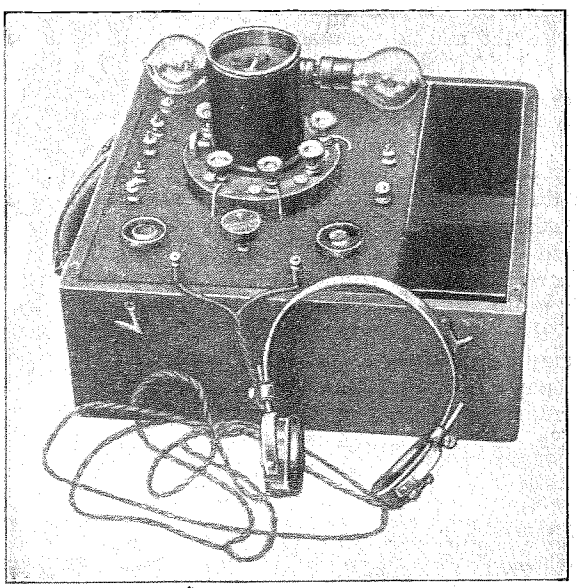


Fig. 1.—Connections of the recorder. C_1 = 1 to 3 mfds.; C_2 = 1 mfd.; R = 10,000 to 20,000 ohms. Two or more valves may be connected in parallel if desired.



The complete instrument. On the left is the "telephone or recorder" switch; centre, filament resistance; and right, grid bias switch. Two valves connected in parallel are used.

Arrangement of the Set.

This is intended to utilise one of the ex-army MKIII. tuner cases. The panel may be of ebonite or one of the well-known insulating materials, or even dry, well-seasoned wood, and on it are mounted the valve holders, relay, rheostat, phone switch, and grid bias adjuster, together with the necessary terminals. Although two valves are shown, one is often quite sufficient. The switch contacts in the set photographed are underneath, but this was only done to use up available material, and can obviously be substituted by the more usual form if required.

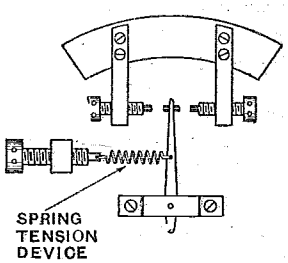


Fig. 2. — Arrangement of a spring to give a fine adjustment of the relay.

The grid bias must be adjustable in one cell steps (1.5 volts), but several initial volts can usually be included before the adjustable tapping starts. Care should also be taken to see that the switch fitted is arranged so as not to short circuit the cells as it passes from stud to stud.

A Post Office "B" type, or other similar sensitive quick-acting relay, is suitable, the former being suggested because they can often be obtained quite cheaply from ex-disposal goods vendors. It should be wound with 44 gauge silk-covered copper wire to a resistance of about 5,000 ohms, and will then operate reliably with about 0.25mA.

In connection with the adjustment of this an interesting fact was discovered by a friend of the writer and is worthy of mention here. When the grid-bias is adjusted for maximum sensitivity, it is found that the anode current is often not zero, and thus the relay is pulled

Recording Wireless Signals.—

over to the marking contact when no signals are being received. To remedy this, it is usual to increase the magnetic bias, but a much better way in practice has been found to be to pull the arm off contact by means of a very light spiral spring as shown in Fig. 2. The relay can then be adjusted for greatest sensitivity without the anode current and with no tension on the spring, the current then being switched on and the spring tensioned up until the contact just nicely "breaks."

For recording on the actual slip a Morse inker is suitable up to about 20 to 25 words per minute, providing it is well adjusted and possibly the moving parts lightened. It may also necessitate increasing the speed of travel of the paper. This can generally be effected by slight adjustment of the fly or air brake, which will be found inside. Should greater speed be desired, it will be necessary to use something in the nature of a Wheatstone or undulator type of recorder, which will work direct from the last valve without the intermediate P.O. relay. The circuit RC_1, Fig. 1, can sometimes be omitted, but tends to improve the operation, especially at the higher speeds.

The actual placing of the components inside the case need not be described in detail, as there is nothing but the grid cells and input transformer. The latter can generally be accommodated on the panel.

When the switch is over to "telephones," the ordinary set can be adjusted aurally, but a slight readjustment is generally required in the pitch of a c.w. signal when put over to the relay, as the note selected as best and loudest in headphones, at any rate, in my own case, did not seem to be the most suitable from a relay operating point of view.

Calls Heard.

Extracts from Readers' Logs.

Tipperary, I.F.S.

British:—2BK, 2CC, 2DX, 2IZ, 2KZ, 2MM, 2NG, 2NM, 2OD, 2XG, 2XY, 5IK, 5MA, 5MO, 5NN, 5PZ, 5XV, 5UQ, 6GH, 6MP, 6NF, 6QB, 6UV, 6XG. *French*:—8AP, 8BA, 8BO, 8CN, 8CT, 8CZ, 8CCP, 8DY, 8EM, 8EU, 8FK, 8FL, 8GD, 8GO, 8HSG, 8MN, 8NS, 8PP, 8RDR, 8RG, 8SG, 8SPR, 8SSU, 8SSV, 8UT, OCDJ (?). *Dutch*:—OGC, OLB, OLL, ORE, OXQ, OZN. *Swedish*:—SMZZ, SMYU. *Finnish*:—FN2NM. *Spanish*:—EAR6. *Italian*:—1CF, 1MT. *Iraq*:—GHH. *Belgian*:—B4AU. *American*:—(0-v-1) 1ARY, 1BBE, 1BCC, 1BLX, 1BWX, 1CNE, 1CRE, 1CX, 1FN, 1GA, 1GS, 1HN, 1PL, 1SW, 1VE, 1YB, 2BGI, 2BQB, 2BUM, 2BW, 2CEP, 2CUB, 2CVJ, 2CXY, 2VA, 3BAL, 3BEI, 3CHK, 3CKJ, 3HG, 3JO, 3NF, 3MF, 3WN, 8BIT, 8ALG.

(0-v-1) and (1-v-1.)

H. Goldsbrough.

Gt, Shelford, Cambs. (From Jan., 1925.)

American:—1BES, 1CAB, 1CC, 1PL, 1AMF, 1CRI, 1AUC, 1SK, 1ANA, 1SW, 2CJ, 2LE, 2XQ, 2KX, 2BM, 2AV, 2BCO, 2KF, 2CJB, 2WIK, 3AHA, 3CJN, 3MF, 3FD, 3BG, 3BN, 3AS, 3HH, 3CSG, 3AUK, 3MH, 3OE, 3BNU, 3HJ, 4TW, 4GW, 8VX, 8BC, 8BCP, 8ADG, 8DGL, 8AOL. *French*:—8PL, 8PS, 8XP, 8SSB, 8HSG, 8EM, 8GG, 8SG, 9CQ, 8GI, 8MAR, 8RO, 8MJM, 8CZ, 8MN, 8CS, 8SSU, 8EE, 8BAL, 8KX, 8BV, 8CPP, 8HSD, 8UD, 8CO, 8WAL, 8C, 8ZV3, 8HRA, 8JBL, 8CT, 8SGR, 8EO, 8XR, 8UU. *Belgian*:—4RS, 4AR, 4AS, 4JN, 4SR, 4XS, 4FG. *Dutch*:—0RW, 0LL, 0ZA, 0II, 0FL, 0ZN, 0BQ, PCK, 0PV, 0KN, 0GC. *Swedish*:—SMZZ, SMGB, SMPL. *Finnish*:—FN5NQ, FN2NS. *Italian*:—1RT, 1AA, 1AM, 1MT. *Spanish*:—9PY. *Swiss*:—9LA, 9BR. 9AD. *Miscellaneous*:—GHH, EARZ, D6BN, 1KX, 1RB, GM. *Mosul*:—9PC.

(0-v-2 and 0-v-1.)

G. A. Jeapes (G2XV).

West Norwood.

British:—2ACK, 2VX, 2ZO, 5AX, 5DA, 5ID, 5IG, 5ZA, 6UV, 6YL. *French*:—8CO, 8SSB, 8JBL, 8PL. *Belgian*:—4AR, 4AU, 4CH, 4UC. *Italian*:—1RT, 3MB. *Finnish*:—3NB, 5NQ. *Others*:—1RB, 7BN, 8SO, 9BR, 9EA, SMYV, SHER (?).

L. F. Aldous (2ZB).

Rotherham, Yorks. (To Feb. 21st.)

American:—1AXN, 1BKR, 1BQ, 1BWX, 1ER, 1FD, 1PL, 1SW, 1WL, 2CVJ, 2CXY, 2TP, 3HQ, 3HH, 4SA, 4TV, WGH. *Belgian*:—4ALS, 4AS, 4GF. *Canadian*:—1AR. *Dutch*:—0BA, 0GC, 0LL, 0NF, 0NTZ, 0XF. *Finnish*:—5NQ, 2NCB, 3NB. *French*:—8AOA, 8HSO, 8MAR, 8NK, 8RBR, 8UU, 8WAL, 1OKZ. *Italian*:—1AF. *Mesopotamian*:—GHH. *Swedish*:—SMGB, SMXV.

(0-v-0.) W. A. Scarr.

Cranleigh, Surrey. (To Feb. 22nd.)

British:—2AQK, 2FV, 2JF, 2LZ, 2MC, 5GH, 5MQ, 5XY, 6GH, 6UV. *Mosul*:—GHH. *American*:—1AAO, 1AFN, 1AMF, 1CX, 1RD, 2ACT, 2ANA, 2AVU, 2AZY, 2BLM, 2BQA, 2CG, 2DD, 2DN, 2SM, 2UC, 2XQ, 3BPM. *French*:—8AB, 8ADG, 8CBA, 8FQ, 8GN, 8TK, 8UT, 8WNM. *Belgian*:—4LOV. *Italian*:—1CF. *Danish*:—7ZM. *Swedish*:—SMXX. *Finnish*:—2NM.

(0-v-1.) F. J. Emuss.

Braintree Essex. (To Feb. 22nd.)

American:—4BQ, 4FM, 4FZ, 4KL, 4KU, 4SB, 4TJ, 5AAZ, 5ALR, 5EF, 5EW, 5UK, 8ABY, 8ACO, 8ADG, 8BCH, 8CED, 8DGU, 8DOO, 8DMX, 8EB, 8ER, 8MC, 8UU, 9CUO, 9CXW, 9DQ, 9DUC, 9RY. *Canadian*:—1AF, 1AR, 1DD, 1DQ, 2CG, 3HI, 3XI, 9AL. *Argentine*:—CB8. *Brazilian*:—SA-WJS. *Australian*:—3BQ. *Cuban*:—Q8TH. *Mesopotamian*:—GHH.

(0-v-1.) D. Woods (G2AXZ).

Dartford, Kent.

British:—2AA, 2JG, 2KF, 2KG, 2LC, 2OD, 2OK, 2RB, 2SU, 2SZ, 2TP, 2XP, 5AA, 5LN, 5PU, 5PZ, 5TY, 5TZ, 5XN, 6KK, 6UT. *French*:—8GG, 8GK, 8GO, 8HD, 8NK, 8PA, 8SS, 8SSU. *Dutch*:—0GC, 0MI, 0YY. *American*:—IBZP, ICF, IPL, 3BOI, 3AVK, 3TA, 5OK. *Canadian*:—IGS, IPC. *Italian*:—IMT, IRE. *Swiss*:—9BR. *Belgian*:—4AS. *Various*:—IRB, GHB, NN2, 6GS, T8U, T1W, AG2, NC0G.

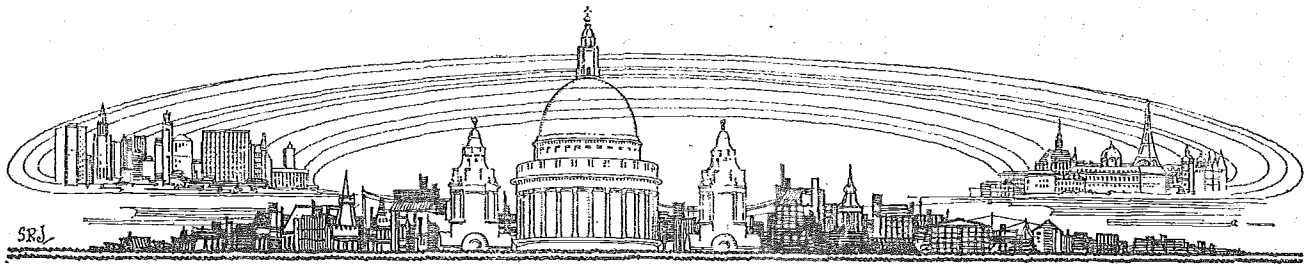
(0-v-1.) C. H. Targett (6PG).

Leytonstone.

French:—8AAA, 8AB, 8AL, 8AOA, 8AQ, 8AU, 8BA, 8BF, 8BN, 8BQ, 8BV, 8CF, 8CK, 8CO, 8CT, 8CZ, 8DE, 8DI, 8DKV, 8DX, 8EE, 8EM, 8ENE, 8FC, 8FI, 8FJ, 8FL, 8FN, 8FQ, 8GI, 8GM, 8HSD, 8HSG, 8II, 8JBL, 8JHL, 8JL, 8JVX, 8KK, 8LMT, 8MAR, 8MJM, 8ML, 8MN, 8MOO, 8NS, 8OK, 8PL, 8PP, 8PS, 8RBR, 8RG, 8RGT, 8RLH, 8RO, 8RV, 8SG, 8SM, 8SPR, 8SR, 8SSC, 8SSU, 8SSV, 8TM, 8UU, 8VG, 8VW, 8WAL, 8WZ, 8XF, 8XP, 8ZUT, 8ZZ, 1OKZ, OCBJ, OC, 5oZ. *Belgian*:—4ALS, 4AS, 4AU, 4RS, 4UC, BI, K2, PI, P2, ICF. *Italian*:—IER, IFP, IMT, 3AF, 3MB, IDO. *Danish*:—7EC, 7QF, 7ZM. *Finnish*:—INA, 2NCA, 2NCB, 2NM, 2NN, 3MB, 3NB, 3NG, 5NQ, FNi. *Swedish*:—SMXV, SMZS, SMZY, SMZZ. *Dutch*:—0AB, 0BA, 0BQ, 0GC, 0GG, 0II, 0NL, 0RW, 0XP, 0XQ, 0ZA, NSF, FCi, PCRR. *Swiss*:—9AB, 9AD, 9BR, 9LA, 9PY. *Russian*:—NRL. *Spanish*:—7BD. *Luxembourg*:—OAA, IRAG, GHH, GHHi. *Mosul*, *Morocco*:—AIN. *American*:—1AF, 1ATJ, 1ATQ, 1BAN, 1BCR, 1BE, 1BHM, IBJ, 1BKR, 1BQB, 1BUB, 1CAK, 1CCG, 1CMX, 1JS, 1KK, 1MY, 1PL, 1QV, 1WL, 1YL, 2QBD, 2ABT, 2AG, 2BGG, 2BJP, 2BRC, 2BUB, 2BZ, 2XE, 2CEP, 2CJB, 2CJX, 2CVF, 2MC, 2XAY, 3ADQ, 3BVA, 3CHC, 3CHG, 3HG, 3OT, 3TJ, 4DU, 6CTO, 8ADJ, 8ALY, 8RG, LPX. *Canadian*:—3NF. *Miscellaneous*:—2YT, 3AR, 3CA, E3CM, 3KO, 6XXX, 9EU, GG, MM, KDKA.

(All between 50 and 120 metres.)

M. G. Hammett.



CURRENT TOPICS

Events of the Week in Brief Review.

NEW FERRO-SILICON CRYSTAL.

M. Felix Thuad, while experimenting on by-products of steel, has discovered a new ferro-silicon combination which is said to be exceptionally good for crystal reception. One experimenter declares that by its use stations 300 miles distant have been heard with perfect clarity and exceptional strength.

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CANCELLED CONFERENCE.

The proposal to hold the Annual Conference of Affiliated Societies in Manchester on April 4th has been cancelled owing to the extremely small number of societies who have signified their intention to send delegates.

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TWO CENTS, PLEASE.

A pathetic plea to American "hams" is issued by a Scottish reader. The postage on QSL cards to this country, he reminds them, is 2 cents. He has recently had to pay 1½d. on each of a dozen cards received.

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NO TRANSMITTING IN SYRIA.

The importation of receiving apparatus into Syria and Lebanon has recently been authorised by General Weygand, the High Commissioner, but the importation of transmitting apparatus is still forbidden.

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A COSMOPOLITAN TRANSMITTER.

The equipment of the station to be erected in Brazil, near Rio de Janeiro, will be somewhat cosmopolitan. The towers are to be erected by the Telefunken Company and the aerial by the Radio Corporation of America. The Marconi Company will supply the transmitting apparatus and the Cie Generale de T.S.F. the generators. The station will be similar in design to that at Ste. Assise.

o o o o

ALBERTA HEARS 2NM.

Strong reception of 2NM's signals has been acknowledged by Mr. Ober (Canadian 4DQ), of Vulcan, Alberta. This is believed to be the most westerly point in Canada at which British signals have been picked up.

BROADCASTING PARLIAMENT.

Great interest centred round the Prime Minister's announcement on Wednesday last that he was thinking of setting up a Select Committee of both Houses to consider the possibility of broadcasting certain debates.

Mr. Baldwin said the time had come when the whole question of permitting certain proceedings in the House of Commons to be broadcast should be considered.

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WIRELESS IMPORTS.

Mr. A. M. Samuel (Department of Overseas Trade) stated in Parliament that the value of the imports of wireless instruments and apparatus from foreign countries for January, 1925, was £100,038, as compared with £23,666 for January, 1924, and that of wireless valves was £13,117 for January, 1925, as compared with £1,214 in 1924.

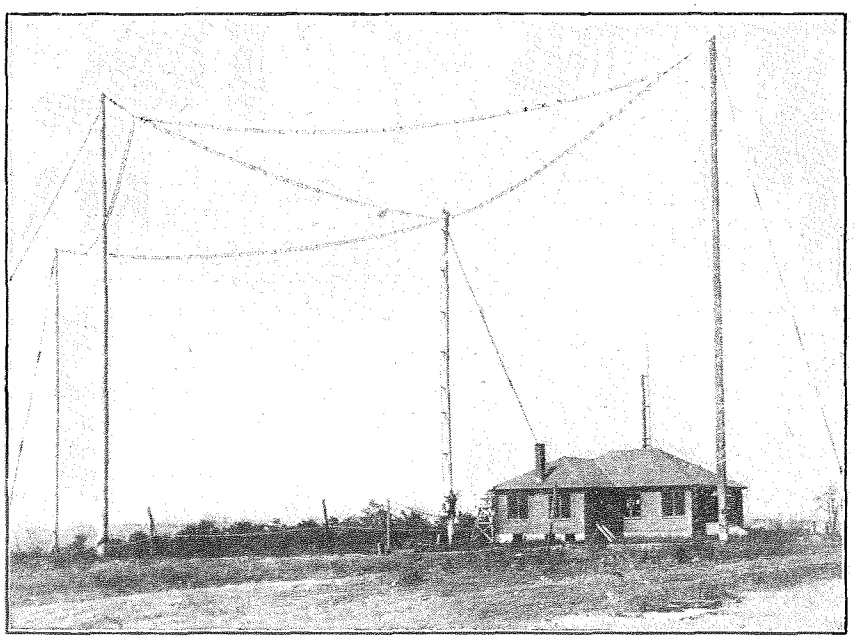
AIR PILOT TO THE RESCUE.

Capt. Barnard, a Croydon air pilot, while passing over Cape Grisnez during a flight from London to Paris, noticed a two-masted vessel in distress. He at once sent out S.O.S. signals which were picked up by stations along the coast, with the result that help was quickly dispatched from the shore and all the crew rescued.

o o o o

BROADCASTING CONCESSION FOR ITALY.

We understand that the Italian Government has granted to the Unione Radiofonica Italiana the exclusive right of broadcasting theatrical and musical performances, speeches, etc., from the national transmitting station in Rome, from Milan, and either Naples or Palermo. Three additional stations will also be controlled by the Unione at places to be decided on later.



KDKA's EXPERIMENTAL AERIALS. The research ground of the well-known Pittsburgh station, seen in the photograph, is situated a mile away from the studio and offices. The long wave aerial is suspended from the high mast, while the short wave antenna is attached to the short vertical pole above the station building on the right.

AS OTHERS SEE US.

High praise was meted out to the British amateurs in the course of speeches made at the recent banquet of the Fifth Annual Convention of the American Second District amateurs.

Mr. Hiram Maxim, President of the American Radio Relay League, who spoke on the American amateur, paid a glowing tribute to his British cousin; he also referred to the formality which attends British radio dinners and meetings, and hinted that Americans might take a lesson from this practice!

British amateurs were represented at the function by Captain H. de Donisthorpe, who made an excellent speech descriptive of British amateur activities. He referred to the advantage of the American in possessing a dry country—meteorologically speaking—and stated that the Britisher, owing to the dampness of his climate, encountered insulation difficulties to which the American amateur was a stranger. After describing the experimental stations of G2OD and G2KF, Capt. Donisthorpe concluded by expressing his faith in amateur radio as a factor in promoting and cementing international friendship.

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ITEMS FROM THE TRADE.

Messrs. Burndept's trade department now occupies larger premises on the first floor, 66, Chandos Street, W.C.2. (opposite Charing Cross Hospital).

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The Damard Lacquer Co., Ltd., of Greet, Birmingham, have issued an interesting illustrated brochure describing the processes involved in moulding "Formite" Bakelite. Bakelite has many uses, being applied to musical and optical instruments, but its primary value lies, of course, in its suitability as an insulator.

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Owing to the increased demands for the products of the Paragon Rubber Manufacturing Co., Ltd., of Hull, the company's sales department has been reorganised. Messrs. Peter Curtis, Ltd., of 75a, Camden Road, London, N.W.1, have become the central sales organisation for the productions of the two companies and an appropriately appointed showroom has been opened at the above address.

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The National Wireless and Electric Co. advise us that a great deal of their correspondence is still being addressed to their old works address, viz., 7a, Church Road, Acton, W.3. Since November last the company's address has been 42, Gray's Inn Road, London, W.C.1, and they trust that this note will reach the eyes of their prospective customers.

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In view of the alarming newspaper reports regarding the recent fire at the factory of Messrs. Peto-Scott Co., Ltd., the company wish to state that the manufacturing side of the business has not been affected, and orders are being attended to as usual.

HEARD IN RHODESIA.

Mr. J. A. Partridge (2KF) has received news that he is the first British amateur to be heard in Rhodesia. 2KF's signals were picked up by Mr. J. M. Davidson (1SR), also a transmitter, of Salisbury, Rhodesia, at 12.35 a.m. on February 14th last. Atmospherics were bad at the time, which reflects still greater credit on both 2KF and 1SR.

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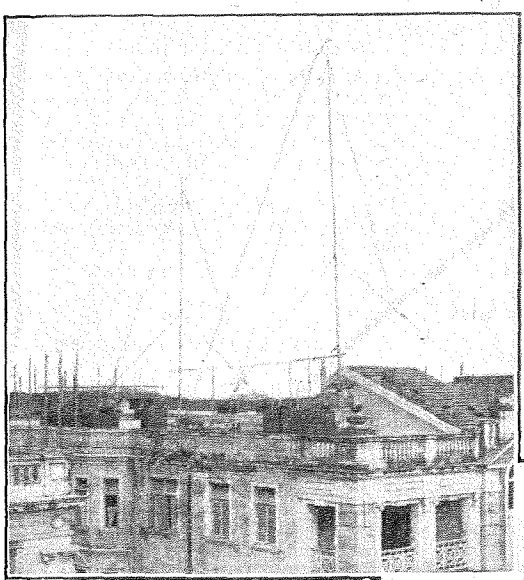
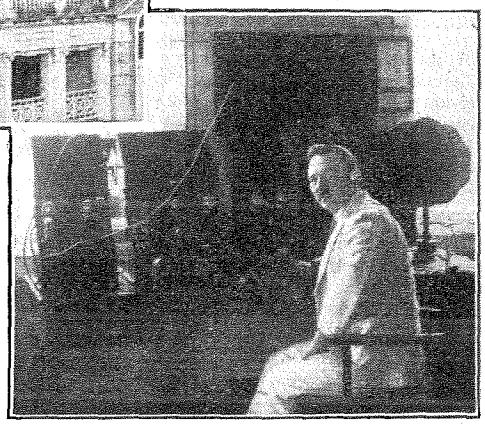
MOSCOW ASKS FOR REPORTS.

The directors of the new station recently opened at Moscow, which broadcasts a special daily programme for amateurs, ask all listeners to report on the reception of this programme so that they can check their transmitter's performance.





BOMBAY HEARS 5XX. An interesting cable was recently received by "The Wireless World" from a Bombay radio engineer, Mr. W. H. Smith, who stated that he had picked up a programme from Chelmsford with remarkable clarity. The accompanying photographs, which soon followed, show that our correspondent had the advantages of a good aerial, and, to all appearances, an efficient receiver. Three valves only were used in the reception of 5XX, and the set is entirely of home construction. Mr. Smith is also a transmitter, with the call sign 2AX.

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EXPERIMENTAL TRANSMITTING STATIONS.

The Postmaster-General stated, in reply to a question in Parliament, that on February 20th there were 2,181 "Sending" licences in force, and 126 applications were under consideration. From June 1st to the end of January, 265 applicants were granted licences and 126 refused.

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WHERE IS E1ZA?

A correspondent has heard the station E1ZA transmitting on about 75 metres. Can any of our readers identify this call-sign?

BATTERY SERVICE SCHEME.

There are at present a number of dealers who, whilst conveniently situated for the reception of batteries from users, are not in a position to install charging plants. Under the extended scheme promoted by the manufacturers of the well-known Exide batteries, each local service station can appoint in its own area "Exide Battery Dealers," who will exhibit a special sign and act as receiving stations for the local service station. Thus a very real service will be brought to every battery user's own doorstep.

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DISTILLED WATER ONLY FOR ACCUMULATORS.

The United States Bureau of Standards has been investigating the cause and effect upon accumulators of impurities in the water used, and states, in a preliminary report, that iron, manganese, chloride and bichromates affect both the positive and negative plates. Bismuth, starch and sugar affect the positive plates only, and platinum, tin, copper, antimony, silver, nitrogen, and tungsten the negative plates. Chlorine and iron are to be found in most tap water, which should therefore always be avoided.

ATMOSPHERICS.

A recent talk from the Nottingham station, entitled "Human Nature," was followed by a telephone-wireless discussion. Illustrations were kindly provided, we understand, by listeners who failed to get through on the telephone.

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The B.B.C. engineers are blamed because the new 2LO has revealed shielded areas in South London. The engineers sometimes wish they, too, occupied a shielded area.

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"There is nothing more annoying," says a broadcast critic, "than the habit some announcers have of abruptly breaking in at the end of a musical number." It certainly does wake one with a start.

SOME ASPECTS OF BRITISH BROADCASTING.

Who Controls the B.B.C.?

This question was raised in a recent editorial, and our contributor, who has special knowledge of the subject, examines certain aspects of the situation.

By G. ROLLAND WILLANS.

AT a time when forcible and occasionally highly prejudiced criticism is being levelled at the quality and extent of the broadcasting services, it may perhaps be of interest to examine certain aspects of the situation from an unprejudiced point of view and with some knowledge of the issues involved.

There can be no harm in expressions of opinion that are not purely destructive, and this article is written with a view to stimulating interest in what appear to the writer as points of major importance in connection with a question of international as well as national significance.

Public Confidence.

In the first place, it is essential that adequate provision should be made for technical development in respect of a reasonably limited number of transmitting stations. Secondly, this work should be in the hands of engineers representative of the best brains in the country unhampered by any other interests than those of the perfection of the plant itself and its economical management. Thirdly, activities in connection with the actual material to be broadcast should be delegated to individuals who are recognised authorities on the subject of public entertainment, whose experience fits them for the gigantic task of catering, day in and day out, for the widely varying tastes of an unlimited and increasingly critical audience.

In commenting on the subject of broadcasting in a recent issue of this journal, the Editor raised a question of considerable interest as follows: "The question naturally arises, Who controls the B.B.C., and whose interests must the company consider first?" Issues raised by this question become of relative importance only in the light of the fact that the agreements upon which broadcasting has so far been based will shortly be open to review. It is, however, useful to raise a further question: Upon what will the future of broadcasting as a national institution depend? The answer is clear: Public confidence in those directly responsible for its development.

The writer had an early opportunity of examining the situation in the United States at the beginning of 1922, and it did not require a visionary to appreciate that here was something to grip the public imagination, something that was bound to spread quickly and internationally, but, above all, something which required to be watched and controlled in order to avoid chaos and confusion. It is clear that some measure of control must remain if chaos, such as would result from unrestricted competition, is to be avoided, but the efforts now being made to stimulate criticism of the existing broadcast organisation should not of necessity be accepted as entirely disinterested.

The revenues of the B.B.C. are admittedly very considerable, and it is convenient to consider their application under two main headings:—

1. The operation, maintenance, and, most important of all, the development of the broadcasting machine itself.

2. The supply of a continuous stream of material to be broadcast, and the support of an organisation devoted to its efficient and economical distribution.

Under the first of these two headings, the broadcasting machine has, from the outset, been developed quickly and efficiently, and represents a technical achievement of which the B.B.C. has every reason to be proud. It is agreed on all hands to work smoothly and efficiently, being second to none in its faithful reproduction of speech and music. The extent to which the permanent staff have in the past been assisted in their task by engineers other than those actually in their employ is not generally known, but it is essential that this branch of the broadcasting activities should be technically self-supporting. No reasonable individual would grudge money properly applied to the research and experimental work necessary if a high standard of performance is to be maintained, always provided that this work is in good hands and that the best material can be made use of, irrespective of the source of supply. The whole art of broadcasting is in its infancy, and it would be indeed unfortunate if in any readjustment of the position as it stands to-day more than adequate provision were not made for every possible technical requirement, or if developments under this heading were to depend upon the goodwill of individual firms or groups of firms with their own commercial interests to serve. Public money applied in this way represents a direct investment in security for the future.

Taxation.

Under the second heading the extent to which the public must of necessity be taxed in order that the supply of broadcast material can be maintained and, above all, improved is another matter and one in which the potential value of broadcasting in connection with every form of enterprise could be made to play an exceedingly important part. Whilst manufacturing interests represented on the board of the B.B.C., incidentally materially influencing the company's activities, have been able to provide a considerable measure of technical support, it is reasonable to assume that they have not had at their direct disposal experts in the art of public entertainment, and, owing to opposition from the entertainment world, one may be forgiven for presuming that this branch of the work has been carried on without sufficient competent guidance. If this is the case, there is no cause for undue criticism, although the road to improvement is clearly indicated. Entertain-

Some Aspects of British Broadcasting.—

ment supplied by outside organisations is a step in the right direction, the recent *Evening Standard* programme providing a striking example of what can be done. This venture has no doubt rewarded the proprietors of the newspaper, as well as being of considerable benefit to the public, and in like manner broadcast excerpts from theatres have provided excellent entertainment for the listener whilst materially benefiting box-office receipts.

Here, then, it would seem, we have a possible source of revenue rather than expenditure, and a slight modification of the ban on advertising by broadcast (Heaven forbid that it should be entirely removed!) would go far towards making broadcasting self-supporting.

There seems no logical reason why Messrs. Brown, Jones, or Robinson should not be allowed to pay for the privilege of providing the public with entertainment, taking the blame or credit for their individual achievements under a guarantee that such programmes will not fall below a certain standard, the right of veto or acceptance being in the hands of individuals entitled by their experience in such matters to the confidence of the public.

To sum up, it appears that direct taxation by way of licence fees can be justified under the first heading, and, to a certain extent, under the second, and we pass, in conclusion, to the problem of where the control of what may ultimately prove to be a vital factor in our national existence shall lie.

Although certain powerful manufacturing interests have been largely responsible for financing the B.B.C., and creating broadcasting as we know it, they can lay no particular claim to a specialised knowledge of what is required by the public, and, having built up a material source of revenue for themselves in a lucrative and rapidly expanding industry, have no doubt been amply repaid for their foresight and what slight risk was involved once Government support was secured. Their undivided attention is needed in the direction of providing satisfactory broadcast receiving apparatus at prices within the reach of the average man so as to make it possible for every home in the kingdom to benefit by what is, after all, a revolution in the social amenities of our time.

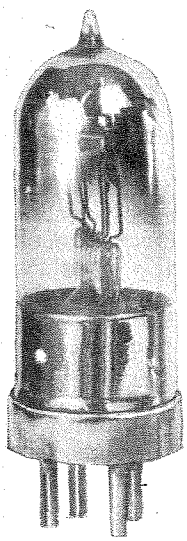
The control of wider issues affecting broadcasting might well be considered as a national trust, and, as such, should appeal to the ablest thinkers and doers of our own or any future generation. Apart from this, the door should be left open to any form of private or public enterprise which, under guarantees of a high standard of artistic and technical performance, would at the same time reduce the ultimate charge on the public to reasonable proportions.

In conclusion, whatever may be the outcome, the B.B.C. have laid the foundations of an important public service under conditions of exceptional difficulty, and can clearly be credited with a remarkable achievement.

VALVES TESTED.

The Economic Electric, Ltd.'s '06 Valve.

WE have recently had an opportunity of carrying out some tests on a new valve shortly to be placed on the market by the Economic Electric, Ltd. This valve is a further addition to the "60 milliampere" class and is rated as a general-purpose valve taking 0.6 ampere at 2.5 to 3.0 volts. The anode rating given is 45 to 75 volts.



Economic Electric, Ltd.'s '06 valve.

As regards construction, the design of the electrodes is the same as that adopted in the "Xtraudion" and "Dextraudion" valves, also marketed by the Economic Electric, Ltd., and familiar to most wireless men.

The first point of interest noted when testing a sample valve was that the filament took even less current than its rated value at full filament voltage, while the emission obtained was quite ample for the work intended. The filament efficiency (the milliamperes of saturation current per watt of filament heating energy) is unusually high and reaches no less than 40.5 milliamperes per watt at full power.

The results of our bench tests are tabulated.

As would be expected from the test figures, the valve gave good performance during the practical test on the set.

A further point of interest noted during the practical test was that this new valve seems particularly free from microphonic noises, a virtue which is not shared by all valves of the 60-milliampere class. For high frequency and detector work a plate potential of 30 to 40 volts should be used. For L.F. amplification the figures in the table suggest useful combinations for grid and plate potentials. For instance, when a grid bias of -3 is necessary, the plate potential should be 60 volts.

The ratio of the amplification factor to the plate impedance is rather lower than in other valves of the same class, but an examination of the valve leads us to believe that this could be improved by a slight alteration in the arrangement of the electrodes.

60 MILLIAMPERE VALVE.
Economic Electric, Ltd.

Filament volts, 3.0. Filament amperes, 0.051.
Emission (total), 6.2 milliamperes. Filament efficiency, 40.5 milliamperes per watt.

Plate Volts.	Plate Current at Zero Grid Volts.	Grid Bias. Volts.	Plate[1] Current. Milliamperes.	Amplification Factor.	Impedance. Ohms.
20	0.3	0	0.3	5.0	23,500
40	1.15	−2	0.7	5.2	21,000
60	2.25	−3	1.36	5.2	21,000
80	3.5	−5	1.85	5.2	21,000

[1] Plate current when grid is biased to the value of Col. III.

BROADCAST BREVITIES.

NEWS FROM THE STATIONS.

Tetrazzini's Fee.

Many minds have been exercised over the fee paid to Madame Tetrazzini for singing at 2LO. The sum of £1,000 was about the shrewdest guess; but even that was a good way out. Including the cost of bringing the prima donna from Italy, the figure mentioned could easily be doubled. That evening's concert cost not far short of £5,000.

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International Wireless Conference.

The Conference of Wireless Experts which was called by the B.B.C. recently had no official backing; but before anything useful can be done it is certain that the respective Governments must take a hand in deciding how undue interference may best be dealt with.

A recent case emphasises the need of regularising wavelengths. An arrangement has been made whereby Oslo (formerly Christiania, the capital of Norway) should work on 369 metres. Consequently, it was officially announced that London would go from 365 to 359 metres; Manchester from 375 to 378 metres; and Bournemouth from 385 to 387 metres. At the last moment Oslo found that in working on 369 metres interference would be caused with another Norwegian station on 370 metres. No change was therefore made, and the three English stations were likewise unable to introduce their proposed alterations.

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Glasgow in Trouble.

In the meantime Glasgow, on 420 metres, was being jammed by Oslo working on 423 metres. The latter station, by arrangement, went down to 419 metres. Then Breslau complained that Glasgow was jamming. Oslo, on being informed, moved down to 380 metres, in which position it jammed Manchester (375 metres). Oslo is now on 380 metres, but no bad interference is experienced with Bournemouth, which works on 385 metres. Slight heterodyning with Manchester is still going on.

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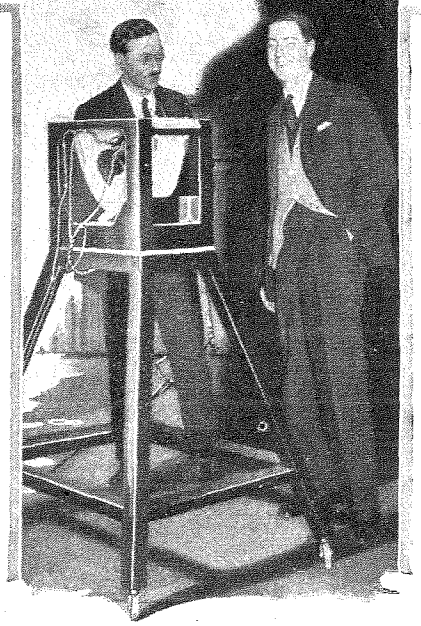
Frigid.

For the latest wireless contrivance it is claimed that broadcast refrigeration will be possible in the same way as radio stations now broadcast musical programmes. The inventor (an American, of course) says that his special receivers can be installed cheaply in ordinary receptacles, and will eliminate the necessity of ice or refrigerating machinery.

The housewife will merely require to keep her receiver tuned in to a central station, which will do the rest. Thus looms the shadow of a new wireless battle; for the manufacturers of refrigerating plant are not likely to sit with folded hands while a concern like the B.B.C., under the pretence of sending out music and other forms of entertainment, was in reality keeping the remains of last Sunday's dinner in a healthy condition in the larder.



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A Prophecy Fulfilled.

The suggestion that hotel guests should have control over a loud-speaker installed in their private rooms, in the same way as the telephone now is, contains nothing new. That eminent journalist W. T. Stead, who met his fate in the "Titanic," foretold some thirty or forty years ago in the "Review of Reviews" the coming of a wireless set in every house and caravanserai, which would go even further than this new hotel idea. The visitor would have control of two switches, one to give him the spoken word and the other to bring before his eyes a picture of the place in which the word was spoken, even if it were at the furthermost ends of the earth. Stead's vision will some day be realised.

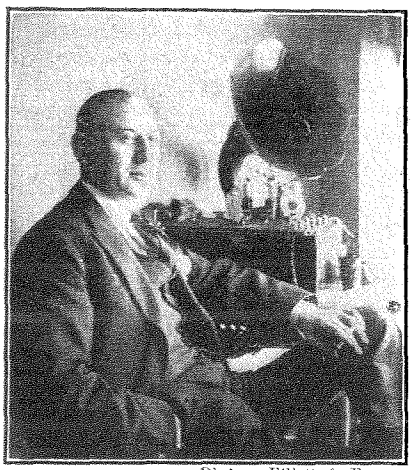

Photo.: Elliott & Fry.

DE GROOT AT HOME. The famous conductor photographed while "off-duty."

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Rebroadcasting of 5XX.

A considerable number of reports of successful reception of the rebroadcasting of 5XX from American stations are coming to hand, not only from listeners in this country, but from various parts of Europe and British New Guinea, among other distant parts of the world.

The rebroadcasting was recently carried out on three successive nights, and on each occasion the signals were easily audible, thus showing that there was nothing freakish about the experiment.

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Too Many Interruptions.

One listener on the Continent complains, however, that the American announcer makes too frequent interruption by telling his unseen audience: "This is Chelmsford, England, being transmitted from the American Station KDKA or WGY" (as the case may be). "These are the chimes of Big Ben, the famous clock at the Houses of Parliament, London, England" and so forth.

The complainant happens to be English, and therefore doesn't need the verbal description, but against him may be set hundreds to whom such descriptions are welcome.

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If You Give It Up.

Although we would like to suppose that once a listener, always a listener, it is a cruel fact that people here and there do give up the pursuit. It would be well if they would advise the Post Office where their licences were taken out, accordingly, as a lot of unnecessary work is undoubtedly being caused to the authorities issuing reminders of expiration of licences. This could be avoided if the licensee would send a postcard saying that his set had been dismantled.

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Harmonics.

Harmonics seem to be plentiful just now. One listener last week thought that he had got 2LO on a sixty metre wavelength; but, after all, it was only a harmonic.

Oscillation.

A wireless expert states on very high authority that 35 per cent. of oscillation is unintentional and accidental, 30 per cent. is due to the presentation of a new set in the hands of an inexperienced listener, and that by the time one listener in his family had learned how to handle the set a new one had arisen elsewhere, and that the remaining 35 per cent. is deliberate. Whatever the division may be, there is need for that new invention by an official in the Ministry of Postes et Telegraphes, Paris, whereby it is claimed that delinquents can be easily detected.

o o o o

Offenders Beware!

The apparatus, unlike that used by radio societies, which is able to detect oscillation within a comparatively small area, can, it is claimed, reveal the actual spot where oscillation is taking place. If there is anything in the invention the National Physical Laboratory will recommend it to the British authorities, and then listeners will have to be very, very careful.

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Broadcasting from Prison.

Harry Snodgrass, an inmate of a Missouri State Prison, and an accomplished pianist, broadcasts regularly programmes from WOS under the surveillance of prison guards. Through his many admirers among the alleged ten million listeners in the United States he is kept well supplied with cigars, cigarettes, candy, fruit and eggs, to say nothing of more unusual gifts such as gold pencils, music, etc.

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What About It?

There is a good deal in this idea. It has been suggested recently that wireless receiving sets should be installed in our prisons. America has shown us that matters should be arranged the other way about, and that transmissions should take place from these congenial homes of the misguided.

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Scrambled Wireless.

An idea which seems to be based on the ingenious mechanism of the Baudot telegraph instrument is being applied in America to radio signals from Europe. The signals are picked up in Maine, scrambled together, and sent in one wave-band by a single transmission to Long Island, where they are unscrambled into many signals which are fed into the long-wave receiving sets for the usual process of detection and transmission to New York. The signals received are exact *replicas of the originals*, and the New York operators are said to be unable to distinguish whether they are the original or the scrambled and unscrambled signals.

o o o o

Listening to the Derby?

To the song of the nightingale and the shrieks of the denizens of the Zoo, the B.B.C. proposes to add to its reproduction of natural and unnatural noises the roar of Niagara and, if possible, at an earlier date, the noises at the Derby.

With the receiving apparatus installed in one of the enclosures it would be possible to pick up the laying of the odds and the shouts of the crowd. Another microphone might be installed at Tattenham Corner, and that one placed near to the winning post would enable listeners to get a very good idea of the excitements and vicissitudes of the classic race.

o o o o

Surprises from Manchester.

Owing to the collapse of some of the trunk lines to Manchester during the recent gale, when an S.B. programme was being relayed, the Station Director had hastily to provide an impromptu concert from some of the provincial stations. Manchester listeners apparently enjoyed the uncertainty of not knowing what the next item would be. Accordingly, another surprise programme is being arranged by the station. It will be given on April 3rd, but the details of it will not be published.

o o o o

London's Advantage.

The task of compiling programmes that will satisfy the majority of listeners is no easy one, and in this respect it cannot be denied that London has the "pull" in being able to command the services of a larger number of higher-class artists than is the case in the provinces. The excellent system of sending prominent artists on tour to the different stations in the country has been greatly appreciated by provincial listeners, and the hope has been expressed that the system will be extended.

o o o o

Cramping at Newcastle.

The view is held by many persons that the Newcastle station of the B.B.C. is the worst off as regards size and available space of all the stations, including relay. The present studio and offices in Eldon Square are rather cramped for space, and when a large choir or orchestra get into the concert room there is little space for anything else. Meanwhile, more commodious premises in the centre of the city have been promised.

o o o o

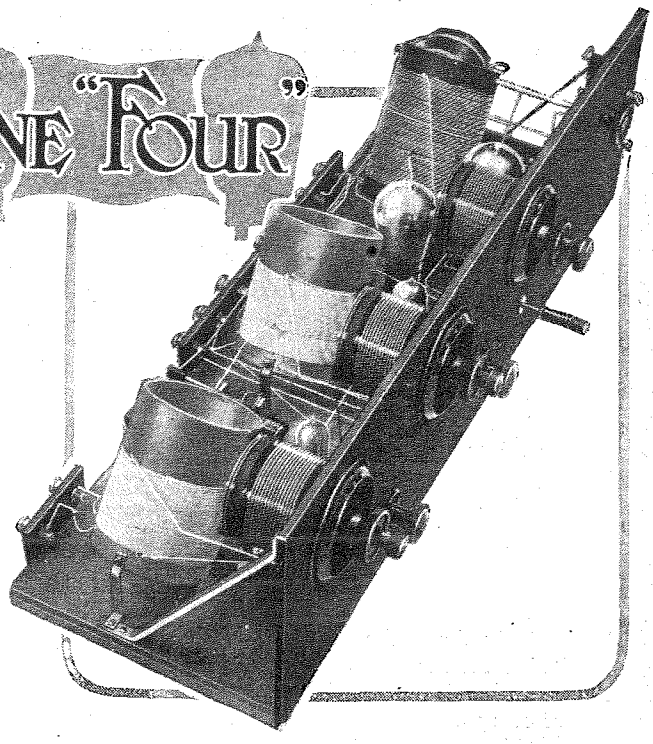
Plea for More S.B.

"Give us more stuff S.B. from London" is the cry of a large number of listeners in the North East, many of whom have been complaining in the local Press of the class of programme broadcast from 5NO. Some little time ago there was a similar outcry, but this died down only to break out afresh.

FUTURE FEATURES.

Sunday, April 5th.		
London and 5XX, 3 p.m.	...	Organ Recital.
Manchester, 3 p.m.	...	Symphony Concert.
London and 5XX, 9 p.m.	...	French Programme.
Cardiff, 9 p.m.	...	The British National Opera Company in "Cavalleria Rusticana." S.B. to other Stations.
Monday, April 6th.		
London, 7.35 p.m.	...	Women in Music.
Birmingham, 7.35 p.m.	...	Special Beethoven Programme relayed from the Town Hall. S.B. to 5XX.
Cardiff, 7.35 p.m.	...	Bristol Night.
Glasgow, 7.35 p.m.	...	Symphony Concert relayed from St. Andrew's Hall.
Tuesday, April 7th.		
London, 7.30 p.m.	...	"Westward Ho!" S.B. to other Stations.
5XX, 7.30 p.m.	...	J. H. Squire's Celeste Octet.
Wednesday, April 8th.		
London, 7.30 p.m.	...	Chamber Music Evening.
Bournemouth, 8 p.m.	...	Winter Gardens Night.
Newcastle, 7.30 p.m.	...	Scenes from Opera.
Aberdeen, 7.30 p.m.	...	"St. Matthew's Passion."
Glasgow, 7.30 p.m.	...	Nautical Programme. S.B. to Dundee.
Thursday, April 9th.		
Bournemouth, 7.30 p.m.	...	Haydn—Mozart—Mendelssohn.
Aberdeen, 7.35 p.m.	...	Scottish Night.
Friday, April 10th.		
All Stations, 7 p.m.	...	"The Messiah" (Handel). S.B. from Manchester.
Cardiff, 5 p.m.	...	"Good Friday" (John Masefield).
Saturday, April 11th.		
London, 7.30 p.m.	...	Band of the Coldstream Guards.
Bournemouth, 7.30 p.m.	...	Sullivan—Elgar—German.
Glasgow, 7.45 p.m.	...	"East to West." Relayed to 5XX.

The Neutrodyne "Four"



Constructing the Receiver.

PART II.

There can be no doubt that a receiver which is really sensitive and selective, and cannot cause interference by radiation, is a desirable thing. Such a set is the Neutrodyne "Four," in which the high-frequency stages are neutralised to prevent them oscillating. Only those who have used a Neutrodyne set can appreciate the ease with which the weakest signals can be selected and amplified. Tuning is remarkably easy, and because of the special features of the set the high degree of amplification is obtained without the least trace of distortion.

By W. JAMES.

IN the last number we described the construction of the three high-frequency transformers. They have secondary windings of 55 turns of No. 20 D.S.C., and primary windings of 15 turns of No. 20 D.S.C. These coils are wound in the same direction. A tap is taken from the 15th turn from the bottom end of the second and third secondary windings, and when wiring the receivers are connected to the neutralising condensers. The third transformer has its secondary wound on an ebonite tube because this carries a reaction coil. The position of the reaction coil was shown in Fig. 7 (page 212), and consists merely of a short length of ebonite tube carried by a length of $\frac{3}{16}$in. brass rod, which is a fairly tight fit in the holes provided.

Having wound these coils we can put them aside and prepare the front panel. This panel is of ebonite, and measures $26 \times 8 \times \frac{5}{16}$in., and may be purchased already trued up and with its surface matted, or a piece can be obtained and finished off by the reader. Then the panel should be drilled to take the screws for fixing the components. The reader who is using components of the same make as the writer can take all his dimensions from the scale drawing of Fig. 1. As may be seen from the illustrations, the three Dubillier 0.0005 mfd. tuning condensers are mounted on this panel, with three Burndept filament resistances, a Lissen neutralising condenser, and the two telephone terminals; the spindle of the reaction coil passes through the panel and carries a knob and pointer. Holes are provided for the screws for fixing the base and the brackets, and the telephone condenser is screwed to the back of the panel just above the telephone terminals. The work of mounting the com-

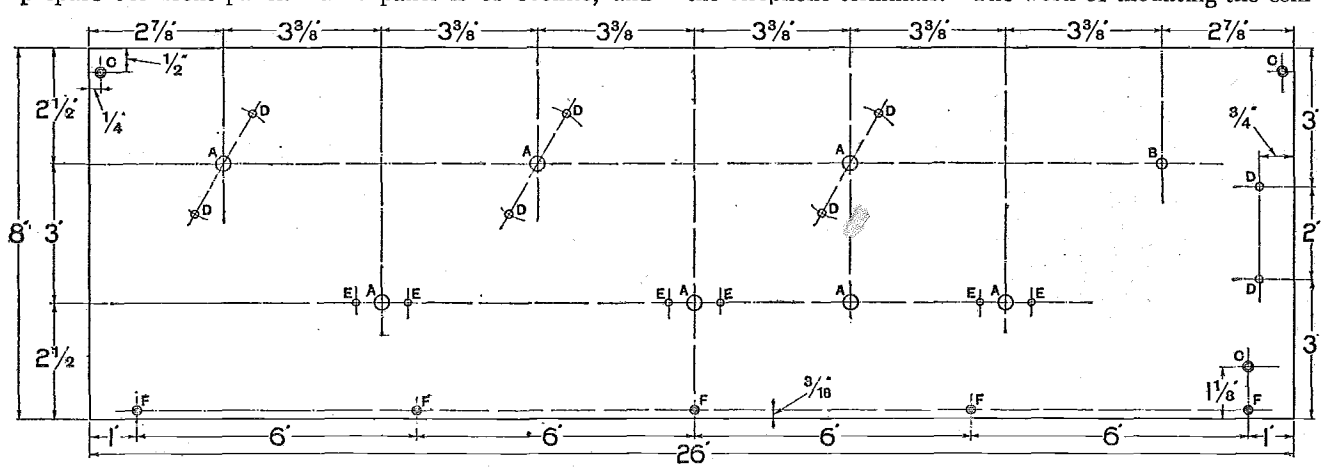


Fig. 1.—Details of the ebonite front panel. The holes should be drilled as follows: A, $\frac{6}{16}$in. dia.; B, $\frac{7}{32}$in. dia.; C, $\frac{5}{32}$in. dia. and countersink; D, $\frac{7}{32}$in. dia.; E, $\frac{1}{8}$in. dia.; F, $\frac{5}{32}$in. dia. and countersink.

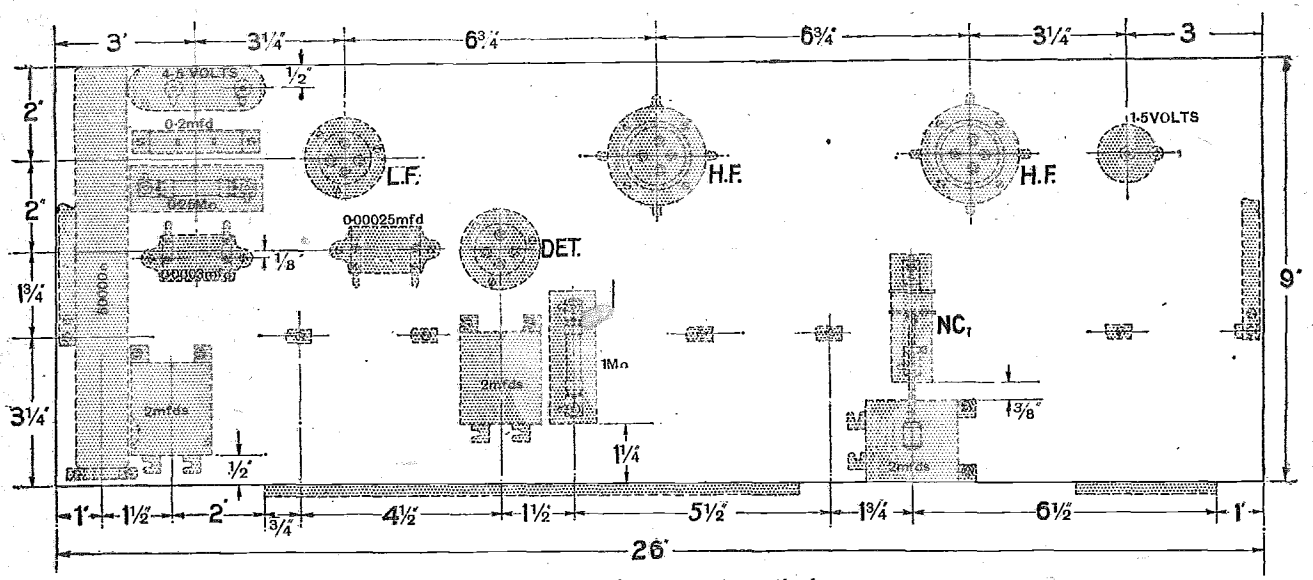


Fig. 2.—Layout of components on the base.

ponents is easily done, the only things requiring special attention being the filament rheostats. The first rheostat (from the left-hand side of the front of the panel) has a resistance of 15 ohms; the second and third a resistance of 7 ohms. Two +L.T. terminals are provided in order that different types of valves may be used; if necessary, for instance, valves of the 60 mA class may be employed in the H.F. stages, with Mullard D.F.A.I. valves in the detector and note magnifier stages; or, if desired, valves of the 2-volt type may be employed in the H.F. stages and others in the detector and note magnifier.

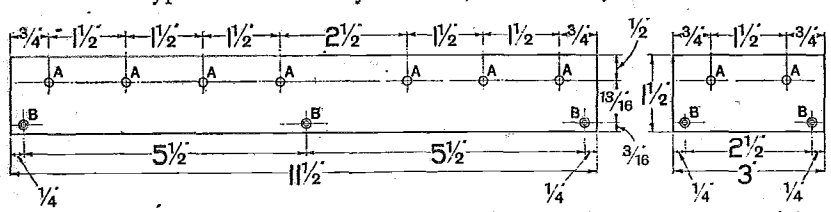


Fig. 3.—Details of the connection strips. A, $\frac{5}{32}$ in. dia.; B, $\frac{3}{32}$ in. dia. and countersunk.

Having finished the panel, the next step is the arrangement of the components on the baseboard. This work has to be carefully carried out if good results are to be obtained. The arrangement of the parts is given in Fig. 2. A board of hard wood should be employed, and be trued up to $26 \times 9 \times \frac{3}{8}$in. On this board are fixed the two brass brackets which serve partly to hold the panel and base at right angles, the three H.F. transformers, three 2 mfd. fixed condensers, a neutralising condenser, the grid condenser and leak, fixed condensers of 0.2 mfd. and 0.0003 mfd., the grid batteries, 50,000 ohm Zenite rod, the four valve holders, and two terminal strips. Particulars of the terminal strips are given in Fig. 3. The two grid batteries can be held with clips cut from brass strips, or other means if desired, and the anode resistance rod is also fixed with a pair of clips. Great attention should be given to the fixing of the H.F. transformers. It is advisable to cut a template of cardboard having an angle of 55° (see Figs. 6 and 7, page 212), and to carefully adjust the position of these transformers so that when finally fixed they lie at this angle with the base. The transformers are put at this angle to prevent magnetic coupling between them; if they are not correctly mounted, most likely trouble will be experienced when operating the set. The position of the brass feet of the transformers on the base is indicated in Fig. 2. When the transformers are fitted, the primary windings will be at the bottom end of the secondary coils, and the tappings of the second and third transformers 15 turns from the bottom end of the secondaries.

The neutralising condenser (NC_1), which is fixed to the base, may be constructed according to the particulars given in Fig. 4, although one may be bought and fixed to the base or the panel if desired. A photograph of this neutralising condenser appears on page 211.

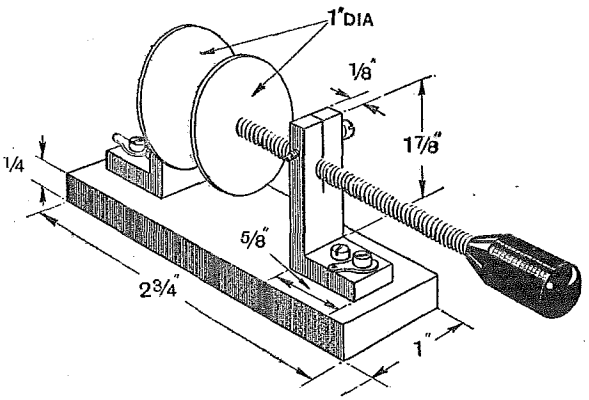


Fig. 4.—The neutralising condenser marked NC_1 in figs. 2 and 5. The base is of ebonite, and the brackets, discs and screwed rod of brass.

Wiring is a fairly simple matter, as the parts are well spaced and arranged for easy wiring. From the wiring diagram of Fig. 5 it will be evident that it is convenient to separate the panel and base, and to put on a number

The Neutrodyne "Four."—

of the wires. Then the panel and base can be screwed together again, and the remainder of the wiring done. Bare No. 16 tinned copper wire, stretched and cut into suitable lengths, was used. It should be noticed that, contrary to the usual practice, the grid leak and grid return wire from the secondary of the third H.F. transformer are connected to the negative side of the filament battery, as this connection was found best. Great care should be taken to space the wires connecting the H.F. transformers. These transformers are not shown on the wiring diagram, but the connections are indicated. The bottom end of the secondaries goes to the filament circuit and the top end to the grids, while the bottom end of the inside or primary windings is connected to the plates of the valve or the aerial, and the top ends to the positive H.T. terminal or to earth according to the H.F. transformer.

Having wired the set, connect it up, choosing anode and filament voltages according to the valves used. Thus, if Mullard D.F.A.I. valves are to be used throughout, both the filament positive terminals should be connected to the positive side of a six-volt accumulator, and the common negative terminal to the negative side, and an anode voltage of 60 may be used for the H.F. valves, 45 for the detector, and 90 for the note magnifier. Other suitable valves are the D.E.5 and B.T.H. B.4, although valves of different types may be tried. However, the H.F. transformers are designed for valves having an impedance of about 7,000 ohms (amplification factor 6), and for best results should be modified if valves having widely different constants are used. Valves of the D.E.5B. type may be used in the H.F. stage if desired, or one can employ valves of the 60 mA type in the H.F. stages with quite good results. The writer has found the new D.E.3B. and Mullard D.06 H.F. valves excellent for this purpose.

With the set connected up, turn the reaction coil at right angles to the winding of the third H.F. transformer and tune in a signal. To do this, set the second and

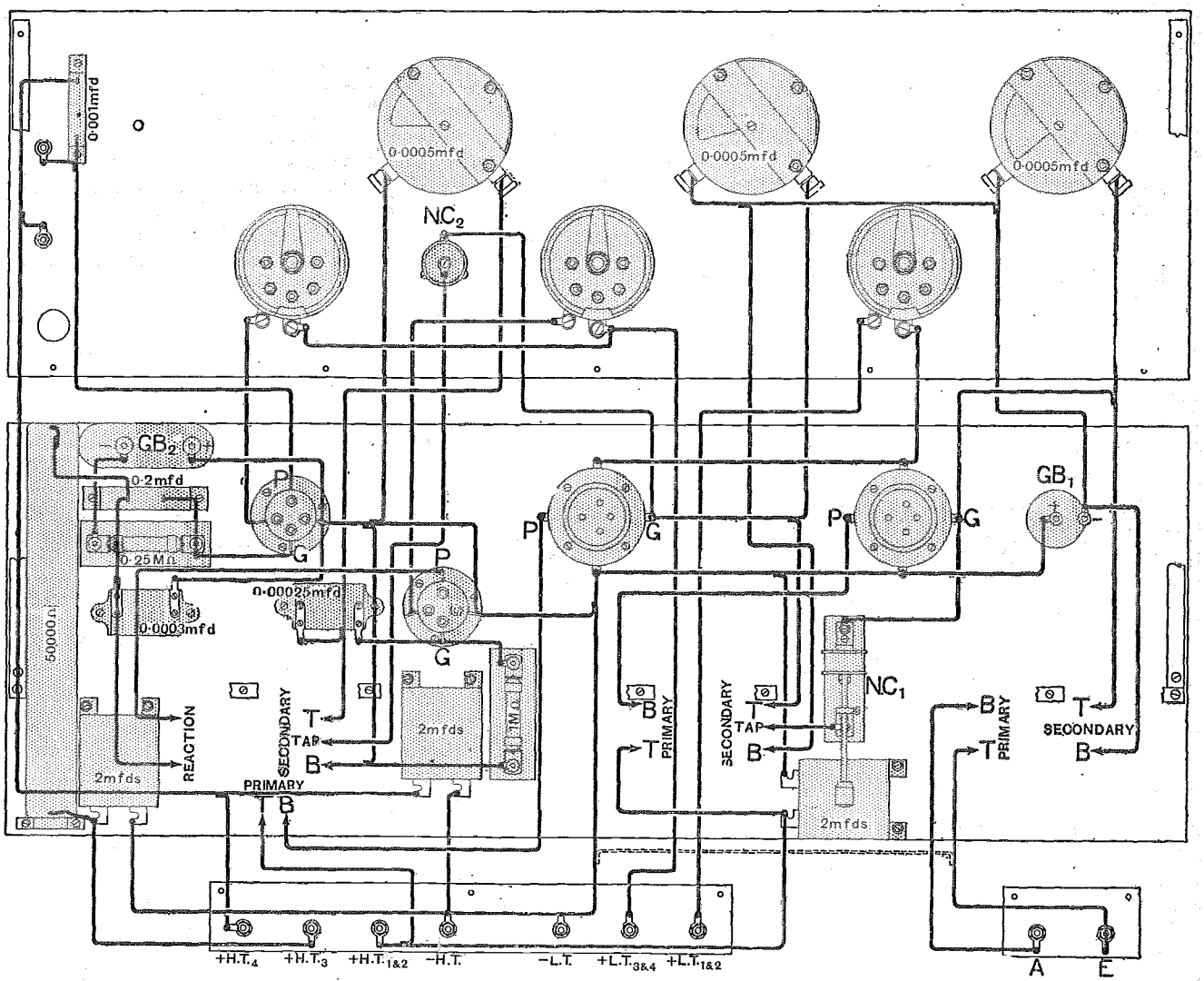


Fig. 5.—Wiring diagram. The letters T and B represent the top and bottom ends of the coils of the H.F. transformers. It is usually desirable to earth the filament heating battery as indicated by the dotted line connection, and this connection should be tried.

The Neutrodyne "Four."—

third condenser dials at, say, 30° and rotate *slowly* the first condenser. Repeat this until a signal is heard. Then carefully adjust the third condenser, then the second, and finally the first, until best results are obtained. The reader will probably find operating a neutrodyne set rather peculiar at first, as the customary whistles and howls heard when adjusting an ordinary set are not heard with a neutrodyne set. It is possible to tell when one is tuned in to a station that is not actually transmitting by a slight hissing sound. Now that a station is heard, remove the first valve from its socket, and carefully readjust the condensers. Most likely the station is still heard; put a piece of thin paper over one of the filament legs of the valve, and replace it in the holder. This valve will of course not light, but yet the grid, plate, and one side of the filament are connected to the circuit. Probably the station is still heard, although at different strength from when the valve was out of the holder. Now the first neutralising condenser should be adjusted until the station is not heard, or is very weak. This adjustment should be made by setting the neutralising condenser—the other tuning controls should not be touched. If the signal cannot be reduced to zero, or at least rendered very faint, the grid and plate wiring of the first valve should be moved a little, and then fresh adjustments made until the required condition is obtained. Finally, remove the valve from its holder and notice if the signals increase in strength. This test shows that the capacity of the grid and plate circuits with the valve in position has been neutralised. The second valve is now taken from its socket, and with the first, third and fourth heated to normal brilliancy, tuning adjustments are made to bring the signal to its maximum intensity. Then a piece of paper is put over one of the filament pins, the valve inserted, and the second neutralising condenser adjusted until nothing, or only a weak signal, is heard.

Having adjusted the set—and this process of setting the neutralising condensers will take a little time and patience—we have a receiver which will not oscillate and set up oscillations in the aerial circuit. The set may then be used with perfect confidence by anyone. It is simply necessary to tune carefully to be able to hear most of the B.B.C. and Continental stations at good strength. Many of them will be heard on a loud-speaker, and the reader will certainly be surprised at the extreme sensitivity and selectivity of the receiver. Because of its selectivity tuning is sharp but not critical, and once a station has been heard and the dial readings noted, one can always return to that station with ease. After practice it will be found that the strength may be improved by adjusting the reaction coil, but the reaction coil is included for the benefit of those who like to feel that they are getting the utmost out of a set, rather than because it is an essential part of the equipment of the set.

TRANSMITTING NOTES.

Amateur with U.S. Fleet.

Mr. F. H. Schnell, traffic manager of the American Radio Relay League, whose projected trip in co-operation with the U.S. Pacific Fleet was referred to in a recent issue, sends the following interesting particulars of the work to be carried out.

The U.S. Fleet will leave San Francisco about April 12th and return about October 1st, 1925. Mr. F. H. Schnell has been called into active service for the period of the cruise to operate the transmitters and work with amateurs. Visits will be made to Hawaii, Australia, and probably New Zealand.

The U.S. Naval Research Laboratory is supplying one transmitter to operate on 27.2 or 54.4 metres, using one kilowatt in the antenna. In addition, Mr. Schnell is taking his own transmitter and receiver to work on 20, 40, and 80 metres, staying as close to those waves as possible.

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Operating at all Hours.

As far as is known, there will be no restriction as to operating hours. "I intend to pound that old key as long as my eyes stay open," writes Mr. Schnell. "In the daylight hours I intend to listen on the 20 and 40 metre band with two receivers and split headphones. At night I intend to cover everything from 75 to 125 metres. The reason for going up to 125 metres is to take care of the foreign amateurs.

"The call of this special A.R.R.L. U.S. Navy station will be NRRL. 54.4 metres will be used for transmission after dark and in daylight whenever possible, shifting to 27.2 in daylight when necessary. Also, 20 and 40 metres will be used in daylight. It is my hope to work far into the United States from Hawaii on 20 metres in full daylight, so amateurs should watch for NRRL on Saturdays and Sundays on 20 or 27.2 metres.

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Constant Wave-lengths.

"Once you spot the 54.4 metre signals you will find them at the same setting on your tuner ever after, if everything else remains the same. Also, the wavelengths of 27.2 metres will remain constant, because the big set is crystal controlled and the note is of the finest kind of pure DC.

"I do not know on what ship the set will be installed; therefore send reports of all reception or two-way work with NRRL to Director, U.S. Naval Research Laboratory, Bellevue, D.C. Be sure and give complete information as to date, time, and wavelength. No matter how many times you hear or work NRRL, always send a report to the laboratory. This is very important."

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Dismantled.

Mr. D. B. Knock (G6XG) informs us that his station is dismantled and is not likely to be in operation during the present year. Any communications should be addressed to 34, Claremont Road, Birkdale, Lancs.

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Reports, Please.

Mr. F. J. Jackson (5FJ), who is carrying out transmitting experiments, would be glad to receive reports of reception. His address is Sunnyside Mansions Hotel, Southport, Lancs.

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An Anglo-American Dinner.

An auspicious event takes place on Friday, April 24th, when a dinner and conference will be held in honour of the American amateurs who will be visiting Europe for the Paris conference. All British amateurs who desire to attend should send in notification as soon as possible to Mr. Gerald Marcuse, hon. secretary T. and R. Section, Radio Society of Great Britain, 53, Victoria Street, S.W.1. Tickets will probably be 12s. 6d. each.

To defray the expenses in entertaining the American visitors on this occasion a fund has been opened to which many British amateurs may wish to contribute. It is particularly desired to extend the warmest hospitality to our U.S. friends, and contributions to the fund will therefore be very welcome. They should be sent to the Society at the above address.

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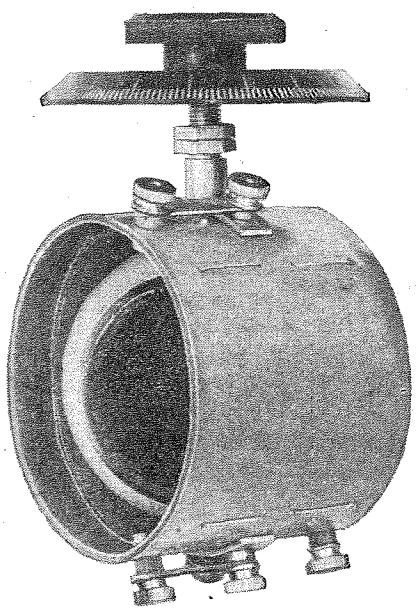
Who is 5OK?

If C 5OK will communicate with the secretary of the T. and R. Section, he will receive QSL cards which are intended for him.

A Review of the Latest Products of the Manufacturers.

THE EDISWAN VARIOMETER.

The new variometer (type WL. 439) recently marketed by the Edison Swan Electric Co., Ltd., consists of a moulded rotor mounted inside a cylindrical tube of special laminated insulating material. The stator windings are fixed to the inside of the cylindrical tube where they are protected from possible damage. The reduction in the distance between the moving and stationary coils obtained with this method of mounting also gives a greater variation of inductance between the maximum and minimum settings of the dial. The variometer is secured to the panel by two shallow nuts, one on either side of the panel. The indicator dial is recessed in order that it may be fitted close to the panel when the outer securing nut is in position.



The new Ediswan variometer.

The windings are brought out to separate terminals, and can be connected either in series or parallel according to the position of the metal bridge pieces.

The wavelength range when the variometer is used as an A.T.I. in conjunction with a standard P.M.G. aerial is 277 to 634 metres with the windings in series, and 205 to 359 in parallel. The price of this component is 9/-

"SURE-A-LIGHT" DRY BATTERIES.

The manufacturers of the well-known "Sure-a-light" H.T. batteries have now produced a series of dry cells of large capacity suitable for the supply of filament current to dull emitter valves.

The following sizes are available: 3 volt and 6 volt, $2\frac{1}{2}$ ins. diameter and 6 ins. deep; 3 volt rectangular, $4\frac{3}{4} \times 2\frac{1}{2} \times 9\frac{1}{2}$ ins.; $4\frac{1}{2}$ volt rectangular, $7 \times 2\frac{1}{2} \times 9\frac{1}{2}$ ins. Carrying straps are provided with each size.

These cells are obtainable in wholesale quantities from Messrs. J. F. Smith, 94-96 Hurst St., Birmingham, who will advise the name of the nearest retailer if supplies are unobtainable locally.

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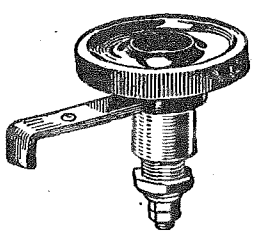
A NEAT SWITCH ARM.

The Athol Engineering Co., Cornet St., Hr. Broughton, Manchester, have recently produced a switch arm, the design of which shows a marked improvement over the ordinary switch arms appearing in large quantities in retail shop windows. A special hollow bush is employed which completely encloses the spring washer. The tension of the spring is adjusted at the works during assembly, and need not be disturbed when fitting the switch to the receiver panel.

It will be observed that the lock nuts on the spindle are smaller in diameter than the threaded portion of the bush, and will therefore pass through the fixing hole in the panel.

The laminated arm and other metal parts are nickel finished, and the good appearance should therefore be durable. The component sells at the very reasonable price of $10\frac{1}{2}$d. retail.

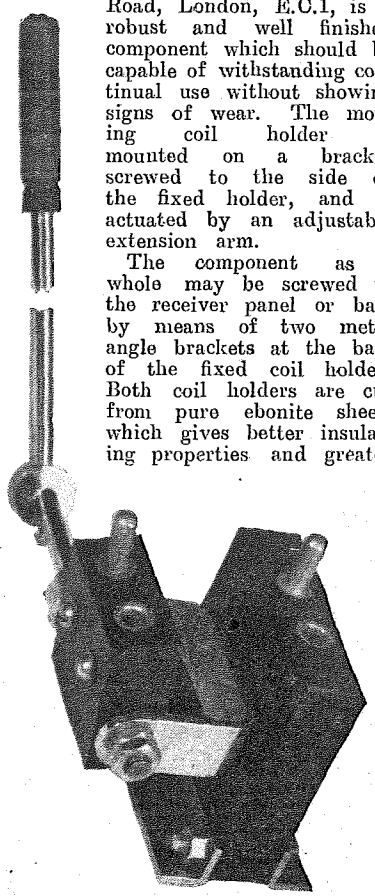


A switch arm of improved design.

THE PETO-SCOTT TWO-COIL HOLDER

The two-coil holder produced by Messrs. Peto-Scott Co., Ltd., 77 City Road, London, E.C.1, is a robust and well finished component which should be capable of withstanding continual use without showing signs of wear. The moving coil holder is mounted on a bracket screwed to the side of the fixed holder, and is actuated by an adjustable extension arm.

The component as a whole may be screwed to the receiver panel or base by means of two metal angle brackets at the base of the fixed coil holder. Both coil holders are cut from pure ebonite sheet, which gives better insulating properties and greater mechanical strength than many of the materials used for mouldings.



A well-made two-coil holder.

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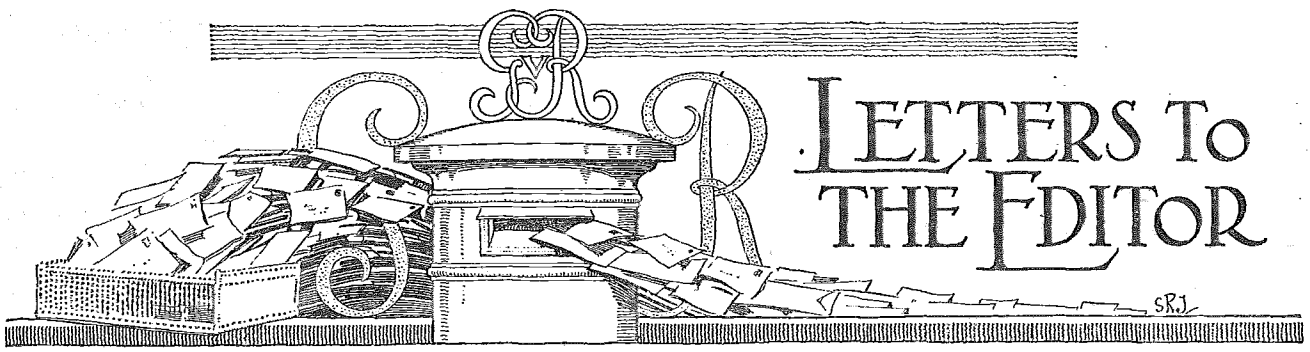
THE "RADIOTESTER"

In the description of the above-mentioned accessory on page 236 of the last issue it should be noted that the range of resistances should be from 1,000 to 20,000 ohms. In the same paragraph "milliameter" should be substituted for "millimeter."



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

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

CRYSTAL OR VALVE SETS FOR BROADCAST RECEPTION.

Sir,—The writer of the "Editorial" in your issue of March 11th appears to have fallen into the common error of thinking that the majority of the population are able to afford sets which are capable of long-distance reception. To compare our conditions with America is surely impossible. It is well known that in America the general wealth of the population is such that they can, especially by the almost universal easy-payment system adopted, afford to have multi-valve sets. Even supposing, however, that the situation were such that half the population of the British Isles were able to afford sets costing £20, £30, or £40, it would still seem that our policy of serving the poorer population first is a good one, since persons who can afford such expensive apparatus have at their disposal many other distractions, whereas the humble crystal set brings to many enjoyment never dreamed of before in their circumscribed lives.

Further—and this is a point which needs the greatest emphasis—there is no reason at all why the democratic policy that the Broadcasting Company have adopted should not enable the more fortunate among us to realise the potentialities of long-distance reception to their heart's content. As a technical paper, you will doubtless agree that it is quite possible to build sets—in fact, such sets are built in America—which are able to cut out the local station and listen to more distant ones, without oscillating and without skilful adjustment. I have seen such sets, and so I speak with some authority. Does it not, therefore, resolve itself into a question of improved design of receiving apparatus to enable those who can afford such apparatus to enjoy the potentialities of wireless to the full, while the crystal user is still allowed to listen to his local station uninterrupted and content?

Lastly, I would ask whether, in fact, listening to distant stations *is* a matter of supreme enjoyment. Atmospherics, fading and Morse tend to mar the enjoyment of the programme, and persons who listen to distant stations are, I think, more interested in the art of receiving the programme than in the programme itself. Broadcasting for its permanency must rely upon its artistic appeal, not its technical, although, of course, there must always be a number of persons interested enough to pursue the technical side of so fascinating an art.

The primary consideration for a broadcast receiver is capability, not of receiving a noise over a long distance as you argue, but of giving pure reproduction at a short distance. The future of the art lies in powerful signals and robust receivers.

P. P. ECKERSLEY,
Asst. Controller and Chief Engineer of the
British Broadcasting Company.

SHORT WAVES.

Sir,—I read a letter from Mr. L. Manning in the issue of *The Wireless World* for March 11 asking for co-operation in short-wave experiments on 20-60 metres. I would be glad to co-operate, as I am now transmitting nightly on 55 metres, for which I am licensed. I have had very few reports on this wave, although I have worked F8SM on it. Mr. Manning states that his receiver oscillates with two turns in the secondary, prompting him to believe he is receiving in the vicinity of 6-10 metres. In case other readers may take this as being an absolute fact, may I remind him that it is somewhat optimistic. With the most elaborate precautions it is extremely difficult to get below that almost universal "limit"—20 metres. Internal valve capacities seem to hold one up here, and this is the experience of several well-known London amateurs. I think Mr. Manning will find on actual measurement that the two turns in conjunction with a 0.0001 μF condenser will tune from approximately 19 to 21 metres. I should be glad if Mr. Manning would communicate with me through the medium of your journal.

N. G. BAGULEY (G2NB).
Streatham, S.W.16.
March 11th, 1925.

LOW-POWER TRANSATLANTIC WORKING.

Sir,—I have pleasure in informing you that as a result of some low-power transmission tests made from my station (G5DN) in January, I have now received confirmation that these transmissions were received at good strength by amateurs in Kentucky and North Carolina, U.S.A.

My set is a loose-coupled reversed feedback, using 600 volts rectified A.C. at 30 mA. on the plate of the valve.

I shall be glad to receive reports on my transmissions from amateurs in any countries. Wavelength used, 100-115 metres.

L. A. K. HALCOMB, Capt. (G5DN).
Sheffield.
February 25th, 1925.

RECEPTION FROM CHINA.

Sir,—I beg to inform you that on February 10th I picked up signals from HVA. This station was calling F8BF, and was received here on two valves (O-v-1). The signals were weak, system pure c.w., and wavelength about 87 metres.

F8BF informs me that the station is operated by M. Nurville, and the address is Poste T.S.F., Hanoi, Tonkin, China.

F8BF also tells me that on February 17th two-way communication was established between his station and that of HVA.

I should be glad to hear from other readers who have received this station.

J. B. DAVIDSON
Worksop, Notts.
March 11th, 1925.

AMERICAN COMPETITION.

Sir,—Anyone looking at one of the American wireless publications which find their way over here will probably come to the conclusion that America is a good way ahead of Europe in radio development. I observe, for instance, that sets are sold which run directly off the public supply mains, dispensing with all H.T. and accumulator troubles. Numerous firms sell arrangements which plug on to the mains and supply the set with H.T. and L.T. current.

There is a patent for a valve with a separate external heater for the filament which can be run off the main.

Batteries of all sorts are the curse of wireless, and one wonders when any British maker will market something to take their place. If he does not it stands to reason it will be imported, and about ten years later British firms will discover

the market and start shrieking for protection. There is a difference, I think, between sound conservative business and stick-in-the-mud business. The market for battery chargers appears to be entirely supplied by America, and it cannot be said that these instruments are sold at a price with which we cannot compete. JOHN KENNEDY.

Westminster, S.W.1.

REPORTS, PLEASE.

Sir,—I should be pleased if you could find room in *The Wireless World* for a note stating that I shall be pleased to receive reports from any amateur, British or foreign, who may hear me working either C.W. or 'phone. Wavelengths 150 to 200 and 440 metres. FREDK. F. WARNER.

Stockport. (2RA).

GOOD WORK WITH A SUPER-HETERODYNE.

Sir,—In reference to the paragraph on "Good Work with a Super Het." in your issue of the 21st January, I give below a comparison with my own log of the night in question by way of observation. I think it will bear very favourable comparison; whether I established a record for 2 valves (on American broadcasting) could perhaps be ascertained. The night was, as stated, exceptional.

Log for December 27th-28th, 1924:—

G.M.T.	Station Logged	Location.
0035	WBZ	Springfield, Mass.
0055	WJAR	Providence, R.I.
0045	WGY	Schenectady, N.Y.
0109	WJAR	
0135	WOR	Newark, N.J.
0138	PWX	Havana, Cuba.
0220	KDKA (68 metres)	Pittsburg, Pa.
0227	WSAI	Cincinnati, Ohio.
0232	KDKA (326 metres)	Pittsburg, Pa.
0235	WBZ	
0240	WGY	
0254	WFI	Philadelphia, Pa.
0257	PWX	
0310	WIP (or WOO)	Philadelphia, Pa.

(Name verified but call jammed.)

At 0300 telephony stations were working on approximately 440, 460, and 510 metres.

Summarised, the above list means I logged KDKA, WSAI, KDKA, WBZ, WJAR, WGY, WFI, WOR, PWX, WIP (?) (or WOO), and two others on 440 and 460 metres.

Total:—10 American transmissions and two unidentified.

Possibly the Montreal Station was heard, but he was too weak to read.

A 3-valve "double dual" set of my own design and make was used, but only two valves (crystal) were utilised to log all stations.

Looking at the log, it will be observed that from 0109 G.M.T. until 0310 G.M.T. covers all the stations logged, *i.e.*, two hours, one minute, actual time taken to log all 10 stations and 2 unidentified.

Several of the above (KDKA, WBZ, and WGY) were at times good on loud-speaker with 3 valves.

On January 8th, 1925, I logged WAHV (Brooklyn, Long Is.), and on February 1st, 1925, I logged WBB (Atlantic City).

With reference to Mr. E. A. Devine's (of Wooler) log, I would suggest his WHAR should read WJAR.

Inverness. JAS. MacINTOSH.

LONDON TO NEW ZEALAND.

Sir,—The shortest line from London to New Zealand is not as some of your readers state. Actually it is along a great circle running:—North, up to the west coast of Scotland; East of Iceland; across N.E. of Greenland; North of Baffin Bay; along 80°N. parallel; West of Patrick Island; across Alaska; East of Behring Sea and Aleutean Is.; over the Pacific, crossing Equator about 195° West longitude, and over Biti Islands; to New Zealand. F. SMITH.

Buenos Aires.

HETERODYNE INTERFERENCE WITH BROADCAST RECEPTION.

Sir,—The rapid increase in the number of broadcasting stations throughout Europe has brought about a peculiar form of interference which is particularly troublesome to the long-distance listeners, namely, heterodyne interference.

While broadcasting is undoubtedly intended for local listeners, the interests of the long-distance listener should not be completely forgotten, especially as no form of receiver, however selective, can deal with that class of interference.

Heterodyning of the carrier waves occurs here between (*a*) Madrid and Hamburg. (*b*) B.B.C. relay and unknown German near 330 m. (*c*) Liverpool and unknown. (*d*) Aberdeen and German station. (*e*) Frankfurt and Birmingham (on new wavelength on January 1st). Other "heterodyne pairs" are probably experienced in other places; these would have to be determined from reports. Could it not be suggested that the latest of the offending stations to open should slightly alter its wavelength (1 or 2 metres would be sufficient). This would allow a selective receiver to be used when it is desired to receive either of the stations which now interfere.

At the same time, every effort should be made to keep wavelengths constant, as even a slight drift up or down may produce interference with a neighbouring wavelength; for instance, Zurich, whose wavelength so far has been 515 metres, now transmits on about 500 (and still announces 515), which, of course, brings it dangerously near Aberdeen.

This, of course, has very little importance for the average listener, but for somebody who has taken great trouble in order to build a selective receiver, it is very disappointing to find that, instead of two neighbouring and separable transmissions, one gets an awful howl and mixed, distorted music.

Watermael, E. JANMOULE, B.Sc.

Belgium.

WIRELESS IN SCHOOLS.

Sir,—Your atention has already, probably, been drawn to a statement which appeared in the daily Press recently, to the effect that educational broadcast lectures to scholars during school hours are regarded by the L.C.C. in an unfavourable light.

So much so, in fact, that that body does not intend further to allow the time of scholars to be taken up, by what it considers a more or less useless performance.

It is not quite clear as to whether the matter transmitted, or the reception of the matter is to blame for this decision, but it is clear that the Educational Authority is not satisfied.

If this failure on the part of the B.B.C. to satisfy yet another important section of the public is to be allowed to rest here, I think, for one, that a protest should be made before such an means of bringing scholars into contact with some of the best minds in the country should be shelved.

Croydon. E. S. TARDREW.

DAYLIGHT SIGNALS FROM U.S.

Sir,—With reference to the daylight transcontinental transmissions on a wavelength of 21 metres which are now being carried out by Mr. J. H. Reinartz, and were referred to on page 584 of your Jan. 28th issue, I have been informed by Mr. S. Kruse, of the A.R.R.L., that signals have been reported now to be fairly strong in France, and Mr. Reinartz would like to know if any English amateur has received them. The transmissions are now taking place at 16.00 G.M.T.

I shall be greatly obliged if any readers of *The Wireless World* who hear these signals will report them at once to me by card, giving time and date of reception, and stating whether there was any QSS.

Incidentally, whilst writing, Mr. Kruse mentioned that the 5-metre transmission experiments organised by the A.R.R.L. on December 27th and January 4th last were a complete failure, owing chiefly to the low power used. The A.R.R.L. hopes to repeat the experiments again in the near future.

"Rossmoyne," ERNEST A. DEDMAN.

65, Kingston Road,

New Malden, Surrey.

NEWS from the CLUBS

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

North Middlesex Wireless Club.

The annual general meeting of the above club was held at the Club's headquarters, Shaftesbury Hall, Bowes Park, N., on March 4th. That the past twelve months have been a very successful period in the Club's eleven years' history was the conclusion one came to after listening to the reports presented by the officers of the club.

Mr. A. G. Arthur, the retiring President, voiced in a few well-chosen phrases the thanks of the members to the officers and committee on whom the success of the club very largely depends, and Mr. W. Gartland briefly replied.

In spite of his pointed remarks that the office of President should be one open to any and every member of the club, Mr. A. G. Arthur was re-elected with acclamation, as also was Mr. F. T. Chapple, the Vice-President. The other elections resulted as follows :—

Hon. Secretary : Mr. H. A. Green.
Hon. Treasurer : Mr. W. A. Saville.
Installation Officer : Mr. W. Gartland.
Librarian : Mr. J. Todd.
Committee : Messrs. Bray, Crowch, Forbes, March and Turner.

On March 18th the evening was devoted to the solution of members' difficulties, and took the form of an informal "question and answer" meeting. The wide range of the interests and experiments of the members was evident from the nature of the questions asked and the suggestions offered.

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

Radio Society of Highgate.

A lecture dealing with the various types of wavemeter was given before the Society on Thursday, March 12th, by Mr. H. Andrewes, B.Sc., who also gave a detailed description of his own heterodyne wavemeter. Mr. Andrewes mentioned that if used below 80 metres, the Hartley Oscillator was liable to prove inefficient unless the capacity effects were eliminated. In his own opinion, the reversed feed back heterodyne with fixed reaction gave the greatest stability, particularly where a range of wavelengths was to be covered.

On Thursday, March 19th, the Chairman, Mr. Andrewes, announced that as a change from the usual technical programme a surprise evening would be held. The surprise consisted of a series of lecturettes by the members present. The subjects were drawn for, and members in their turn were called upon to speak upon the subjects. These were more humorous than technical, with the result that the meeting concluded amid much laughter.

Hon. Secretary: F. J. W. Squire, 31, Harvey Road, Hornsey, N.8.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 1st.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30 p.m.). At the Institution, Savoy Place, W.C.2. Lecture: "The Leafield Coupled Arc." By Major A. G. Lee, M.C., B.Sc., and A. J. Gill, B.Sc.

Manchester Radio Scientific Society.—Lecture: "The Modified Greibe Circuit." By Mr. G. G. Boullen.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, Golders Green, N.W.11. Question Box Night.

THURSDAY, APRIL 2nd.

Derby Wireless Club.—Lecture: "Unit Experimental Set." By Mr. E. F. Clark.

FRIDAY, APRIL 3rd.

Sheffield and District Wireless Society.—At 7.30 p.m. At the Department of Applied Science, St. George's Square. Exhibition and Sale of Members' Apparatus.

MONDAY, APRIL 6th.

Dorking and District Radio Society.—At 65, South Street. Lecture: "The Latest Development in Radio."

TUESDAY, APRIL 7th.

Lyons Wireless Club.—Lecture: "The Design of Broadcast Receivers." By Mr. F. H. Haynes.

WEDNESDAY, APRIL 8th.

Streatham Radio Society.—Lecture: "Valves." By Mr. Robinson.

MONDAY, APRIL 20th.

Eastern Metropolitan Group Radio Lecture Association.—At 7.30 p.m. At St. Bride's Institute, E.C.4. Lecture: "Short Wave Receivers."

FRIDAY, APRIL 24th.

Dinner and Conference in honour of American amateurs visiting this country. Applications to attend to be addressed to Hon. Secretary, T. and R. Section, Radio Society of Great Britain, 53, Victoria Street, S.W.1.

Ilford Radio Society.

On March 3rd, the display and judging of sets entered for the Society's Constructional Competition, provided one of the most successful meetings of the season. The abilities of the members were shown to advantage in the excellent array of sets. The awards in the valve sets class were as follow: 1st, Mr. J. F. Payne. 2nd, Mr. Ison. 3rd, Mr. J. Farley, and 4th, Mr. W. H. Dennis. In the dual receivers class, the prizewinners were: 1st, Mr. G. F. Gregory. 2nd, Mr. E. G. Dennis.

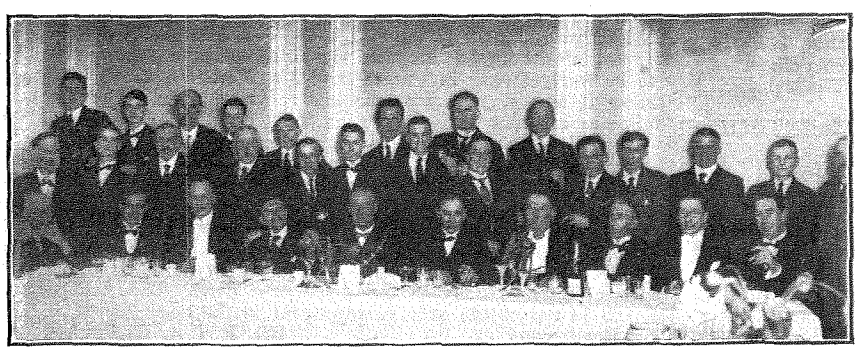
"Short Wave Reception" formed the title of an able lecture delivered by Mr. T. St. J. L. Clark (6VX) on March 17th. Mr. Clark recommended the use of a single wire aerial. He emphasised the desirability of using the best components in the construction of a short wave set, mentioning at the same time that simplicity should be aimed at in order to eliminate unwanted capacity. The lecture concluded with full particulars for the building of a short wave "Reinhartz" receiver.

Streatham Radio Society.

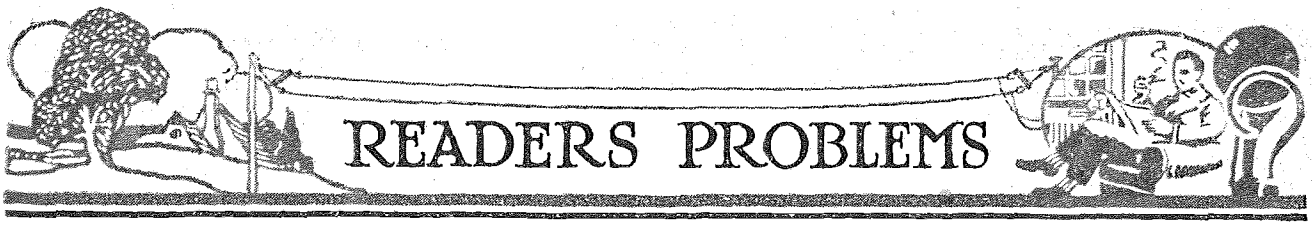
A lucid description of the action of the thermionic valve was given by Mr. W. Robertson in his lecture on March 11th. A feature of the lecture was his discussion of the numerous experimental valves specially constructed during the war for official experiments. Of considerable interest, also, were the details regarding vacuum pumps and methods employed in exhausting thermionic valves.

Dorking and District Radio Society.

At the Society's last meeting, Mr. L. F. Cooke continued his valuable series of elementary lectures. Further explanations were given as to the functions of different varieties of valves, and instructive illustrations were provided showing the various methods of coupling. The discussion centred on the respective merits of various kinds of aerial.



The company assembled at the Stoke-on-Trent Wireless Society's Annual Dinner which was held recently and proved a great success.



Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Correct Design of Grid Leaks.

IN view of the fact that the use of wire-wound anode resistances is constantly advocated in the anode circuits of resistance-coupled low frequency valves instead of those of the grid leak type, a reader asks if any advantage would be gained by constructing grid leaks in this manner also.

The reason for the noisy background which is experienced with resistance-coupled low frequency amplifiers when graphite resistances are used in the anode circuits of the valves is that these resistances are called upon to carry a comparatively large current. Owing to heating, and the peculiar construction of the unit, minute changes occur in their resistance, which is reflected in correspondingly small fluctuations in the steady anode current. Any variation in the anode current is of course at once reproduced in the telephones or loud-speaker. The grid leak is not called upon to carry a steady flow of current, and consequently does not give rise to these noises. Apart from this it must be remembered that it would be exceedingly difficult to construct wire-wound resistances of such a large ohmic value as .5 megohms having a small self-capacity. In addition, a reliable article of this description would be exceedingly bulky, and no advantage would be gained by using such a component in place of the ordinary grid leak.

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Causes of Low-frequency "Buzzing."

A READER recently wrote to this department for advice concerning a three-valve set which he had constructed. The set consisted of a detector valve followed by two note magnifiers, and he stated that the only result he had obtained was a very loud buzzing noise in the loud-speaker.

The cause of this noise, of course, was that the amplifying valves were oscillating at an audible frequency. Our correspondent stated that all components and wiring were well spaced, and that the H.T. battery had been shunted by a condenser of large capacity, but all attempts to eliminate this buzzing were without avail. Upon examination of the wiring diagram which was submitted to us, the cause of the trouble was very evident. Our correspondent was using a common H.T. voltage on all valves, and in order to safeguard his valves, in the event of the H.T. wiring inside the set coming into contact with the L.T. wiring, he had included a non-inductive resistance of high ohmic value in the common H.T.+ lead. The result of this, of course, is that varying potentials are set up across this resistance, in accordance with the variations of the current flowing through it. Now since this resistance is common to the anodes of all valves, a varying potential is communicated to all valves and low frequency oscillation is brought about. The effect of this resistance is precisely the same as that caused by a high resistance H.T. battery, and a similar remedy can be applied, namely, shunting it with a large capacity condenser. Our correspondent was enabled to eliminate the howling by this method, but was then troubled by extraneous noises, the cause of which was at first puzzling, until he informed us that this resistance was constructed of graphite instead of being wire wound. The result was precisely similar to that which is met with in resistance coupled amplifiers where anode resistances of the grid leak type are used.

When using a common H.T.+ tapping for all valves, it is extremely unwise to use a high resistance in this common lead. It is far better to use a separate H.T. tapping for each valve with a protective device in each, or if a common lead is used, it is better to use a low resistance protective device, such as a small flash lamp bulb or a small fuse of suitable melting point.

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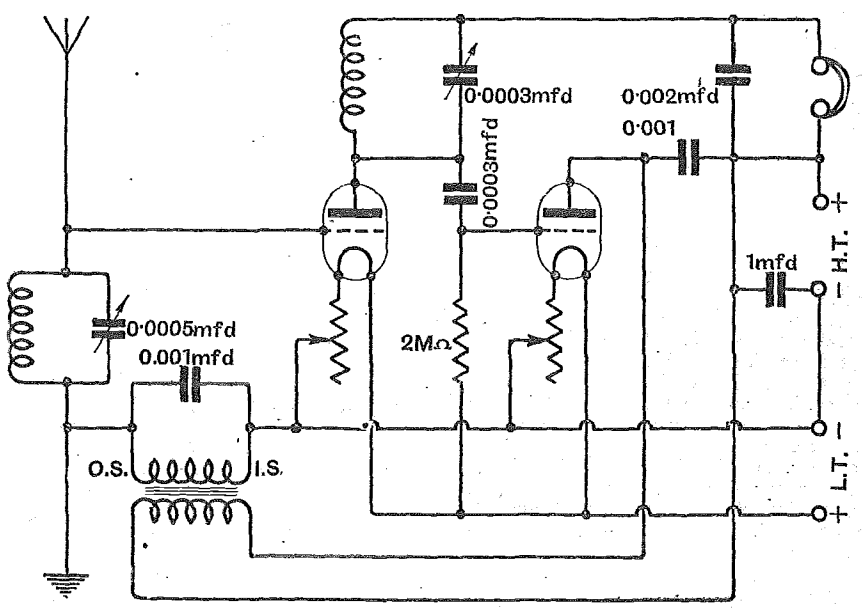
Dual Receiver with Valve Detector.

MANY readers, while obtaining very good results from the conventional type of one-valve reflex-set, find that the great drawback is the presence of the crystal detector, owing to the fact that when searching for distant stations there always exists a feeling of doubt as to whether this component is correctly adjusted or not.

We give below a diagram in which the crystal detector is replaced by a valve. It is usually found that when a valve is used for detection purposes in place of the crystal, that the set is more prone to instability, owing to the removal of the damping effect of the crystal. In order to circumvent this, it is recommended that no magnetic reaction be attempted in this circuit, or, if used, that only a slight degree of magnetic coupling be tried. This can be effected by loosely coupling together the aerial and anode coils.



A two-valve dual or reflex receiver, with valve detector. The first valve gives high-frequency and low-frequency amplification.

Increasing the "Range" of a Receiver.

A CORRESPONDENT has raised the question as to whether adding a stage of low-frequency amplification to a crystal set adds range and volume to an existing receiver, or merely volume, and he asks for our opinion in this matter.

After rectification of a received signal has taken place, it appears in the telephones as an audio-frequency current, and as is well known, we can if we choose first pass it through one or more stages of amplification, and so increase the volume of sound. In fact, it is possible in this manner to bring up a faint, scarcely audible signal to full loud-speaker strength, which, however, is a course not to be recommended, since distortion may be caused. It might appear that the addition of low-frequency amplification cannot add range to a receiver. Yet very often adding an amplifier of this type will definitely enable us to hear distant stations which hitherto we were quite unable to tune in. The signals of the distant stations have hitherto been present in our tuning circuits and have been rectified, but they were of such feeble intensity that no appreciable movement was imparted to the diaphragm of the telephones, or if it did move, the amplitude of its vibrations was too small to be heard. In spite of this the rectified signals were actually present in the windings of our telephones all the time, and the addition of low-frequency amplification has enabled us to hear them, and has therefore effectively increased the range of our receiver. In this connection it may be mentioned that the range of a crystal set is usually given as twenty miles or so from the main broadcasting station, and it will be frequently found that signals which were inaudible at thirty miles can be received on a crystal set at forty miles if a stage of low-frequency amplification is added.

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Efficacy of H.F. Amplification.

A READER has written questioning whether H.F. amplification is really effective on wavelengths of 300 metres or so, since he finds that when using it he is unable to obtain any better results than when he dispenses with it.

This question is one which readers repeatedly raise. It is, of course, quite useless to waste filament current on an H.F. valve if it is not going to give any better results than a plain regenerative detector valve. It may be said in the first place that provided an H.F. amplifier is properly designed and properly operated, it will be found that it is very effective indeed on wavelengths considerably below those used by the B.B.C. However, it is highly problematical whether in many cases any advantage is secured by using a stage of H.F. amplification. This is due to two reasons, the first being that the amplifier is badly designed, and the second reason is that many users of H.F. amplification fail to get even passable efficiency from it even if correctly designed, owing to the fact that a set containing H.F. presents somewhat greater difficulties in tuning because of there being an additional condenser to adjust. It is highly probable that however carefully an H.F. amplifier is designed and operated, full efficiency will not be obtainable unless the stray capacities are balanced. The use of the neutrodyne method of coupling H.F. valves is not only productive of greater efficiency in the amplifier itself, but it also renders it far easier to tune. Anyone who has handled a receiving set embodying one stage of neutrodyne coupled H.F. will no longer be in any doubt as to the efficacy of H.F. amplification. Possibly the novice will find that he obtains no better, and perhaps not quite so good, results when using a stage of H.F. than when not using it. This, however, cannot be taken as an argument against H.F. amplification, the apparent anomaly being the fact that the novice obtains a far greater percentage of efficiency from the detector and reaction set than he does from the set containing H.F., owing to there being a less number of controls to operate.

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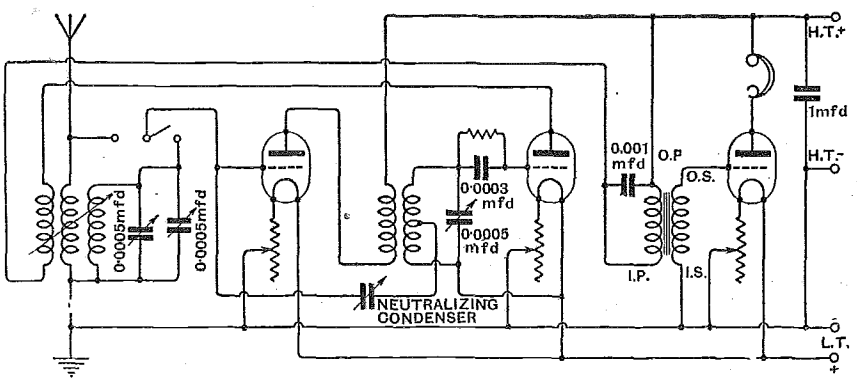
A Selective Three-Valve Circuit.

A CORRESPONDENT requires a three-valve set which is both sensitive and selective. It is required to operate a loud speaker on the local station, but at the same time must be sufficiently selective to eliminate this station and bring in other B.B.C. or Continental stations at will.

Since selectivity and sensitivity are both essential, it is desirable that both a stage of high frequency and also a loosely coupled aerial circuit be employed. This combination, however, is apt to give rise to instability, and offers considerable difficulties in tuning. It is therefore necessary to neutralise the internal capacity of the H.F. valve, and also the stray capacity in the wiring of the circuit. Fortunately this can be done very efficiently by employing the neutrodyne method of coupling between the H.F. and detector valves. A three-way coil holder may be employed for mounting the aerial, secondary, and reaction coils, the aerial and secondary coils can be tuned by .0005 μF variable condensers in the usual manner, a double pole switch being employed in order to make use of direct coupling if required.

The neutrodyne transformer may be constructed by winding 24 turns of No. 24 D.C.C. wire in the form of a basket coil on a former 1½ inches in diameter, 13 pegs being used. This will be the primary winding of the transformer. The secondary winding should be wound on a similar former with a similar gauge of wire, and should have 66 turns. The tapping for the neutralising condenser should be taken at approximately the midway point of the secondary winding. This transformer will amply suffice for covering the broadcast band of wavelengths.



A selective three-valve receiver, with one stage of balanced high-frequency amplification.

Once the internal capacity of the valve has been neutralised by means of the neutralising condenser, this component will not require further adjustment unless the H.F. valve or the neutrodyne transformer is changed.

It will be found that this circuit is remarkably free from instability and very sensitive.

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Using an Intervalve Transformer in a Filter Circuit.

A CORRESPONDENT wishes to know if it is possible to use an intervalve transformer in the anode circuit of the final valve of an L.F. amplifier in order to prevent the steady anode current from flowing through the loud-speaker windings.

This can be accomplished by connecting the secondary windings of the transformer in the anode circuit of the final valve, the loud speaker being connected to the primary terminals. A low ratio transformer is preferable for this purpose, when a slight step-down effect will be obtained which will be beneficial rather than otherwise. Care should be taken to employ a transformer whose secondary winding is wound with a gauge of wire which will safely carry the current. This warning is necessary because certain transformers have relatively thick wire primaries and thin wire secondaries.

It would be better, of course, to employ a transformer specially designed for coupling the last valve and loud-speaker.

The Wireless World AND RADIO REVIEW

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THE B.B.C. RETORTS.

IN our issue of March 11th we criticised the policy which has been adopted in this country of building up a broadcasting organisation primarily for crystal receiver reception. It is only natural, since the B.B.C. has aimed at bringing broadcasting within the range of crystal sets in any part of the country, that Capt. Eckersley, as representing the technical side of the B.B.C., should have replied to our comments; his letter was published under "Correspondence" in our issue of last week.

Capt. Eckersley is not correct in assuming that we "have fallen into the common error of thinking that the majority of the population are able to afford sets which are capable of long-distance reception." Our contention is rather that the policy of the B.B.C. is calculated to dissuade those who can afford the more expensive sets from buying them, because, according to the B.B.C., they gain little or nothing over the crystal user.

Again, Capt. Eckersley quotes £20, £30, or £40 as the cost of valve sets. This figure we consider to be altogether too high for sets of the type required to replace the crystal and give loud-speaker results. We agree, of course, that the price of sets in this country is altogether too high, and in our comments to which Capt. Eckersley takes exception we stated that the encouragement of the use of valve sets should so increase the demand as to bring about a very substantial reduction in the price. Our own opinion of the sets in this country is that, whilst the finish is excellent and the electrical standard high, not nearly enough attention is paid to design with a view to cheapening production costs, and it is in this direction more than any other that the British manufacturer is lagging behind the foreign competitor.

Lastly, we are asked to believe that listening to stations other than the local one is not a matter of enjoyment. We certainly agree that, unless there is sufficient variety in the programmes from the distant stations, there is not much advantage to be gained when, for instance, most, or perhaps all, of the B.B.C. stations are transmitting the same programme. We, however, had set out to draw a comparison between conditions here and in America, and there it must be agreed that, although the programmes are not of such a high standard as our own, yet each station transmits an entirely different programme, so that there is no lack of variety.

Perhaps the fault lies in the fact that broadcasting here has been built up on the slogan of "quality first," whereas if perfection in quality had been permitted to grow with the art rather than forcing the art to stumble along after the ideal, we might to-day have had a better satisfied and less hypercritical public to cater for.

Capt. Eckersley's letter concludes with the assurance: "The future of the art lies in powerful signals and robust receivers." This policy would be all very well if no other transmitting stations existed except those operated by the B.B.C., but, unfortunately, there are other applications of wireless which require some consideration even apart from broadcasting.

CONTENTS.

We fail also to see how the policy of drowning out all interference by increasing and ever-increasing the power of the transmitters is going to work out when, say, every European country decides to establish broadcasting stations as numerous as our own to serve equivalent areas and the same " power " policy is adopted. No, the time must come when, if not national, then international, legislation will have to decide on the limit of power of broadcasting stations, and these will then have to submit to similar regulations to the commercial stations where the rule is that the power used shall be the minimum necessary to cover the required range, and certainly that range will not be based on the assumption of crystal reception.

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BROADCASTING PARLIAMENT.

VERY great interest attaches to the recent statement by the Prime Minister that he was considering setting up a Select Committee of both Houses to consider the possibility of broadcasting certain debates.

Such an innovation would contribute greatly to the national status of broadcasting, quite apart from the additional interest which would be provided.

Only a very small percentage of the voting population of this country is ever likely to be able to be present in the galleries of the House whilst debates are in progress, and yet it is most desirable that everyone should have some acquaintance with the procedure and conduct of Parliament. To broadcast certain proceedings would do much to bring the voting population into more intimate touch with those who are their representatives.

No doubt it will be a matter of some difficulty to decide what shall and what shall not be broadcast, and in this particular case the Broadcasting Company will no longer be in the position of exercising a censorship over the subject-matter broadcast. It would produce a funny situation if an announcement had to be made in the House to the effect, say, that the debate next Wednesday would be broadcast, and, therefore, those members who desired to speak were reminded that the manuscript of their speeches must be submitted to the B.B.C. forty-eight hours before !

Whatever decisions are made with regard to the matter of Parliamentary broadcasting, we sincerely trust that this form of broadcasting will be introduced with some caution and that the public will not have their appetites satiated before sufficient time has been given for a taste for programmes of this kind to be acquired. We believe that, introduced gradually, the public demand will grow, but not if the proportion of Parliamentary broadcasting introduced at first is in excess of the public demand and the interest shown in it.

There is another point in connection with this subject which we would like to emphasise here. If debates are freely broadcast, there is little doubt that the popularity of individual members will grow in proportion to the eloquence of their speeches. At the present time it is probably a very fortunate thing that the ability of individual members is judged entirely from the subject-matter of their remarks, and the average voter has no idea what the powers of oratory of the speaker are. Again, the broadcasting of debates is likely to create a false impression with regard to those members who speak little, but are, nevertheless, valuable Members in other respects.

The popularity of film stars is dependent entirely upon personal appearance. In broadcasting Parliament, will the situation arise that the public will concentrate their attention on the voice and oratory of the speakers, forgetting that it is not always the best orator who makes the finest statesmen?

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THE WIRELESS TELEGRAPHY BILL.

THE Radio Society of Great Britain is keenly alive to the danger of undue interference with amateur experimenters and broadcast listeners which is threatened in certain clauses of the new Wireless Telegraphy and Signalling Bill. It has issued leaflets to all affiliated societies throughout the country stating clearly the objections to the Bill in its present form, and has asked them to co-operate with the parent society in submitting a memorandum to the Postmaster-General on the subject of these objectionable provisions.

The leaflets point out that, in the Act of 1904, the use of electrical apparatus for purposes other than the transmission of messages was exempt from the operation of the Act. The proviso in Section 1 (7) states : " Provided that nothing in this Act shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages."

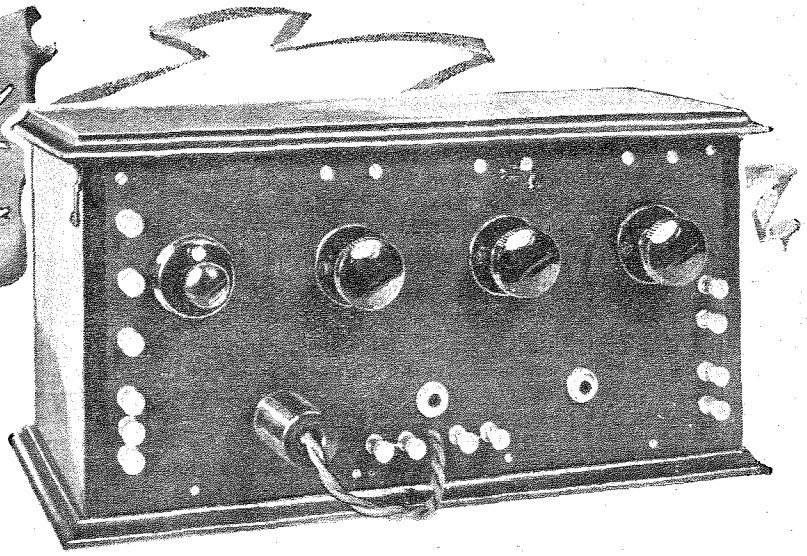
This proviso has been omitted from the new Bill, and if it becomes law any dynamo, battery, electric lighting and heating apparatus, electric bells, and odd pieces of apparatus of various kinds, such as sparking plugs, magnetos, and electro-medical apparatus, which may be used directly or indirectly for the production and transmission of electric waves, comes within the scope of the Bill. The Post Office has, in the past, sought to administer the Act of 1904 as if it applied to any piece of apparatus that might be used for wireless telegraphy, and has collected fees and issued licences for experimental work with indoor circuits (artificial aerials) incapable of sending signals. A literal interpretation of the new Bill would prevent inventors and research workers using any apparatus which happens also to be used in wireless telegraphy without official provision and the payment of fees.

But it is not only the experimenter who is threatened. By means of a few lines in Section 11 (2) at the end of the Bill, it is provided that the word " transmission " in the Act of 1904 is " deemed always to have included references to the reception of messages."

The Act of 1904 was framed mainly with respect to military and naval signalling. Private stations were then few in number, and broadcasting was not thought of. The effect of these few lines is to empower the Post Office or the Police to search for unlicensed sets and to exact heavy penalties if such sets are discovered.

The Society fully recognises that the Post Office should have power to prosecute malefactors, but the Act should be so framed that the man who uses his set properly is not subjected to official interference.

A UNIVERSAL DETECTOR—AMPLIFIER



An Instrument for Testing Experimental Tuners and H.F. Circuits.

By F. L. DEVEREUX, B.Sc.

A LARGE proportion of the experimental work carried out by the amateur in reception is connected with the development, particularly on short wavelengths, of efficient tuning methods and systems of high-frequency amplification. The remarkable achievements of British and Australian amateurs in recent short wave tests have directed the attention of many workers, both professional and amateur, to this fascinating field of study.

Before commencing original experiments, however, the amateur would be well advised to try out a few circuits representative of the work that has already been done in this particular direction. This will give him a better sense of proportion, and will save him from making extravagant claims for new circuits which in reality may be in no way superior to older and simpler arrangements.

It will be found that the connections of the detector valve and the subsequent low-frequency amplifiers remain the same for most, if not all, experiments of this kind; and, to expedite the process of changing the tuner and H.F. connections, the writer has found it convenient to build these valves and their associated components into a permanent set. Whenever particulars of a new circuit are published a practical test can be arranged in a remarkably short time, as one is relieved from the tedium of repeating the already familiar detector and low-frequency connections.

The Circuit.

Several features of general interest have been introduced into the design in order to make the utility of the set general.

L.T. Supply—Filament Resistances.

A variable filament resistance having two resistance ranges has been fitted to each valve. Bright or dull emitter valves of any filament rating can therefore be used in each stage. The variable resistance is supplemented in each case by a fixed resistance unit, which increases the resistance range indefinitely. A further advantage of this resistance is that it can be set to pass the maximum permissible current to the valve when the whole of the variable resistance is switched out of circuit. Thus, a fixed resistance of 50 ohms would be employed when a D.E.3 valve is to be run from a 6-volt accumulator. Under these conditions the filament current can only be reduced below its maximum value, and the possibility of inadvertently burning out the valve by turning on the filament resistance too far is obviated.

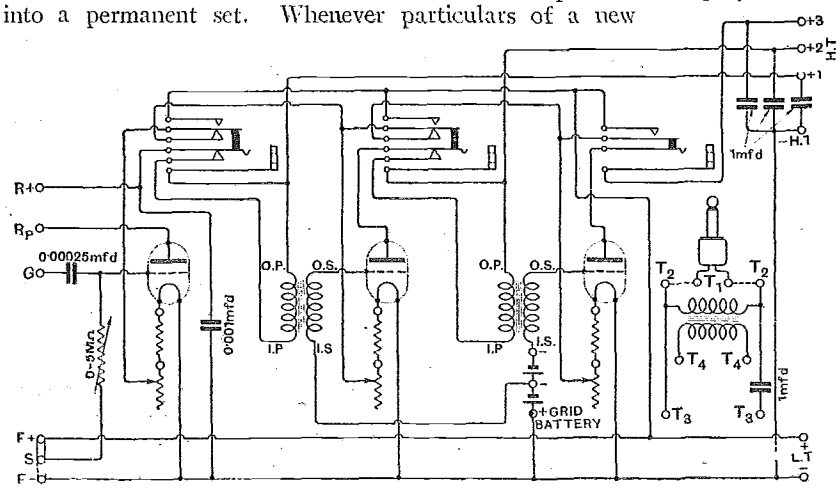


Fig. 1.—The circuit connections.

It will be observed that all the filament resistances are connected in the positive filament leads. In the case of the low-frequency amplifying valves, where the grid return leads are connected to —L.T., a fluctuating grid bias would result if the resistances were connected in the negative lead. A difference of potential due to the filament current is established across the ends of the resistance and is transferred to the grid of the valve. The grid potentials would therefore change in value whenever the

A Universal Detector Amplifier.

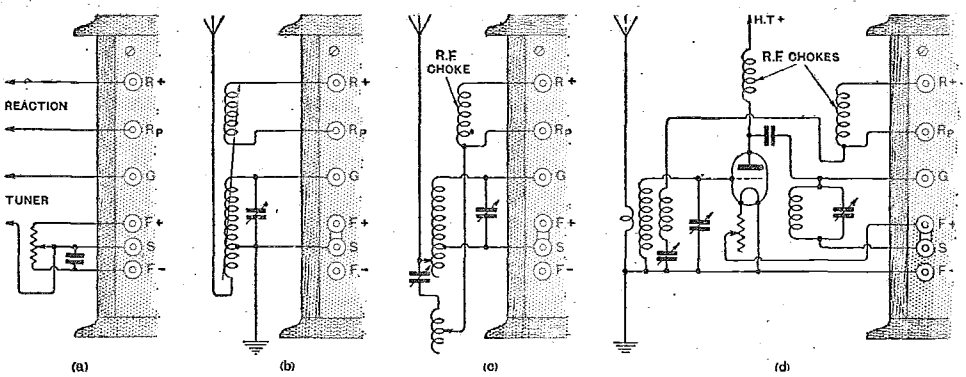


Fig. 2.—The connections of a few typical circuits.

filament resistances were adjusted. In the case of the detector valve, the filament resistance should be joined in the negative lead when the grid leak is connected to +L.T., and in the positive lead with the grid return to −L.T. It is impracticable to change the position of the first filament resistance, and it has been connected permanently in the positive side to correspond with the resistances for the amplifying valves. When the grid leak is connected to −L.T., therefore, the grid potential will be unaffected by the setting of the filament resistance. When a definite and unvarying positive grid bias is required, a potentiometer should be used, and the setting readjusted every time the filament resistance is moved.

H.T. Supply.

A separate H.T. tapping is provided for each valve, in view of the fact that a variety of types is to be tried. To reduce the possibility of oscillation at audio-frequency, condensers are connected between each H.T. tapping and −L.T.

The H.T. battery generally has a certain amount of internal resistance, particularly after it has been in use for some time. As the H.T. battery forms a part of the anode circuit of each valve, it will be at once apparent that a fluctuating E.M.F. set up across its internal resistance by one valve will be transferred to the others. With one or more condensers connected across the sections of the battery in use, the voltage variations across the battery due to fluctuation of anode current will be smoothed out by the condensers to a degree depending upon the condenser capacities.

Grid Control.

The grid potential of the detector valve is controlled by a condenser of 0.00025 mfd. capacity, and a leak

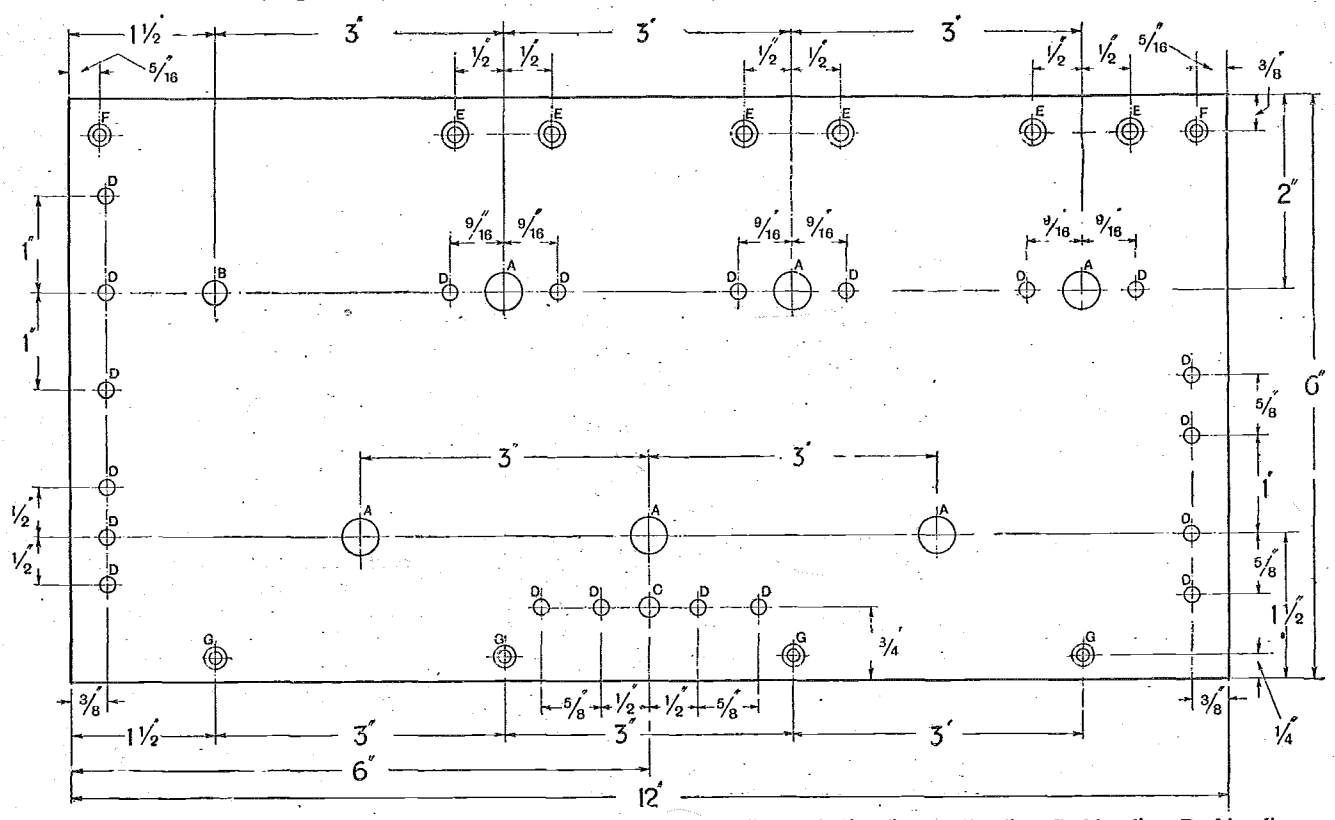


Fig. 3.—Dimensions of the main ebonite panel. The drill sizes are as follows: A, ¾in. dia.; B, ½in. dia.; C, 7/16in. dia.; D, 5/32in. dia.; E, 5/32in. dia., and countersunk for No. 4B.A.; F, ⅛in. dia., and countersunk for No. 6B.A.; G, ¼in. dia., and countersunk for No. 4 wood screws.

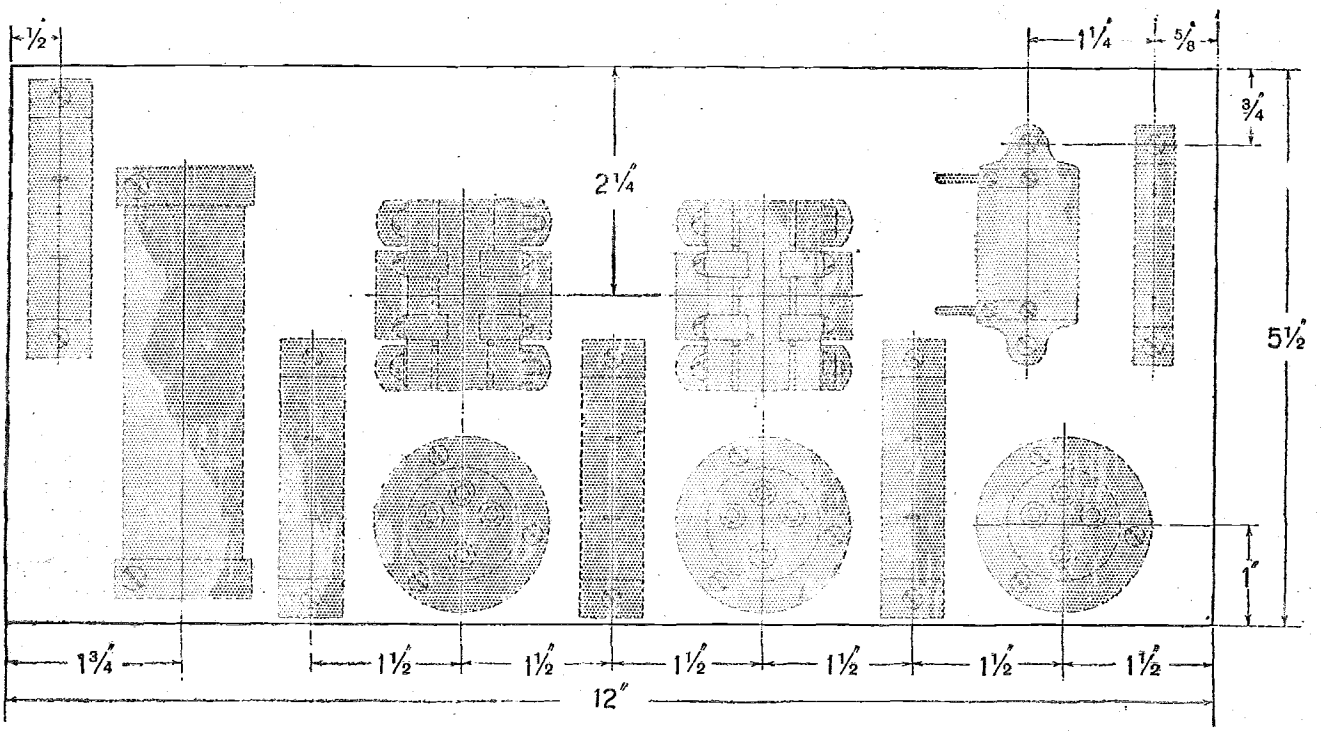


Fig. 4.—Plan of baseboard showing arrangement of components.

variable between 0 and 5 megohms. It will be found that low resistance values for the grid leak will give good quality when receiving telephony. A reduction in the value of the grid leak, however, is generally accompanied by a reduction in signal strength and the condition of reaction coupling referred to as "flopping" or "back-lash." When quality of telephony is of secondary importance, a value for the leak approaching 5 megohms will give best results with most valves in general use.

The filament end of the grid leak may be connected either to + or −L.T., according to the position of the link between the terminals F+, S and F−. The grid leak may be supplemented, if necessary, by a potentiometer connected to the set externally, as in Fig. 2 (*a*). With both the variable leak and the potentiometer in use there should be little difficulty in arriving at the correct rectifying conditions for any of the valves in common use.

The grid potential of the L.F. valves is controlled by a dry cell battery connected externally to the set by three terminals at the back. The voltage of this battery must be adjusted to suit the particular valves and operating conditions prevailing at the time.

L.F. Transformers.

In view of the fact that the valve used for rectification usually has a high impedance, the first transformer connecting the detector and first note magnifier has been chosen with a primary winding of high impedance and a low turn ratio (2.6 : 1). The second transformer has a smaller primary winding and a ratio of 4 : 1, as it is proposed to use low impedance valves for both L.F. stages. For long-distance C.W. work, where quality is of secondary importance, the high amplification obtain-

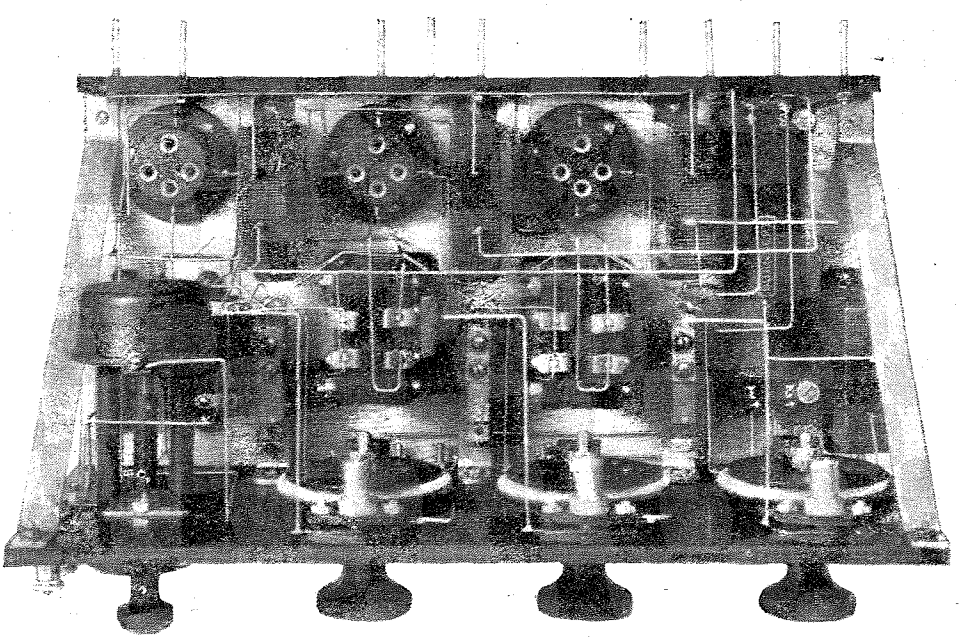


Fig. 5.—Plan of the finished set, showing relative position of components on the panel and base.

A Universal Detector Amplifier.—

able with transformer coupling with D.E.5B. valves should not be overlooked.

Switching.

Any number of valves from one to three may be used, depending upon the position of the telephone plug. Whichever jack is used, the appropriate valves will be automatically lighted and connected in circuit, and when the plug is withdrawn from the set, all the valve filaments will be switched off.

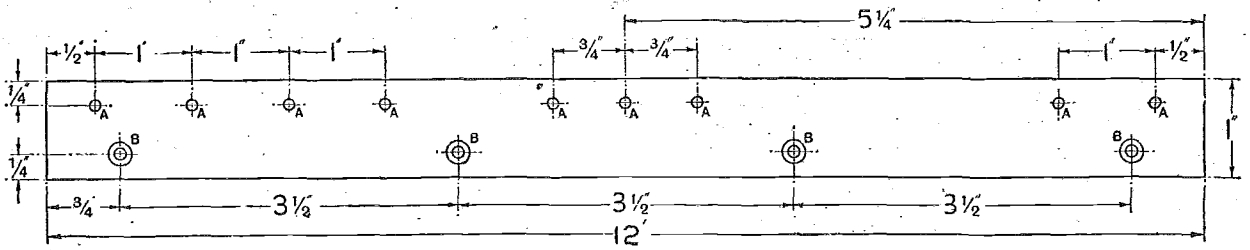


Fig. 6.—Dimensions of terminal strip. The holes are drilled as follows: A, No. 4B.A. tapped; B, ⅛in. dia., countersunk for No. 4 wood screws.

Telephone Connections.

The connections of the telephone plug terminate at T_1. When the telephones are connected at this point, therefore, they will be included directly in the plate circuit of the last of the valves in use at the time. By connecting together the pairs of terminals T_1 and T_2, the telephones will be connected through to the telephone transformer. Low resistance 'phones can then be fed from terminals T_4; and, using the primary winding as a choke (with, of course, the secondary circuit open), the "filter feed" method may be used for high resistance telephones connected to T_3.

Assuming that the impedance of the telephones or loud-speaker is suited to the valve in the last-stage, the loudest signals will be obtained with the windings connected directly in the plate circuit. The D.C. component of the anode current flows through the windings with this method of connection, and is a source of difficulty, particularly when the loud-speaker movement is of the electro-magnetic or balanced armature type. With both the transformer and "filter feed" methods of connecting the sound reproducer to the valve, the D.C. component is eliminated. Low resistance windings for the reproducer are to be recommended on the score of reliability if their impedance is suited to the ratio of the transformer in use.

Connections of Typical Circuits.

The methods of connecting externally a few short-wave tuners and circuits are illustrated in Fig. 2. Previous mention has been made of the potentiometer connections in Fig. 2 (*a*), which may be applied, if desired, to any of the succeeding circuits.

Fig. 2 (*b*) shows a simple short-wave tuner employing an "aperiodic" aerial circuit coupled to a tuned secondary circuit between grid and filament of the detector valve. Magnetic reaction is used, the reaction coil being joined across R+ and R_P.

An arrangement of the familiar Reinartz circuit is shown in Fig. 2 (*c*). It will be observed that in this case the reaction terminals receive the ends of the radio-frequency choke coil.

The addition of a high-frequency amplifying valve coupled to the set with a series resonant circuit may be carried out as in Fig. 2 (*d*). A combination of magnetic and capacity reaction is employed.

Many other combinations are possible, and it would be difficult to find one that could not be adapted to the set.

If for any reason it should be desired to connect the grid leak in parallel with the grid condenser, it is necessary only to remove the link from terminal S and to connect this terminal to G.

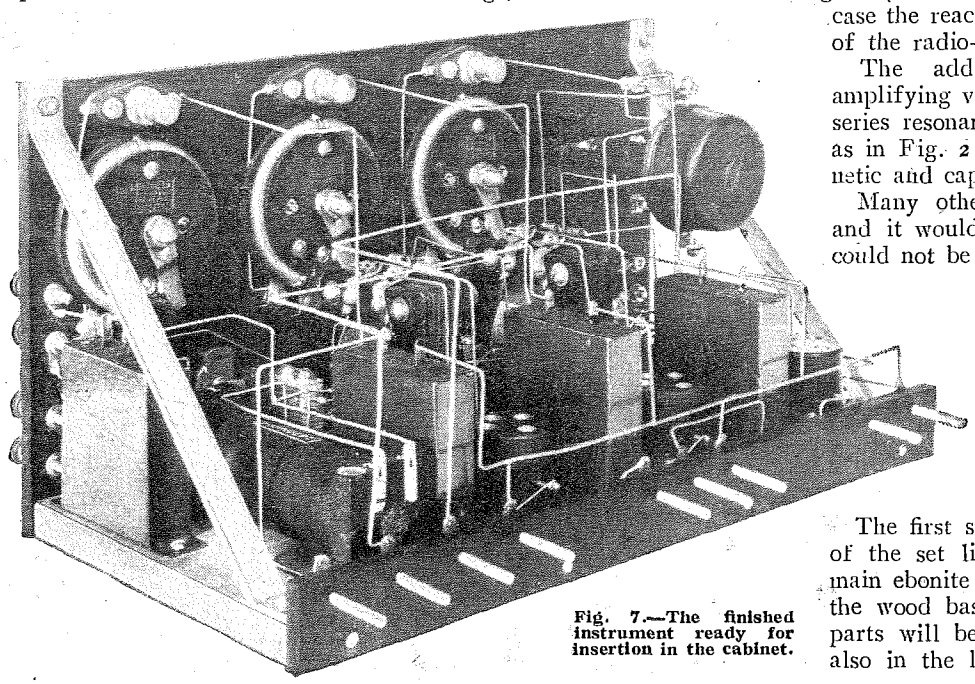


Fig. 7.—The finished instrument ready for insertion in the cabinet.

Panel, Base, etc.

The first step in the actual construction of the set lies in the preparation of the main ebonite panel, the terminal strip and the wood base. The dimensions of these parts will be found on the drawings and also in the list of components. Having

A Universal Detector Amplifier.—

drilled the panel in accordance with the dimensions given in Fig. 3, the terminal strip and panel may be screwed to the base and the brass angle brackets fitted. These brackets are cut 8in. in length from brass strip $\frac{1}{2}$in. wide and $\frac{1}{16}$in. thick. The ends are bent up for a distance of $\frac{5}{8}$in. at an angle of approximately 45°.

Assembly.

Having built up the foundation of the set in this way, the components may be assembled in position ready for wiring. The filament resistances, telephone jacks and terminals on the ebonite panel should be assembled first and the remaining parts may then be screwed to the wood base. If the components are assembled in this order, it will be possible to effect a better distribution of the space, in the event of any of the components differing from those mentioned in the article. Every component should be used in making this preliminary distribution of space, but the three 1 mfd. condensers immediately in front of the telephone jacks need not be screwed into position until the wiring of the jacks has been completed.

Wiring.

The best way of wiring the set is to commence in the angle between the base and the front panel, and to work outwards. There will be less likelihood of congestion if this system is adopted, and the soldering iron can be used with greater freedom. Every junction in the set is accessible when a reasonably small iron is used, and no difficulty was experienced in wiring the set described. No. 18 S.W.G. tinned copper wire was used wherever possible, but it was found necessary to use No. 22 S.W.G. for the connections of the telephone jacks, which have to be made with great care, owing to lack of space. Separate pieces of wire from 4in. to 6in. in length were

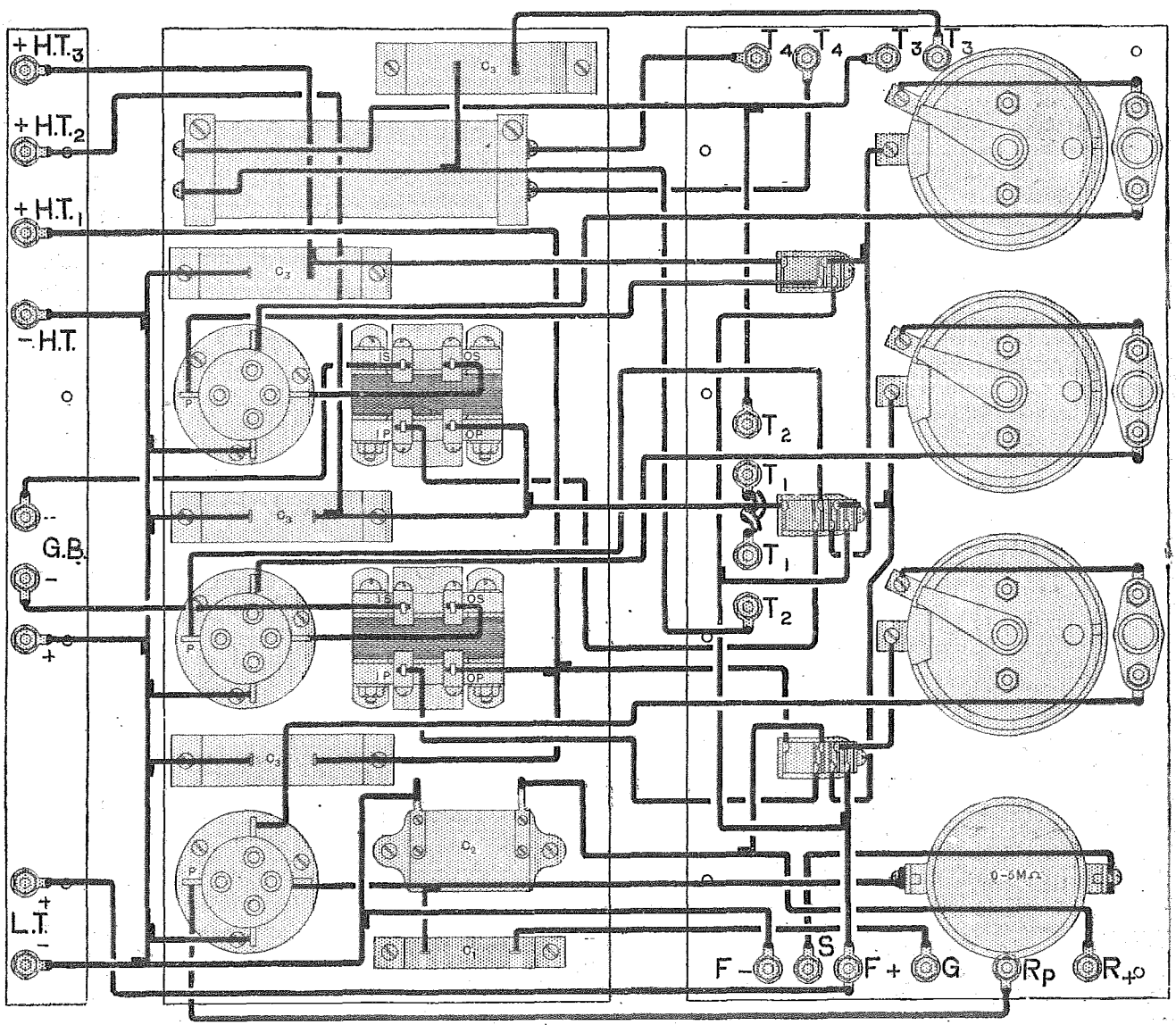


Fig. 8.—Wiring diagram. The condenser capacities are as follows: C_1, 0·00025 mfd.; C_2, 0·001 mfd.; C_3, 1 mfd.

LIST OF COMPONENTS.

1 Ebonite panel 12in. × 6in. × ¼in.
1 Ebonite terminal strip 12in. × 1in. × ¼in.
1 Hard wood base 12in. × 5½in. × ½in.
3 Dual filament resistances (Burndept).
3 Fixed resistance holders and plugs (Burndept).
3 Valve holders (Burndept).
1 Single filament telephone jack (C. F. Elwell).
2 Double filament telephone jacks (C. F. Elwell).
1 Telephone plug (C. F. Elwell).
1 Intervalve transformer, high ratio (Burndept).
1 Intervalve transformer, low ratio (Burndept).
1 Telephone transformer (Burndept).
4 Condensers, 1 mfd. (T. C. C. Mansbridge).
1 Condenser, 0·00025 mfd. (Dubilier, 600a).
1 Condenser, 0·001 mfd. (Dubilier, 600).
1 Variable grid leak, 0-5 MΩ (Igranic).
4 B.A. Screwed rod.
Brass strip, 16in. × ½in. × 1/16in.
Terminals, screws, flex, tinned wire, etc.

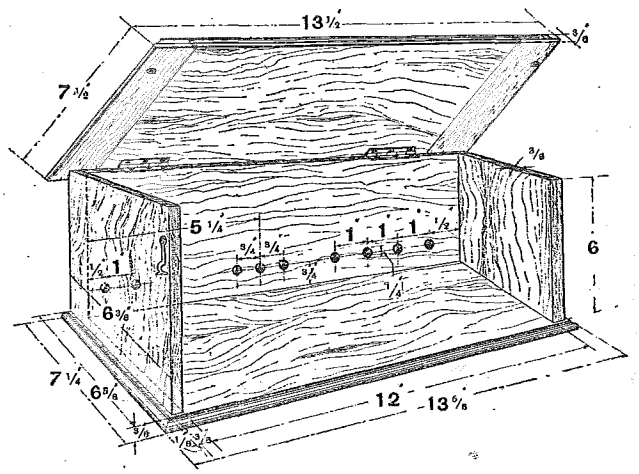
soldered to each tag connection and then bent to shape and connected to the appropriate points.

Finally, the 1 mfd. condensers were screwed in place and connected up.

The back of the cabinet should be drilled to receive the 4B.A. terminal screws projecting from the terminal strip at the back of the baseboard. The holes in the cabinet may be bushed with ebonite if desired, but this is not really necessary if the wood is of good quality.

Only the battery terminals have been fitted at the back of the cabinet, so that poor insulation can only cause a slight leakage current from the batteries. With the wood used for cabinet work, however, leakage is of rare occurrence. Important terminals such as the grid and reaction terminals have been mounted on the main ebonite panel.

With the set in position in the cabinet, washers and terminal tops may be fitted to the screws projecting from the back, to take the battery connections and to hold the set in position in the case.



No. 9.—Dimensions of the cabinet.

ABSORPTION WAVEMETERS.

WHEN an oscillatory circuit consisting of an inductance connected in series with a capacity is placed near a transmitter or a receiving set in a state of oscillation, energy will be absorbed and a current will flow in the circuit if it is tuned to resonance with the source of oscillations. Such a circuit when calibrated in terms of wavelength or frequency is known as an absorption wavemeter, since the condition of resonance is indicated by an absorption of energy and a consequent change in the operating conditions of the transmitter or receiver. The aerial current of the transmitter may change slightly and the power input will increase, while in the case of the receiver oscillations will cease or the signal strength will be reduced.

A series of coils calibrated in conjunction with a variable condenser can often be used in this way as a substitute for a buzzer or heterodyne wavemeter, and will prove useful even to the fortunate possessors of such instruments when the wavelength range available is limited.

To calibrate the wavemeter, the coil should be placed near a receiver which is just oscillating, and tuned to the silent point of a C.W. station of known wavelength. Then, rotating the condenser dial of the wavemeter, a double click will be heard as the oscillations start and stop when the wavemeter goes into and out of resonance with the receiver. If the two clicks are separated by several degrees on the condenser dial, the coupling between the wavemeter and the set should be reduced until there is only one point at which the oscillations cease.

For purposes of calibration on short wavelengths, the lower harmonics of broadcasting stations may be used, but on no account should a wavemeter be calibrated on the fundamental wavelength, as interference with other receivers may be caused. The harmonics occur on wavelengths which are exact sub-multiples of the fundamental, so that a station on 600 metres would be capable of producing harmonics on 300 metres, 200 metres, 150 metres, etc.

Several readings should be taken for each wavelength and the results plotted as a curve showing the relation between wavelength and condenser reading.—S. K. L.

A WESTON RELAY HINT.

EX-GOVERNMENT Weston moving coil relays are being widely used by experimenters as measuring instruments. In making the conversion the relay contacts are generally removed and replaced by a light pointer or reflecting mirror. The relay contacts, if left on the instrument, can be utilised as a safety device.

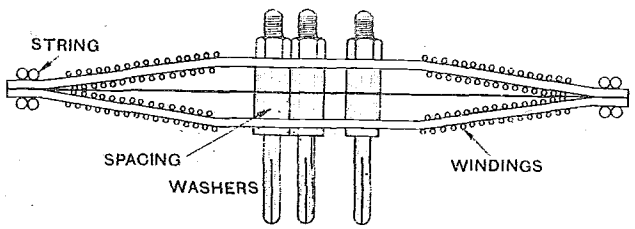
Adjust the screw contacts so that the tongue just touches at either end of the instrument scale. Then by a suitable arrangement of the connections, the instrument will be automatically short-circuited when an excessive current is accidentally passed. A better method is to make the contacts open the circuit through a trip relay, as this eliminates chattering and destruction of the contacts when a very heavy current flows.

NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

MOUNTING H.F. TRANSFORMERS.

High-frequency plug-in transformers consisting of two basket coils mounted side by side are in general use, but are rather fragile and require careful handling. Their mechanical strength may be greatly improved by lacing together the edges of the formers with string. The coils should be separated at the centre by pairs of spacing washers between which a disc of cartridge paper or other suitable material is clamped; and the slots in the formers should, of course, be made to coincide before drilling the holes for the valve legs.



An H.F. transformer of rigid construction.

The resulting wedge-shaped formation gives greater rigidity and facilitates the removal of the transformer from its holder.—W. R. M.

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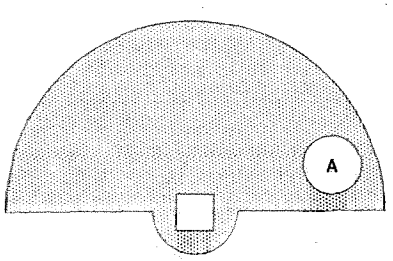
A CONDENSER IMPROVEMENT.

Square law condensers are undoubtedly superior to the ordinary type in which semi-circular plates are employed. Existing condensers of the latter type can be greatly improved by drilling a hole, A, near the edge of the moving vanes on the side which first enters the spaces between the fixed vanes. This will not give a true square law characteristic, but will reduce the rate of change of wavelength near the beginning of the condenser dial, where tuning is often very critical with the ordinary condenser. —A. C. D.

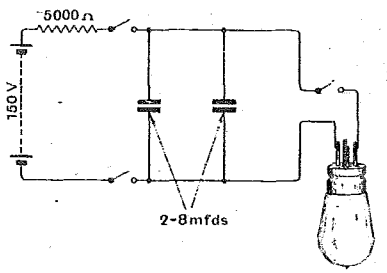


Improving the tuning properties of variable condensers.

FREEING VALVE FILAMENTS FROM CONTACT WITH GRID.

The filaments of valves that have been in use for a considerable period often sag until they touch the grid. In this condition they are, of course, useless and are generally thrown away. A method of freeing the contact between grid and filament that has proved successful on many occasions depends upon the high instantaneous current obtained from a reservoir condenser discharging through the filament. The diagram of the circuit connections shows that the condenser is charged through a safety resistance, and then, after disconnecting the battery, is discharged through the filament. Starting with a small charging voltage and capacity, the values of both should be increased until the discharge produces visible heating of the filament.

It is difficult to explain exactly how the filament becomes detached, but it is significant to note that a faint metallic sound accompanies the discharge. It should be remembered also that an intense magnetic field



Connections used for freeing filament-grid contact.

surrounds the filament during the early stages of the discharge when the current attains very high values.—E. P.

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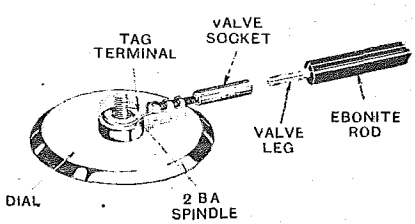
A PLUG-IN EXTENSION HANDLE.

When several tuning condensers are assembled side by side in a receiver, it is impracticable to fit them individually with extension handles. Unless the handles were arranged to rotate in different horizontal planes, they would interfere with each other.

The difficulty may be overcome by using a single extension arm which may be fitted in turn to each condenser for final adjustment. A convenient way of making the arm interchangeable is shown in the diagram. The joint between the extension arm



A detachable extension handle.

and the condenser is made with a valve pin and socket, the pin being screwed into the end of the extension arm. The valve socket is held in a terminal tag which is clamped between the condenser knob and dial. —D. R. M.

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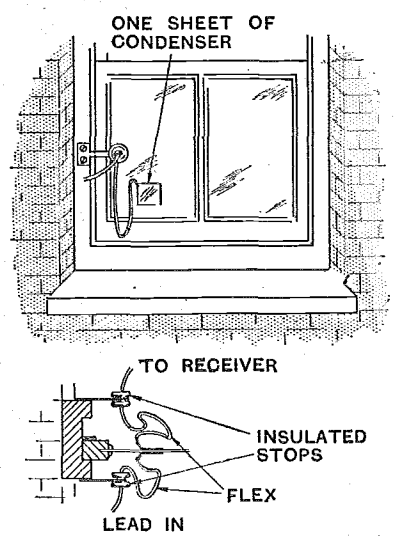
A NOVEL LEAD-IN.

The lead-in from the aerial may be brought into the house without drilling the window pane or frame by the following simple method.

Two sheets of tin-foil of equal size are prepared with a thin connection soldered to each corner. A projecting strip may be left at one corner, and may be rolled up to give increased thickness. The sheets are then stuck on opposite sides of a selected pane with thick shellac varnish to form a condenser with glass dielectric. The flexible leads are soldered to the aerial



A capacity lead-in of novel design.

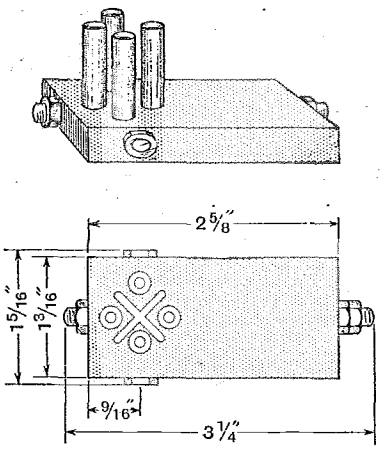
wire and to the aerial lead inside the house, both joints being anchored to insulators fixed to the window frame.

The high-frequency currents induced in the aerial will pass freely through this condenser if the capacity is not too small, and the insulation will be quite satisfactory if the condenser plates are attached to the centre of the window pane.—A. G. W.

oooo

AN ADAPTOR FOR FOUR-PIN VALVES.

Some of the ex-Government receiving apparatus on the market at the present time is designed to take valves of the " Ora B " type. The diagram shows the construction of an adapter which will permit the use of ordinary valves. After cutting the ebonite to size, the valve socket holes are drilled and tapped. Lateral holes are then drilled in the sides and tapped for 2 B.A. screwed rod.



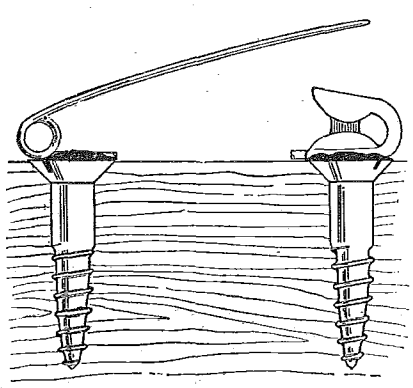
An adaptor for " Ora B " valves.

Suitable lengths of 10d are then screwed into these holes and tightened up to the valve socket screws. Securing nuts are then fitted, the side screws being filed flush with the screws. Slots may be cut between the valve legs if desired, to reduce capacity effects and increase the surface insulation.—T. H.

oooo

A CHEAP SWITCH FOR EXPERIMENTAL CIRCUITS.

Those amateurs who are in the habit of trying out new circuits on a wooden baseboard before building a permanent set will find it very easy to make switches from ordinary safety-pins. The heads of two brass countersunk wood screws are carefully tinned and then soldered to the two parts of the safety-pin, which has been previously cut in the way indicated in the diagram. The screws may be screwed into the base before soldering the parts together, and if the wire is of a suitable thickness the slots in the screws may be set in line so that the wires fit into them. This precaution will give additional strength to the joints. The spring pressure gives an excellent electrical connection, and the switch when open has a low capacity.—A. J. D.

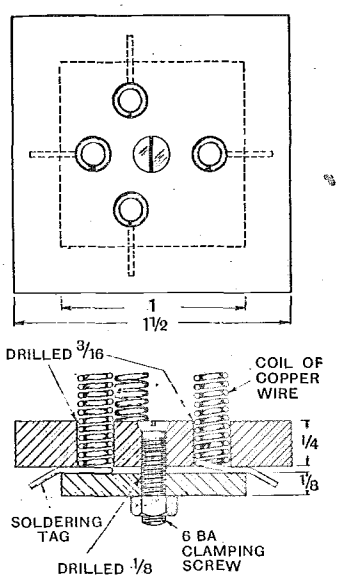


A novel switch.

oooo

SHOCK-PROOF VALVE HOLDER.

An effective valve holder may be made by using coils of copper wire for the valve sockets. The coils are inserted in suitably spaced holes in the receiver panel and are clamped at the back by a rectangular piece of ebonite.



A cheap anti-vibration valve holder.

The holes for the sockets may be $\frac{3}{16}$in. in diameter. For this diameter the coils should be wound with No. 24 or No. 26 S.W.G. copper wire, using a 6 B.A. screwed rod as a former. Each coil should consist of 15 turns, and after winding may be pulled out to a length of $\frac{1}{2}$in. A convenient size for the ebonite clamp is 1in. × 1in. × $\frac{1}{8}$in., and a 6 B.A. screw will be found satisfactory for holding the square in position.

The valve holder made in this way is cheap, and effectively protects the valve from damage from vibration.—G. L. E.

CHOKE-COUPLED BROADCAST AMPLIFIERS.

A comparison is made of resistance and choke couplings, and it is shown that a properly designed choke-coupled amplifier will give high-quality amplification. The effect of the coupling condensers and grid leaks is also discussed.

By G. W. SUTTON, B.Sc.

THERE is little doubt that the simplest satisfactory type of coupling for broadcast amplifiers, in those cases where the provision of ample H.T. voltage supply is no matter of difficulty, is the resistance/capacity method. When considering first cost, more stages may be required to provide the necessary amplification, or more expensive valves used, but against this is the much lower cost of the coupling unit itself, as compared with a choke or good transformer. Where it is desired to work with a minimum of H.T. voltage, or at a low first and running cost, however, the D.C. drop of potential in the anode resistance is an important consideration, particularly when coupled with the low voltage factor [1] of, say, an 80,000 ohms unit. Using this resistance, the anode drop is 80 volts if the mean anode current is 1 milliampere, while q has a value of only 0.76 with a 25,000 ohm valve. Thus the amplification with $\mu=8$ is only 6.1 against about 30 for transformer coupling. With a valve such as the D.E.5*b* the amplification could be raised to 12 or 14.

Resistance Coupling.

From the point of view of constancy of the ratio e_{g2}/e_{g1} with frequency this coupling is unapproachable. The only sources of variation are (*a*) residual inductance and self-capacity of the resistance itself, and (*b*) the necessary grid condenser and leak. It is found that even with wire-wound anode resistances the effect of (*a*) is negligible. Thus a self-capacity of as much as 50$\mu\mu$F introduces a shunting reactance of 660,000 ohms at 5,000*f* in parallel with R_a, and so reduces its effective value by an altogether negligible amount. The residual inductance is dependent on the method of winding, and may readily be made so small that its effects will also be inappreciable. There is some danger that these residuals may cause supersonic oscillation if similar resistances are used in successive stages. The writer has met this trouble in practice. It was overcome by suitable arrangement of the resistances on the panel, so that reverse magnetic coupling damped out the oscillation.

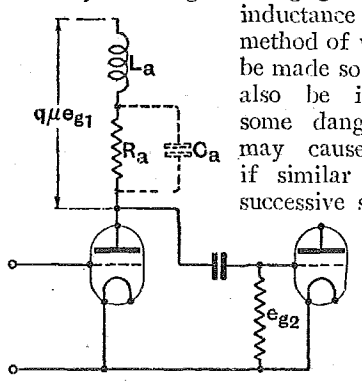


Fig. 1.—One stage of resistance coupling: R_a is the anode resistance, L_a the self inductance, and C_a the self capacity of the resistance.

[1] By "voltage factor" is meant the ratio of the voltage actually applied to the grid condenser of the succeeding valve, to that available in the anode circuit of the amplifying valve. When multiplied by the μ of the valve this gives the amplification per stage. Following D. W. Dye, the symbol "q" is used here to represent the voltage factor.

The effect of (*b*) depends upon the magnitude of the condenser and leak, and is illustrated in Fig. 2, for three commonly used values of grid leak, and one condenser. In Fig. 2, q is plotted to a base of log.f for a reason given below.

Choke Coupling.

It is now fairly well established that choke coupling is very little inferior to resistance coupling when judged

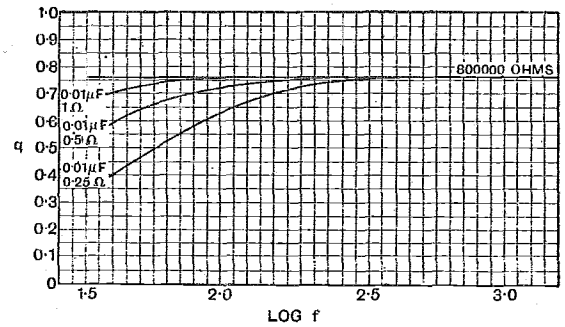


Fig. 2.—The effect of the coupling condenser and grid leak of a resistance amplifier.

by the quality of reproduction, the use of suitable components and correct adjustment being assumed. Its advantage is twofold. First, the D.C. potential drop in the choke is negligible, and, secondly, by suitable design, the value of q may be made practically constant over a wide range of frequency. The value of q may be readily calculated, since it is equal to the

$$\frac{\text{impedance of choke}}{\text{impedance of anode circuit, including valve}},$$

i.e.

$$q=\frac{\sqrt{(2\pi fL)^2+R^2}}{\sqrt{(2\pi fL)^2+(R+R_0)^2}},$$

L being the inductance of the choke in henries, and R its resistance in ohms, while R_0 is the internal resistance of the valve. R is usually small compared with R_0, so that

$$q=\sqrt{\frac{(2\pi fL)^2}{(2\pi fL)^2+R_0^2}}.$$

Thus q depends upon two quantities, the frequency to be amplified, and the inductance of the choke. We shall now endeavour to determine a value of the latter which will give suitable values of q over such a range of frequency that distortion will be reduced to an unnoticeable amount. It is obvious that *some* distortion of the complex vibrations constituting music and speech may take place whatever value of L is adopted, but it is found that by making it sufficiently large the practical result is satisfactory.

Choke-coupled Broadcast Amplifiers.—

A suitable method of tackling the problem is to assume various reasonable values of L and to plot graphs of the resulting values of q to a base of frequency. We shall take the limits of frequency as 0 and 5,000 cycles per sec. In Fig. 3 this has been done for values of L between 5 and 40 henries. The curve for a commercial transformer of some reputation is also included, the values having been obtained from the manufacturer's published experimental results.

The scale of frequency adopted is that most commonly adopted for purposes such as this, but to the writer's

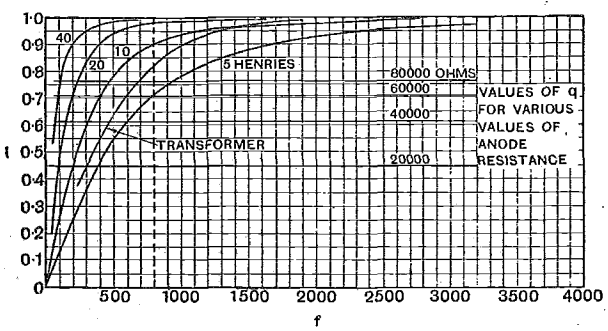


Fig. 3.—Comparison of choke and resistance coupling.

mind it leads to incorrect conclusions. The average person thinks in octaves, not in vibration numbers or frequency. Moreover, the space to the right of mean speech frequency (800) is the region of harmonics; the fundamentals of speech and singing notes and of most instruments all lie to the left, and whilst admitting that articulation is largely a question of harmonics, it is obviously necessary for faithful reproduction to pay due attention to the amplification of the fundamentals.

In Fig. 4, therefore, the same curves have been redrawn to a base of "log.f," thereby allotting equal space to each octave. The horizontal axis now resembles the keyboard of a piano, "C" being the "middle C" on that instrument, "C^1" the octave above, and so on.

Transformers.

It is at once seen from Fig. 4 that for faithful reproduction the inductance of an anode choke should be of the order of at least 40 henries.

It should be noted that the factor q is equally important in transformer coupling, and it is a common failing in present-day designs that their primary inductance is too low.[1]

The above curves are drawn on the assumption that the chokes have negligible resistance. If the bulk of the choke is to be reasonably small this cannot be the case, and curves have been added to show the effect of the winding having a resistance of 10,000 ohms. This figure was selected as a probable limit, assuming the use of 47 S.W.G. wire. It will be seen that whereas this increases q at the lower frequencies, it decreases it at higher values. In the case of the 40H choke it has the same effect as reducing L by about 7H.

[1] [Vide D. W. Dye, *Exp. Wireless*, Vol. II., No. 14. He deduces from exhaustive experiments that the most important single property of an intervalve transformer is the inductance of the primary winding, and that this should be of the order of 20H.]

The voltage developed across the anode choke due to an input of e_{g1} volts to the grid of a valve (assuming correct values of H.T. voltage and mean grid potential) is $q\mu e_{g1}$. In the case of an intervalve transformer some multiple of this is handed on to the grid of the next valve by inductive coupling. The exact numerical value of this multiple depends on many factors; amongst others, the nature of the anode circuit of the second valve and the state of the iron core of the transformer itself. The writer's experience indicates that so long as $q\mu e_{g1}$ is not more than about half a volt, and the transformer has an iron core of liberal cross-section, appreciable distortion is not caused so long as great care is taken to ensure correct mean grid and anode potentials for the ensuing valve.

Construction of Chokes.

This means that a good transformer behaves satisfactorily in the plate circuit of a detector valve or after a crystal rectifier. For subsequent amplifying valves, however, it is much better to couple by means of a suitable grid condenser and leak. The effect of such coupling on the ratio e_{g2}/e_{g1} has already been illustrated in Fig. 2.

The secondary windings of broken-down intervalve transformers frequently make good chokes. For those desirous of winding suitable chokes, the following data may be useful:—10,000 turns of No. 47 S.W.G. enamelled and S.S.C. wire were wound on a moulded ebonite spool, such as are commonly sold for "transformer bobbins." Iron stampings from an old intervalve transformer were tightly packed into this, forming a closed iron core. Before fitting the iron core the choke had an inductance of 2.317 henries and an effective resistance of 4,772

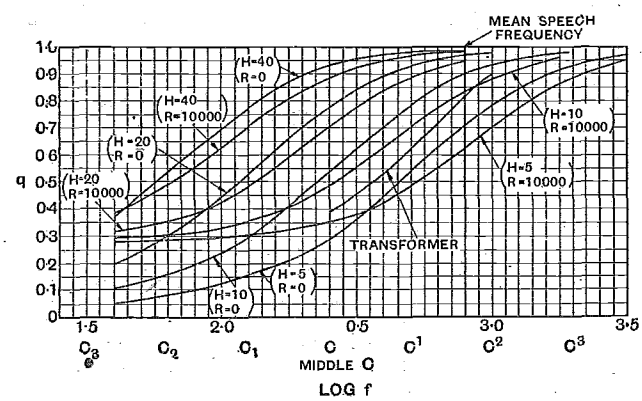
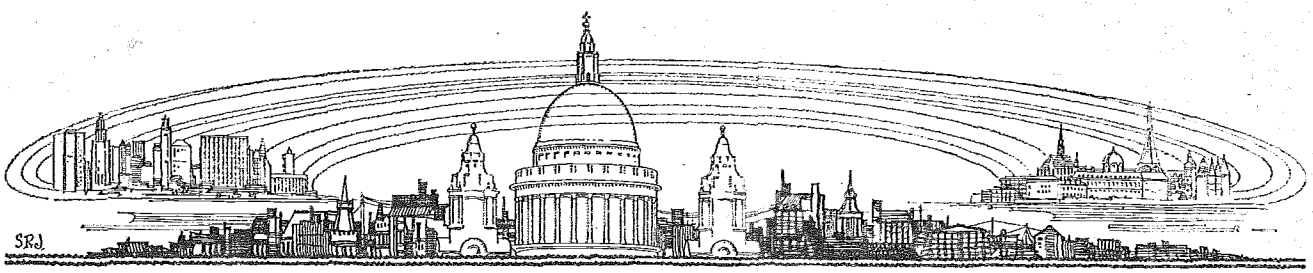


Fig. 4.—Variation of q with log. f for various values of anode choke inductance and resistance.

ohms, both at 1,000f. After the core was in place, the inductance was found to be 49.3 henries.

The writer has had several chokes wound and fitted with a closed iron core of fine gauge wire. These are wound with 12,500 turns of wire, spaced to reduce self capacity, and have an inductance in the neighbourhood of 50 or 60 henries. It may readily be seen that ordinary values of self-capacity (say 30 to 50$\mu\mu$F) have no appreciable effect on the value of q. The spacing of the winding, however, reduces the likelihood of breakdown of insulation due to inductive rise of voltage across the choke on switching off the valve.



CURRENT TOPICS

Events of the Week in Brief Review.

SENATORE MARCONI.

Senatore Marconi has just celebrated his forty-ninth birthday. It is now nearly twenty-nine years since he took out his first British patent for wireless telegraphy, No. 12039 of 1896.

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SHORT WAVES FROM ITALIAN ARMY.

Amateurs listening in the neighbourhood of 47 metres may be interested in the following message, received at 2.55 p.m. on March 17th by Mr. S. Hills, of S.E. London. The message ran: "Experimental transmission on short waves from Military Radio Works, Rome, Viale Angelico, 19. Amateurs are invited to send notices relating reception."

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A RADIO MENU.

At the Woolwich Radio Society's first annual dinner, held on March 25th, the menu contained, among others, the following attractive items:—

Fish: Filament du Plate . . . . Gridbias.

Joints: Soldered Joint, Heaviside Layer.

Sweets: Trifle Resonant, Accumulator Juice.

We understand that the guests departed in a highly charged condition!

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BROADCASTING IN FRANCE.

The broadcasting station at Agen, France, which recently ceased transmission, has reopened with experimental programmes. Two transmissions take place daily, at 11.40 a.m. and 8.30 p.m., and consist of weather reports, time signals, news and market reports. Musical programmes are sent out at irregular intervals. The wavelength is 318 metres.

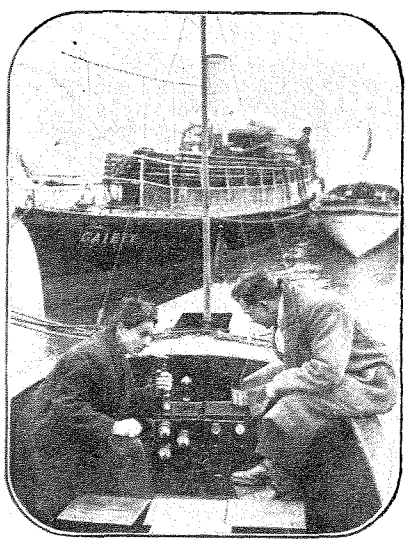
oooo

AMERICA'S HIGHEST WIRELESS AWARD.

The Hoover Cup for 1924, the highest honour that an amateur wireless operator can win in the United States, has recently been awarded to a San Francisco amateur, Mr. B. Molinari. His station, 6 AWT, in accordance with the conditions of the award, was almost entirely home-made, and has put up a fine transmission record during the past year. Amateurs have reported hearing 6AWT's signals in Europe, Africa, Asia, Australia, South America, Central America, and the South Sea Islands.

GERMAN LANDLORDS DEFEATED.

Amateurs in Bautzen, Germany, are jubilant over a recent court decision which gives them the right to erect wireless aerials regardless of their landlords' sentiments in the matter. The only objection which the luckless landlord may make with success is that the erection of an aerial would endanger the safety of his property.



THE BOAT RACE Captain R. Tingey and Mr. Ridley are here seen with the wireless transmitter which followed the University crews on March 28th. Details of the race were broadcast from loud speakers at prominent points between Putney and Mortlake.

SCHOOL WIRELESS IN AUSTRALIA.

The value of wireless in education has early been recognised in Australia, where seventy-eight schools are equipped with receiving apparatus. Regular educational programmes are broadcast, and an inspector of education has been appointed to superintend the preparation of suitable lessons for transmission during school hours.

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DAYLIGHT WORKING WITH AMERICA.

Exchange of signals with American short-wave stations was carried out in broad daylight on March 28th, 29th and 30th by Mr. J. A. Partridge (2KF), of Wimbledon, and Mr. K. Secretan (5LF), of Barnes.

Mr. Secretan was in communication with American stations practically all day on Sunday, March 30th, the stations worked including NKF (Washington) and Mr. John L. Reinartz (1XAM). Mr. Partridge was in touch with 1CMP.

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CRUMBS OF COMFORT FOR FRENCH AMATEURS.

The bitterness of amateurs in the South of France over the lack of broadcasting stations in that part of the country is being alleviated to a certain extent by the excellence of the transmissions from the Spanish station at Bilbao, recently erected by a French company. It transmits on 350 metres with a power of 1 KW., and many reports have come from French amateurs, who have been listening to the transmissions with a kind of national pride.

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AUSTRIAN LISTENERS GRUMBLE.

The B.B.C. may take heart from the knowledge that theirs is not the only broadcasting policy subject to criticism.

The directors of the Vienna broadcasting station are being subjected to fierce attacks by an army of listeners who demand an improvement in the quality of the programmes transmitted. At first the public were inclined to sympathise with the efforts of the station directors, realising that money was short, as in many other Austrian enterprises, but it is now felt that with the large number of subscriptions sent in by listeners, something could be done to improve the service.

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LOUD SPEAKERS IN NOTRE DAME.

Visitors to Notre Dame Cathedral recently had a startling experience, according to our Paris correspondent. While wandering through the dim and silent aisles, they were alarmed to hear a mighty voice, which they took to be that of the recording angel, counting: "Vingt-six, vingt-sept, vingt-huit." Their relief was great at discovering that the voice emanated from the pulpit, where an electrician was testing the new loud speaking apparatus.

Notre Dame now has five powerful loud speakers, so that the lowest-toned cleric can make himself heard with ease throughout the vast building.

A PERMANENT WIRELESS EXHIBITION?

As a result of the success of the wireless section at the recent International Trade Fair in Vienna, manufacturers are considering the advisability of setting aside a building for the permanent display of the latest wireless apparatus. The primary object of such an exhibition is stated to be the suppression of unscrupulous concerns, which are rampant in Austria. Only goods of proven value will be on view, and the customer who patronises exhibitors will have the assurance that his money is not being wasted.

The scheme appears to be a good one, provided a monopoly is not created.

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THE "RADIOTESTER."

A typographical error appeared in our description of the "Radiotester" on page 236 of our issue of March 25th. Should the amateur possess a milliammeter, the "Radiotester" can supply valuable information concerning the relative resistances of components between 1,000 and 20,000 ohms.

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RADIO SOCIETY OF GREAT BRITAIN.

An informal meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, at 6 p.m. this evening (Wednesday), when Mr. E. C. Atkinson, M.A., F.R.A.S., will give a talk on "Home-made Wireless Components and Sets."

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2DX BUSY.

A special series of transmissions is being transmitted daily at noon, on a wavelength of 24 metres, by Mr. W. Kenneth Alford (2DX), of Rosedene, Camberley. Reports of reception will be particularly welcome.

WIRELESS IN SCANDINAVIAN EXHIBITION.

A special display of radio apparatus and components will be a feature of the Scandinavian-Baltic Fair to be held this year during the early summer. In addition to the three Scandinavian countries, Sweden, Norway and Denmark, the exhibits will also represent Finland, Esthonia, Latvia, Lithuania, and Poland. We understand that the Fair will be open from June 14th to 21st.

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40-METRE AMERICAN SIGNALS.

Evidence of increasing American activity on the low wavelengths is shown by a report sent to us by Mr. W. Hartley (G2 AWP), of Follifoot, near Harrogate. Between 11 and 12 p.m. on March 18th he received the following in the neighbourhood of 40 metres:—1AF, 2BPB, 2CZR, 2CY, 2AAY, 4XE, and NKF. The last-named kindly indicated his exact wavelength (42.7 metres) several times during his transmission. The strength of signals on the one-valve set was hardly as strong as from those on the 75-85 metre band.

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ITALIAN RADIO JOURNAL'S TRANSMISSIONS.

Using the call sign IIRG, the station of the "Radio Giornale" at Bellagio, Lake Como, Italy, is transmitting a series of signals every Saturday and Sunday at 8, 9 and 10 o'clock (G.M.T.). Wavelengths of 65 and 50 metres are employed with a power input of 20 watts.

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NEW CONTINENTAL BROADCASTING STATIONS.

Two new European broadcasting stations will soon be opened, one by the Cie Anatolienne des Télégraphs, at Constantinople, and the other at Saint Sebastien, in the south-west of France.

A new station is also contemplated for Czecho-Slovakia, to be erected at Strasnice, which will broadcast on short wavelengths, and another station for Poland is under consideration.

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RADIOTELEPHONY ON FRENCH FISHING VESSELS.

Radiotelephony is being used to great advantage in the French fishing industry. The Newfoundland fleet, from Saint Malo, Saint Servan, and Carcale, which last year had only one vessel, the "Rouzie," fitted with wireless telegraphy, will now have three more—the three-masted ships "Armoricain," "Carcalais," and "Côte d'Emerande"—equipped for telegraphy and telephony. Conversation between these ships and from ship to shore will soon lighten the long and tedious weeks of cold and discomfort experienced by deep sea fishermen.

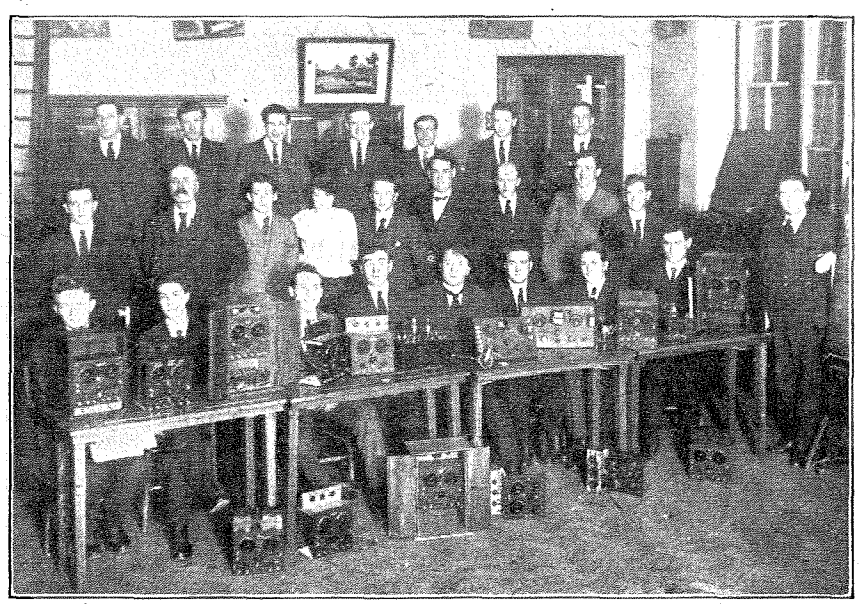
oooo

ATMOSPHERICS.

An American physician believes that broadcasting is harmful to the insane. Personally we believe that half-an-hour of typical broadcast humour might have a distinct homeopathic value.

The authorities were well-advised in selecting American jazz music to broadcast to the U.S.A. It really was time to retaliate.

Loud-speakers are being placed on the slopes of Mount Etna to warn the inhabitants, by means of rumbles, of impending eruptions. If the loud-speakers resemble many we know, the inhabitants must live in perpetual fear



THE WIRELESS CLASS. Unexpected success has rewarded the enterprise of the Breconshire Education Committee in organising practical and theoretical wireless classes at Ystradgynlais, Swansea Valley. The above photograph, taken at the end of the last session, shows a practical class with some of the apparatus made.

CATALOGUES, ETC., RECEIVED.

[The catalogues and price lists mentioned in this section can in most cases be obtained on application to the firms concerned. As a matter of business courtesy stamps for return postage should be enclosed.]

Sterling Telephone and Electric Co., Ltd. (210-212, *Tottenham Court Road, London, W.1.*). Publication No. 408, illustrating and describing the Sterling crystal receiver. Publication No. 409, descriptive of metal covers for Sterling receivers.

Mikro, Ltd. (32, Craven Street, London, W.C.2). "Marvels of the Microphone," by J. Skinderviken. Fourth edition, Price 6d.

S. A. Lamplugh, Ltd. (King's Road, Tyseley, Birmingham). Description and N.P.L. Curve of Lamplugh .0005 mfd. square law condenser.

Wireless Apparatus, Ltd. (35, Panton Street, Haymarket, London, S.W.). Description of Richardson's non-directional "Perfex Aerial."

Siemens Brothers and Co., Ltd. (Woolwich, S.E.18). *Price Sheet 645, dealing with H.T. dry batteries.*

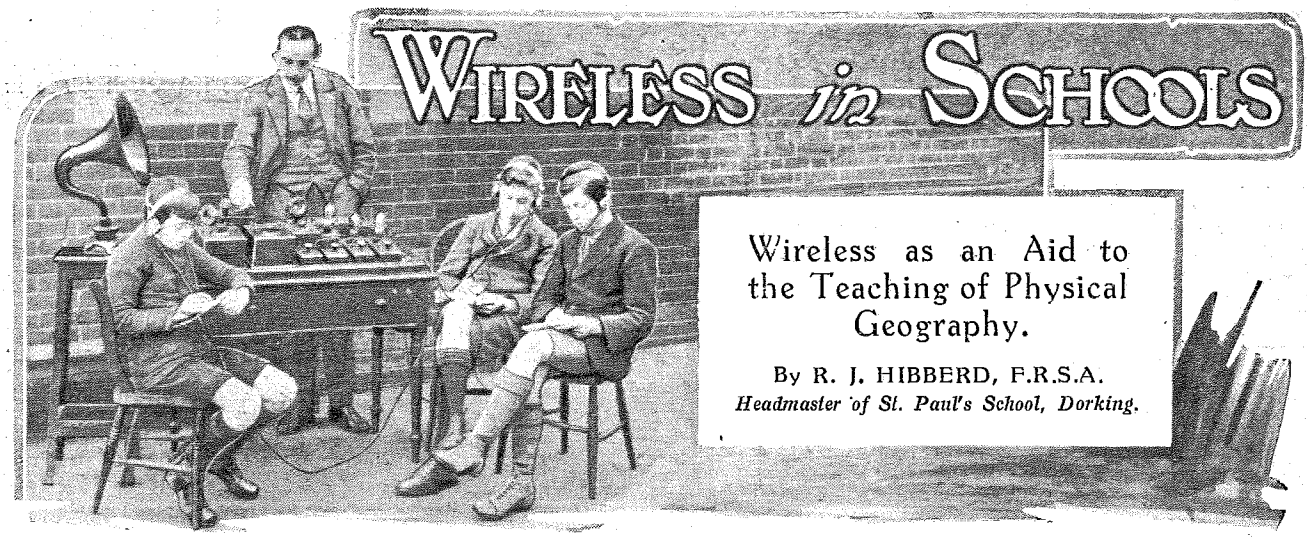
L. McMichael, Ltd. (Hastings House, Norfolk Street, Strand, W.C.2). Leaflet dealing with H.F. amplification.

Igranic Electric Co., Ltd. (149, Queen Victoria Street, London). Publication No. 6147, "Honeycomb Duo-lateral Inductance Coils," illustrated. Publication No. 6145. Igranic radio accessories.

Money, Hicks and Mills, Ltd. (York Road, Wimbledon, London, S.W.19). Illustrated sheet and price list dealing with Ebonex and Ivorex wireless dials, scales and labels.

A. F. Bulgin and Co. (9, 10, and 11, Cursitor Street, London, E.C.4). *Abridged* list of superheterodyne apparatus.

Excelsior Motor Co. (King's Road, Tyseley, Birmingham). Illustrated description of the "Excelophone" long range receiving set.



WIRELESS in SCHOOLS

Wireless as an Aid to the Teaching of Physical Geography.

By R. J. HIBBERD, F.R.S.A.
Headmaster of St. Paul's School, Dorking.

THERE is, amongst the teaching profession, at the present time a certain amount of scepticism as to the actual educational value of wireless in schools. If pupils are to be permitted only to construct sets from standard parts and follow this up by listening solely to broadcast matter, then wireless certainly has a limited scope in the school.

The application of the science of radio should receive far more attention than it is at present. There is a vast field for what may be termed "applied wireless," especially in the study of wireless weather reports.

There are still many people who are unaware of the fact that the weather conditions prevailing from Moscow to San Francisco are being observed by wireless stations on land and in ships at sea, and that data so collected from definite areas between these points are transmitted daily, so that a summary of the weather conditions extending over a distance of something approximating ten thousand miles could be made every twenty-four hours.

It cannot be expected, however, that such work as this can be carried out in schools; there is neither the time nor room for it in the curriculum. Nevertheless, local conditions—that is, those prevailing within the region of the British Isles—can be made full use of.

This has been done in my own school for the past three years with a marked degree of success, and has proved exceptionally useful in connection with the teaching of physical geography. I propose to describe in detail the actual nature of the work in the hope that it may prove of value to other schools who desire to develop the idea.

In the first place, it is desirable that the work should be carried out only in the upper classes by scholars of twelve years of age upwards. It is essential that the pupils should learn the Morse code, so as to be capable of picking up Morse transmissions up to speeds of twelve words per minute. Of course, an automatic recorder could be used; but I do not advocate this, as Morse reception cultivates concentration of a very high order, and is of value in this respect in schools.

In my own school I overcame the difficulty of learning Morse by advocating voluntary homework and offering a small prize to the first scholar who could receive accurately the Air Ministry's report. Each week I gave a speed test by means of a powerful buzzer. The Morse difficulty being mastered, the next thing to do was to decide on suitable weather reports for reception, it being necessary to take the time of day into consideration. In the early days, the morning weather summary transmitted from Poldhu to the Admiralty was selected. Of late years this work has been taken over by the Air Ministry who transmit a weather summary in plain language each morning at 9.0 o'clock G.M.T. and 10.0 a.m. B.S.T. on a wavelength of 4,100 metres, the call sign being GFA. For this wavelength I would recommend the use of a Burndept No. 300 or 400 coil for the A.T.I. with a 0.001 mfd. condenser in parallel.

I mention the fact that the transmission is in plain language, because a good deal of the weather data are transmitted by means of the International Weather Figure Code, and the mastering of this is rather outside the scope of school work.

Two boys are detailed each morning to receive the weather report. In conjunction with this, a special weather chart has been designed and made at the woodwork class by the boys. The actual weather report received is placed on the chart in the section provided at the top left-hand corner. A copy is also placed on the school notice-board for the information and guidance of local gardeners, farmers, and other interested outdoor workers.

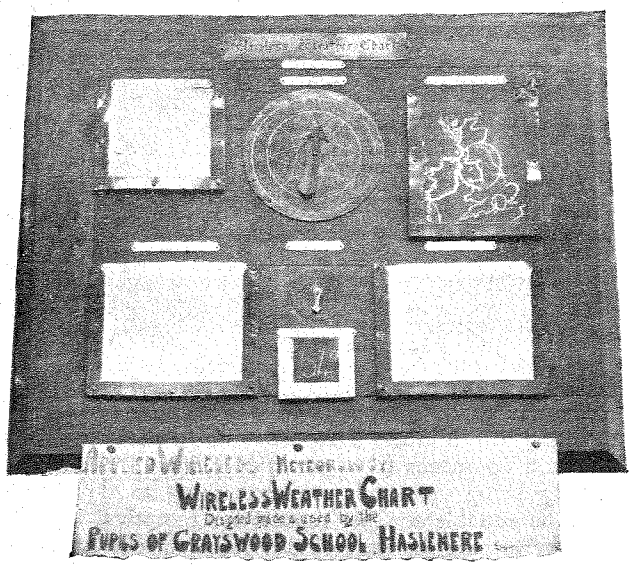
The chart in the top right-hand corner consists of a small blackboard on which is painted a blank map of the British Isles. On this map the scholars mark, with coloured chalks, the meteorological observations received, such as depression, anti-cyclone, direction and force of wind, and so on. With reference to this a lesson on the signs and code used in meteorology is previously given; and I would point out that any teacher not conversant with these signs can obtain the necessary information from the Air Ministry's Meteorological Department.

The large dial which can be seen in the illustration has a pointer which indicates the direction of the *local*

Wireless in Schools.—

wind. This is compared with the direction of the wind as issued by the Air Ministry, and comparisons are made and conclusions deduced.

Below the large dial is a smaller one which we term the "wind speed indicator." The purpose of this is to show



An indicator board for recording weather reports.

the approximate speed of the wind at the time the observations were taken. It is divided up into twelve sections, which are numbered to correspond with Beaufort's wind scale (see table). Scholars learn the equivalents of these numbers, and accordingly know at a glance the wind velocity.

The chart seen in the bottom right-hand corner of the board is used in conjunction with the weather report. It is divided into eight sections by means of pencil lines, which point N., N.E., E., S.E., S., S.W., W., N.W. The direction of the wind, as given in the Air Ministry's daily morning weather report, is marked on this graph, and at the end of each month the chart is taken down and a new one put in its place. It can be easily seen from this graph the direction from which the prevailing winds have occurred during this period. This is compared with the time of year, prevailing weather, and so on. The value of such observations in the physical geography lessons is obvious, and needs no emphasis here.

The chart in the bottom left-hand corner is a temperature graph, and the observations plotted out have naturally a bearing on the wind graph.

It is well to point out here that no daily observations are destroyed, but are kept in a log book in order that a summary of the meteorological conditions throughout the year may be arrived at.

The details given here of what I term "applied wireless" and "weather reports" are by no means final, and I have no doubt that many other ideas may be incorporated in the scheme to make it still more valuable. Suffice it to say that such work successfully carried out eventually becomes an essential and integral part of the geography lessons.

I should mention here that I am of the opinion that meteorology is not at present given generally in schools, but since it has such an immense bearing on physical geography it should be given a more important place in the curriculum. It can be made at once attractive and interesting by adopting the scheme which I have outlined in this article. To those who would know more of the weather than the daily announcement of "depression" from 2LO, I would strongly recommend the study of W. G. Mitchell's "Time and Weather by Wireless." This interesting little book will give you all the information you require for school work.

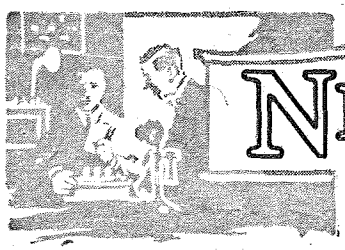
In conclusion, I would add that there is another section of wireless reception which is made use of in my school, namely, the daily time signals from the Eiffel Tower, which take place at 9.25 a.m., 10.0 a.m., and 10.44 a.m., on a wavelength of 2,600 metres, the call sign being FL.

Time signal charts can be made out by scholars, and, as the spark transmission is strong and slow, any child can follow it easily without a knowledge of Morse. These receptions form a useful means for explaining latitude and longitude, and there are other uses to which such reception can be put, which will be at once apparent to teachers.

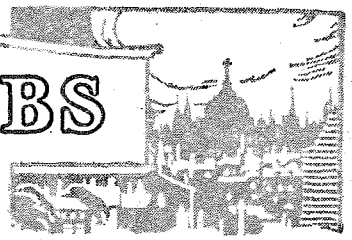
I hope the foregoing article will act as a stimulus and guide to all those who seek to make wireless a useful and permanent part of the school curriculum.

EXPLANATORY TABLE OF BEAUFORT WIND FORCE SCALE.

Beaufort No.	Name of Wind.	How to identify Force by Effect of Wind on Observer and on Surrounding Objects.	Velocity of Wind in M.P.H. 5ft. up.	Symbol for Use in Synoptic Charts.
0	Calm.	Smoke rises vertically.	Less than 1.	⊙
1	Light air.	Direction of wind shown by drift of smoke, not by wind vanes.	1—3.	
2	Slight breeze.	Wind felt on face, leaves rustle ordinary vane moved by wind.	About 4.	
3	Gentle breeze.	Leaves and small twigs in constant motion, wind extends light flag.	About 6.	
4	Moderate breeze.	Raises dust and loose paper, small branches are moved.	About 9.	
5	Fresh breeze.	Small trees in leaf begin to sway, wavelets form on water.	About 13.	
6	Strong breeze.	Large branches in motion, whistling in telegraph wires, umbrellas used with difficulty.	About 18.	
7	High wind.	Whole trees in motion, difficulty felt when walking against wind.	About 25.	
8	Gale.	Breaks twigs off trees, generally impedes progress.	About 31	
9	Strong gale.	Slight structural damage occurs, chimney pots and slates moved.	About 36.	
10–12	Storms and hurricanes.	Seldom experienced inland, trees uprooted with damage to property.	About 40–75.	Not Used.



NEWS from the CLUBS



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

Golders Green and Hendon Radio Society.

"High Frequency Currents and Electric Wave Production" were dealt with in an absorbing lecture delivered by Mr. Maurice Child on March 18th. The lecturer demonstrated his points with a number of arresting experiments performed with a great variety of apparatus.

One experiment consisted in energising an oscillatory circuit with approximately ¼ kw. of energy by means of a transformer and a rotary spark gap. Members were thus actually able to see the effects of H.F. currents due to the glow produced on the wires of the various circuits and by the help of neon tubes.

The advantages gained by using a large number of turns in the secondary of a H.F. transformer were shown in another interesting experiment, and other subjects demonstrated were the best method of coupling coils, the degree of vacuum present in a number of valves, and the nature of harmonics in an artificial aerial.

Vacancies still exist for membership in the Society, and enquiries should be addressed to the Hon. Secretary, "The Dawn," 111, Prince's Park Avenue, Golders Green, N.W.11.

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Radio Society for Newcastle.

A new Radio Society for Newcastle and the surrounding district has been formed with Mr. Ransom as Chairman. At the inaugural meeting, held recently at the Phoenix Hall, Red Lion Square, Mr. A. H. Wilson, of Hanley, gave an interesting lecture on the "Principles of Radio Science."

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Ipswich and District Radio Society.

"Super Circuits" formed the subject of an instructive lecture given by Mr. Stanley Lewis at the Society's monthly meeting on March 18th. The lecturer dealt chiefly with the Armstrong Circuit and referred to the ease with which a receiver in Ipswich, built on this principle, could pick up American broadcasting stations. During the evening the Society's new badge was passed round for inspection and evoked favourable comment.

Hon. Secretary, Mr. H. E. Barbrook, 55, Fonnerean Road, Ipswich.

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Wrexham and District Wireless Society.

This society is in a flourishing condition if we may judge from its imposing list of members, a copy of which we have received.

Up to March, 1925, the membership comprised 99. The Hon. Secretary is Mr. John Davies, Maesgwyn Cottage, Maesgwyn Road, Wrexham.

Dublin Wireless Club.

On Thursday, March 19th, Mr. D. L. Finlay delivered a lecture entitled "The History of Wireless, and The Theory and Possible Explanation of Fading." Under this comprehensive heading, the lecturer dealt with a period extending from 1831 to the present day; he then proceeded to discuss the phenomenon of fading, describing the Heaviside Layer and hinting at its possible influence on the inconstancy of wireless signals. Mr. Finlay's remarks were the outcome of a long period of research, and considerably enlightened his audience on some of the mysteries attending the bugbear of fading. The lecture was followed by a profitable discussion.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 8th.

Radio Society of Great Britain.—Informal Meeting. At 6 p.m. At the Institution of Electrical Engineers. Talk on: "Home-made Wireless Components and Sets," by Mr. E. C. Atkinson, M.A., F.R.A.S.

Streatham Radio Society.—At 35, Streatham High Road, S.W. Lecture: "Valves," by Mr. Robinson.

Manchester Radio Scientific Society.—Lecture: "Magnetism and Electricity," by Mr. W. C. Hewlett.

WEDNESDAY, APRIL 15th.

Golders Green and Hendon Radio Society.—At the Club House, Willifield Way, N.W.11. Lecture: "Measuring Instruments and their Functions," by Mr. F. McCabe.

THURSDAY, APRIL 16th.

Sheffield and District Wireless Society.—At 7.30 p.m. At the Dept. of Applied Science, St. George's Square. Lecture: "Electric Furnaces," by Mr. H. A. Greaves.

MONDAY, APRIL 20th.

Eastern Metropolitan Group Lecture Association.—At 7.30 p.m. At St. Bride's Institute, E.C.4. Lecture: "Short-Wave Receivers."

FRIDAY, APRIL 24th.

Radio Society of Great Britain (T. and R. Section).—Dinner in honour of American visitors.

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A Mystery Debate.

A successful meeting of the T. and R. Section of the Radio Society of Great Britain was held at the Institution of Electrical Engineers on March 20th, when a mystery debate was held. The members present drew lots for the privilege of opening a discussion on one of three subjects named upon the blackboard. Mr. W. K. Alford and Mr. Bagley were the two members upon whom fell the task of addressing the meeting, and they chose as their subjects "The Elimination of Harmonics" and "Methods of Keying."

The two subjects were most ably dealt with, and an interesting debate followed, in which the following members took part: Messrs. Basil Davis, Marcuse, Gay, Woof, Hogg, Ryan, Robinson, and M. Ajourian, the last-named a visitor from Roumania. By far the greatest interest was centred in the methods of keying, and the pros and cons of the various methods were freely discussed.

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Woolwich Radio Society.

A pleasant evening was held on March 18th, when the Society was "At Home" to other societies of South London. This was in conformity with a suggestion made at a recent committee meeting of the South London League of Radio Societies.

From 7 to 8 p.m. an exhibition of members' apparatus was held, and aroused great interest. Among the exhibits was a four-valve set by Mr. Sinclair, a short-wave low-loss tuner by Mr. Potter, and a special Reinhartz set, capable of tuning down to 30 metres, by Mr. Hill. The club set was in operation at intervals during the evening.

At 8 p.m. Mr. Ward gave a useful talk on short-wave reception, and supplied helpful advice on the choice of valves, coils, condensers, and circuits. Later in the evening Mr. A. F. Bartle provided a talk on "How to operate a wireless set entirely from the electric lighting mains." Mr. Bartle also described a method of switching on the set from any part of the house.

The Society's annual dinner was held at Blackheath on March 25th, and was attended by more than fifty members and friends.

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.

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Hackney and District Radio Society.

Mr. P. K. Turner addressed a public meeting of the Society on March 30th, choosing as his subject "Distortionless Reception."

Mr. Turner stated that, in his opinion, 90 per cent. of distortion is due to valves, loud-speakers being in most cases wrongly blamed. He dealt with overloading and its remedies, and surprised many members by his attack on resistance coupling. He proved that this method of amplification could distort far more than the use of L.F. transformers.

Many receivers and other apparatus made by the Society's members were on view, some under working conditions.

Hon. Secretary, Mr. G. E. Sandy, 114, Parnell Road, E.3.

THE CRYSTAL RECEIVER.

Methods of Connecting Crystal Sets for Obtaining Highest Efficiency.

By R. D. BANGAY.

THE simplest possible form of crystal receiver and one which possesses all the essentials for reception is illustrated in Fig. 1. It consists of a tuned aerial circuit and a detector circuit. The aerial circuit includes a tuning inductance L, and the detector circuit includes a crystal detector C and a pair of phones T, across which is shunted a condenser K. It should be noted that the aerial end of the inductance is connected to the crystal and the telephones to earth. This is an important detail, because even if the insulation of the telephone coils is perfect, there is always a considerable capacity between the coils and the magnet system. The latter being in contact with the headgear can be regarded as being connected to earth through the body of the listener, and, consequently, if the telephones were connected to the aerial end of the inductance, the high-frequency aerial current would be shunted to earth through the capacity of the telephone coils. The effect would, in fact, be much the same as if one touched the aerial during reception.

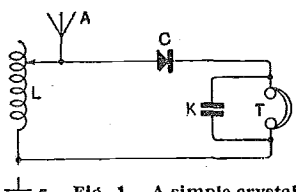


Fig. 1.—A simple crystal receiver.

The next point to which attention is drawn is the condenser K connected across the telephone receivers. The object of this condenser is to absorb the peaks of the high-frequency current pulses passed by the crystal, thus maintaining a better average potential across the telephone coils. In other words, it helps to smooth out and utilise the high-frequency component of the signal. The self-capacity of the telephone coils also fulfils the same function, but is not always sufficient to give the best results in this respect, and therefore it is desirable to increase the capacity by connecting a small shunt condenser as shown. The best value of capacity to use can be found by experiment, but will be approximately 0.002 μF. Too large a condenser will tend to absorb the higher frequencies of the telephone modulations and thus muffle and distort the reproduction of the sound.

Using a Voltage Bias.

If it is desired to use a voltage bias on the crystal, and this is essential if a carborundum crystal is used, we shall require a two-cell dry battery and a potentiometer connected as shown in Fig. 2. By connecting the telephones to the middle point of the battery we are able to obtain conveniently either a positive or a negative bias on the crystal by moving the slider towards either the positive or negative end of the potentiometer. The resistance of the potentiometer should be as high as possible to economise battery current; a resistance of 250 ohms at least should be used.

In the simple diagrams illustrated in Figs. 1 and 2, it will be noticed that the crystal is connected direct to the aerial terminal, thus including the whole of the aerial tuning inductance across the detector circuit. In a great many single-circuit crystal receivers it will be found that the crystal is connected permanently to this point, the idea being that since it is the point of highest potential to earth, the maximum current will be passed through the detector circuit by connecting it to that point. This, however, is by no means necessarily the best arrangement, as a little consideration will show us.

Obtaining Maximum Signal Strength.

Perhaps the best way to examine this question is to look at it from the energy point of view. An incoming signal of given intensity can be regarded as imparting a definite amount of energy to the aerial system with each successive wave. When the aerial circuit is in tune with the frequency of the wave, we get conditions of resonance in which the energy imparted to the aerial system builds up with each successive wave. If there were no expenditure of energy in the aerial system, the building up process would continue indefinitely, and the amplitude of the EMF across the circuit as well as that of the current flowing through the circuit would continue to increase with each successive wave or cycle. In practice, however, there are always losses in the circuit, the chief causes being the resistance losses in the aerial wire and earth connection and in the associated tuning coils and dielectric losses in the surrounding vegetation, trees and buildings, and in the tuning condensers. The actual amount of energy lost per cycle in this way increases with the amplitude of the oscillations, the resistance losses increasing as the square of the current, and the dielectric losses as the square of the voltage. Since each incoming wave only imparts a definite amount of energy to the aerial circuit, it is evident that after a certain number of cycles a balance is reached when the loss of energy during each cycle is equal to the gain from each wave, and therefore when this point is reached the building up process has reached its maximum limit.

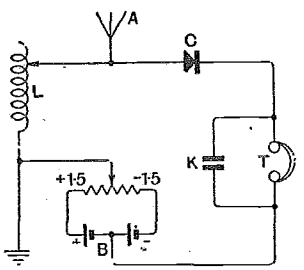


Fig. 2.—A crystal receiver with a carborundum detector and bias battery.

In a crystal receiver the whole of the energy which operates the telephones is obtained from the oscillatory circuit, and, consequently, as soon as we connect the crystal circuit across the oscillatory circuit, we immediately increase the expenditure of energy in the latter, and therefore substantially reduce the maximum amplitude of EMF which would otherwise be attained by a given signal.

Owing to the bend at the bottom of the characteristic

The Crystal Receiver.—

curve of a crystal detector, the efficiency of detection is less for voltages of small amplitude. If, therefore, we connect the crystal across the points of maximum potential in the oscillatory circuit, we may in certain cases so overload the aerial as to practically wipe out the resonance effect and thus bring about reduced efficiency of detection and a consequent loss of signal strength. Moreover, we shall unnecessarily flatten out the resonance curve of the oscillatory circuit, thereby bringing with it the further disadvantage of reduced selectivity.

The problem is somewhat similar to driving a motor car uphill. If we drive on the top gear we may over-

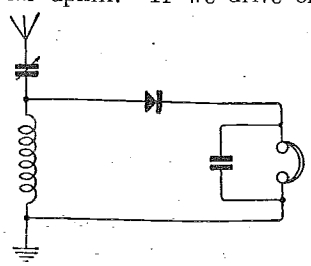


Fig. 3.—The aerial tuning condenser is connected in series with the aerial coil in this receiver.

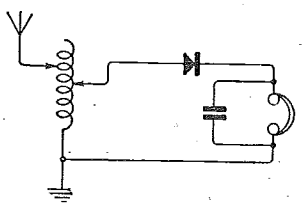


Fig. 4.—Connections when a tapped coil is used.

load the engine and perhaps fail to take the hill, but, if we change into a lower gear, we can take the hill at a fairly high speed. It will be found that for a given motor car there is an optimum rate at which power can be taken from the engine, and to get the best result we must regulate this by changing the gear ratio to suit the characteristics of the car as well as the conditions of the road. In the same way there is an optimum rate at which energy can be transferred from the aerial circuit to the detector to get the best results from a given signal, and this rate must be regulated to suit the conditions of the oscillatory circuit as well as those of the detector circuit.

High and Low Resistance Crystals.

Now the crystal detector itself may belong to either of two main classes, namely, the high resistance class, of which carborundum and perikon can be quoted as the most useful examples, and the low resistance class, such as galena and most of the proprietary crystals ending in "ite." The resistance of a carborundum crystal is about six or seven times that of a galena crystal. It therefore becomes a question of how to regulate the constants of the tuned receiving circuits and the points from which connections to the detector are taken to suit the character or impedance of the detector circuit.

The high resistance crystals require a greater amplitude of EMF across them to deliver the same energy to the telephones, but take a proportionately lower current from the oscillatory circuit, while conversely the low resistance crystals take a larger amount of current from the oscillatory circuit at a lower voltage. This, however, is by the way, and does not affect the question we are considering, namely, the best point at which to connect the detector circuit. In the case of both classes of detector, the rate at which the energy is transferred to the detector circuit is governed by the amplitude of the EMF across the circuit, but the optimum voltage for a particular set of conditions will only differ in magnitude in the two cases.

The Ratio of Capacity to Inductance.

If the wavelength of the incoming signal is somewhere near that of the receiving aerial, only a very small inductance would normally be required to bring the aerial circuit into tune; in which case the amplitude of the EMF generated by an incoming signal across this inductance would probably be too small for efficient detection. This can be got over by connecting a series condenser in the aerial circuit, as shown in Fig. 3, to enable a greater value of inductance to be used with a corresponding increase in the amplitude of the EMF across it. We can in this way adjust the EMF applied to the detector to the optimum value required for detection. The smaller the series condenser the larger the necessary inductance for tuning purposes. Therefore, when using a high resistance crystal, a smaller series condenser will be required than for a low resistance crystal. The amount of inductance introduced in this way should not be more than is necessary to produce the optimum conditions for detection. Otherwise, we overload the aerial with the detector, as already explained, besides introducing unnecessary losses in the aerial system.

If the wavelength of the incoming signal is very long compared with that of the receiving aerial then the amount of inductance required for tuning purposes will probably be more than sufficient to give the necessary amplitude of EMF for optimum detection, which again would mean overloading the aerial circuit if the detector were connected across the whole inductance. In such cases there are two convenient ways of adjusting the circuit to obtain the best result. Either we may arrange to connect the detector to some intermediate point along the tuning inductance without disturbing the tuning of the aerial circuit, as shown in Fig. 4, or we may connect a parallel condenser in the aerial circuit as shown in Fig. 5, thereby reducing the amount of inductance required for tuning purposes and consequently reducing

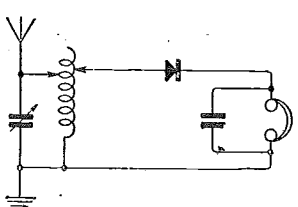


Fig. 5.—The tuning of this receiver is carried out by adjusting the tapped coil and the parallel condenser.

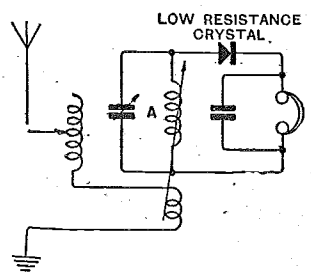


Fig. 6.—A coupled circuit receiver.

the amplitude of EMF across it. Of the two methods, the former will generally be found to be the best and most convenient arrangement in practice, although this will depend largely upon the resistance of the aerial and earth and the relative resistances of the condensers and inductances employed.

In the case of a coupled circuit receiver, we have a

the Crystal Receiver.—

much better opportunity of making the best use of the energy imparted to the oscillatory circuit by the signal because we have the whole of the oscillatory circuit under our control and we can arrange the proportion of the inductance and capacity of that circuit to suit the needs of the particular detector used without introducing unnecessary resistance into the circuit. For example, suppose we have two closed oscillatory circuits, both tuned to the same wavelength, one having a large capacity and small inductance as in A, Fig. 6, and the other having a small capacity and large inductance as in B, Fig. 7, but both tuned to exactly the same wavelength and both having exactly equivalent internal losses. Clearly, if the circuits are excited so that the same amount of energy is imparted to both, the oscillations built up in the circuit A will reach a higher current amplitude, but a lower voltage amplitude than those in the circuit B. From this it is easy to see that in designing the circuit for a high resistance detector we should keep the L.C. ratio of the circuit high as in Fig. 7, and for a low resistance detector the L.C. ratio should be low as in Fig. 6.

There is, of course, an optimum value in each case, but, generally speaking, it will be found that for a carborundum crystal the capacity of the circuit should be kept down to the lowest possible value by using an inductance coil of very low self-capacity and of sufficiently high inductance to tune to the necessary wavelength with the smallest possible condenser.

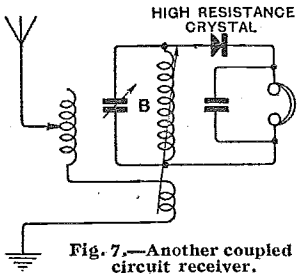


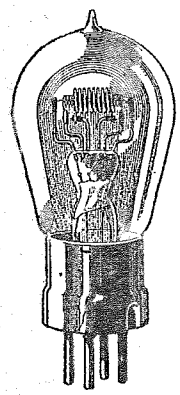
Fig. 7.—Another coupled circuit receiver.

In the case of both the single circuit and coupled circuit receiver the higher the H.F. resistance of the oscillatory circuits the less critical will be the adjustment of the correct detector conditions. On the other hand, we can obtain far more efficient reception, both in intensity and selectivity, by reducing the losses in the oscillatory circuits to a minimum. But the advantage of using circuits carefully designed to give the minimum high-frequency losses may be entirely lost by ignoring the principles explained above.

VALVES TESTED.

The Louden H.F. and L.F. Valves.

THE Louden valve, manufactured by the Fellows Magneto Co., Ltd., Park Royal, is offered in two distinct forms, one for high-frequency work and the other for low-frequency amplification and detection. The construction of both types is materially the same, the essential difference being in the number of turns contained in the grid, the F2 or high-frequency valve having of course the larger number.



The Louden valve.

The anode, instead of the usual metal cylinder, is also in the form of a spiral, but of somewhat shorter length and coarser wire than the grid. Louden valves are bright emitters, and both types have the same filament and plate ratings, which are given by the makers as follows :—

Filament volts 4.5 to 5; filament current 0.4; plate voltage 40 to 80. The usual bench tests were applied to sample valves of these two types, the results of which are given in the tables.

In both cases the ratio of amplification factor to plate impedance is rather on the low side. This appears to be the case with most valves having the anode in the form of a spiral, and this result confirms that obtained with another make of somewhat similar construction.

Nevertheless, the F2 is a very good high-frequency amplifier, using about 60 volts H.T. This valve also gave excellent results as a detector, and, for this work, we prefer it to the other Louden valve, although the latter is advertised for detecting and L.F. amplifying.

The F1 is quite a good L.F. amplifier provided the input is kept at a moderate value, but for serious L.F. work the emission is rather low. It cannot be emphasised too strongly that for L.F. work we require a valve having a fairly low impedance if satisfactory results are to be obtained with the ordinary type of intervalve transformer.

For a bright emitter the Louden filament consumption is unusually low and at its moderate price should command a ready sale.

LOUDEN F1 (LOW FREQUENCY).
Fellows Magneto Co., Ltd.

Filament Volts, 4.8. Filament Amps., .41.
Emission total, 6 milliamperes. Efficiency, 3.05 milliamperes per watt.

Plate Volts.	Plate Current. Milliamps.	Grid Bias. Volts.	Plate Current. Milliamps.[1]	Amplification Factor.	Impedance. Ohms.
40	1.13	−2	0.68	5.32	28,000
60	2.2	−3	1.3	5.32	21,000
80	3.36	−5	2.0	5.4	20,000

[1] Plate current when grid is biased to the value of Col. III.

Similar tests on the H.F. valve gave the results enumerated below :—

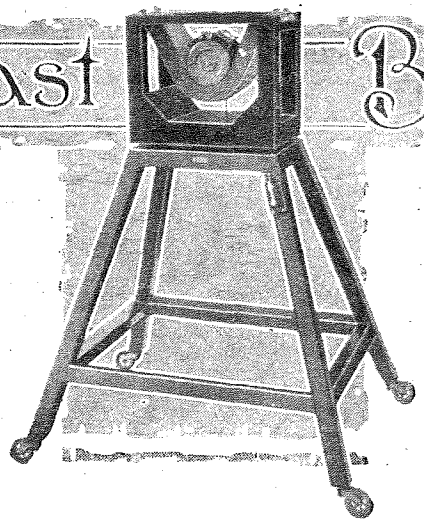
LOUDEN F2 (HIGH FREQUENCY).

Filament Volts, 5.0. Filament Current, .42.
Emission (total), 6 milliamperes. Efficiency, 2.6 milliamperes per watt.

Plate Volts.	Plate Current. Milliamps.	Grid Bias. Volts.	Plate Current. Milliamps.[1]	Amplification Factor.	Impedance. Ohms.
40	0.34	0	0.34	14.8	83,000
60	0.67	−1	0.41	14.8	74,000
80	1.05	−2	0.49	14.9	73,000

[1] Plate current when grid is biased to the value of Col. III.

Broadcast Brevities



NEWS FROM THE STATIONS.

Listening v. Legislation.

Colonel Moore-Brabazon, M.P., does not relish the publicity which he received in connection with the installation of a wireless receiving set in his room at the House of Commons. He argues that if he wants to listen to selected items from the B.B.C. programmes, he should be able to do so as and when he is able to spare the time. A newspaper reader does not necessarily read his paper through religiously from start to finish, but picks out items which interest him. Likewise, Colonel Moore-Brabazon only listens to wireless items that interest him. He is not the type of politician who is likely to be a wireless "fan" at the expense of his parliamentary duties.

oooo

A Danish Conductor.

M. Paul Klenau, who conducted a performance of Beethoven's Ninth Choral Symphony from the Birmingham Station on April 6th, is the only Dane who has conducted the Royal Philharmonic Orchestra of London in all its 113 years of existence.

oooo

An Essay Competition.

The B.B.C. has arranged another Essay Competition for the Easter term in connection with its series of wireless broadcasting to schools.

Specimens of the children's written descriptions of these educational talks show the value of this particular method of teaching. Even youngsters of nine years of age write well on the subjects treated by Mr. J. C. Stobart, the Director of Education to the B.B.C., and other lecturers, but the schoolboy "howler" and the flash of unconscious humour are conspicuous by their absence.

oooo

Marconi Criticised.

It is another story when the children are given a free hand in expressing their opinions of broadcasting as a science. For instance, among some recent essays emanating from a London secondary school which have found their way to B.B.C. headquarters, is a rather depreciatory criticism of Marconi.

"What," asks the writer, "would the work of this man be worth without the invention which brought about a revolution in the science of wireless? I mean the Fleming Valve."

Another scholar who visited a broadcasting studio noticed "an air of supreme quietness floating about." The slightest cough, he writes, would immediately be heard by millions of people; and then: "What a great rag it would be to make a noise!" We can quite imagine the restraint which the young rascal had to put upon himself to resist the obvious temptation.

oooo

Subtle?

"Wireless instalments"—a frequently recurring term in children's essays—conveys a subtle meaning—a good deal more subtle, indeed, than the term "installations" which is intended—to those listeners who got their programme in patches when the new 2LO was suffering the pangs of an untimely birth, a short time ago.

oooo

Less Oscillation Now.

One redeeming feature of listeners' experiences of reception from the early efforts of the new permanent station was that the extra power of the station reduced oscillation considerably. One report stated that transmission was strong enough to bear down the Morse in the Channel.

On the other hand, nearly a dozen stations, mainly Spanish, have recently been interfering on the wavelength of 5XX. Some of these are CW and some spark.

oooo

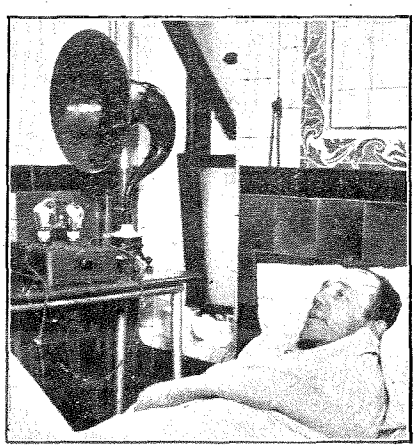


Photo: Daily News.

WIRELESS IN HOSPITAL. A few weeks ago a partially blind hawker, Albert Knowland, seen in the photograph, was knocked down and seriously injured in the Strand, London. Hearing of his plight, Messrs. Burndept have installed an Ethophone Duplex receiver at his bedside to while away his hours of pain.

Investigating Interference.

In the meantime many listeners will think it quite a bright idea of Captain Fraser, M.P., to suggest that the Postmaster-General should utilise a portion of the profit which he holds as a result of his department's share of the licence fees for the purpose of an administrative and technical enquiry into all interference with broadcasting caused by service, commercial, and other transmissions or electro-magnetic radiations of the frequencies used for broadcasting.

oooo

Broadcasting from a Liner?

A proposal has been made to use one of the largest British liners when she next docks as a broadcasting station for a single night only, in lieu of the adjacent land station of the B.B.C.

As the Postmaster-General has interdicted the establishment of additional broadcasting stations for the present, it is open to question whether he might not consider this temporary departure from custom as a breach of the rules; besides, what practical purpose could be served which has not already been accomplished by the use of the ordinary station in the same neighbourhood?

oooo

A New Crystal.

During blasting operations at the sewage works at Esholt, the workmen noticed that the debris had a silvery appearance, and on closer examination they discovered crystal deposits, the pieces being about the size of the average wireless crystal. One man, attracted by the similarity, took a piece home, fixed it to his set, and found that it improved reception from the nearest relay station by some 300 per cent. Local listeners are now trying to obtain these crystal detectors, which have been tried by a number of the men employed at the sewage works with remarkably good results.

If the analyst's report on the samples submitted to him show that the crystallisation is directly due to the work carried on at the sewage farm, we may see municipal corporations throughout the country setting up in a new line of business.

Broadcasting Parliament.

The Prime Minister told the House of Commons the other day that the time had arrived when a Select Committee should be set up to consider the desirability of broadcasting the proceedings in both Houses of Parliament. But a plebiscite is surely necessary to ascertain whether listeners themselves favour the idea of having political speeches, often of a tedious nature, added to the burden which they already (sometimes) bear.

oooo

Afternoon Speeches Only?

It is true that many of the speeches would be transmitted in the afternoon, when the average listener who wants entertainment and amusement is engaged in his normal avocation. So far as the evening speeches are concerned, difficulties could be overcome by allocating a special wavelength to parliament and carrying on with the station programmes as usual on their own wavelengths.

oooo

Difficulties to be Surmounted.

The B.B.C. is always willing to broadcast matter of importance and interest from the public point of view, and while there is no inseparable difficulty in arranging to broadcast parliamentary speeches limitations are imposed by the nature of the arrangements which would be necessary in such places as the House of Lords and the House of Commons. It will be comparatively simple, for instance, to broadcast the front bench speakers without the interjections and other interruptions, but if it were desired to transmit the back-benchers as well, the ideal arrangement would be for each Member to have a microphone of his own and a plug so that he could put himself into circuit when he rose to speak. That might, however, upset parliamentary etiquette, for how could the speaker put his hat on if he had a microphone apparatus attached to his head? It might also be necessary to have a separate high power station to broadcast Parliament on a greater wavelength, and so avoid interference with the ordinary B.B.C. programmes. The cost of such a station might be in the neighbourhood of £20,000 to £30,000. These are the chief points that would call for solution when the Select Committee met.

oooo

Tipsters, Take Note.

The Canadian Parliament has adopted a resolution prohibiting the broadcasting of racing odds and selections, but the Bill, if it becomes law, will only control the activities of the bookie in a limited degree, as American broadcasting stations would not be affected, and there would still be nothing to prevent the Canadian racing enthusiast from picking up information broadcast from American stations.

The problem of broadcasting racing odds may in future call for legislation throughout the world, as there will be no scientific barrier in the way of the dweller in Montreal from indulging in a flutter on a race in England, or alternatively, to prevent a Londoner from backing a horse in an Australian race on starting price information broadcast from Melbourne or Sydney within a few seconds of the commencement of the race.

oooo

Mr. Clifford W. Collinson.

Mr. Clifford W. Collinson, who has given several talks from 2LO, including "Surfing at Sydney," and South Sea topics, suffered minor injuries in the disaster to the Bordeaux-Paris express the other day.

In a recent letter to the B.B.C. he said:

"I am very sorry that the condition of my throat will not permit me to give my wireless talk next Saturday evening. My throat has been bad now for over two months, and under medical advice I am proposing to take a short sea trip.

"A friend of mine, a captain in the Mercantile Marine, is sailing for Alicante, in Spain, to-night, and I have arranged to go with him. I hope the trip will effect a cure, so that I shall be in good health for my next engagement at 2LO on April 11th."

oooo

A Real Globe-Trotter.

Mr. Collinson has travelled on liners, sailing ships, and tramp steamers, and once said that he had been round and round the world till he got dizzy, and stepped off on a South Sea island.

He has shot alligators in the tropics, rapids in America, and dice in Alaska. He has caught salmon in British Columbia and malaria in the Solomon Islands; has raised wheat in Canada and Cain in China; has spent money in Java, time in Japan, and Christmas in the Philippines; and has grown coconuts in the South Seas and whiskers in Borneo, where presumably he was in need of hirsute adornment.

oooo

Licence Fees in Other Countries.

Australian listeners are complaining of having to pay a licence fee of 35s.; the Germans protest against 2s. a month, which is the contribution enforced upon them for their entertainment; so listeners in Great Britain should take heart of grace, as their case might be far worse than it is.

FUTURE FEATURES.

Sunday, April 12th.	
London, 3 p.m.	Tchaikovsky Concert. S.B. to other Stations.
London, 9 p.m.	De Groot and the Piccadilly Orchestra.
Aberdeen, 3 p.m.	Bach Afternoon.
Monday, April 13th.	
London, 8 p.m.	Bank Holiday Programme.
Glasgow, 8 p.m.	Old English and Pastoral Scenes.
Tuesday, April 14th.	
London, 8 p.m.	Star Ballad Concert. S.B. to all Stations
5XX, 8 p.m.	Chamber Music and Drama.
Wednesday, April 15th.	
Cardiff, 8 p.m.	Pre-War Reminiscences—III.
Glasgow, 8 p.m.	Operatic Night. S.B. to Aberdeen, Edinburgh, and Dundee.
Belfast, 7.30 p.m.	Symphony Concert.
Thursday, April 16th.	
London, 8 p.m.	Chamber Music and Drama.
Birmingham, 8 p.m.	British Composers' Night.
Aberdeen, 8 p.m.	Operatic Night.
Glasgow, 8 p.m.	Jacobite Memories.
Friday, April 17th.	
Bournemouth, 8 p.m.	Comic Opera Night, "La Mascotte."
Manchester, 8 p.m.	Symphony Concert with Augmented Orchestra.
Glasgow, 8 p.m.	Scots Composers and Authors.
Saturday, April 18th.	
London, 8 p.m.	Musical Comedy Night.
Bournemouth, 8 p.m.	Operatic Cross-Word Puzzle. S.B. to 5XX.
Glasgow, 8 p.m.	Around the British Isles in Folk Song and Dance.
Belfast, 7.30 p.m.	The Orchestral Players' Benevolent Fund Concert.

HOW TO MAKE VALVES.

An Inexpensive Method of Valve Construction Within the Reach of the Amateur.

By G. R. M. GARRATT (5CS).

IN the past, amateur wireless enthusiasts have, I think, been too much inclined to regard the manufacture of valves as a monopoly of certain large firms equipped with expensive and elaborate machinery. It is therefore my object to disprove this belief and to show that the average amateur is quite as well able to construct his own valves as anyone else. I am ready to admit that plenty of patience and spare time are required, but there is no reason why anyone possessing these qualifications should not become proficient at valve construction. It is an occupation which is capable of providing endless interest and opportunities for private research work, and at the same time the initial outlay is not beyond the reach of the average amateur.

The most expensive items in the equipment are the glass-blowing apparatus and the pumping apparatus, but at the outside the total expenditure need not exceed £5 or £6. Such a sum is not excessive in view of the interest to be derived from such a hobby.

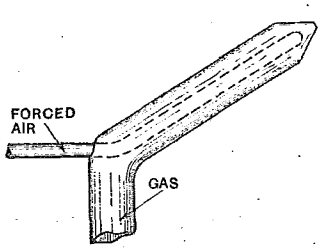


Fig. 1.—The usual arrangement of a blow-pipe.

The glass-blowing apparatus consists briefly of a small blow-pipe and a pair of foot bellows. The blow-pipe is worked off coal gas, and the forced air from the bellows. Fig. 1 is a sketch of the usual arrangement, and it may quite easily be constructed from odd pieces of brass tube. The gas is led up the outer tube, while the air is forcer up the inner tube and through the fine jet at the end. Such a blow-pipe will give a very hot, concentrated flame, which is very suitable for glass blowing.

Double-acting Bellows.

The bellows are rather difficult to make at home, and it is certainly advisable to buy them ready made. It is essential that they should be double-chamber bellows, in order to give a constant steady flow of air. A jerky flame varies so much in temperature that the glass is liable to crack.

Double-acting bellows are rather difficult to make, owing to the valves and the complicated binding, but they are fairly cheap to buy. In case anyone should attempt the construction of one—and it is certainly not beyond the capabilities of an average man—a diagram (Fig. 2) shows the main points.

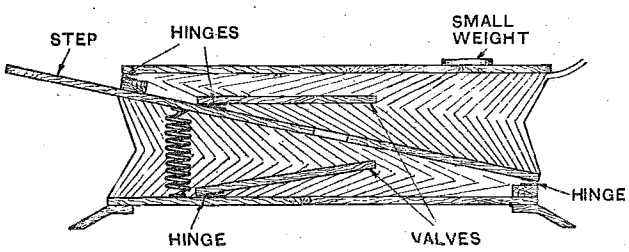


Fig. 2.—Explaining the construction of double-acting bellows.

On the downward stroke the air in the lower chamber is forced into the upper chamber, which it leaves by means of the outlet pipe. A weight on the top keeps the pressure fairly constant. During the upward stroke, air is drawn into the lower chamber, but it is prevented from entering or leaving the upper chamber by the valve.

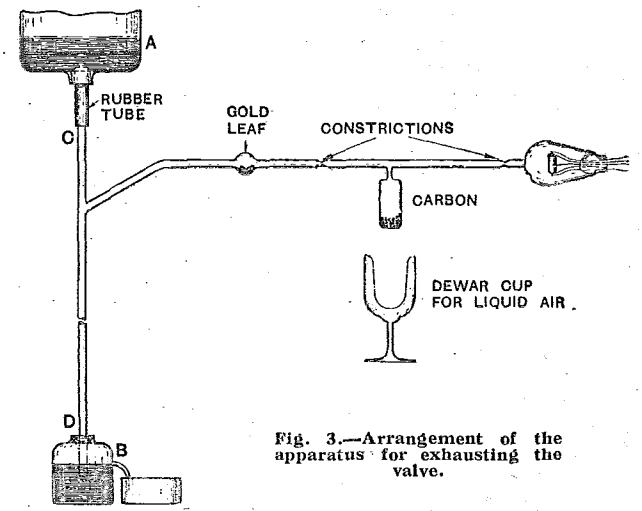


Fig. 3.—Arrangement of the apparatus for exhausting the valve.

The Vacuum Pump.

Valves, to be of any real use, require a very hard vacuum, and to produce this a highly efficient pump is required. As a rule, efficient vacuum pumps are expensive pieces of apparatus, but the one described here is neither expensive nor complicated, although it is, perhaps, somewhat tedious in operation.

Referring to the illustration, Fig. 3, CD is a long glass tube about 45in. in length, down which mercury is allowed to flow from the reservoir A at the top. The lower end is fastened into a glass vessel, B, by means of a cork. A few millimetres above the level of the lower end of the tube is a small spout from which the mercury can escape, to be returned at intervals to the reservoir at the top.

The tube CD is attached to the reservoir at the top by a piece of rubber "pressure tubing," which is fitted with a strong adjustable clip to regulate the flow of mercury. The upper part of the tube CD branches off into another tube communicating with the valve to be exhausted.

The mercury is allowed to fall drop by drop down the tube, and as each drop passes the branch tube it carries with it a small quantity of air which is drawn out of the valve. As soon as the mercury starts to flow, the exhaustion commences, and the whole tube is seen to

How to Make Valves.—

be filled with little pellets of mercury separated by small drops of air. Air and mercury escape by the spout of the bulb B.

After the exhaustion has been proceeding for some time it will be noticed that the air dividing the drops of mercury gets smaller and smaller, until the lower part of CD appears to contain a solid column of mercury about 30in. high. At this stage of the operation a considerable metallic noise is heard, caused by the drops of mercury falling on the top of the column, without enclosing any air to act as a cushion. The evacuation is as complete as the pump will get it when the drops of mercury fall without enclosing the slightest air bubble.

Such a pump, however, is itself scarcely able to produce a sufficient vacuum for even the softest valves, and certain other precautions have to be taken to ensure success. A mercury pump alone will evacuate to a pressure of about .00045 mm. of mercury, and it acts far more efficiently when the temperature is very low. The reason for this is that the vapour pressure of a liquid such as mercury decreases with the temperature, but it might be mentioned that a mercury pump will in fact evacuate to a pressure rather lower than the vapour pressure of the mercury at that temperature.

Exhausting the Valve.

One serious defect of the pump is that it will not deal with water vapour, and, consequently, traps have to be inserted to absorb water vapour and mercury vapour. These consist of two small glass bulbs containing respectively gold leaf to trap the mercury vapour, and phosphorus pentoxide to trap the water vapour.

In order to reduce the pressure of the gas in the valve below the limit of the pump, it is necessary to make use of the ability of charcoal to asborb gases. By the use of carbon absorption apparatus it is possible to obtain very hard vacua indeed—about 3×10^{-8} mm. is a normal value. Oxygen, nitrogen, and water vapour are readily absorbed, hydrogen and carbon dioxide rather less so, and helium, neon, and argon least of all, but as these latter exist only in minute quantities their presence is of insufficient importance to justify serious attention. If carbon absorption apparatus is used, a trap for water vapour is unnecessary.

The actual process is as follows: The apparatus is set up as in Fig. 3. Each part of the apparatus should be joined up with glass tube by means of the blow-pipe in preference to pressure tubing, and small constrictions should be made as indicated to facilitate the sealing-off process. The pump is started and left running until it is judged by the sound of the mercury that the pump has done its work. Then a flame from a Bunsen burner is gently applied to the carbon container in order to expel some of the gases already absorbed by the carbon. At this point the filament must be heated as brightly as possible and a fairly high potential applied to the anode. The grid should also be connected to the anode for a short time, but care must be taken to see that it does not melt. After a short time the grid may be connected to the filament leads. The object of this process is to bombard the electrodes and force them to give off any absorbed gases. If it is possible, the glass of the valve itself should also be gently heated to drive off stray gases. These absorbed gases consist mainly of hydrogen and water vapour, and if they are not removed at this stage the valve will become soft after a little use. The gas seems to cling tenaciously to the surface of the glass and the electrodes in the form of a condensed surface layer, but when heated to a temperature of 200° or 300° C., practically all the gas is liberated. If this is pumped off now, the performance of the valve will be far more constant in use.

All this time, while the electrodes and carbon are being heated, the mercury pump is still in operation, but after ten or twelve minutes the constriction on the pump side of the carbon container may be sealed off with the blow-pipe and the pump stopped. The carbon may now be allowed to cool while the valve is still heated, and after a few minutes the carbon container should be lowered into a flask of liquid air. The liquid air should be kept in a special flask, or it will evaporate speedily. This action causes the carbon to absorb the very last traces of gas, and after a few minutes the valve may be sealed off at the pip. Care must be taken to heat only as much of the glass as is necessary to make a perfect seal.

The filament wire, which is obtainable from Johnson, Matthey and Co., 78, Hatton Garden, London, E.C.1, is made of tungsten. It is made in a large number of standard sizes, but wire intended to carry about .4 amp. is most suitable for receiving valves.

The construction of dull emitter valves should not be beyond the capabilities of an amateur, but, as a rule, they are not very reliable. Either the filament coating falls off, the vacuum gives up, or the valve is too hard and dry to start with. There are so many accidents which may happen, and the finished product is so unreliable that it is advisable for an amateur to confine his attentions to bright emitters.

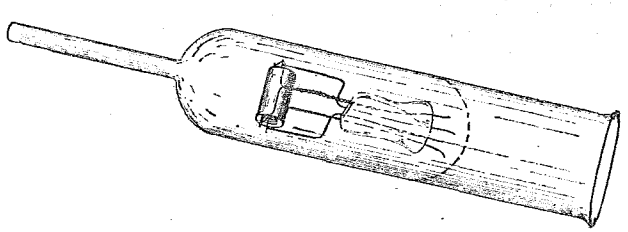


Fig. 4.—Putting a new bulb on a valve.

Dull Emitter Valves.

In case any reader should care to experiment in this direction, a few details may be useful. It is necessary to make a thin layer of thorium oxide adhere to the filament, and this is most easily done by dipping the filament into thorium nitrate and then heating gently in a low-temperature flame to reduce the nitrate to the oxide. Care must be taken to use the non-luminous part of the flame, as the luminous flame deposits carbon, which ruins the filament as a dull emitter. The process of dipping the filament has to be repeated several times for good results, but the whole coating is very delicate and liable to be severely damaged by excessive heating or careless handling.

How to Make Valves.—

As a rule, it is easier to use the electrodes and "foot" of an old valve and seal them into a new bulb than to repair the filament of a valve through holes in the bulb. The ebonite cap and glass bulb must be taken off, and the wires to the valve legs coiled up inside the foot.

Fitting a New Bulb.

Seal a small glass tube on to the closed end of a lead glass test tube, which will act as the new bulb for the valve. The electrodes may now be laid inside the tube, the open end of which is sealed off with the electrodes loose inside, Fig. 4.

Now allow the foot to fall gently against the closed end, and heat all round with the blow-pipe until the foot becomes entirely sealed to the end of the test tube. Then, with an odd piece of tube, pierce the bottom of the tube to gain access to the foot and the connecting wires. Pull away with the glass tube as much of the glass round the seal as possible without reducing the strength of the seal. By blowing gently through the exhaustion tube, the seal may be gently rounded.

After extensive glass work on a valve, it should be allowed to cool very gently, and, if possible, should be kept at a high temperature for some time before cooling. If the valve is cooled quickly, the glass is certain to crack, so it pays to spend considerable time on this operation.

Conclusion.

In conclusion, the author would like to state that he has never had any experience with commercial valve manufacturing. The valves which have been made so far are not perfect, but as greater skill is acquired, the performance of the valve gets better, and there is no reason why, with greater skill, they should not be as good as any valves on the market.

I hope that this article will help to stimulate amateur interest in experimental valve construction, and that it will show that valve manufacture is not limited to large companies with complicated and expensive instruments, but is an art which may be acquired by anyone possessing the necessary spare time.

TAPPING COILS.

A New Method of Making Taps on Cylindrical Coils.

By P. J. PARMITER.

THE following method of tapping off a cylindrical coil will be found highly satisfactory and will give the finished coil an extremely neat appearance.

Assuming that the "former" is fixed in position in the lathe or winder, proceed as follows:—Cut two strips of "sticky" insulating tape, to be 3 or 4 inches longer than the axial length of the former, and lay the strips parallel to one another on the surface of the former, separating their adjacent edges by about $\frac{1}{8}$in. Their natural stickiness will usually suffice to enable them to remain in position without any additional support.

Drill a hole in the former to secure the end of the wire in the usual manner, and loop the end of one of the tapes around the wire so as to subsequently secure it. Wind the coil in the usual way, laying the turns on the top of the tapes. When a tapping is required, raise the first tape, and, bending the wire sharply at right angles, bring it up between the tapes; then bend it in a sharp loop about an inch long, finishing with a second right-angled bend, over which the second tape is laid. Stretch the tapes tightly so that the loop projects symmetrically between them and continue winding the coil on the top of the tapes until the next tapping is required, when the process is repeated.

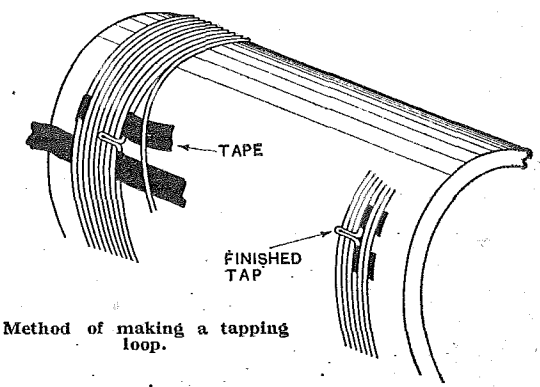
Terminating the Winding.

Two or three turns from the end of the coil loop back one of the tapes, and at the last turn cut off the wire, leaving a free end of convenient length, and pass it through the loop. By firmly pulling the free end of the tape the last turn of wire is secured. Cut off the remaining ends of the tape which project beyond the coil and draw out the initial end of the coil from the hole in the former. The coil will now be secured by the tapes alone without the inconvenience of having its ends passing to the inside of the former.

The ends of the loops are carefully cleared of insulation and then tinned ready for soldering on the leads to the studs on the tapping switch.

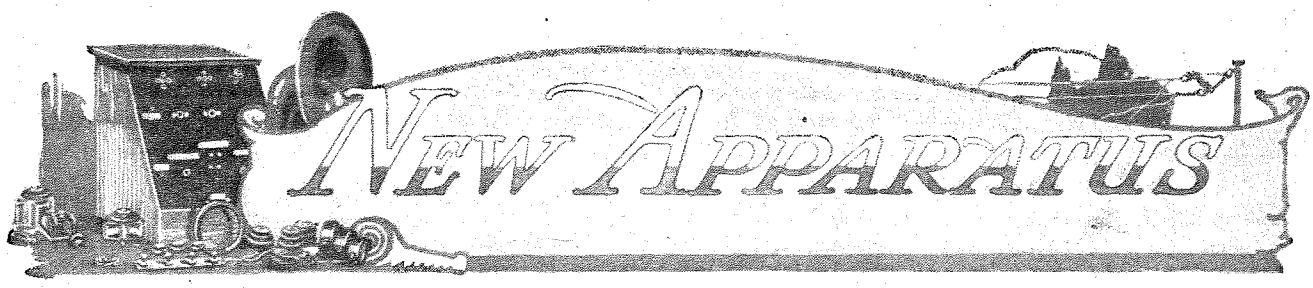
Best Spacing for Tappings.

If tappings are to be taken every few turns along the coil it is advisable to lay on the tapes at an angle of about 30° to a line passing through its axis, as then the turns



Method of making a tapping loop.

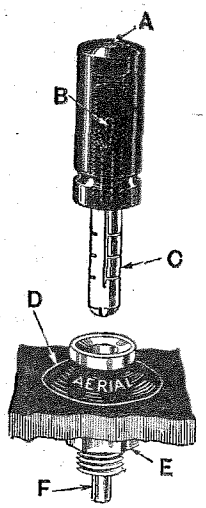
will be "staggered" around the periphery of the coil, rendering the process of making connection to the loops easier and more expeditious. In addition the taps will have a larger space between them, which is an advantage, as the self-capacity of the completed coil will be lower than when the taps are arranged closer together.



A Review of the Latest Products of the Manufacturers.

A USEFUL PLUG AND SOCKET TERMINAL.

The "Multi-Kontact" (M.K.) plugs and sockets produced by Messrs. Belling & Lee, Ltd., Queensway Works, Ponders End, Middlesex, are extremely well made, and provide a convenient and certain method of connecting the aerial, earth, telephones, batteries, etc., to a receiver.



An efficient plug and socket connection.

The success of these units is due largely to the special arrangement of lateral slits in the plug C. When a single longitudinal slit is employed to give springiness to a plug, the two sides frequently become pressed together and a loose and uncertain contact results. This condition is not likely to occur with the method of slitting employed in the M.K. plugs.

The upper part of the plug is turned out of insulating material, and encloses a special form of internal chuck B, which will effectively hold stranded flex or any gauge of solid wire below No. 14 S.W.G. The split chuck is securely fixed to the insulating sleeve, and is closed up by the threaded upper end of the plug C. The wire is inserted through the top of the sleeve at A.

The socket is provided with a soldering lug F of small diameter, which reduces general heating of the socket when the joint is made. Indicating washers D are supplied marked with the lettering in general use, and also unmarked so that special markings may be adopted if required.

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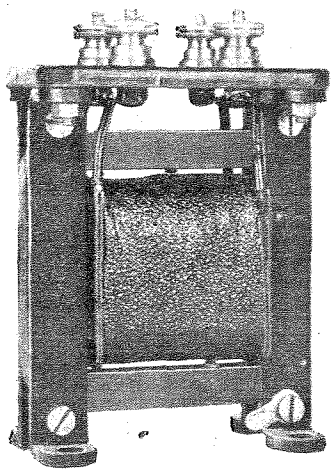
"FERRANTI" INTERVALVE TRANSFORMERS.

The name of Ferranti is well known to electrical engineers in connection with power transformer design and construction, and the Ferranti type A.F.2. intervalve transformer upholds the reputation for sound workmanship and reliable performance, which this firm has held for nearly 40 years.

The core, though rather small in cross section, is constructed from thin laminations of the best transformer steel, and fitted together without air gaps. Special attention has been paid to the winding of the transformer coils, the individual layers of which are separated with insulating material. The finished transformers are subjected to exhaustive electrical tests, which include, in addition to the usual insulation tests, an a.c. test of the transformation ratio (1 : 4) and a test for power loss in the windings and core. This transformer can be thoroughly recommended where reliability is of first importance.



The Ferranti intervalve transformer.

The address of the manufacturers is: Messrs. Ferranti, Ltd., Hollingwood, Lancashire.

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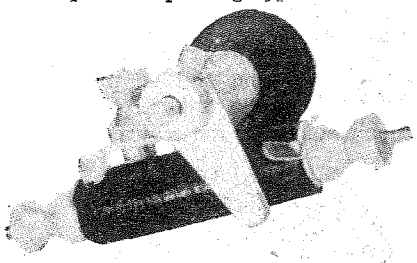
THE "MICRO-RADIO" POTENTIOMETER.

It is often inconvenient, where space is limited, to fit a potentiometer of the circular type, and a neat instrument of the type illustrated herewith can often be use with advantage. The resistance of the "Micro-Radio" potentiometer winding is 450 ohms, and is wound as a single layer on a cylindrical former $1\frac{1}{2}$ in. long, and $\frac{1}{2}$ in. in diameter. The bushes, spindles, terminals, etc., are well made, and the silver plated finish gives the component a pleasing appearance.



The "Micro-Radio" potentiometer.

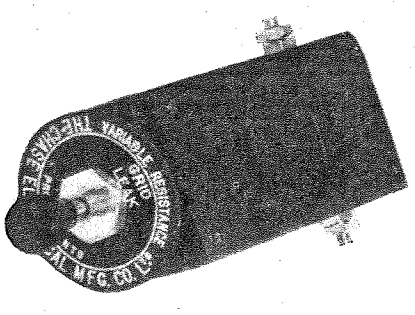
The distributing agents for "Micro-Radio" resistances and potentiometers are Messrs. J. F. Smith, 94-96, Hurst Street, Birmingham.

oooo

THE CHASEWAY VARIABLE GRID LEAK.

The adjustment of the resistance in this component, manufactured by the Chase Electrical and Manufacturing Co., Ltd., is obtained by a sliding rod, which may be pushed in, or pulled out, until the correct resistance is obtained. This method facilitates prompt adjustment where the resistance has to be varied over wide limits, and is superior in this respect to the screw adjustment usually adopted in this type of component. It is found that fine adjustment is not more difficult with the slider than with the screw adjustment.

The resistance range is tested before the product leaves the works, and the limits are adjusted to 0.001 and 20 megohms. This range will be found to satisfy all the requirements of ordinary experimental work.



The "Chaseway" variable grid leak.

The resistance element and slider adjustment are enclosed in a rectangular moulded case, which is mounted perpendicularly at the back of the panel with the usual "one hole" method of fixing. The approximate overall dimensions of the moulded case are $2\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ in.

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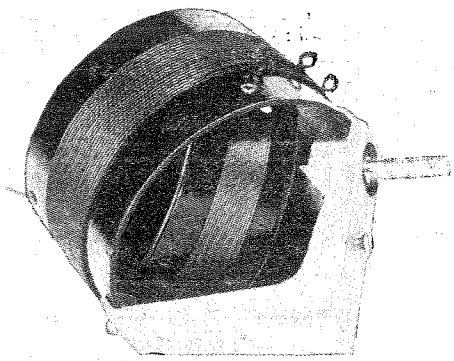
A SHORT-WAVE VARIO-COUPLER.

The "Fada" vario-coupler is of rigid construction and is built up on a right-angle aluminium die casting. The rotating coil is supported on a single spindle and bearing so that the difficulty of aligning two spindles is avoided. The relative position of the fixed and moving coils is arranged in such a way that a movement of the tuning dial of 180 degrees is necessary in order to change the coupling from the minimum to the maximum position. An efficient stop is provided on the moving coil, so that it is possible to make the connections to this coil through flexible leads.



The "Fada" short-wave vario-coupler.

Three tapping points are provided on the outer coil, and the wavelength range is stated by the makers to be 70 to 150 metres. Supplies are obtainable from Messrs. Henry de Leeuw, Sentinel House, Southampton Row, London, W.C.1.

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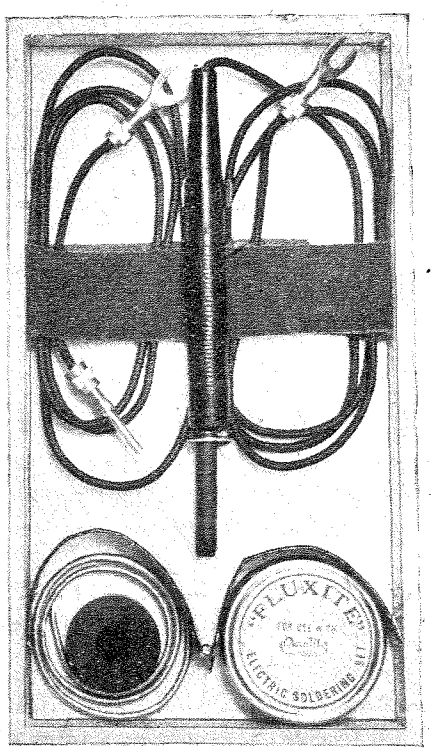
AN EMERGENCY SOLDERING OUTFIT.

When there is difficulty in heating an ordinary soldering iron, the electrical soldering set manufactured by the Goswell Engineering Co., Ltd., 12a Pentonville Road, London, N. 1, may save the situation.

Local heating of the parts to be soldered is obtained by passing a current from a 4 or 6 volt accumulator through the carbon electrode acting as the "iron," and a metal return electrode, pressed against the work at a suitable point. To localise the heating, the return electrode must be situated as near as possible to the joint. An accumulator of large capacity, such as a car starter battery, should be used, if possible, as the discharge current, when the joint is being made, is heavy, and might damage a small battery with thick plates.

Instructions are sent out with each outfit, and the cost is 5s. 6d.



A Novel Soldering Outfit.

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A WELL-MADE VARIABLE CONDENSER.

Sound mechanical construction is of as great importance to the success of a variable condenser as careful electrical design. Variable condensers, more than any other components, are subjected to considerable wear, and the bearings and mounting of the plates must be built to withstand the strains imposed upon them.

The outstanding merit of the variable condenser produced by Messrs. Peto-Scott, 77, City Road, London, E.C.1, lies in its massive construction and reliability. In addition to the usual three securing bolts for the fixed vanes, a fourth spacing bolt is provided to give additional rigidity to the end plates, which are turned from solid ebonite of unusual thickness. The bearings are accurately machined and have a large surface area which renders the use of spring friction washers unnecessary. Contact to the moving vanes is made through a coil spring which ensures silent operation when the condenser is connected in circuit. The bevelled dial is fixed to the plain spindle by a set screw in the side of the tuning knob.

THE EDISWAN EARTHING CLIP.

An earthing clip should be readily adaptable to all the diameters of water pipes in general use, and one of the best ways of providing this adjustment is to make use of a perforated metal strip clamped round the pipe. A clamping screw is inserted through two of the holes, the distance between these holes being adjusted to suit the diameter of the pipe that is to be used for the earth return.

In the Ediswan earthing clip (WL.241) the strip is of soft copper, perforated with $\frac{5}{16}$in. holes, whose centres are spaced $\frac{1}{2}$in. apart. The clamping screw and nut are specially designed to simplify insertion in

An adjustable earthing clip.

the perforated strip and to prevent rotation of the nut when tightening up. All the parts are well tinned, so that a good electrical joint will be obtained if the pipe is well scraped and cleaned.

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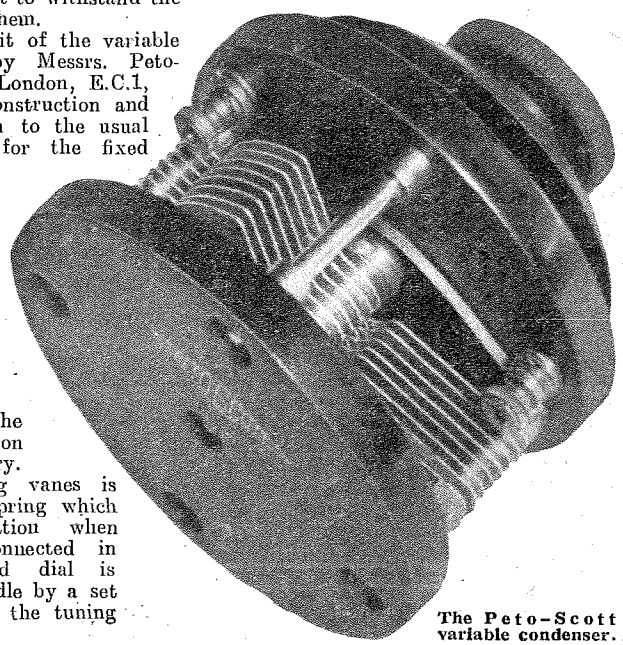
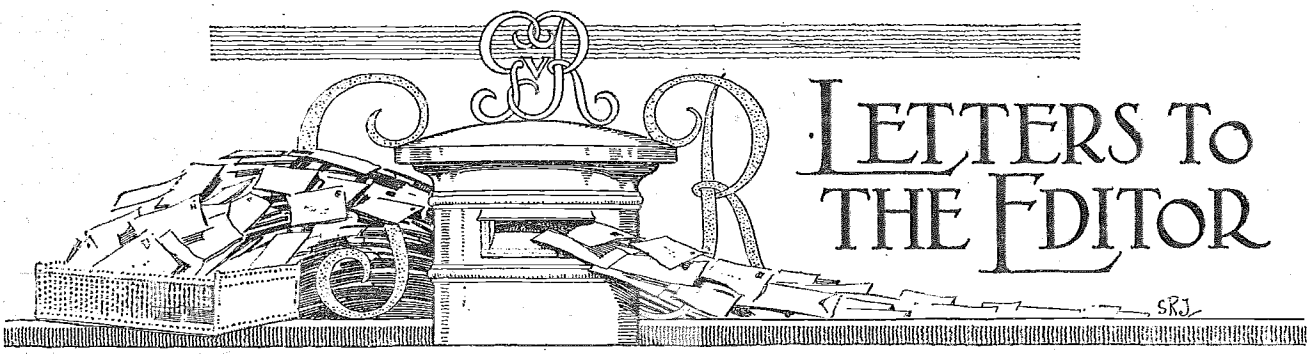
SIFAM ELECTRICAL INSTRUMENTS.

In the double-scale instruments of this make referred to in the last issue, it should be noted that the L.T. scales are marked on the dial in red. A panchromatic plate was used in making the photograph of the instrument, and in consequence the red scale and markings were not recorded on the white background. The scale is from 0 to 6 volts.



The Peto-Scott variable condenser.



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

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

GERMAN BROADCASTING ON A CRYSTAL.

Sir,—For three nights in succession (February 20th, 21st, and 22nd), between 7 o'clock and 8.30 p.m., I have picked up a German broadcast transmission on a crystal.

This was done quite independently of a valve. The reception was remarkably good, much stronger than either Eiffel Tower or Radiola, and only ignorance of German prevented me from hearing the name of the station.

As the wavelength is near 290 metres, I conclude that it must be Hanover.

The receiver used was a Mark III*, utilising the perikon detector, an arrangement hardly as sensitive as the more modern wire contact-galena combination. It should therefore be possible for many of your readers to pick up this transmission.

Lee, S.E.12. W. KIRBY.

DISTURBANCE ON KDKA's SHORT WAVELENGTH.

Sir,—On the night of 3rd/4th February a peculiar phenomenon was observed here, and I would be interested to hear if other observers had a similar experience. At about 0200, KDKA started transmitting a "query" programme, the transmission being S.B. from WGY, WJZ, WRC and KDKA. Listening on the 60-odd metre wavelength, the concert was all but blotted out by the most appalling outbreak of "howling" from oscillating sets I have ever heard. Some of the noises sounded as if coming from across the street, so loud were they. Up till that hour and date I have hardly ever heard a squeak on KDKA's short wave, and during the earlier part of the night, before the S.B. commenced, there was absolutely no interference.

Is it possible that KDKA picked up the programme by radio and the "howls" were those of American amateurs trying (or not trying) to tune in KDKA? If so, I am truly thankful my home is not in the States. The experiences of other amateurs would throw some light on the matter.

With reference to the calibration signals from U.S. Bureau of Standards, I heard these from WWV early on February 6th. Strength was very poor compared to the average American amateurs' signals, and the speed of transmission was such that only listeners with a fairly good knowledge of morse could read every word. The note, pure c.w., was unsteady and QSS was pretty bad. It is interesting to note that KDKA's wavelength appears to be about 65 metres from these tests.

Glasgow. J. GORDON RITCHIE.

TRANSMITTING TO U.S. ON TWO WATTS.

Sir,—With reference to the item under "Transmitting Notes" in *The Wireless World* of March 18th on my communication with the United States with a power of only two watts, I give here further details of this event, which may prove of interest.

On February 15th, the first time for three months on which Station 5SI was put into operation for Transatlantic work, I succeeded at midnight, G.M.T., in getting into communication with American station U1PL, who reported my signals as easily readable, but not strong. I informed him of my input power, which was only eleven watts. U1PL expressed surprise, and asked me to reduce my power. This was done in successive stages to approximately 8 watts, 5 watts, 3½ watts, and finally 2.2 watts. Transmissions on all these power inputs were acknowledged successively by U1PL. Nothing under 2.2 watts was attempted owing to the difficulty in keeping the wavelength steady on the transmitter adjustments used, and the danger of the signal being lost in QRM from other stations on this side, many of whom were working at the same time. The final power used has been measured as 240 volts at 9 milliamps.

The exceptional part of the test is the aerial used here. The usual aerial had been blown down in the gales then raging, and in its place a temporary *single wire* was erected, the complete length being 70 feet, and reaching from the lead-in 7 feet from the ground up to a point 28 feet high on a mast, and then *down again* to one of the counterpoise posts, the height of the aerial at the far end being only 10 feet, and within 5 feet of the counterpoise. The counterpoise consisted of four wires, 50 feet long, spaced 4 feet, and about 6 feet high.

Power for the transmitter is provided by a 15 watt M.L. anode converter run off accumulators, there being no power mains in the district, and the power is therefore limited for transocean tests. The circuit used is the inductively coupled Hartley, and as oscillator a single Mullard 0/15 valve is used. The emitted wave is pure and by compensating devices has been made perfectly steady.

Confirmation of the low power tests has been received by letter from U1PL, and great credit is due to him for his remarkable reception, and for his resource in asking for the reduction in the power input at this end. I understand that he uses a Reinartz receiver for short wave reception.

It should be added that the wavelength used by this station for the low power tests was 96 metres, and it would be interesting to hear opinions on the efficiency of the aerial system used. C. L. NAYLOR (G5SI).

Shrewsbury.

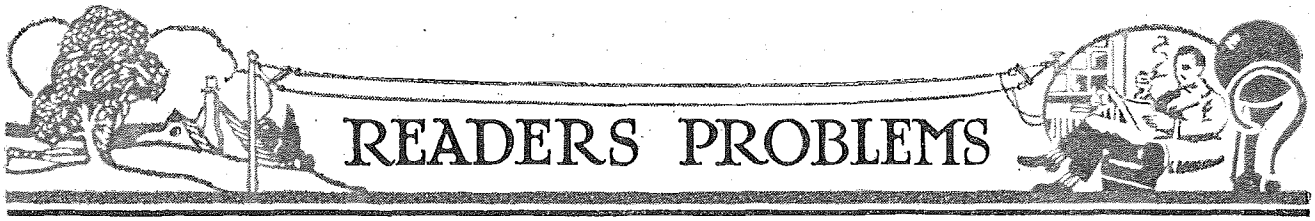
SHORT-WAVE RECEPTION.

Sir,—With reference to the short-wave set described in your issue of February 11th, designed by Mr. W. James, I have pleasure in passing you the following information, which may be of interest.

Using a set with coils made up according to the instructions and only the detector, I have logged during the past three weeks about 150 stations, and seem to gather a fresh bunch every night. The best DX achieved so far has been U2BY and GHH (Mosul). This latter station came in at about R.4 to 5 and was heard working G6NF at about 11.00 G.M.T., March 16th, 1925.

I am not using potentiometer control, but, nevertheless, find the control of reaction delightfully smooth, and have no trouble in making the set oscillate over the full tuning range. My aerial is not by any means good, being a single wire about 65 ft. long, at an average height (electrical) of 15 ft., and slightly screened. I intend fitting a new square law condenser with vernier, when I anticipate the tuning will be considerably improved. J. L. OAKLEY.

Brixton Hill, S.W.2



Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Causes of Valve Distortion.

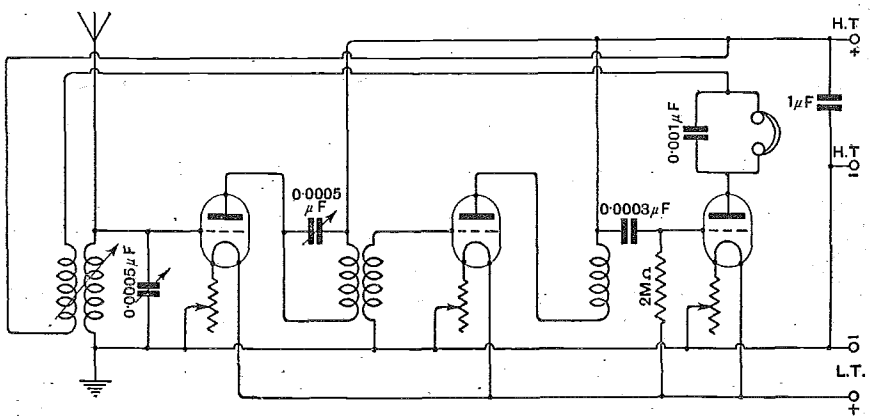
A READER has noticed that we invariably advise that the type of power valve advertised as being specially manufactured for use in resistance coupled amplifiers, should *not* be used in the final stage of a resistance coupled, or indeed any, amplifier, and he enquires the technical reason for this.

It is well known that the maximum volume which any valve is capable of handling without distortion is determined by the length of the straight line portion of the grid-volts anode-current characteristic curve. The normal grid potential should be so adjusted by means of biasing cells that it lies midway between the lower bend extremity of this line and the point where grid current commences to flow. If too low an anode voltage is used the length of this line will be considerably reduced. It is obvious that the maximum grid voltage input which can be applied to the valve without causing distortion is limited by the length of this straight portion. With valves of the D.E.5 type the length of the straight portion will be fairly considerable, very much greater than is the case with a valve of the ordinary type. This type of low impedance valve has not, of course, a high amplification factor. Consequently, although it is capable of dealing effectively with a large input power, it is not a very good valve for stepping up the intensity of signals of comparatively small amplitude, such as will usually be met with in the first stage of a resistance coupled amplifier. For this purpose valves having a high amplification factor have been designed by various manufacturers, a good instance of which is the D.E.5.B. These valves will be found excellent for use in a resistance coupled amplifier, but they possess a short length of straight line portion of the characteristic curve we have been discussing. Since strong signals are expected in the last stage of an amplifier, it is obvious that this valve is unsuitable for this position, and a valve of the D.E.5 or power type should be used. In the case of signals of exceptional strength, a valve having a still greater permissible grid voltage swing, such as the L.S.5 or L.S.5.A., should be used. The high amplification factor type of valve, besides being extremely useful in a resistance coupled amplifier, will also be found very effective as an H.F. amplifier on medium and long waves provided suitable precautions are taken.

A Stable Three-Valve Circuit Employing Two H.F. Valves.

A CORRESPONDENT has written us asking for a circuit employing two high frequency valves, one of which can be sharply tuned, and the other coupled by means of an aperiodically wound anode choke coil, which will respond fairly uniformly over a small band of wavelengths.

We give below a circuit suitable for accomplishing this. It will be noticed that we include the tuned stage first, the second H.F. valve having the un-tuned coil in its anode circuit. Selectivity is obtained, of course, by means of the tuned anode circuit. If the first valve is made aperiodic and the second one tuned, the circuit will usually be found not so selective, since the aperiodic coil in the first stage will amplify signals coming in on different wavelengths, and as these are all passed to the second H.F. tuned valve, it is obvious that this tuned circuit will have stronger interfering signals to eliminate than is the case when the tuned anode is used in the first stage. The tuned circuit then only amplifies the signal which it is desired to receive, which is passed on to the second valve and amplified still further. It must not, of course, be expected that this circuit will be productive of such good results as regards sensitivity and selectivity as when two sharply-tuned stages are used, but it will be found more stable, and as there is one less control, it will, of course, be more simple to tune.



A three-valve receiver, with two stages of H.F. and valve detector.

Correct Method of Using Spade Tuning.

A CORRESPONDENT has written to us saying that he has been experimenting with the "spade" method of tuning by removing the variable condenser which is connected across the aerial coil of his single valve set and bringing a copper disc into close proximity with the aerial coil, but he has not been able to produce the same volume from a given station as with the more conventional method. Loudest signals are obtained when the disc is moved away from the coil.

The latter remark gives the key to the difficulties which our correspondent has experienced. It is evident that he is attempting to employ spade tuning using the same aerial coil which he has found to give good results when using the more conventional method. When tuning with a coil and parallel condenser it is necessary, as is well known, to employ a coil of such an inductive value that in conjunction with the aerial it does not quite tune up to the wavelength which it is desired to receive. The circuit is then brought into resonance by a small amount of added capacity which is provided by the variable condenser. The effect of bringing a sheet of copper into the magnetic field of a coil carrying alternating or oscillatory current is to set up small currents in the copper which are known as "eddy currents." These currents produce magnetic fields of their own which act in opposition to the magnetic field of the coil, thus reducing

the number of magnetic lines of force associated with the coil. The result of this is, of course, to reduce the effective inductance of the coil; consequently it will not respond to so great a wavelength as when the copper sheet or disc is not present. It will be seen, therefore, that in order to employ "spade" tuning successfully we must employ a coil of such a size that in conjunction with the aerial it naturally responds to a wavelength slightly in excess of that which it is desired to receive. If a copper disc is now brought into the sphere of influence of this coil, its effective inductance can be slightly reduced until it is in tune with the incoming signal. Obviously, the nearer the natural period of the coil and the aerial to that of the incoming signal, the greater is the efficiency of this method of tuning. If a fairly large band of wavelengths is required to be covered with one coil, however, a larger coil giving a bigger margin for the operation of the "spade" must be employed.

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Switching Arrangements of a Four-Valve Set.

A CORRESPONDENT has written regarding the diagram of a four-valve set which was published in this section of the journal in the issue of February 11th, 1925. He reports having obtained excellent results with this receiver, both as regards quality and distance reception, but he informs us that upon attempting to add switching for cutting out one or more valves in the conventional manner, he has met with only partial success, since the receiver produces considerable distortion except when both L.F. stages are used, and he asks us to suggest a cause for this.

It is well known that however carefully we design a low frequency amplifier for giving us pure reproduction by taking great care to use a correctly designed transformer or choke coil, and by employing the correct type of valves we shall completely nullify these effects if we do not at the same time pay attention to the correct adjustment of the plate voltage and mean grid potential. In the circuit published in this section of the issue of February 11th, 1925, the correct adjustments of both these were given. The effect of putting switching into this receiver will make no difference when both low frequency valves are used. The usual method of switching out a stage of L.F. amplification is to switch out the final amplifier, and to pass the output of the preceding valve through the telephone circuit. If we are using valves of differing characteristics in our L.F. amplifier, we shall, of course, have the anode voltages and grid potentials of the two valves adjusted differently. Upon switching out the second amplifier and bringing the telephones into the plate circuit of the preceding valve, it is obvious that we have now changed the anode voltage of this valve. If this first valve, therefore, is a valve of different characteristics, having its anode voltages and grid potential adjusted accordingly, it is obvious that distortion will be caused when we alter its plate voltage without at the same time altering the mean grid potential. If the switching arrangements given in the circuit below are carefully followed out, this trouble will be avoided.

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Fixed Condensers.

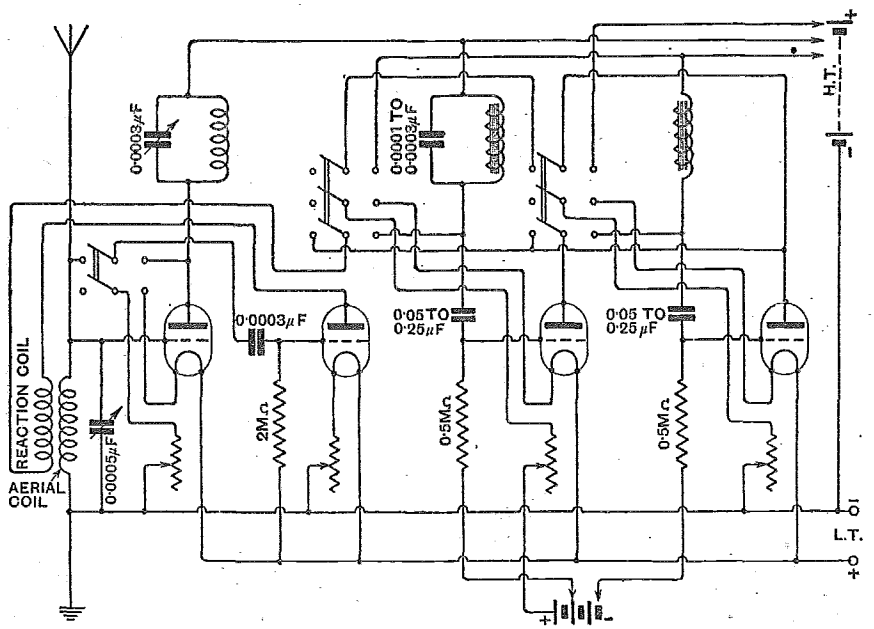
A READER has asked a number of queries concerning fixed condensers, one of which is the reason for the fact that a mica dielectric condenser of a given capacity can be constructed with so much less bulk than can an air dielectric instrument of similar capacity rating.

The capacity of a condenser is dependent on three factors, the variation of any of which will affect the capacity of the instrument. It is directly proportionate to the area of overlap of the plates; is inversely proportionate to the distance separating the plates, and it depends also on a constant which is known as the specific inductive capacity of the dielectric or more shortly the dielectric constant. The inductive capacity of dry air at a temperature of 0° Centigrade and a pressure of 76 centimetres is taken as the standard, and is reckoned as unity. The dielectric constant of any substance is equal to the number of times it increases the capacity of a condenser over the capacity obtainable when air is used as a dielectric, all other factors being kept equal. A table is given below giving the dielectric constants of various substances which are likely to be encountered in the course of experimental work. All substances, of course, including gases, have a certain dielectric constant. It will be noticed that in the case of various substances, such as glass, the dielectric constant varies over a wide range. This is due to differences in the quality of particular specimens.

Air	1.00
Paper	1.5 to 4
Paraffin (solid)	1.9936
Indiarubber	2.220 to 2.497
Ebonite	2.284
Gutta percha	2.462
Transformer oil	2.5
Sulphur	2.58
Shellac	2.74 to 3.7
Glass	3.013 to 10
Wood	3 to 6
Silk	4.6
Castor oil	4.7
Bakelite	5 to 7.5
Mica	5.5 to 8
Celluloid	7 to 10
Distilled water	81.07

To revert to the original question, it will be obvious that a mica dielectric condenser of given size will have a capacity equal to that of an air-spaced condenser which is over five times larger in its physical proportions.

In the usual type of variable condenser the capacity is changed by varying the area of overlap between the fixed and moving vanes. If at any time it is desired for some reason to greatly increase the maximum capacity of an air-spaced variable condenser, it can be immersed in a suitable receptacle filled with transformer oil. In the case of a condenser whose rated maximum capacity is 0.001 μF, for instance, it is obvious from consideration of the above table that this value will be increased to about 0.0025 μF. If the vessel contains castor oil instead of transformer oil, the capacity is increased 4.7 times.



Method of connecting switches to a receiver so that one to four valves may be employed.

The Wireless World AND RADIO REVIEW

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THE FUTURE OF BROADCASTING.

FOLLOWING close on the statement by the Prime Minister that he proposed to set up a committee of both Houses to consider the question of broadcasting Parliamentary proceedings, comes the announcement that this question is to be deferred until the future of Broadcasting generally is considered prior to the date of expiration of the present Broadcasting Agreement between the B.B.C. and the Post Office.

We may remind our readers that the present Agreement under which the British Broadcasting Company operates, with the extension which has already been granted, will now terminate in the summer of 1926. Mr. Baldwin's decision is to have an enquiry next winter so that the Cabinet may be put in possession of all the information necessary to assist them in deciding, when the time comes, whether the present experimental Broadcasting organisation has merited extension or possible expansion, or whether it will be necessary to revise the whole position and establish broadcasting anew on different principles.

Whilst some regret may be felt at the prospect of considerable delay before the possibility of Parliamentary Broadcasting can be realised, yet, as we agreed in our Editorial comment last week, it is well that this new field of operation for Broadcasting should be introduced with caution, because it is not likely that the general public will appreciate the new service unless they are introduced to it more or less gradually.

It is welcome news that the Government proposes to enquire very thoroughly into the Broadcasting problem before making any hasty decisions as to the system under which the Broadcast service shall operate after the expiration of the present agreement. There are very many questions which will require consideration, because we are sure that many objections are to be found to the present arrangement, and not all of these objections will be brought forward by interests outside the B.B.C. itself.

CONTENTS.

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EMPIRE WIRELESS.

THE Post Office we see has recently again been the subject of public criticism in regard to its attitude towards wireless and particularly Empire schemes.

Sir Alfred Mond, at a meeting of the council of the Empire Press Union recently, strongly denounced the attitude of the Post Office, which he described as one of apathy towards wireless development. He said it was clear that the Post Office does not like wireless, and we are continually having impressed upon us the much greater importance of the other activities of the Post Office in comparison. Sir Alfred Mond took the view that if the Post Office persists in this attitude it would be better for them to go out of the business and hand it over to private enterprise, or, alternatively, to devote to its development the same energy and determination which private enterprise would ensure.

Unfortunately we feel that there is considerable justification for this attack upon the Post Office, which, when analysed, is an attack upon the Post Office system

more than upon actual work which it carries out. The principal fault in Post Office control of wireless development, as, for instance, in the Empire scheme, is that even after plans have been approved and work has been authorised, the machinery of the Post Office organisation is so slow in operation that by the time work is actually in hand the designs are obsolete.

Some considerable time ago we pointed out in these columns that in our opinion a great deal of overlapping and consequently unnecessary expenditure occurred owing to the number of different Government departments which were engaged in wireless development. We advocated that at least the wireless research work of the Government should be centralised, and that, as far as possible, this central wireless organisation should undertake research and design work for the Post Office, the Army, the Navy, and the Air Force. Each of these services would, of course, define their particular requirements, but the central wireless department would prepare and submit designs to meet their requirements, and would be in a position to embody all the latest developments with which it would be the business of that department to keep in touch.

In this way those responsible for Government wireless would be specialists, and the situation would no longer arise where, say, Post Office officials are expected to take responsibility in connection with wireless matters of which they have but a superficial knowledge.

Unfortunately rivalry between the various Government services would hamper the introduction of such an organisation at first, and it is well known that during the late war a little co-operation in technical development might have resulted in greater progress, particularly in wireless. We consider, however, that such a centralisation of wireless research would rapidly prove itself of such inestimable value that old prejudices would rapidly be overcome with the realisation of the importance of the work which could be undertaken.

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AMERICAN AMATEURS VISIT ENGLAND.

AT the time of writing, the first international amateur conference is due to take place in Paris. The conference is in point of fact the outcome of the visit made to this country and to France early last year by Mr. Hiram P. Maxim, who, as is well known, is President of the amateur organisation, the American Radio Relay League. During Mr. Maxim's visit to Paris an unofficial gathering of representative amateurs took place, and it was then decided to call the international conference which is now progressing in Paris, when very many matters of importance relating to the interests of amateurs throughout the world will be considered.

At the conclusion of the conference, Mr. Hiram P. Maxim, Mr. K. B. Warner, Secretary of the A.R.R.L., and a party of prominent American amateurs who are attending the conference will pay a visit to this country.

The occasion is an appropriate opportunity for the British amateur to show his interest in his American co-workers by extending to these representative American amateurs the heartiest possible welcome.

The strongest ties exist between the amateur of this country and the United States of America. The first long-distance communication employing short waves was achieved between Europe and United States by amateurs, and, although France succeeded in reaching America first, British amateurs quickly followed, and since that date two-way direct communication has been permanently established with many friends on the other side.

It is impossible to over-estimate the importance of the American section of the amateur fraternity. The amateurs of the United States are by far the largest national amateur body, and their organisation, the American Radio League, is without parallel in the world. The amateur of America has, moreover, a unique position in so far as his status with his Government is concerned; in no other country is such freedom extended to amateur activity or such use made of the facilities so granted.

The Radio Society of Great Britain is making arrangements for the entertainment of the American visitors, who are due to arrive in London from Paris on the evening of April 21st. It is proposed to conduct the party to places of general interest in London, and arrangements have also been made to visit the British Broadcasting Company and several other places of wireless interest. On the evening of April 24th the visitors will be entertained to dinner as the guests of the Society, whilst tickets can be purchased on application to the Secretary by any persons desirous of attending. Immediate application should be made for the tickets as the Society announces that its arrangements will have to be completed by April 16th.

In view of the fact that the officers of the Society are not authorised to appropriate the general funds of the Society to defray the cost of this entertaining, we are asked to state that it is hoped that it would be possible to cover the expenses incurred by voluntary contributions by members of the Society and others interested in the objects in view. No amount will be regarded as too small, and contributions should be sent to the Secretary of the Society. We feel sure that many of our readers will appreciate this opportunity of contributing towards the welcome which all must feel is due to our friends from across the Atlantic.

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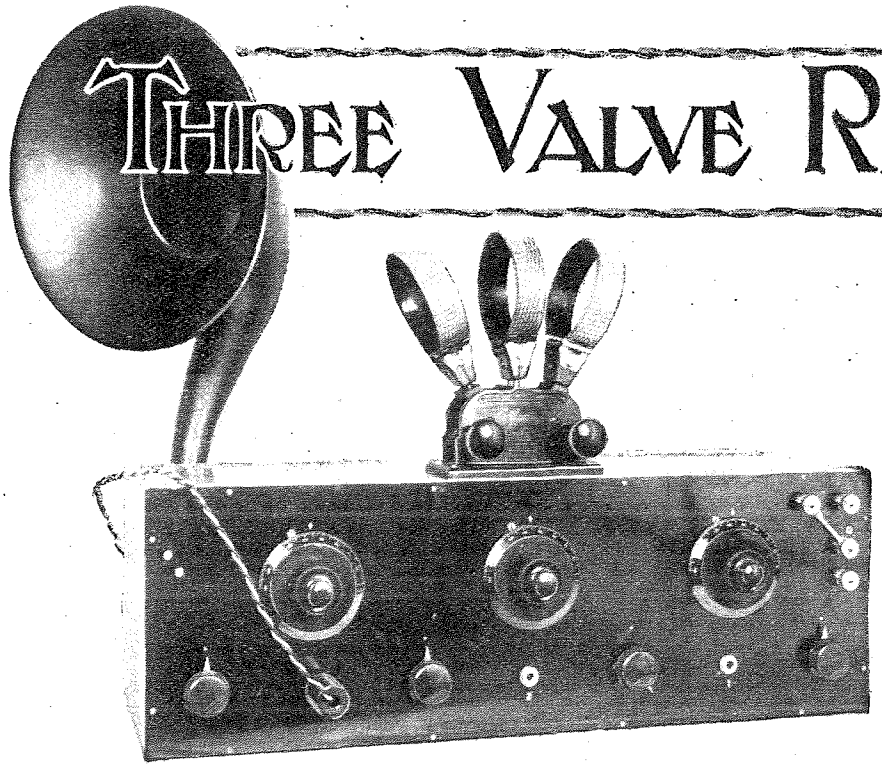
SHORT WAVE PERMITS.

TRANSMITTERS are about to win a very valuable concession from the Postmaster-General in the shape of permission to transmit on wavelengths of 23 and 45 metres. There only remains the question of allocating definite hours for this class of work.

In America much has been done already on wavelengths in the neighbourhood of 20 metres, notably by Mr. John L. Reinartz (1XAM), of South Manchester, Conn., whose transmissions on 21 metres have been received in California, Iowa, and Florida. These transmissions gain their significance from the fact that they were carried out in broad daylight, and afford indication that the very low wavelengths may prove the salvation of the short wave transmitter for daylight working. Already certain British amateurs have strengthened the evidence on this point, 2KF and 5LF both having worked with America in daylight on 23 metres.

THREE VALVE RECEIVER



Detector and Two Note Magnifiers with Tuned Reaction.

By W. H. PAULETT.

WITH amateurs on short wavelengths, broadcast stations on medium wavelengths (300-500 metres), and the high-power station on a long wavelength (1,600 metres), a receiver capable of receiving efficiently over a wide band of wavelengths is a very useful instrument to make.

This receiver is designed for listening to distant stations with headphones, and near-by stations and the high-power station with the loud-speaker. Having decided what the receiver is required to do, its components can then be chosen accordingly. Do not assume that because a writer of an article recommends condensers and transformers of certain capacities and ratios that any condenser or transformer of the same value will do, for it will not; always use components of the same *quality* as recommended in the article, and if possible use better. Good results can only be obtained by employing scientifically made components correctly arranged and carefully connected up.

In addition to good components one must have a good aerial and earth, a stable, selective, and sensitive circuit, and for loud-speaker work some means of distortionless amplification. The present instrument employs a loose coupled detector valve with tuned reaction and two stages of note magnification. The straight circuit ensures stability, the tuned loose coupled circuit selectivity, and the tuned reaction and potentiometer control of the grid circuit sensitivity. This circuit is, of course, much used by amateurs, and with it America has been received on short wavelengths. In the writer's opinion, no other three-valve set can equal it for all-round good results.

Referring now to the circuit diagram, Fig. 1, it will be seen that the aerial tuning condenser has a capacity of 0.0005 mfd., and that it can be connected in series with the aerial inductance coil by connecting the aerial to the terminal A, and the earth to terminal E. The condenser is readily connected in parallel with the aerial coil by connecting the aerial to the terminal A^1, and connecting the terminals A and E^1 together. The reason for using four terminals for the series-parallel arrangement instead of the usual three is to avoid the necessity of removing the

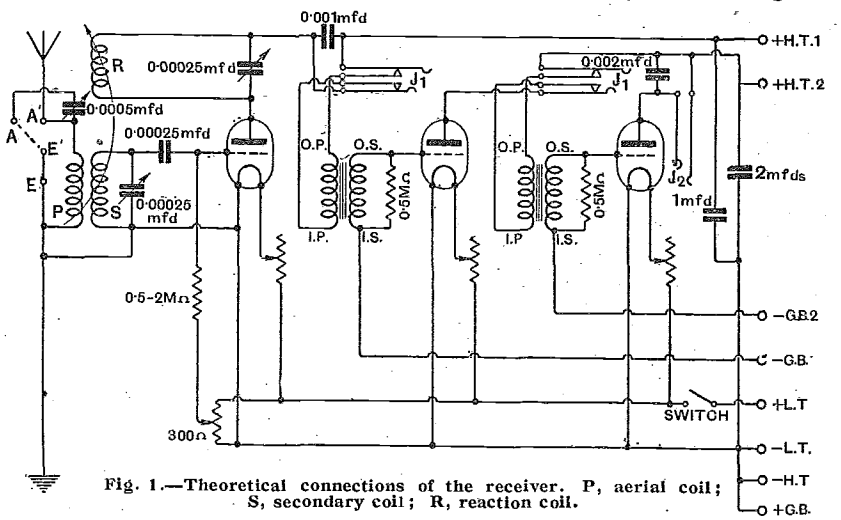


Fig. 1.—Theoretical connections of the receiver. P, aerial coil; S, secondary coil; R, reaction coil.

Three Valve Receiver.—

earth lead, which is permanently connected to E. The secondary inductance coil is tuned with a smaller capacity condenser, 0.00025 mfd., in order that as large an inductance coil as possible may be employed on short wavelengths. The reaction coil is tuned with a condenser of the same value. Perhaps one may think this unnecessary, but when it is remembered that extreme range with a detector valve is only obtained by critical control of reaction, the tuned reaction coil is very efficient.

The grid condenser has a capacity of 0.00025 mfd., and the writer has found this value satisfactory for all wavelengths. For the grid leak, however, one of 0.5 megohm is preferred for near-by stations, and one of 1 or 2 megohms for distant stations. A set of grid leak resistances ranging from 250,000 ohms to 5 megohms is very useful in conjunction with a potentiometer, as they enable one to adjust the grid potential to exactly the best value. For short wave work and good quality reception the potentiometer is well worth its cost and the small amount of current it consumes from the accumulator. As regards the inductance coils, these must be of the plug-in type in order efficiently to cover a wide band of wavelengths. In purchasing plug-in coils choose air-spaced, protected coils, in order to reduce losses to a minimum.

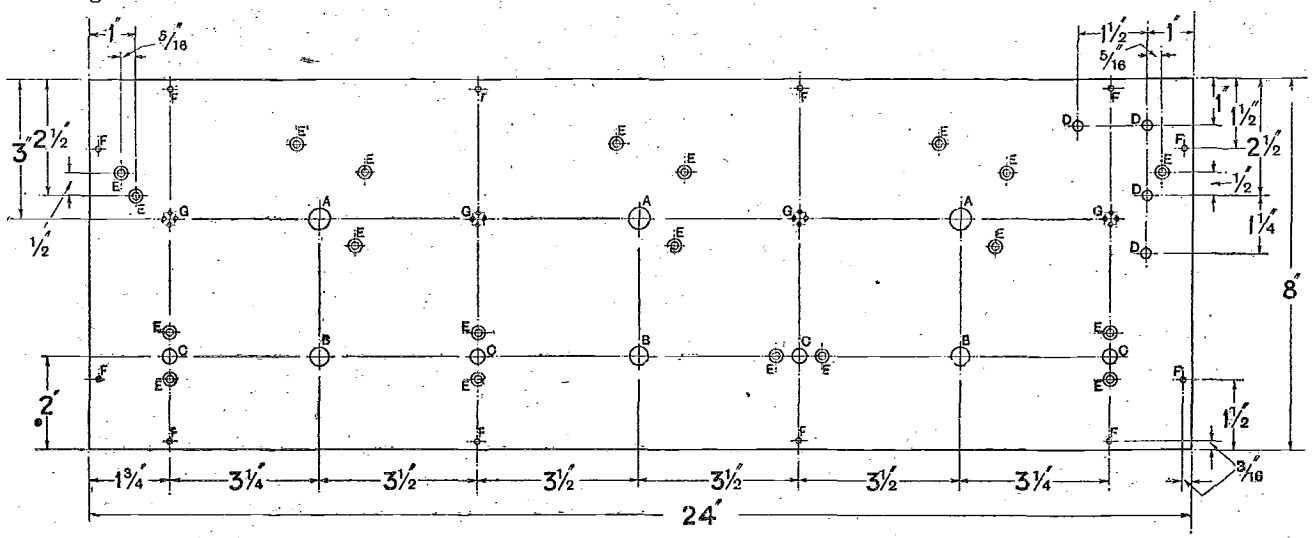


Fig. 2.—Drilling details of ebonite front panel. A, $\frac{7}{16}$in. dia.; B, $\frac{3}{8}$in. dia.; C, $\frac{5}{16}$in. dia.; D, $\frac{1}{2}$in. dia.; E, $\frac{5}{32}$in. dia., and countersunk for No. 4 B.A. screws; F, $\frac{1}{8}$in. dia.; G, $\frac{1}{16}$in. dia.

For the purpose of enabling one, two, or three valves to be used as required, the jacks J_1, J_1, and J_2 are provided. It will be seen that the primary winding of the low ratio first stage transformer is shunted by a fixed condenser of 0.001 mfd. when the plug is not inserted in the jack J_1, and that the condenser shunts the phones when the plug is inserted. This condenser is necessary to by-pass the high-frequency component of the plate circuit when reaction is used, and should be connected across the outer springs of the jack J_1.

A low ratio transformer is employed for the first stage, as the impedance will more nearly correspond with the impedance of the detector valve. If a six-volt accumulator is used, a DE5B valve makes a good detector, and

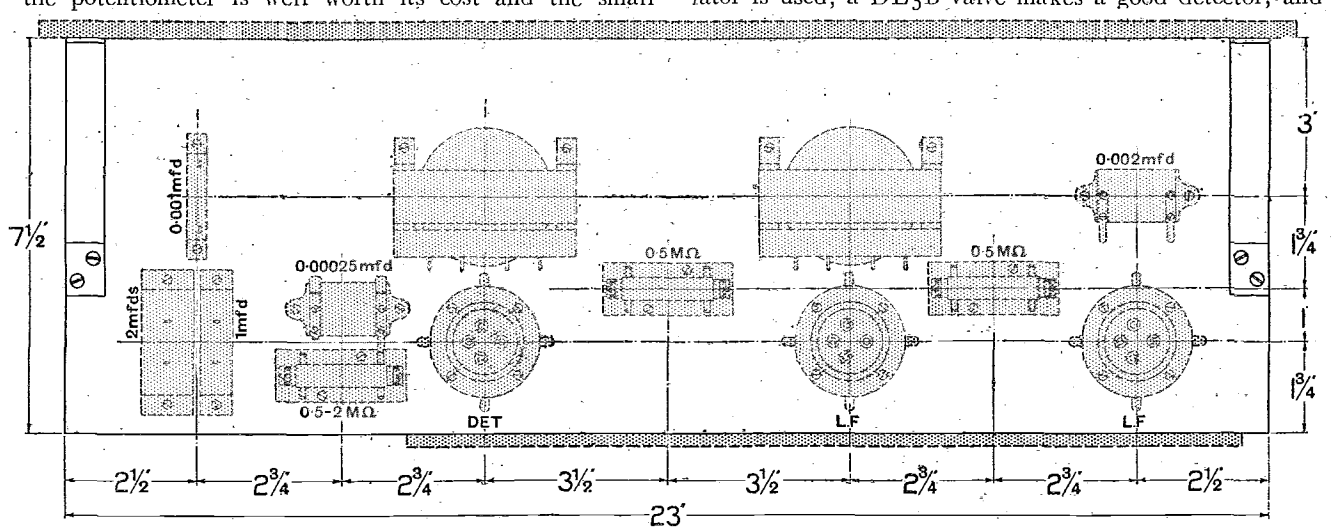
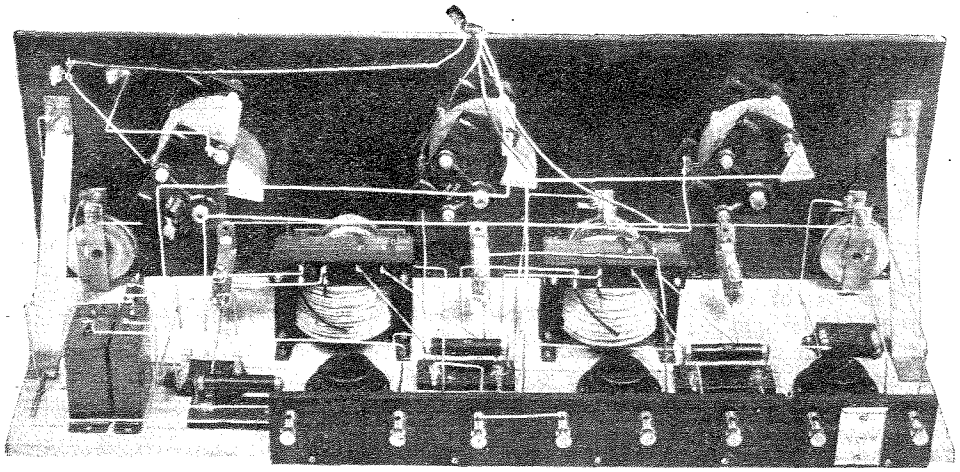


Fig. 3.—Arrangement of parts on the wooden base.

Three Valve Receiver.—

for a four-volt accumulator a DEQ. The latter will require a special holder. For the first and second note magnifiers valves of the DE5 class may be used, but remember that, for distortionless amplification, the last valve must be a power valve.

The second stage transformer has a 6 to 1 ratio, which will give very strong signals with a power valve. The plate voltages used with any type of valve should be those recommended by the makers, and for this purpose a separate H.T. tap is provided for the detector valve. A separate grid bias terminal is provided for each L.F. valve, as it is found that, when using different valves requiring a plate voltage of 120, better results are obtained with different grid voltages. Of course, if both L.F. valves are of the same make, the grid terminals GB1 and GB2 can be connected together, and a single negative lead taken to the grid battery.



View of the back of the set, showing the particularly neat arrangement of the parts. The wires at the top are connected to the coil holder after the set is mounted in the box.

It will be noticed that the secondaries of the transformers are shunted by grid leaks of 0.5 megohm, and as clips are provided these shunts can be removed and similar resistances of higher or lower value inserted as required. With Marconiphone Ideal transformers these shunts are not essential, but they are very convenient for raising or lowering the volume from the loudspeaker. Do not forget to connect the 1μF and the 2μF condensers across the H.T. negatives and H.T. positives, as these all go to make better reproduction. It will also be seen that the positive low-tension terminal is connected *via* the single-way switch to the valve rheostats; this connection is of particular advantage, as one can regulate the electron emission from the filaments without altering the grid bias.

From the photographs it will be seen that the valves, transformers, grid condenser, and grid leaks are mounted on a baseboard inside the set, and that the variable condensers, rheostats, jacks, potentiometer, and aerial and earth terminals are on

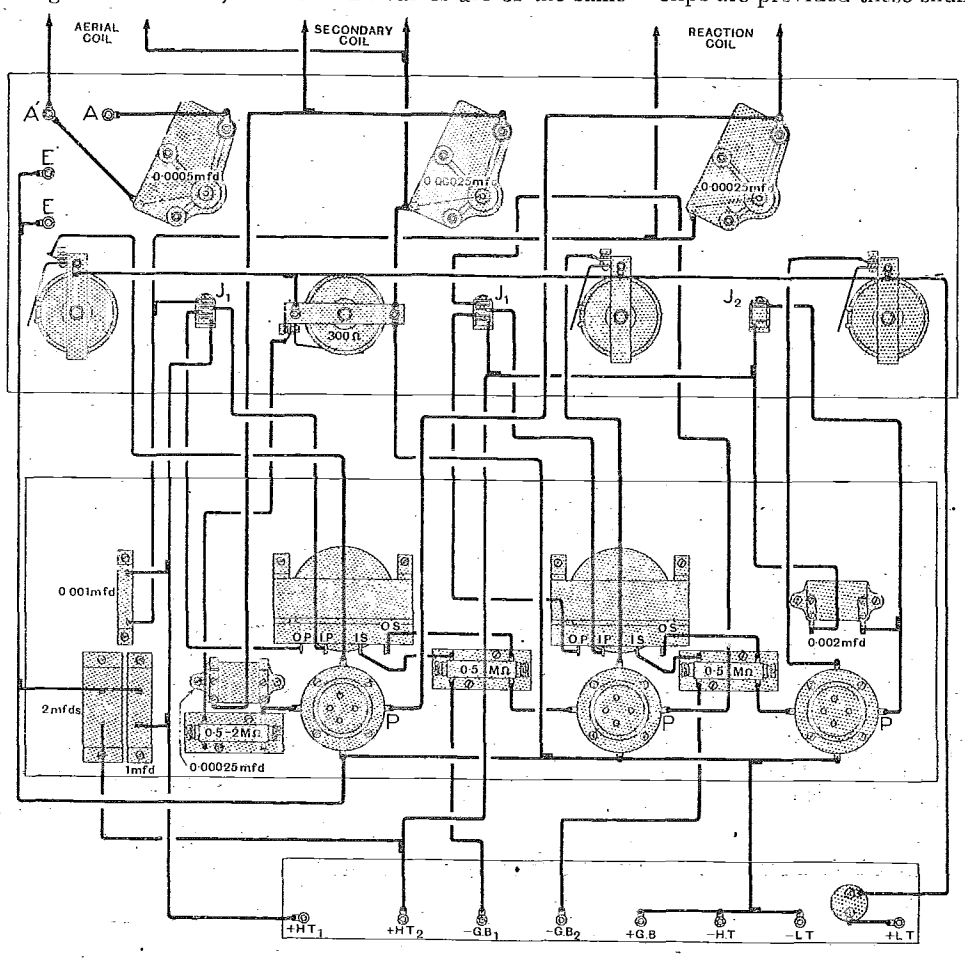


Fig. 4.—Wiring diagram. The wires marked "aerial coil," "secondary coil," and "reaction coil," are connected to the three-coil holder.

Three Valve Receiver.—

the ebonite panel. The three-coil holder is mounted on the top of the containing box, giving plenty of room for the moving coils. Here it might be mentioned that the flexible wires from the coil holder pass through short lengths of $\frac{3}{16}$in. ebonite tubing let into the top of the containing box. These flexible wires should be of the type of "flex" used for connecting electric motor brushes to the brush holders; ordinary flex will not last very long on movable coil holders.

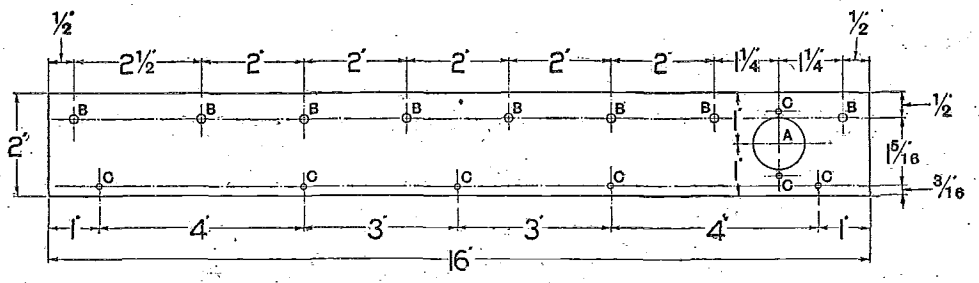
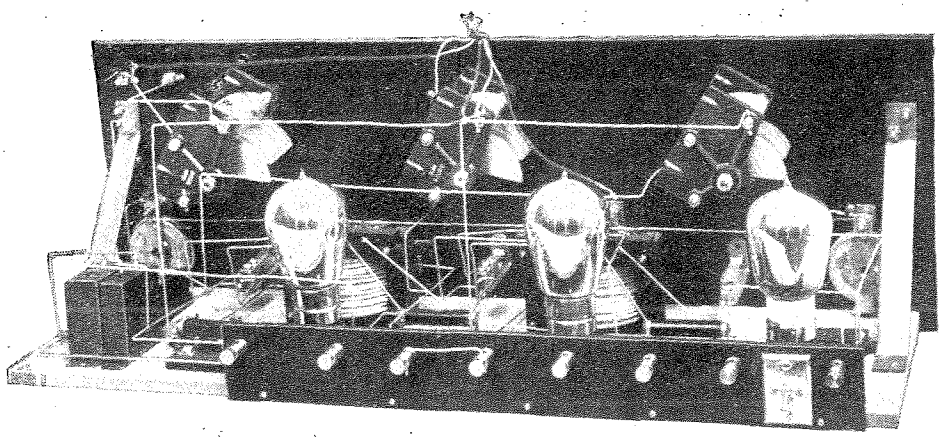


Fig. 5.—Details of the terminal strip. A, $\frac{1}{16}$in. dia.; B, $\frac{5}{32}$in. dia.; C, $\frac{3}{32}$in. dia.

In wiring up the set, connect up the rheostats, potentiometer, and filament circuits before fixing the transformers in position. The actual layout of the set can be readily understood from the photographs and drawings without detailed description, while the leading dimensions of the ebonite panel, baseboard, ebonite terminal strip, and containing box are given in Figs. 2, 3, 5, and 6. No. 16 tinned copper wire is suitable for all wiring, and should be stretched and cut into two- and three-foot lengths. Use tinned copper soldering tags and resin-cored solder, as these are little details which go to make a good set

Take plenty of time over the connecting-up part, and make sure that every connection is properly soldered; a badly soldered joint will give endless trouble, besides being very difficult to locate. A point to remember in testing out the set is that a reaction effect will be obtained by tuning the reaction coil, no matter which way it is connected, and therefore the reaction condenser should be set at zero, and a reaction effect obtained by coupling the reaction coil to the secondary coil. If signals are weakened by this adjustment, the connections to the coil should be reversed.

Tuning will be found very sharp, and both the tuned reaction and potentiometer control of the grid will take a little getting used to, but after a little practice no difficulty will be obtained in cutting out one station in favour of another.



Another view of the back of the set.

APPARATUS REQUIRED.

1 Three-coil holder (Burndept).
1 Set of plug-in coils.
3 Rheostats, 6 ohm (Igranic).
2 Jacks, Elwell type DC.
1 Jack, Elwell type SO. [phone).
3 Grid leak mountings (Marconi-
1 0·001 fixed condenser (Dubilier).
1 0·002 fixed condenser (Dubilier).
1 1 mfd. fixed condenser (T.C.C.).
1 2 mfd. fixed condenser (T.C.C.).
12 No. 4 B.A. terminals.
1 On-and-off switch (Connecticut).
½ lb. tinned copper wire.
1 Ebonite panel, 24×8×$\frac{5}{16}$ ins.
1 Ebonite strip, 16×2×$\frac{5}{16}$ ins.
1 Hardwood baseboard, 23in.×7½in.×⅜in.
1 0·0005 mfd. variable condenser with vernier (Sterling).
2 0·00025 mfd. variable condenser with vernier (Sterling).
1 Potentiometer, 300 ohms (Igranic).
2 Plugs, Elwell (one for loud speaker).
3 Valve holders, anti-phonic (Burndept).
1 Marconiphone Ideal transformer, 6 to 1, or one of equal quality.
1 Marconiphone Ideal transformer, 2·7 to 1, or one of equal quality.
1 Set of grid leaks, ·1 to 2 megohms (Marconiphone).

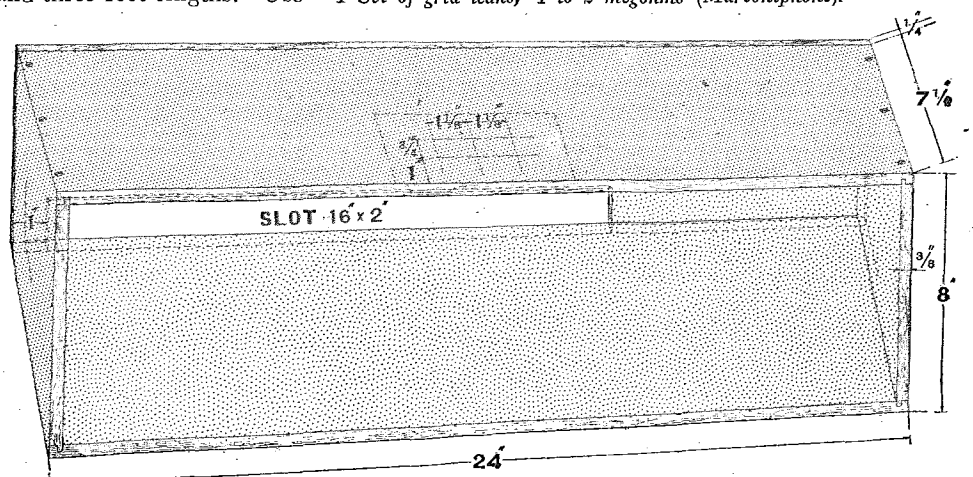


Fig. 6.—Details of the cabinet. The coil holder is mounted on the top of the cabinet as indicated.

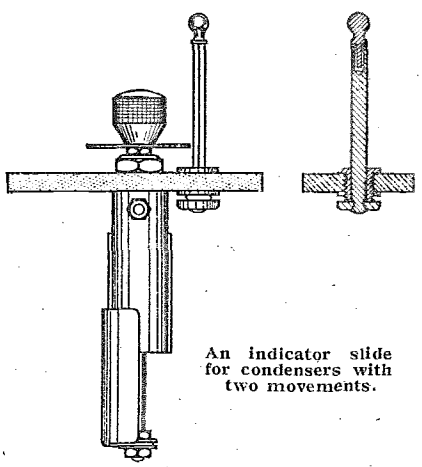
NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

AN INDICATOR FOR DIALS WITH VERTICAL MOVEMENT.

The adjustment of some vernier condensers and variable grid leaks is accomplished with a motion vertical to the panel in addition to the more usual rotary adjustment. The "Polar" vernier condenser may be cited as a typical example. With condensers of this type some difficulty is experienced in keeping records of settings for different stations and wavelengths, as the position of the rotary dial must be combined with the distance between the dial and the panel.

A convenient way of combining the two readings is to provide at the side of the dial a rod of square or hexagonal section sliding in a metal bush in the panel. The centre hole in the bush is filed or cut with a drift to the same cross-section as the sliding



An indicator slide for condensers with two movements.

rod, the length of which must not be less than the travel of the condenser spindle. The side of the indicator rod nearest to the dial is graduated in equal divisions; a spacing of 1 mm. for the divisions will be satisfactory. As the condenser spindle is withdrawn, the edge of the dial will engage the flange at the end of the indicator rod and withdraw it by an amount equal to the movement of the condenser. The number of divisions visible above the bush can then be recorded in conjunction with the readings on the condenser dial.—W. I. B. S.

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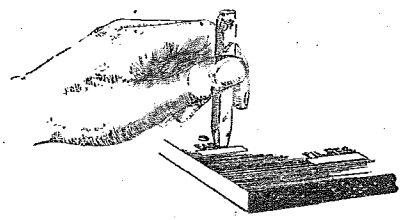
MARKING PANELS.

Those amateurs who object to marking panels with name-plates and tablets, and who are unable to obtain the use of an engraving machine, will find that lettering can be quite neatly carried out with the ordinary letter stamps used in engineering practice.



A guide for lettering punches.

The principal difficulty in using these stamps is to keep the letters in line. Owing to variations in the shape of different punches, it is difficult to estimate the exact position of the bottom edge of the letter. The sense of touch will be found very helpful in obtaining a correct alignment, and if the following method is adopted there will be little difficulty in obtaining satisfactory results.

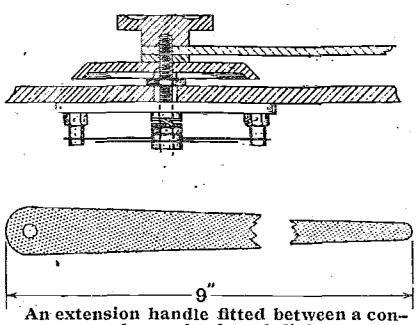
A slip of cartridge paper should be cut with a perfectly straight edge a little longer than the word which has to be inscribed and fixed to the panel with glue or paste. By drawing the punch across the panel until it touches the edge of the paper, the principal difficulty of keeping the bottom of the letters in line will be overcome. The letters are always cut parallel to the sides of the punch, so that it is a comparatively easy matter to keep the letters vertical.

A hammer of medium weight should be used, and only one blow is permissible. With a little practice the strength of the blow can be regulated to give an equal depth to each letter. The lettering may be filled in finally with a mixture of zinc oxide and paraffin wax, the excess being wiped off with a clean warm rag.—A. E. K.

oooo

A SIMPLE EXTENSION HANDLE.

Extension handles are indispensable when critical tuning adjustments have to be made. It is quite a simple matter to fit extension arms to many well-known types of condenser in which the tuning knob and dial are separate units locked together on the condenser spindle. It is necessary only to cut from sheet ebonite or wood a suitable arm, and to clamp this between the knob and



An extension handle fitted between a condenser knob and dial.

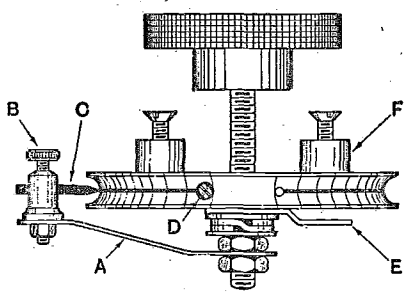
dial. A washer may be fitted, if desired, to raise the extension arm so that the scale markings may be conveniently seen.—A. T. W.

oooo

A VARIABLE GRID LEAK.

The accompanying diagram shows how a variable grid leak can be con-

structed from an old filament resistance former. The contact spring of the filament resistance is replaced with a special arm A, to which the terminal B is attached at the end. A short length of blacklead pencil which should not be softer than H is held in the terminal, and its length adjusted until it makes contact with the ebonite former throughout the whole of its movement. The spring arm should be arranged to give a slight downward pressure if an even contact is to be obtained. The end of the pencil line is connected to the terminal screw D, through the



A variable grid leak.

medium of a washer consisting of several layers of tin foil. The connection to the pencil contact C is made through the soldering washer E, which is clamped under the spring washer.—N. E. P.

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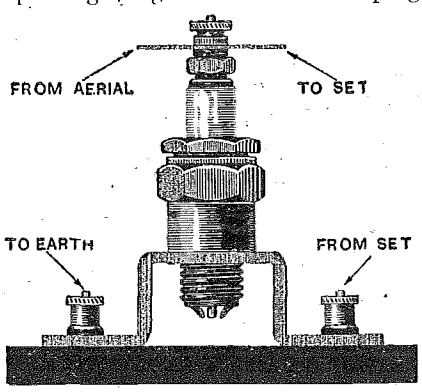
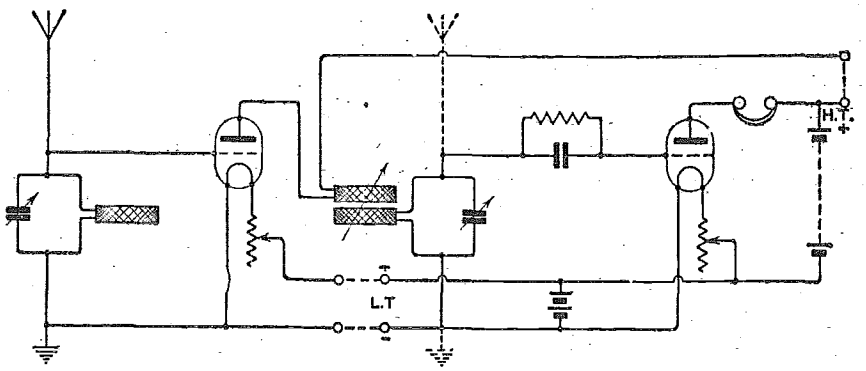
AN AERIAL SAFETY DEVICE.

A lightning arrester can be quite easily constructed from an ordinary sparking plug. A brand new plug



A sparking plug used as a safety gap.

should be used if possible, as the insulation of old plugs is not above suspicion on account of internal carbon deposits. The plug is mounted on a bridge specially drilled and tapped to take the threaded base of the plug. The method of making the connections is indicated in the diagram. It is recommended that the gap should be decreased by bending the electrodes towards each other. —D. B.

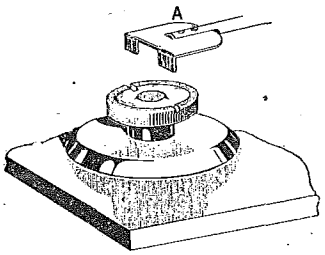


Connections of an external H.F. amplifier.

oooo

A DETACHABLE EXTENSION HANDLE.

Two slots are cut along a diameter on the edges of the condenser knob with a piece of hacksaw blade. The spade A is cut and bent to shape from sheet metal having a thickness approximately equal to the width of the slots. An ebonite rod is recommended for the extension arm, which may be slotted to take the metal spade with the same piece of hacksaw blade.—T. J. B.



Fine adjustment for condensers.

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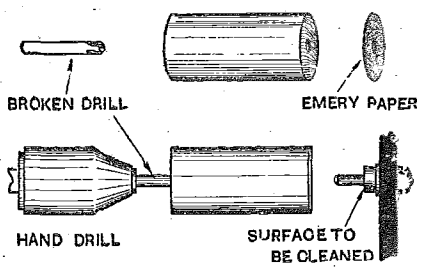
ADDING A H.F. AMPLIFIER.

A stage of high-frequency amplification can be added to an existing receiver without in any way altering the wiring. The A.T.I. is made the secondary winding of a high-frequency transformer, and a coil of a larger size will have to be employed if the same wavelength is to be received. The original A.T.I. may be used to tune the grid circuit of the H.F. valve, which is connected to the existing receiver according to the circuit given in the accompanying diagram. The coil connected in the plate circuit of the H.F. valve is coupled to the coil in the aerial circuit of the original set. The battery connections are made at three points only, as the negative terminal of the H.T. battery is already connected to the low-tension battery in the receiver. —E. A. B.

oooo

MAKING CLEAN TERMINAL CONNECTIONS.

The two surfaces of a terminal which grip the connecting wire should be cleaned from time to time to ensure a good electrical connection. The top part of the terminal can be cleaned quite easily by rubbing down on a flat piece of emery-paper. The cleaning of the base, however, is not quite so easy. A simple cleaning buff may be constructed with a piece of broken drill, a round piece of wood and a disc of emery-paper. The wood should be drilled centrally and wedged on to the broken drill, care being taken that the end surface of the wood is running true. The emery-paper disc may then be stuck to the



An emery buff for cleaning terminals.

end with glue. The buff is then held in a hand drill and applied to the terminal, and it will be found that a perfectly clean surface will be obtained.—E. A. A.

A STANDARD MULTIVIBRATOR WAVEMETER.

A Description of the Design of the Instrument and its Operation.

By W. H. F. GRIFFITHS.

IN these days of crowded wavebands and numerous radio broadcasting stations, the necessity for accurate determinations and standardisation of wavelength is ever increasingly felt. Moreover, it is felt that our electro-magnetic waves should be standardised in terms of frequency rather than in terms of wavelength since, as is well known, it is the *frequency* difference between transmission waves which determines their mutual non-interference. A standard wavemeter in which electro-magnetic waves are standardised in terms of the fundamental unit *time* has been recently developed at the National Physical Laboratory by D. W. Dye, and was demonstrated at the Exhibition of the Physical Society of London of this year by Messrs. H. W. Sullivan, Ltd., the manufacturers.

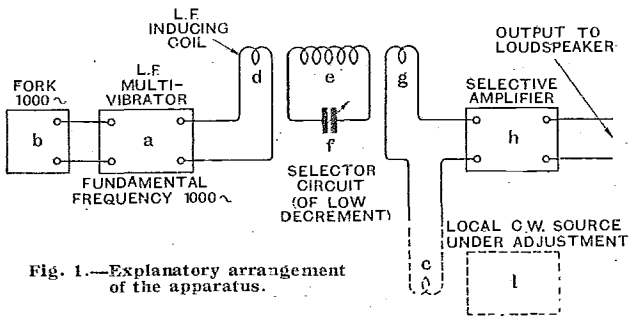


Fig. 1.—Explanatory arrangement of the apparatus.

The wavemeter depends for its action upon the control of the fundamental frequency of an Abraham-Bloch multivibrator by a standard valve-maintained tuning fork, auxiliary apparatus for the selection and selective amplification of the desired harmonics from the multivibrator being provided.

A preliminary idea of the principle of the arrangement may be obtained by reference to the diagrammatic sketch of Fig. 1, in which a system of thermionic valves *a* (termed the multivibrator) generates a discontinuous current very rich with harmonics. The tuning fork *b*, valve maintained, and generating electric impulses, of a known and standardised frequency (1,000 cycles per second), holds the multivibrator *a* in synchronism, so that the harmonic rich current itself has a known and standardised fundamental frequency.

This harmonic rich current of 1,000 cycles fundamental frequency is passed through the coil *d*, and so induces into the selector circuit *e f*, which may be tuned to resonance with harmonics of 1,000 cycles per second. Thus, by an adjustment of the variable air condenser *f*, any desired harmonic of the inducing current may be selected and reinforced in the selector circuit. By means of the coupling coil *g* the reinforced harmonic circulating in the selector circuit may be used to heterodyne a local source *l* of oscillations to be standardised. A selective four-valve amplifier *h*, tuned, naturally, to the frequency of the harmonic being selected, amplifies not only this harmonic, but also the continuous oscillation with which it is required to heterodyne, and which is superposed upon the harmonic through the medium of the additional coupling coil *c*.

It will be observed that the accuracy of standardisation of radio frequencies by this method is limited only by the accuracy of the standardisation of the vibration frequency (whilst being maintained) of the fork, which is capable of exceedingly accurate measurement. Any small changes in value of the inductance and capacity of the selector circuit do not, of course, affect the accuracy of the wavemeter, and are of no account so long as the changes are not of a sufficiently high order to cause doubt as to the particular harmonic being selected for a given condenser setting.

Arrangement of the Fork.

Now that the general idea of the scheme has (it is hoped) been conveyed, the individual parts of the wavemeter and their functioning will be briefly described.

The standard controlling tuning fork, together with its valve and associated circuits necessary for the purpose of maintaining its vibration electrically, is diagrammatically shown in Fig. 2(*a*), in which F is the fork itself.

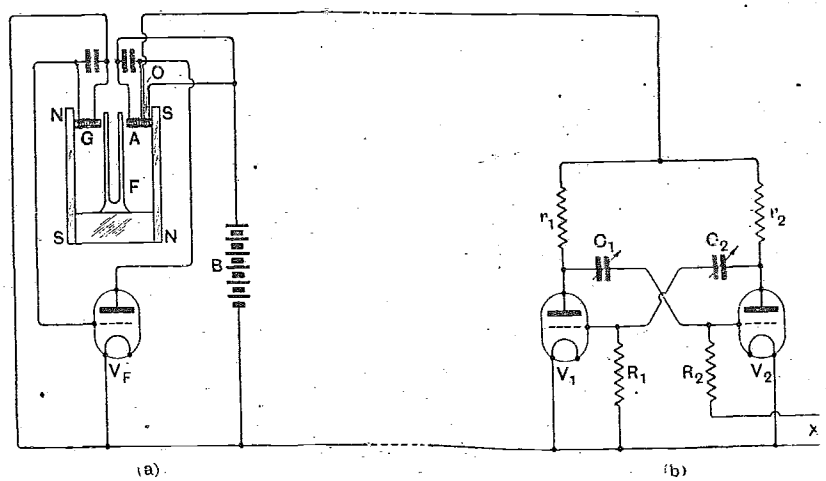


Fig. 2.—The controlling fork with its associated circuits.

A Standard Multivibrator Wavemeter.—

The method of maintaining is, of course, that well known of Eccles and Jordan. The fork is very rigidly mounted with the extremities of its prongs between two iron wire cores on which are wound coils G and A forming the grid and anode circuits of the maintaining valve respectively. These polar cores are fitted to polarising bar magnets NS, SN, the magnetic circuit being completed by means of a mild steel yoke which serves also as a clamp for the fork. The vibrations of the fork prongs induce an E.M.F. across the coil G producing variations (at the frequency of the fork) of grid potential and consequent variations of the same (fork) frequency in anode current. Provided that the grid and anode windings are correctly phased, this alternating component of the anode current will provide the energy necessary to maintain the fork in constant vibration.

A third coil O, magnetically coupled with the anode winding, serves as an output winding from which energy necessary for controlling the multivibrator is supplied.

The fork itself is balanced, and is constructed from Elinvar steel, having an extremely low temperature coefficient and arranged to be very constant. The fork frequency is adjusted by reducing the length of the prongs by grinding, the frequency, of course, being inversely proportional to the length of the prong from its extremity to its nodal point. Its frequency is adjusted as nearly as possible to 1,000.0 complete vibrations per second, several valves are selected to serve as spares for the purpose of maintaining, and with these valves the variabilities are reduced to only two or three parts in one hundred thousand. Moreover, the temperature coefficient of the fork is very small—of the order of minus 8 parts in one million per degree Centigrade *rise* in temperature. Exact measurements of the vibration frequency of the fork are made at a definite temperature, and with given valves.

The Low-frequency Multivibrator.

The other part (*b*) of Fig. 2 shows the circuit arrangement of the multivibrator (termed the low-frequency multivibrator). Two thermionic valves V_1 V_2 of the ordinary three electrode type are symmetrically coupled together by means of constant wire wound anode resistances, and grid leaks r_1, r_2, R_1, and R_2, and condensers C_1 C_2, to govern a multivibrator capable of self-generating a discontinuous current of the harmonic rich wave-form shown in Fig. 3. This curve represents the current variations in the grid circuit, and the grid potential variations will be roughly similar to the current variations. The action of this multivibrator is fairly easily followed when it is remembered that an increase of anode current in, say, the valve V_2 causes a decrease in potential of the anode of that valve, and that this diminution of anode potential is conveyed to the grid of the other valve V_1 through the medium of the grid condenser C_2, causing a decrease in the anode current of this valve with a consequent rise in the potential of its anode. This rise in potential of the anode of valve V_1 increases the grid potential of V_2, thereby accelerating the already increasing anode current of this valve. This action continues until the rising anode current of V_2 produces such a negative potential on the grid of V_1 that the anode current of the latter is reduced to zero. The negative potential of the grid of V_1, of course, gradually falls (due to leakage current passed by the leak R_1) permitting anode current to start to flow which will in time lower the potential at the foot of r_1, with a consequent reduction in grid potential, and anode current of the valve V_2, the cycle (of opposite sign) thus recommencing. It will be seen that the period of the cycle is, roughly, equal to $C_1R_1 + C_2R_2$, and, by giving suitable values to C_1, C_2, R_1 and R_2, the natural frequency of the multivibrator is made approximately equal to that of the fork, but, in order to bring the low-frequency multivibrator within the range of synchronisation of the controlling fork frequency, small portions of the condensers C_1, C_2, are made variable, and may be adjusted by the user of the wavemeter.

The high-tension battery B (fig. 2) is common to both the low-frequency multivibrator and the controlling fork, and it will be observed that the output coil of the fork

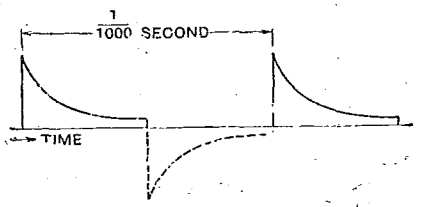


Fig. 3.—The current flowing through the low-frequency inducing coil d, fig. 1.

is also included in the common anode supply circuit of the multivibrator valves, and in this manner the controlling energy of the fork is superposed upon the normal anode supply to these valves.

During the operation of the wavemeter it is quite easy to determine whether the low-frequency multivibrator is being held in synchronism by the tuning fork. If the fork is not controlling the multivibrator, a very discordant sound will be heard in a pair of telephones placed in the grid circuit of one of the multivibrator valves, as at X (Fig. 2*b*). As the frequency of the multivibrator is brought nearer to the fork frequency by varying, simultaneously, the two condensers C_1, C_2, the discordant sound will gradually develop into a rattle of a gradually diminishing period until, finally, the multivibrator is held in synchronism, and remains so whilst the condensers are varied through a considerable capacity change. That this "holding in" adjustment is not critical may be judged from the fact that the capacity change through which the multivibrator condensers may be varied without upsetting the state of synchronism would, in the absence of control, cause a change of about 10 per cent. in the frequency of the multivibrator. The correct "control" setting for the multivibrator condensers is, of course, at the mid point of this "holding-in" region.

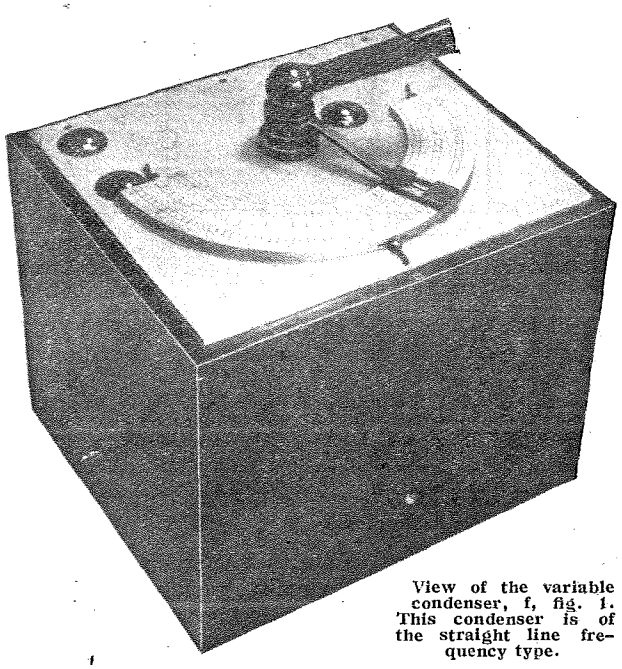
The Selector Circuit.

The output from the low frequency multivibrator is taken from the grid leak circuit of one of the valves, as at X (Fig. 2*b*), *i.e.*, the low frequency inducing coil, *d* (Fig. 1), is included in the grid leak circuit of one of these valves, and a current somewhat similar to that of Fig. 3, very rich with harmonics, is flowing in this coil.

A Standard Multivibrator Wavemeter.—

From this impulsing low-frequency multivibrator grid current of 1,000 cycles per second fundamental frequency, harmonics up to the 120th (120,000 cycles per second) are selected by the selector circuit *e f*, which consists of a large variable air dielectric condenser *f* and one of a series of interchangeable inductances *e*.

The variable condenser is of a high-grade type designed to ensure a high degree of constancy, and is of a negligibly low power factor, the only insulation employed



View of the variable condenser, f, fig. 1. This condenser is of the straight line frequency type.

in its construction being silica-quartz in the form of stout accurately ground washers. The maximum capacity of this condenser is of the order of 2,500 $\mu\mu$F., and the moving plates are shaped to give a uniform scale of *frequency*. The condenser is completely screened, electrostatically, and the moving plate system is electrically connected to this screen. A condenser of this type is illustrated above.

One of six large inductances is interchangeably plugged into sockets provided in this condenser in order to form a simple oscillatory circuit of small damping. The inductances are of low high-frequency resistance, being wound as air-spaced multilayered coils with Litzendraht wire (in the case of those of the higher values) or of solid strip. They are mounted, when in use, well away from the metallic mass of the variable condenser.

The efficiency of this selector circuit is such that its logarithmic decrement has an average value of about 0.008 over the whole range of wavelengths covered.

The Calibrated Amplifier.

Coupled to the selector circuit inductance is an "amplifier coil," the function of which is to superpose the selected and reinforced harmonic (which is circulating in the selector circuit) upon the local source of oscillations, Fig. 1, through the medium of another coupling coil *c*, and to couple to the input of the four valve selective amplifier *h*. This amplifier has one radio-frequency amplifying stage, a detector and two note frequency amplifying stages. The coupling coils *g* and *c* are connected (in series) directly between the grid and filament of the first valve, in the anode circuit of which is an efficient oscillatory circuit forming a tuned anode coupling to the next (detector) valve, from which retro-action coupling to the tuned anode circuit is taken. The tuning of the amplifier is in this way arranged so that any frequency between the limits of 8 and 2,000 kilocycles per second can be very selectively amplified and rectified. The amplifier is calibrated so that it can be readily set to amplify only at the frequency of the harmonic being selected. Retro-action can be made sufficiently strong to cause the amplifier to maintain self-oscillation if desired, but when in use in connection with the external source of oscillations to be standardised, however, the retroactive coupling must stop short of the self-oscillating point. The degree of note frequency amplification is such that a loud speaker can normally be used with the wavemeter.

When adjusting the local source of oscillations during standardisation, to an exact frequency corresponding to any odd or even harmonic of 1,000 cycles per second between the limits of 10 kilocycles and 120 kilocycles, say the 20th harmonic (20 kilocycles), the natural frequency of the selector circuit is adjusted to 20 kilocycles (by setting the variable condenser to a previously calibrated scale marking), and the selective amplifier is also adjusted to a wavelength corresponding to this frequency. The local source may now be made to heterodyne the selected harmonic, the usual characteristic heterodyne "beat" being heard from the loud speaker. In addition, however, when the source has been set to exact synchronisation with the selected harmonic (*i.e.*, where there would ordinarily be dead silence) a note of 1,000 cycles per second is heard; a note due partly to direct coupling from the multivibrator and partly to the rectification by

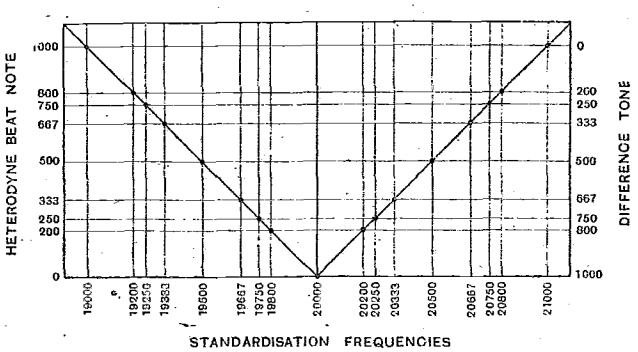


Fig. 4.—Intermediate standardisation points, indicating both the heterodyne beat note and the corresponding difference tone, which, by interference, give rise to each slow synchronisation beat.

the selective amplifier of the modulated current in the selector circuit.

Exact synchronisation between local source and selected harmonic is recognised by slow "synchronisation beating," the period pulsations of which occur at gradually lengthening intervals until, when the condition of exact synchronisation is very nearly approached, they occur at a frequency of about one or two per second.

A Standard Multivibrator Wavemeter.—

The residual note of the fork frequency occurring at exact synchronism assist standardisation by providing other synchronising beats when the source is varied off the exact synchronisation point, due to the synchronisation beating between the 1,000 cycles permanent note and a 1,000 cycles heterodyne beat note, and at certain other heterodyne beat notes (such as 500, 250 and 200) due to the synchronisation beating between these notes themselves (or harmonics of them) and difference tones due to the interference between the beat notes and the permanent note of 1,000 cycles per second.

Arranged below is a tabulation of *some* of these slow synchronisation beats, useful in standardisation, occurring between the 19th and 20th harmonics directly available from the selector circuit.

Maintaining Synchronism.

Fig. 4 graphically depicts these intermediate standardisation points, indicating both the heterodyne beat note and the corresponding difference tone which, by interference, give rise to each slow synchronisation beat.

With the above-described arrangement, i.e., fork—low-frequency multivibrator—selector circuit—selective amplifier, it is only found practicable to select and use harmonics up to the 120th, giving frequency standardisation up to 120 kilocycles per second, corresponding to a wavelength of 2,500 metres. For frequencies higher than this a second multivibrator (termed a high-frequency multivibrator) is used. This high-frequency multivibrator is shown in the second half (*b*) of Fig. 5, and it will be seen that it is very similar to the low-frequence multivibrator, with the exception that inductances L_5 L_6 are used in this case instead of non-inductive anode resistances. The natural (uncontrolled) frequency of oscillation of this high-frequency multivibrator is arranged to be approximately 20 kilocycles, but this frequency has, of course, to be controlled in some way by the tuning fork. This is accomplished in the manner to be described later, and we thus have a high-frequency multivibrator

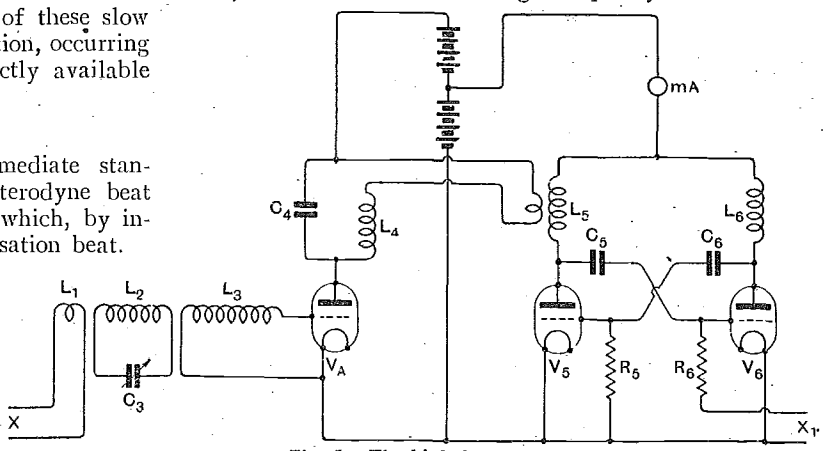


Fig. 5.—The high-frequency multivibrator.

set operating to supply (to the inducing coil coupled to the low-decrement selector circuit) impulses having a fundamental frequency of exactly 20 kilocycles per second from which can be selected harmonics up to the 60th, giving standardisation frequencies up to

$$60 \times 20{,}000 = 1.2 \times 10^6 \text{ per second,}$$

corresponding to wavelengths down to 250 metres.

The high-frequency multivibrator is held in synchronism by the tuning fork in the following manner, reference being made to the diagrams of Fig. 2 and Fig. 5. The *low*-frequency multivibrator, vibrating at 1,000 periods per second, and held in synchronism by the tuning fork, being no longer required to impulse the low-decrement selector circuit, induces into another selector circuit, L_2 C_3 Fig. 5(*a*), through the medium of the inducing coil L_1, which is the output X from Fig. 2(*b*). This selector circuit may be tuned to 19, 20, or 21 kilocycles per second, and may therefore be made to select the 19th, 20th, or 21st harmonics of the fork-controlled low-frequency multivibrator. The selected and reinforced harmonic (usually the 20th) is then applied, through the medium of a large inductance coupling coil, L_3, to the grid of a single-valve thermionic amplifier, V_A, in the anode circuit of which is an oscillatory circuit, L_4 C_4, which is fairly flatly tuned to 20 kilocycles. Energy from this tuned anode circuit is employed to control the oscillation frequency of the high-frequency multivibrator by magnetic coupling between the inductances L_4 and L_5.

The uncontrolled oscillation frequency of the high-frequency multivibrator must, however, be brought within the frequency range of synchronisation by a very fine adjustment of filament current of the valves V_5 V_6, two

Harmonic to which the Selector Circuit is Set.	Heterodyne "Beat" Note (Cycles per Second).	Difference Tone between 1,000 Cycles and "Beat" Note.	Frequency of Local Source being Standardised (Cycles per Second).	Wavelength of Local Source in Metres.	Synchronisation Beating occurring between:
20th*	0	1,000 (fork frequency).	20,000	15,000	Exact synchronisation beating.
20th	200	800	19,800	15,151.5	4th harmonic of beat note and fundamental of difference tone.
20th	250	750	19,750	15,189.9	3rd harmonic of beat note and fundamental of difference tone.
20th	333.3	666.6	19,666.6	15,254.2	2nd harmonic of beat note and fundamental of difference tone.
20th	500	500	19,500	15,384.6	Fundamental of beat note and fundamental of difference tone.
20th	666.6	333.3	19,333.3	15,517.3	Fundamental of beat note and 2nd harmonic of difference tone.
20th	750	250	19,250	15,584.4	Fundamental of beat note and 3rd harmonic of difference tone.
20th	800	200	19,200	15,625.0	Fundamental of beat note and 4th harmonic of difference tone.
20th	1,000	0	19,000	15,789.5	Fundamental of beat note and fork tone fundamental.

* The 20th harmonic is here meant to be a frequency of 20 *n* where *n* is the fork frequency in complete vibrations per second.

A Standard Multivibrator Wavemeter.—

filament rheostats, one coarse and the other very fine, being provided for this purpose. The milliammeter shown in Fig. 5(*b*) indicates the anode current supply to the two multivibrator valves, and gives some idea as to when the frequency is correctly adjusted to within the synchronisation range. The condition of synchronism is distinguished by the gradual slowing up of a discordant clucking sound until a final quiet synchronisation region is obtained, the correct "control" setting, of course,

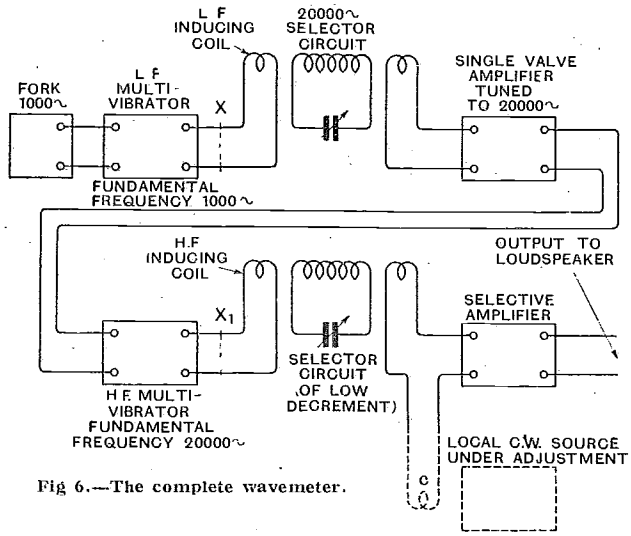


Fig 6.—The complete wavemeter.

being at the mid-point of this "holding in" region, as in the case of the low-frequency multivibrator. Constancy of supply from the filament and anode batteries is essential if the high-frequency multivibrator is to "hold in" for long periods without readjustments of the filament rheostats. The high-frequency multivibrator takes about ten minutes or so to settle down into a steady state of oscillation, and it is no use trying to synchronise it until this period has elapsed after switching on.

The output from the high-frequency multivibrator is taken from the grid-leak circuit of the valve V_6, as indicated by the leads X_1 Fig. 5, which terminate in the "high-frequency inducing coil" shown in Fig. 6. This inducing coil impulses the low-decrement selector circuit at a fundamental frequency of 20 kilocycles per second, the selection and selective amplification of the harmonics of which is performed as when inducing by means of the low-frequency multivibrator direct, except that now the standardisation frequencies available by successive harmonic selections will be 20 kilocycles per second apart, instead of 1,000 cycles per second. A further series of interchangeable inductance coils of lower values are now used to form the low-decrement selector circuit, and a different set of harmonic calibrated scales are used with the variable air condenser of this circuit.

The Complete Wavemeter.

The complete scheme for the wavemeter as set up for the standardisation of the higher frequencies is given in Fig. 6, which should by now be self-explanatory.

When using the high-frequency multivibrator in this manner, sub-harmonics occur when the local source being standardised is varied off the setting of exact synchronism with a main selected harmonic, and these give useful intermediate standardisation frequencies between the main harmonics. As an example of these sub-harmonics, those occurring near to the 30th harmonic of the high-frequency multivibrator (600,000 cycles per second) are indicated in Fig. 7, which also gives some idea of the relative ease with which they are recognised. From this visual picture of events it will be seen that, in addition to the slow synchronisation beats occurring when the source is set to the exact proximity of the 30th harmonic which is being selected by the low-decrement selector circuit, other slow synchronisation beats or pulses occur when the heterodyne beat note has frequencies of 1,000, 2,000, 3,000, etc., on either side of 600,000 cycles per second, due, of course, to interference between these beat notes and the permanent note of the fork frequency. The further synchronisation beats at frequency differences of 200, 250, 333·3, and 500 cycles per second from the sub-harmonic settings of the source may also be heard by careful listening and by setting the source with extreme precision. In order to obtain frequency standardisation points midway between the lower main harmonics selected when the high-frequency multivibrator is oscillating at a frequency of 20 kilocycles per second, the 19th or 21st harmonics of the low-frequency multivibrator are selected by the circuit L_2 C_3 of Fig. 5(*a*) in order that the controlled fundamental frequency of the high-frequency multivibrator shall be 19 kilocycles or 21 kilocycles respectively. The selection of, say, the sixth harmonic of the high-frequency multivibrator would then, for example, give standardisation frequencies of 114 and 126 kilocycles per second, instead of 120 kilocycles. This method of changing the high-frequency multivibrator control proves useful in bridging the rather large wavelength gap existing between the sixth and seventh harmonics of 20 kilocycles.

In addition to the calibration of sub-standard wavemeters, the standard multivibrator wavemeter may be

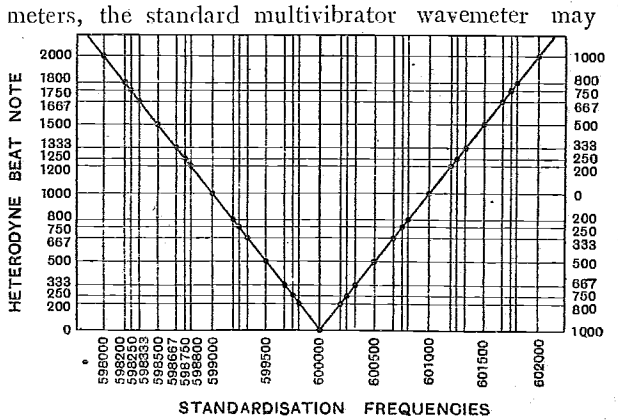
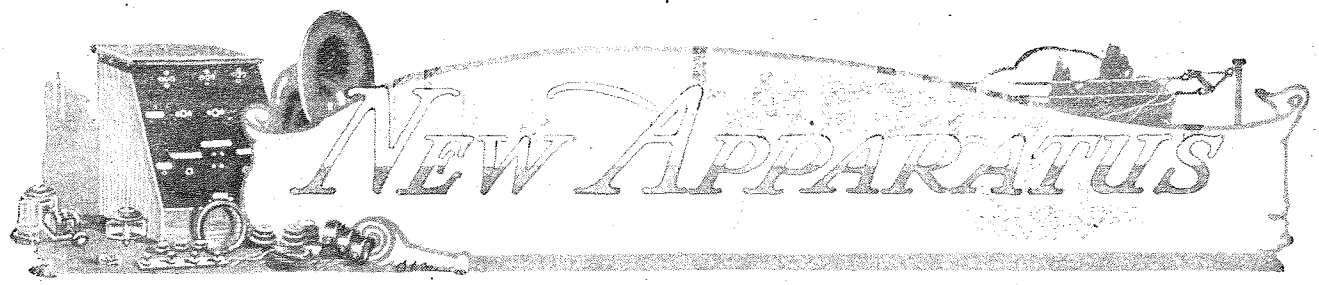


Fig. 7.—Intermediate stardardisation frequencies.

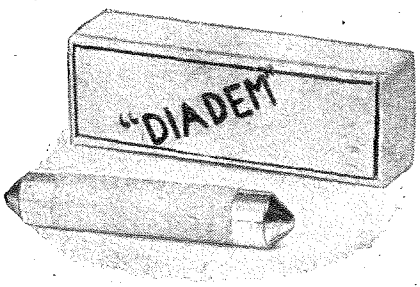
used for the measurement of frequency of received waves and for the measurement and adjustment of transmitted waves. For the measurement of received waves, a local source of oscillations is used, and interpolation is employed between its variable condenser readings corresponding to the harmonics or sub-harmonics nearest to the frequency of the received waves. When measuring the frequency of transmitted waves, the apparatus is best set up at a distance from the transmitter, and leads run from the amplifier to the transmitting station.



A Review of the Latest Products of the Manufacturers.

THE "DIADEM" GRID LEAK.

Messrs. C. Hughes, Diadem Works, Tenby Street North, Birmingham, have produced a neat and reliable grid leak having a resistance of 2 megohms. Each resistance is carefully tested before leaving the works, and the resistance value



A new grid leak.

engraved on the outside. The leaks are supplied in black or red colour, and the retail price is 1s. 6d. each.

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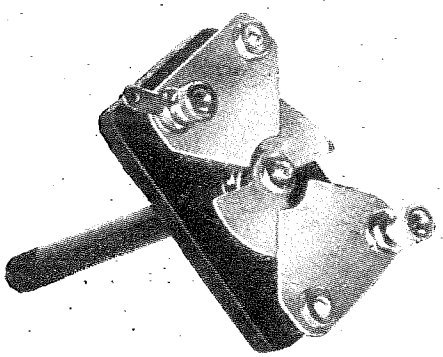
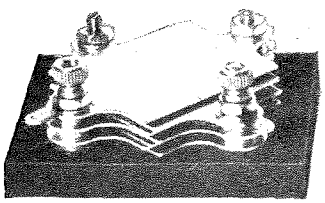
TWO NEW ORMOND PRODUCTS.

The Ormond Engineering Co., Ltd., 199-205, Pentonville Road, King's Cross, London, N.1, have produced a small variable condenser which should prove very useful in neutrodyne circuits. The condenser terminals are connected to two fixed vanes, and their mutual capacity is varied by a specially shaped rotating vane. The condenser is neatly made, and the short ebonite extension handle considerably reduces hand capacity effects.



The Ormond neutralising condenser.

The same firm has also produced a small fixed air dielectric condenser for use on short wavelengths. The efficiency of the air dielectric condenser renders its use on short wavelengths a necessity if maximum signal strength is to be obtained. The condenser can be



A low-loss air dielectric condenser.

used in series with the aerial as in the short-wave receiver described in the issues of this journal for October 8th and 15th, 1924, and numerous other uses will suggest themselves to the experimenter.

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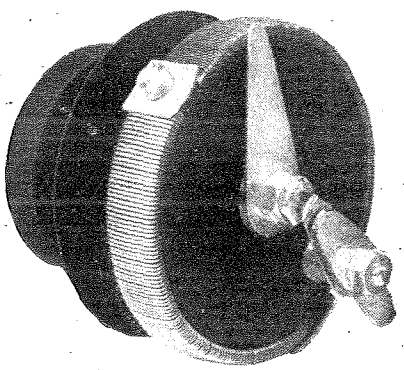
A DUAL FILAMENT RESISTANCE.

A filament resistance of improved design has recently been put on the market by Messrs. L. McMichael, Ltd., Hastings House, Norfolk Street, Strand, London, W.C.2, which has resistance



The McMichael dual filament resistance.

ranges suitable for both bright and dull emitter valves. The resistance elements are wound round a strip of insulating material which is screwed to the periphery of an ebonite disc. The first half of the winding is suitable for dull emitter and the second half for bright emitter valves. The contact arm is lifted off the windings at the junction between the two segments by a special metal washer. Contact with the spindle and rotating arm is made through a spring contact brush resting on top of the spindle. Only one hole is necessary to fit the resistance to the panel. A bevelled dial is used to indicate the amount of resistance in the circuit, and is marked with two scales, one in white for dull emitter valves and the other in red for bright emitter valves.

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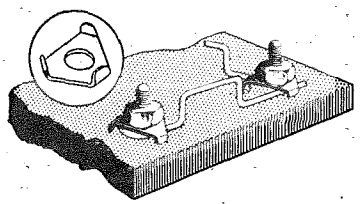
A SUBSTITUTE FOR SOLDERED CONNECTIONS.

The "Gripsit" wiring washer produced by Messrs. Kirby Banks Screw Co., Ltd., Beeston, Leeds, is of great utility in making wire connections to valve sockets,



The "Gripsit" wiring washer.

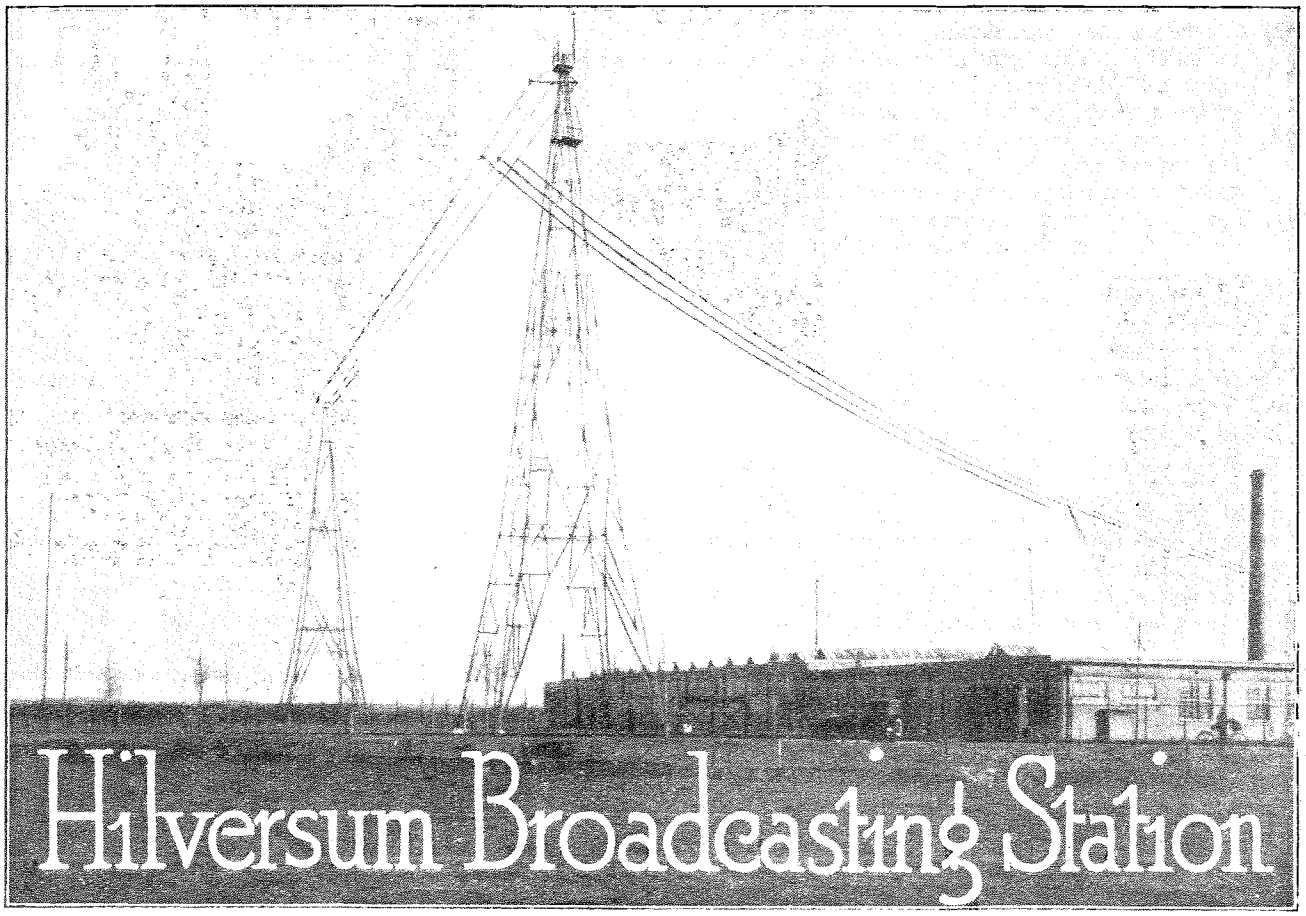
etc. When ordinary circular washers are employed, it is difficult to prevent the wire from slipping out unless it is bent round the screw. The "Gripsit" washers are triangular, and are bent over at the points to prevent the wire from moving when the nut is tightened down. Several wires and washers can be built up under each nut.

oooo

A CONDENSER EXTENSION ROD.

When the top of a condenser spindle is threaded to take the tuning dial and knob the extension rod manufactured by Messrs. A. W. Bryant, 83, Balham Park Road, London, S.W.12, may be used with advantage when tuning on short wavelengths. The ebonite rod is $\frac{3}{8}$in. in diameter, and is fitted with brass caps at each end. One knob is threaded internally to fit the condenser spindle, and the condenser knob may be fitted to a projecting screw at the other end. The total length of the extension rod is $6\frac{1}{2}$in., and the retail price is 1s.

An ebonite extension rod for variable condensers



Hilversum Broadcasting Station

A Description of the New High Power Station in Holland.

By F. C. OSORIO.

ABOUT a year ago the directors of The Nederlandsche Seintoestellen Fabriek (Dutch Wireless Apparatus Factory) at Hilversum became interested in the transmission of music by wireless, and wireless experiments were commenced. A modest experimental transmitter was built up with an aerial slung between two 70ft. field station masts. During the tests an occasional Sunday concert was transmitted, the consequence of which was that thousands of letters arrived from enthusiastic listeners, who, to keep these entertainments going, contributed sufficient money to allow two concerts a week to be broadcast. Eventually the managers of Philips' Lamp Works became interested, and, by the gift of two 200ft. steel towers, made it possible for the station to radiate five times its original energy.

From then onwards a great deal of experimental work has been done on the transmitter in order to obtain maximum energy radiation, together with good quality speech and music—two exceedingly difficult things to obtain at the same time.

The station itself is situated in one of the buildings belonging to the N.S.F., and as most of the space here is taken up by the factory's offices, only four rooms are available in which to house the entire plant.

A room 24 × 18ft. in size, draped with one thickness of felt to prevent echo effects, is used as a studio. The microphone is of the Marconi moving coil type, and is suspended in the conventional manner from an oak stand. The energy from the microphone is taken by a shielded cable to the first amplifier room.

The Transmitting Equipment.

A combined resistance-capacity coupled and transformer coupled amplifier giving a voltage amplification of the order of 10,000 times is employed. The valves and amplifier are carefully supported to stop microphonic noises, and the whole is screened from high- and low-frequency currents. In the experimental stages the valves were usually protected by keeping them in their cotton-wool packing boxes and making contact to the pins where they projected out of the box. That this was effective was proved by the quality of the amplification. The energy is taken from here to the control room, which contains

(*a*) The power amplifier of four valves, giving a voltage of amplification of about 400.

(*b*) Potentiometers arranged so that the person in charge of the controls can vary the input and output of the amplifier and thus correct for different intensities of sound at the microphone.

Hilversum Broadcasting Station.

(*c*) A receiver for ascertaining the quality of the radiation. This generally consists of a two-valve set (detector and note magnifier), without aerial or earth, connected to a small loud-speaker.

(*d*) Apparatus for connecting up telephone wires to the second amplifier, which is used when programmes are relayed from concert halls, etc.

(*e*) The filter apparatus used to correct for distortion due to the microphone, and, more important still, that due to long telephone wires. The transformers used throughout the amplifiers and line systems are of the Marconiphone type.

The energy leaves this amplifier for the transmitter, which is of the "choke control" type as used in the B.B.C. stations. A 50-cycle 3-phase current transformed from 220 to 8,000 volts and smoothed, is applied to the transmitting valves. One valve is employed as a master oscillator to excite the grid of the main valve, producing an aerial current of 12 amperes, or an aerial energy of 750 watts. The modulating system consists of one sub-modulator valve rated at 500 watts, which is resistance coupled to one main modulator valve, a Philips 10-kilowatt water-cooled valve with a negative grid potential of 700 volts.

The aerial system consists of three wires 600ft. long slung between two steel towers, and a counterpoise of eight wires 750ft. long and 155ft. high.

Results Expected.

Concerts are paid for by public subscription and by Messrs. Philips. They take place every Sunday at 7.40 p.m., Monday at 5.40 p.m., and Friday at 7.40 p.m. On Thursday evening concerts are relayed from the Amsterdam Concert Gebouw (Hall). During these transmissions those in charge of the controls at N.S.F. follow the music with the score in front of them, so as to be prepared for any change in volume. Some difficulty was experienced in placing the microphones in the hall, as for small orchestras it is necessary to place microphones near every set of different instruments, and, where singers and choruses are concerned, near the sections of different voices, so that any combination of microphones can be switched in at will. After much experimenting, however, the N.S.F. engineers placed two microphones right at the feet of the conductor. In passing, it may be mentioned that these concerts are well worth listening to and should be comfortably audible on a two-valve set. During the beginning of January the writer was able to visit N.S.F. and see for himself the station's layout. Everything was just developing from the experimental state to that of the finished broadcasting station, and though the public and Messrs. Philips have very generously helped to keep the station going, a large staff, or even a sufficient one, cannot yet be employed.

A point of interest regarding this station is that it is at present only second to Chelmsford as regards power in Europe, and the engineers are doing their best to reach Chelmsford's high standard of quality, after which they hope to beat it. In comparison Chelmsford received in Holland is about 15 per cent. better all round than Hilversum received here, which is good considering the limits to the station's resources.

Reports as to reception of N.S.F. are useful to the engineers and are much appreciated. They should be addressed to

N.S.F.,
Hilversum,
Holland,

and should contain details regarding strength, quality, steadiness of transmission, receiver used, and so on.

Calls Heard.

Extracts from Readers' Logs.

Halifax.

American:—1ANA, 1AJA, 1ARY, 1AT, 1BDX, 1BES, 1BCQ, 1CMP, 1CPU, 1CX, 1DA, 1FD, 1GBL, 1LC, 1PL, 1SW, 1ZT, 2AR, 2BRC, 2BQU, 2BW, 2BY, 2CE, 2CJB, 2GK, 2CLA, 2EB, 2PD, 2TP, 2TQ, 3BG, 3CHA, 3HG, 3HH, 3LR, 8TR. *Canadian*:—1AR. *Dutch*:—OGC, OZN. *Belgian*:—3AS, 4AS, 4AU. *French*:—8BV, 8CT, 8FJ, 8GN, 8HSD, 8IP, 8LF, 8MJM, 8NK, 8PL, 8PS, 8RA, 8RF, 8RG, 8SSC, 8SSU, 8TK, 8WA, 8WU, 8XH, 8YN. *Italian*:—1VR, 1CF, 1MT, 1RT, SMB. *Swedish*:—SMPL, SMXY, SMYV, SMYY. *Swiss*:—9AA. *Finnish*:—2NAM. *Mosul*:—GHH. *British*:—6NH, 6RM, 6GH, 6NF. *Russian*: NRL (Radio Laboratory, Nijni-Novgorod).

(All below 100 metres.)

J. W. Jagger.

Ilkley, Yorks.

British:—2CC, 2DR, 2DX, 2FN, 2KW, 2LZ, 2MM, 2NB, 2NM, 2OA, 2OD, 2OG, 2SH, 2VO, 2VS, 2VX, 2XY, 5JH, 5MA, 5MO, 5OK, 5TZ, 5UL, 5UQ, 5US, 5WI, 6CH, 6GH, 6IG, 6FG, 6MX, 6NF, 6NH, 6TD, 6UV, 6QB, 6XJ. *French*:—8AZ, 8BF, 8CT, 8EX, 8GG, 8GK, 8GL, 8GP, 8QG, 8RF, 8SO, 8SSU, 8TK, 8UU, 8WU, 8WV. *Dutch*:—OBA, OGG, OH, OLL, ORE, OZA, OZZ. *Belgian*:—4UC, 4ALS, 4AU. *Finnish*:—2NN, 2NCA. *Danish*:—7EC. *Italian*:—1RT, 1MT. *Swiss*:—9LA. *U.S.A.*:—1IYN, 1SW, 2CVJ. *Unknown*:—1CF, 1AM, 1KX, YZ, 1DO, PCRR, SHER, EAR6.

(All below 120 metres.) (0-v-0 Armstrong Super.)

G. H. Ramsden (6BR.)

W. Ealing.

French:—8MN, 8SSU, 8BN, 8GK, 8HSM, 8FNN, 8UU, 8CSM, 8EB, 8FV, 8AAA, 8DE, 8CPP (?), 8BQ, 8PL, 8CS, 8HSD, 8AGL, 8AP, 8RF,* 8TH, 8HSG, 8EE, 8MJM, 8HGU, 8DL. *Danish*:—7EC. *Italian*:—1ER, 1CO. *Finnish*:—1NA, 2NM. *Belgian*:—4RS. *Swedish*:—SMZZ. *Swiss*:—9BR. *American*:—1PL,* 1AWF, 1KC,* 1RP,* 1ABF, 1XA, 1DAC, 1AG, 1SU, 1BL, ZCVU, ZBY, ZABG,* 2AL, RBG, 3AEW, 3BWT, 4IO,* 4CK,* 5HL, 8DO, 9CU, 1SW, 2BM, 1ER, 2GK, 2CXY.

* Received in daylight. (0-v-1.)

W. W. Crabbe.

Wavertree, Liverpool.

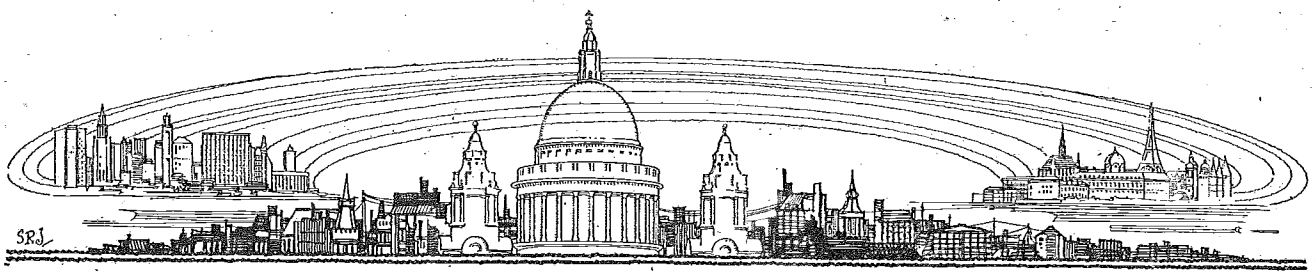
British:—2IV, 2VU, 2PP, 2SS, 2LV, 2FM, 2SZ, 2WJ, 2NM, 2JF, 2UG, 2WY, 5UU, 5TZ, 5AJ, 5CC, 5GN, 5YZ, 5LS, 5MA, 5PU, 5PZ, 5MO, 5DA, 5GC, 5WI, 6NF, 6TM, 6KK, 6RW. *U.S.A.*:—1BDX, 1ARA, 1RBS, 1AXN, 2CC, 2PC, 2NK, 2BCO, 2PU, 2RB, 2YVJ, 2XAM, 2CVJ, 4SB, 9BR. *French*:—8UU, 8FL, 8KX, 8BP, 8CPP, 8BO, 8DV, 8RG, 8XR. *Italian*:—1WBI, 1NU, 1MT, 1DD. *Finnish*:—1NA, 1NU, 2NC. *Argentine*:—CB3, CB8. *Canadian*:—1AR. *Unknown*:—ZU, YZ, ZI.

H. Hardy (G2AOX).

Lowestoft.

British.—2BQ, 2MQ, 2TF, 2YQ, 5KC, 5VG, 6ME, 6RY. *French*.—8ALG, 8AOA, 8CO, 8CVA, 8GN, 8HRA, 8PBR, 8RF, 8RCN, 8TH, 8UT, 8WY, 8WP, 8WJ, 8YY. *Dutch*.—0NF, 0NL, PCI. *Belgian*.—4AS, 7GF. *Finnish*.—5NQ. *Italian*.—1CO, 1WB, 3MB. *German*.—1RB. *American*.—1ARY, 1BWX, 2BQS, 2JF, 4XV. *Unknown*.—7XX, 3AA. (calling test on above 130 metres), c.w. R6.

(0-v-1.) P. L. Savage (G2MA).



CURRENT TOPICS

Events of the Week in Brief Review.

NEW AUSTRALIAN BROADCASTING STATION.

Plans are being completed for the erection of a new broadcasting station at Brisbane. A 5 KW. transmitter will be employed, the constructional work being carried out by the Amalgamated Wireless of Australia.

oooo

WIRELESS SETS IN SWITZERLAND.

For the benefit of readers who may be travelling to Switzerland and who desire to take a wireless set into the country, we publish the following particulars of the present regulations, forwarded by the Swiss Legation in London.

An application to take a wireless set into Switzerland must be addressed to "Direction Générale des Télégraphes et Téléphones," Berne. It should contain these particulars:—Name and surname, exact address, date of birth, nationality, and dates of arrival and intended departure. If possible the applicant should also indicate his route and places of residence in Switzerland.

oooo

A BROADCASTING TEXT.

A text singularly expressive of the sentiments of the broadcast listener who prefers to enjoy his church service at home, has been lighted upon by the Rev. Father Degen, of Coalville.

The text is: "Faith cometh by hearing"; but the Reverend Father is opposed to broadcast services, caustically remarking that many persons prefer listening-in so as to be freed from "the nuisance of church offertories."

oooo

SIGNALS FROM FRENCH INDO-CHINA.

Test signals from HVA (Tonkin, French Indo-China) have been picked up by Mr. Marcus Samuel (5HS) of N.W. London. HVA was working with a French Army station at 10.15 a.m. on March 25th, using pure C.W. on a wavelength of 100 metres. He was employing a power of 90 watts.

Did any other readers pick up this transmission?

CHILDREN'S PROGRAMMES FROM PTT.

For the first time in its history, the Ecole Supérieure Station in Paris now broadcasts a "Children's Hour." A course of Esperanto is also being broadcast once a week.

oooo

AUSTRALIAN AMATEUR ASKS FOR REPORTS.

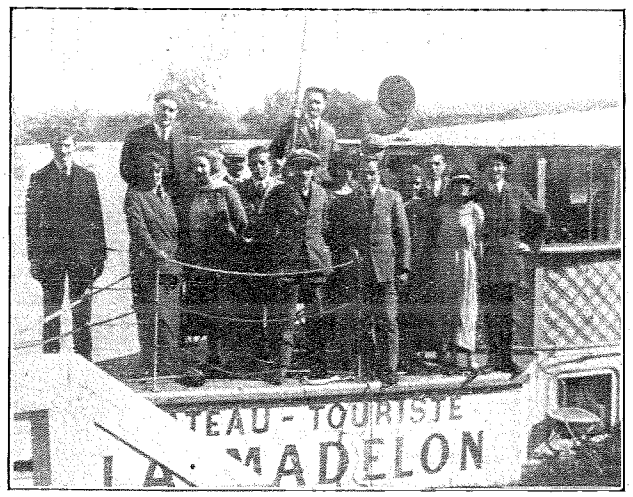
An optimistic request, in view of the approaching summer, comes from Mr. P. Spencer-Nolan, Australian 2YI, who states that he would be grateful to receive reports from English amateurs who pick up his signals. His full address is 152, Bellevue Road, Double Bay, Sydney, N.S.W., Australia. No particulars of wavelength are given.

oooo

FRENCH CLUB'S FLOATING LABORATORY.

A floating wireless laboratory will shortly be in use by the Société Française d'Etudes de T.S.F., it having been decided to transfer the whole of the club's transmitting and receiving equipment to an old tug boat on the Seine. Financial reasons are partly responsible for this decision, although it is felt that many technical advantages will incidentally be gained. The Society has had previous experience in operating on the Seine, for in the autumn of last year highly successful transmission and reception tests were carried out when the members journeyed down the Seine on a hired steamer.

The tug boat will serve a useful purpose in connecting up the various affiliated societies situated on the banks of the Seine. The Society's call sign is 8AE.



WIRELESS EXPERIMENTS ON THE SEINE. The advantages of a mobile experimental plant have been recognised by the Société Française d'Etudes de T.S.F., and the whole of the club's equipment is being transferred to a tug-boat on the Seine. Members are here seen enjoying a "Field Day" on the river.

oooo

DEBATE ON WIRELESS TIME SIGNALS.

The British Horological Institute announces that a debate will be held at the Institute, 35, Northampton Square, London, E.C.1, on Wednesday, April 22nd, at 6.30 p.m. on the subject of Wireless Time Signals, and the most desirable type of transmission code from the point of view of the watch, clock, and chronometer manufacturers in the British Isles. The debate will be open to all interested in the subject.

oooo

LISTEN FOR 3XR.

Special transmissions with an underground aerial are now being conducted from 3XR, the experimental station of the Rogers Research Laboratory at Hyattsville, Maryland, U.S.A. In a cable received by *The Wireless World* the operators state that transmissions will take place daily except Sunday on a wavelength of 170 metres from 6 to 7 p.m. Eastern Standard Time (11 to 12 p.m. G.M.T.). Sharp tuning is necessary for reception. We shall be glad to receive reports from any readers who pick up these transmissions.

oooo

EIFFEL TOWER FAILS TO SATISFY.

It should in one sense be a source of gratification to the B.B.C. to know that recent experimental transmissions from the Eiffel Tower broadcasting station on a wavelength of 1,500 metres met with French disapproval because this wave-

length hindered the reception of the Chelmsford programmes.

The regular wavelength of 1980 metres is also causing displeasure owing to interference by Spanish stations, and listeners are asking why the Eiffel Tower cannot use a wavelength in the neighbourhood of 1,100 or 1,200 metres.

oooo

STAMPED ADDRESSED ENVELOPE, PLEASE.

An appeal to amateurs in the British Isles, other than transmitters, to enclose a stamped addressed envelope with all enquiries is made by Mr. Alfred G. Gay (6NF), of West Norwood. Mr. Gay is at present sending acknowledgments to America at the rate of 30 per week, and postage fees are therefore a considerable item. Many other amateurs are placed in similar circumstances.

oooo

ITALIAN RADIO JOURNAL'S TRANSMISSIONS.

A more complete schedule has now been received from I1RG, the experimental station of the "Radio Giornale," whose transmissions were referred to in our last issue.

I1RG transmits with an input of 30 watts, every Saturday and Sunday as follows:—

0700	G.M.T.	... ...	60 metres
1500	,,	... ...	20 metres
1600	,,	... ...	40 metres
2200	,,	... ...	60 metres
2300	,,	... ...	80 metres

Reports are welcome and should be addressed to "Il Radio Giornale," Viale Maino N9, Milan.

oooo

PARIS MYSTERY STATION.

The mysterious "Zero Station" in Paris, operated by an American amateur, Reginald Gouraud, is resuming its activities. Two years ago this station, operating in the heart of Paris, broke in upon broadcast programmes and defeated all efforts of the authorities to locate it.

Mr. Gouraud now challenges the efficacy of the latest direction-finding invention of the Ministry of Posts and Telegraphs, and announces that his "Zero station" is about to resume working.

TELEVISION APPARATUS ON VIEW.

An opportunity to inspect the television apparatus of Mr. J. L. Baird, whose articles on the subject have appeared in *The Wireless World*, is offered by Messrs. Selfridge & Co., Ltd. Mr. Baird's apparatus is housed in the electrical section (first floor) of the famous Oxford Street store, and demonstrations are given daily by the inventor at 11.30 a.m., 2.30 p.m., and 3.15 p.m.

oooo

A GRIEVANCE IN HOLLAND.

Dutch amateurs are raising an outcry against the activities of one of their country's coast stations. The offending station is Scheveningen-Haven, which works on 1,800 metres with a spark or tonic train transmitter. On this wavelength Scheveningen-Haven effectually spoils Dutch reception of Chelmsford and Eiffel Tower, and, to a lesser extent, interferes with reception of these stations in some parts of England.

According to the Dutch "Radio Express," Scheveningen-Haven once occupied a position of European import-

AT HILLMORTON. This glimpse of the switchboard at the new Post Office high-power station at Hillmorton, near Rugby, gives some idea of the magnitude of the work now nearing completion.

ance, but times have changed, and while the coast stations of other countries have undergone modifications and improvements, this Dutch veteran continues to fill the ether with spark transmissions on an inexcusable wavelength. A bitter feeling now exists in Holland against this station, which is considered by many to be of considerably less importance than some of the broadcasting stations.

oooo

3,000 FRANCS FOR LOUD SPEAKER.

Dissatisfied with the performance of even the best loud speakers, M. le Baron Lestrange has made an offer of 3,000 francs to be awarded to the first Frenchman who produces a loud speaker giving a faithful rendering of the notes and tones of the pianoforte.

oooo

AN OMISSION.

In consequence of an oversight, the advertisement of the Bretwood Variable Mercury Condenser on advertisement page 16 of our issue of March 25th omitted to state the name of the product. As stated in the advertisement, the sole distributing agents of this component are the Wireless Distributing Co., Ltd., Stoke Newington Road, N.16.

TRANSMITTING NOTES.

WELCOMING THE AMERICANS.

Details appear on another page regarding the arrangements which are being made to entertain the American visitors during their brief stay in London on April 22nd, 23rd and 24th. Particular attention is drawn to the appeal for subscriptions for the purpose of welcoming these visitors in a manner appropriate to the occasion.

TOURING WITH THE PARTY.

With regard to the programme arranged for April 22nd and 23rd, when the party will visit places of interest in London and inspect various research laboratories and the B.B.C., it is hoped that some members will be able to accompany the party on these tours. It will be appreciated if anyone who is able to assist in this direction will communicate with the hon. secretary.

CALL-SIGN BADGES.

It may interest members to know that arrangements have been made for the supply of call-sign badges at 1s. each. Members desirous of obtaining badges should apply to the secretary of the R.S.G.B., giving their call sign and enclosing remittance. It should be understood that these call-sign badges are not connected with the Radio Society badge, regarding which an announcement will be made shortly.

NO INFORMAL MEETINGS.

Owing to the Paris Conference it will not be possible to hold any informal meetings of the T. & R. Section during April.

SHORT WAVE PERMITS.

The principal item of DX interest during the past two or three weeks has been the two-way communication of 2KF and 5LF with U.S. amateurs on 23 metres. It is gratifying to be able to announce that permits will shortly be issued to T. and R. members to transmit on wavelengths of 23 and 45 metres. The hours of these transmissions have yet to be settled, but members who wish to participate in the forthcoming daylight tests on these waves are asked to communicate at once with Mr. Gerald Marcuse at 53, Victoria Street, S.W.1.

GH1 IN THE FLESH.

Captain Durrant, of Mosul fame, will be in London following the Paris Conference and has asked Mr. Marcuse to convey his best thanks to British amateurs who have assisted in his tests. Captain Durrant has worked with 36 British stations and remarks that "2LZ is the star turn, followed closely by 2NM and 2OD."

WHERE IS AGST?

Mr. Walter G Sherratt, 11, Bath Road, Cowes, Isle of Wight, would be pleased to hear from AGST, with whom he worked from his station G5TZ on March 28th.

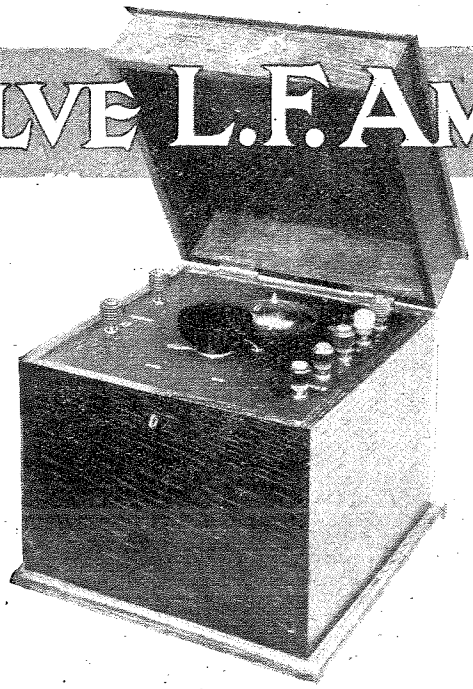
CANADA WORKS WITH NEW ZEALAND.

Two-way communication has been established between amateurs in New Zealand and Galt, Ontario, over a distance of 9,600 miles.

ONE VALVE L.F. AMPLIFIER

Constructing a Single Valve Note Magnifier.

By R. H. COOK.



A one-valve note magnifier such as described here is a most useful instrument because it can be added to an existing crystal or valve receiver. Further, it is easily constructed, and looks well when finished.

THIS single valve amplifier was primarily designed for use in conjunction with the crystal set described by the author in a previous issue of this journal.[1] For this reason the instrument is contained in a case of similar design and dimensions to the crystal set, the two together forming a particularly neat combination. The amplifier is, of course, equally suitable for use with any other type of receiving set, whether valve or crystal, in which it is desired to obtain greater signal strength, either for the purpose of bringing signals of rather weak intensity to comfortable audibility in several pairs of telephones, or, in a case where telephone signals are already fairly strong, to enable a small loud-speaker to be operated. When used for amplifying the output of a crystal set, however, it must not be expected that the instrument will provide sufficient increase in signal strength for the operation of even a small loud-speaker if the broadcasting station is more than five or six miles distant. Although very efficient and eminently suitable for the purpose for which it was designed, the instrument should not be used after a set which already contains one stage of low-frequency amplification, since no special provision has been made for the inclusion of grid biassing cells, and distortion is therefore likely to occur under these circumstances. When used, however, for the amplification of weak or moderate signals, the absence of these cells will not have a serious detrimental effect on the quality of reproduction.

Arrangement of the Set.

As the amplifier was primarily intended to be used in conjunction with a crystal set, it was decided to use an ordinary low-frequency transformer of 4 to 1 ratio as the inter-valve coupling. This gives us a considerable advantage over choke or resistance coupling since it enables an immediate step up in voltage to be obtained, which is of great advantage in a crystal set whose output is naturally not very large. There is no special reason for the use of a transformer having a very large impedance primary to follow the crystal detector, and therefore we can use a "general purpose" transformer, and so obtain the additional voltage step up provided by the higher "turn ratio."

From the theoretical diagram of the circuit given in Fig. 1 it will be seen that connections are simple and present no difficulty. The filament rheostat is included in the negative lead of the low tension battery in order to give a slight negative bias to the grid. It will be noticed on reference to the photograph that the mounting of the valve is rather unusual, the valve legs being affixed to a small ebonite platform below the main panel. The top of the valve then protrudes through a circular opening in the main panel. The reason for this arrangement is in order to obviate the necessity of having a very deep cabinet, since it is evident that, if the valve were placed on the main panel in the customary manner, a box with a very deep lip would be called for, and this would render the instrument rather clumsy in appearance. This method of mounting serves also to protect the valve from damage.

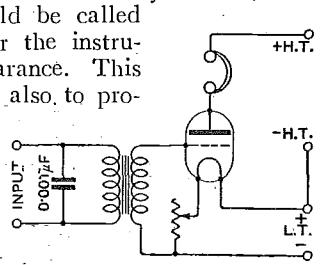


Fig. 1.—Theoretical connections of the amplifier.

The lay-out of the panel can be clearly seen by referring to Fig. 2, where all requisite dimensions are given. In order to facilitate the work of drilling the panel, the different sizes of holes which have to be drilled are marked by letters. By referring to the corresponding letters given in the drilling list below the figure, the reader will see at a glance the size of drill which it is necessary to use for the various holes. The necessity of using a good quality grade of ebonite is of paramount importance, and if this is not bought ready prepared it will be necessary to remove the "gloss" by means of emery paper, since this tinfoil film is by no means a good insulator. Coarse emery paper should be used at first, the panel being finished off with a very fine grade of paper. Unless the panel is cut exactly to size, it will be necessary also to true it up with a file. When using the latter instrument for this purpose, great care must be taken that the panel is held

[1] *Wireless World*, Vol. XV, p. 592, Feb. 4th, 1925.

One Valve L.F. Amplifier.—

firmly in the vice, care also being taken to insert some material between the vice and the surface of the panel in order to prevent scratching it.

The only points likely to give any trouble are the cutting of the large 2in. diameter hole in the panel through which the valve will protrude, and the mounting of the valve platform. A circle of 2in. in diameter is first marked out with a pair of dividers, a second concentric circle being marked out with a diameter of $1\frac{7}{8}$in. In the space contained between the peripheries of these two circles a number of marks, about $\frac{1}{8}$in. apart, are made with a centre punch, a $\frac{3}{32}$ in. hole being afterwards drilled at the points marked by the punch. There will now be a complete circle of holes, and the small pieces of ebonite between these holes should be cut away with a fretsaw, a half-round file being finally used to remove the projections left by this process. To finish off it will be necessary to take a round piece of wood of 2in. diameter, having a piece of carborundum cloth wrapped round it. This can then be placed in the orifice and given a rotary motion, which will finally remove all traces of roughness. If this is done carefully, little difference should be noticed in comparison with a hole made by a proper cutter, which is a tool few amateurs possess.

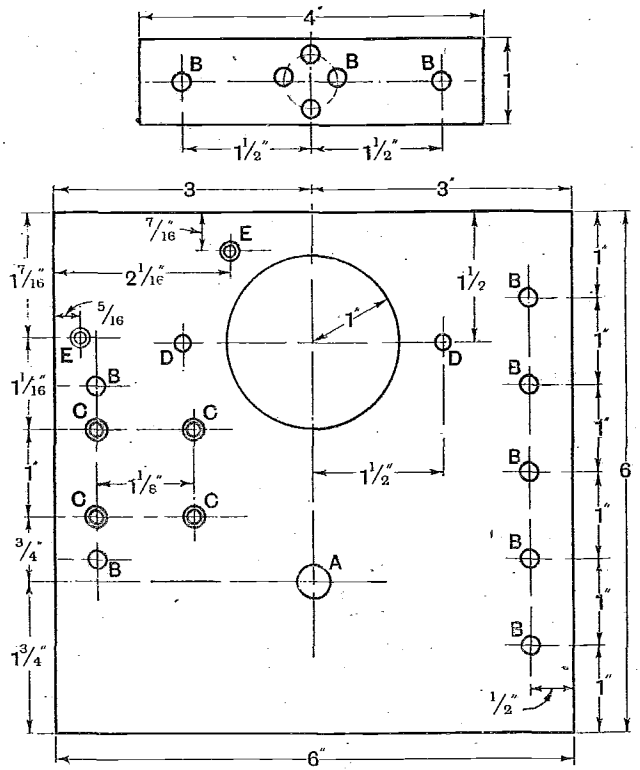
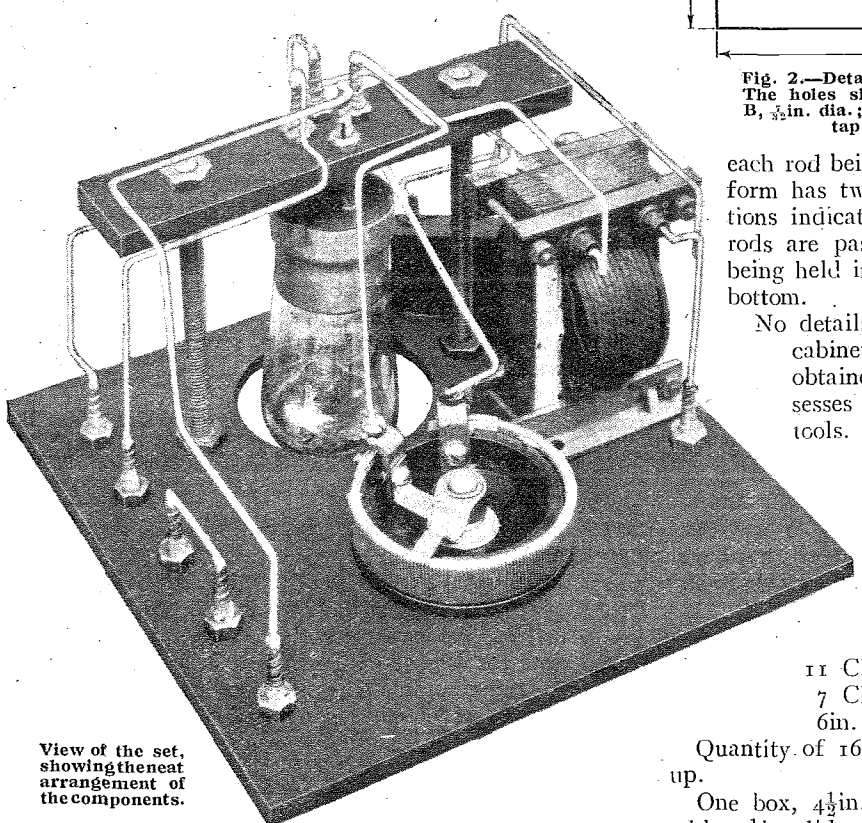


Fig. 2.—Details of the ebonite panel and valve support. The holes should be drilled as follows: A, $\frac{3}{8}$in. dia.; B, $\frac{7}{32}$in. dia.; C, drill $\frac{7}{32}$in. and countersink; D, $\frac{5}{32}$in. and tap 2BA; E, drill $\frac{1}{8}$in. and countersink.



View of the set, showing the neat arrangement of the components.

After drilling the panel it will be expedient to mount the valve platform. For this purpose it will be necessary to cut two pieces of 2B.A. rod to a length of $2\frac{3}{4}$in. These should be screwed into the underside of the panel until their edges come flush with the top surface, each rod being secured with a 2B.A. nut. The platform has two holes drilled through it in the positions indicated in Fig. 2. The other ends of the rods are passed through these holes, the platform being held in position by a nut both at the top and bottom.

No details are given for the construction of the cabinet, since it is recommended that this be obtained ready made, unless the reader possesses some aptitude for the use of carpentry tools.

In order to facilitate matters a complete list of parts is appended below :—

1 ebonite panel, 6in. × 6in. × $\frac{1}{4}$in.
1 ebonite panel, 4in. × 1in. × $\frac{1}{4}$in.
1 filament rheostat.
1 L.F. transformer.
1 0.001 mfd. fixed condenser.
11 Clix sockets.
7 Clix plugs.
6in. of 2B.A. rod.

Quantity of 16 S.W.G. tinned copper wire for wiring up.

One box, $4\frac{1}{2}$in. high, to take 6in. × 6in. × $\frac{1}{4}$in. panel, with $1\frac{1}{2}$in. lid. When closed this makes a cube, the internal dimensions of which are 6in. × 6in. × 6in.

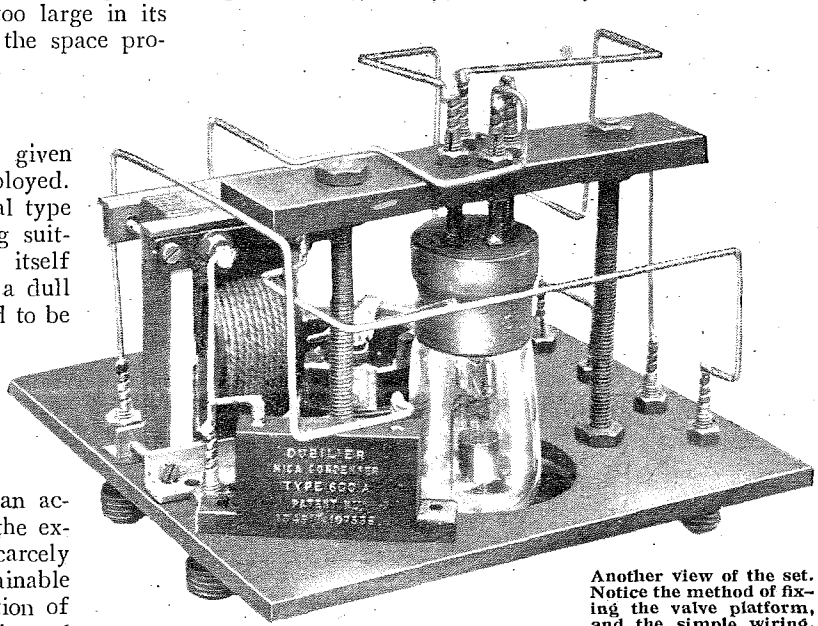
No difficulty should be experienced in wiring up this set if the scheme of connections given in Fig. 3 is carefully followed. It will be noticed that Clix sockets have been used in place of terminals. These facilitate rapid con-

One Valve L.F. Transformer.—

nection of the amplifier to the other instruments of the receiver, but ordinary terminals may be substituted if desired. The other components need be of no special make, but the transformer must not be too large in its external dimensions or it will not fit in the space provided. A Peto-Scott transformer is used.

Choosing the Valve.

A few words of advice may well be given concerning the type of valve to be employed. There is no great need to employ a special type of valve, any general purpose valve being suitable. The question, therefore, resolves itself into a choice between a bright emitter or a dull emitter valve. If the amplifier is intended to be used to amplify the output of a valve set for which an accumulator is already used, a valve of a type suitable for working off the accumulator will naturally be chosen. In the case of the crystal user, however, things are different, since he does not already possess an accumulator, and he may justly feel that the expense and trouble of the accumulator is scarcely compensated for by the extra results obtainable when using a valve amplifier. The solution of his problem is to use a dull emitter of the .06 ampere class in conjunction with two dry cells of the type used for operating electric bells. This valve will be found to give excellent results, and, provided that only two dry cells are used, no alteration need be made to the set. It has been found possible, by the writer, to operate a valve of this description three or four hours nightly for from eight to ten weeks before the two dry cells need to be renewed. The cost is, therefore, about one penny per evening. Two cells are recommended rather than three for three reasons. First, no alteration is required to the set; secondly, there is not the slightest risk of damaging the valve; thirdly, if three dry cells are used it will be necessary to reduce the voltage to the requisite value by means of a resistance, which represents so much power unnecessarily wasted in heating up this resistance. A high tension battery will also be needed, but since the demands made on it will be small, it should give useful service for several months.



Another view of the set. Notice the method of fixing the valve platform, and the simple wiring.

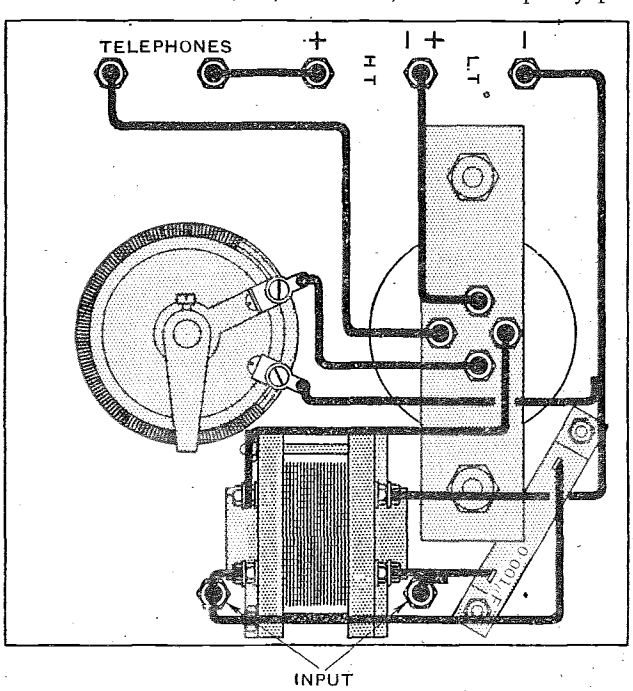


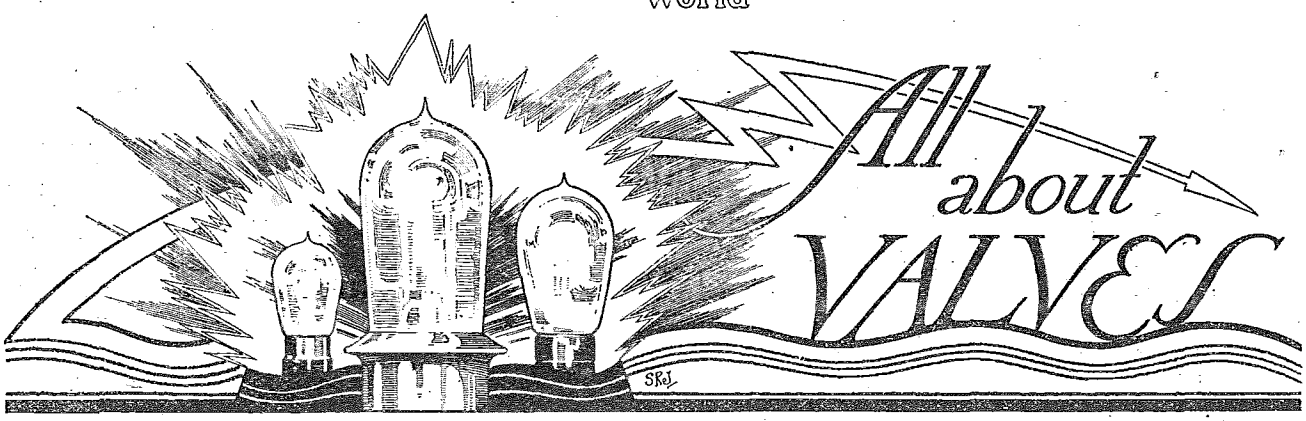
Fig. 3.—Wiring diagram.

SIMULTANEOUS TRANSMISSIONS ON A SINGLE AERIAL.

M. Leon Deloy's Valuable Experiments.

M. LEON DELOY, the well-known amateur at Nice, France, recently conducted Transatlantic tests in which he transmitted simultaneously on wavelengths of 55 and 90 metres. Two stations were employed, each working on an independent untuned aerial, but both were fed from the same transformer, yielding a voltage of 2,000. The key was operated in the primary of the transformer, and therefore controlled the radiation from both aerials. The 55-metre station was fed directly from the 25-cycle supply, and consumed about 400 watts. The 90-metre station was operated by means of two kenotrons, and took about 200 watts. The two transmissions were received strongly in America during the first test.

A few days later the experiment was repeated, using only one aerial, the layout of the two stations being the same as in the earlier experiment. The single aerial was, however, connected to the two transmitters by two inductances mounted in series. Equal success was obtained, proving the simplicity with which the short waves can be adapted for simultaneous transmission. M. Deloy's work opens up some interesting possibilities for amateur experiment.



Two New Dull Emitters for L.F. Amplification.

FROM the General Electric Co., Ltd., we have received an interesting valve.

This valve, the D.E.3B., belongs to the 60 milliampere class, but while its outward appearance closely resembles the D.E.3 the electrode construction has been modified so as to produce a high magnification factor.

The D.E.3 is, of course, a low filament consumption general purpose valve, whereas the D.E.3B., while having the same filament characteristics, has been designed for a special class of work.

At the present time a considerable amount of attention is being given to resistance coupling for L.F. amplification, and the valve under review has been evolved for this specific purpose. As it is never possible, practically, to obtain the full valve magnification when using the resistance capacity method of coupling, it is essential to have a valve with a moderately high magnification factor to start with. This means that its plate impedance will also be high, but it should not be disproportionately so. In a practical amplifier using the D.E.3B. we have employed 150,000 ohm. anode resistances at the same time increasing the plate battery voltage to 150. The reader will, of course, appreciate that as a high resistance is used in series with the valve, a higher anode battery voltage must be used in order to overcome the fall of voltage across the resistance.

It is interesting to note that this valve gives excellent results as a detector, for which purpose a plate voltage of about 50 will be found correct, and for H.F. resistance-coupled amplifiers for long-wave work it is particularly efficient.

D.E. 3B.
M. O. Valve Co., Ltd.

Filament Volts, 3.0. Filament Amperes, 0.063.
Emission (total) Milliamperes, 6.4. Efficiency, 34 Milliamperes per watt.

Plate Volts.	Plate Current, Milliamperes at Zero Grid.	Grid Bias, Volts.	Plate Current.[1] Milliamperes.	Amplification Factor.	Plate Impedance, Ohms.
40	0.26	0	0.26	16.8	72,000
60	0.64	−1	0.34	16.6	64,500
80	1.16	−1.5	0.56	16.6	52,500
100	1.62	−2	0.76	16.5	47,000
120	2.25	−2.5	1.08	16.5	45,000

[1] Plate current when grid is biased to value of Col. III.

This class of valve is not intended for the final stage of a L.F. amplifier where large changes of current are required.

SOMEONE has stated that the present age is one of specialisation, and this is undoubtedly true in the valve world, for we are rapidly approaching the ideal state of having a special valve for each and every wireless purpose.

The question for long-distance reception coupled with pure reproduction has resulted in the manufacturers providing many special types, and, in particular, as the result of the more general use of the loud-speaker (horrible term), several really excellent small-power amplifying valves have been placed on the market.

We have recently tested a new valve of the power amplifier class, the results of which we give below.

Known as the P.V.6 D.E., it is rated at 0.4 ampere at 1.8 to 2.0 volts, with a plate rating of 60 to 120 volts.

The electrodes are arranged vertically in a comparatively small bulb, but it is noted that the usual Ediswan base having contact pins of unequal lengths has not been employed in this particular type.

P.V. 6 D.E.
Edison and Swan Electric Co., Ltd.

Filament Volts, 2.0. Filament Amperes, 0.45.
Emission (total) Milliamperes, 19. Efficiency, 21 Milliamperes, per watt.

Plate Volts.	Plate Current, Milliamperes.	Grid Bias.	Plate[1] Current.	Amplification Factor.	Plate Impedance, Ohms.
60	2.2	−2	1.45	6.9	20,000
80	3.4	−3	2.15	6.8	17,800
100	4.95	−4.5	2.7	6.8	15,400
120	6.55	−6	3.5	6.8	14,500

[1] Plate current when grid is biased to value of Col. III.

This valve is, of course, particularly useful for the worker who uses a 2-volt accumulator, as the P.V.6 D.E. can be connected straight on without any filament resistance. As shown by the table above, quite considerable inputs can be handled, and, using the full 120 volts H.T., enough power will be delivered to operate any of the usual types of loud-speaker.

We have given the valve an extended trial in the last stage of a L.F. amplifier, and the results obtained have been very satisfactory. The valve is, of course, equally suitable for the first stage of a low-frequency amplifier, and when good volume and purity are required should be used in all L.F. stages. The tests further indicate that a very long life should be obtained, which is a point of no mean importance.

VALVE CHARACTERISTICS.

An Explanation of the Properties of the Three-Electrode Valve.

By R. D. BANGAY.

BEFORE we can properly understand the different circuits adopted in practice for applying the properties of the three-electrode valve to the purposes of either detection or magnification, it is most necessary to have a very clear idea of the essential characteristics of the valve on which the action of the circuits depend, and we propose, therefore, to devote this article to a study of some of these characteristics, leaving it to later articles to show how they can best be applied.

Fig. 1 illustrates the simplest form of valve receiver in which the three-electrode valve is used as a detector and from which, for the time being, we have omitted the filament heating battery. This is done merely for the sake of clearness, as the effect of the voltage drop along the filament can be considered later.

An examination of this diagram shows us that there are two separate and distinct circuits. The circuit G L F, which includes a portion of the oscillatory circuit, and the circuit A B, T F, which includes a battery and a pair of telephones. Each circuit includes an independent source of EMF, and each has a separate path through the vacuum chamber of the valve. These two circuits are known as the "grid circuit" and the "anode circuit" respectively. In each of these circuits a current can only flow in one direction, through the vacuum of the valve from the filament to the cold electrode, *i.e.*, from the filament F to the grid G, in the case of the grid circuit, and from the filament F to the anode A in the case of the anode circuit. Also, in both circuits a current can only flow when the potential of the cold electrode is at a positive potential relatively to the filament.

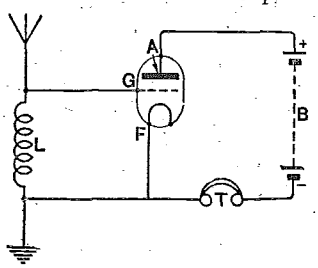


Fig. 1.—A simple receiving circuit.

Source of Voltage.

In the case of the grid circuit, the voltage is derived from the signal oscillations, and therefore alternates at a high frequency from a positive value at one moment to a negative value at the next. Consequently, if the normal potential of the grid relatively to the filament is zero a current can only flow in the grid circuit during the positive half cycles of the signal oscillations.

In the case of the anode circuit, the voltage is derived from the H.T. battery, the positive terminal of which is permanently connected to the anode, and, therefore, except for any influence exerted by the presence of the grid, a continuous current could flow through this circuit at all times. The current through this circuit, however, is controlled by the potential of the grid quite independently of the grid current, the latter being purely incidental and occurring, as already noted, only when the grid is at or near a positive potential relatively to the filament. Thus, while the currents in the two circuits are entirely independent of one another, they are both controlled by the potential of the grid relatively to the filament.

Currents and Voltages in the Circuits.

Having grasped these essential distinctions between the two circuits of the valve, we may now proceed to study the relation which the current in each circuit bears to the potential of the grid. This relationship can most conveniently be illustrated by curve diagrams, as shown in Fig. 2. These two curves represent the currents which will flow in the two circuits respectively corresponding to different steady potentials of the grid, and assuming a perfectly constant voltage applied to the anode. The full line curve represents the anode current flowing from the battery B through the anode circuit, and is known as the "grid-voltage-anode current" characteristic of the valve, while the dotted line curve represents the grid current and is known as the "grid-current curve." It will be seen from the diagram that the magnitude of the grid current is extremely small compared with that of the anode current, and also that it starts very nearly at zero grid volts. Beyond noting these two important points, however, we are not particularly concerned with its shape. The shape of the anode current curve, on the other hand, as well as the position it occupies relatively to zero grid volts, is of the greatest importance. Both of these factors may vary considerably in different cases, as will be seen later.

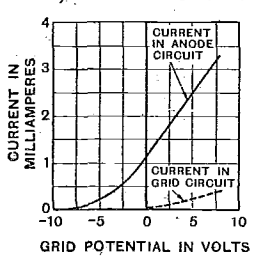


Fig. 2.—Characteristic curves, showing grid and anode currents.

As will be seen from Fig. 2, a certain negative potential has to be applied to the grid before the anode current is reduced to zero (in the case illustrated about − 10 volts). The actual value of this negative potential, however, depends not only upon the type or design of valve used, but also upon the voltage of the anode battery. The effect of increasing the anode voltage is to move the curve bodily to the left, making it necessary to apply a larger negative potential to the grid to reduce the anode current to zero. This effect is illustrated in Fig. 3, which shows three curves plotted for the same valve, but using different anode voltages in each case. It will be seen, however, that apart from this displacement of the position it occupies, the shape of the curve remains substantially the same in each case. The effect on the grid current curve of increasing the voltage of the H.T. anode battery is practically negligible, that is to say, it still starts to flow at a point near zero grid potential. Thus the change in the anode voltage alters the position of the anode current curve not

Valve Characteristics.—

only relatively to zero grid volts, but also relatively to the grid current. This is an important point to remember, as it has a vital influence on the arrangement of all valve circuits.

Effect of Constructional Differences.

The effects caused by differences in the design of the valve are illustrated in Fig. 4, where we have illustrated the characteristic curves of three different types of valve using the same anode voltage in each case. These curves show that not only is the position of the curve relatively to zero grid volts dependent upon the design of the valve, but also the shape of the curve. Thus, with No. 1 valve, the current starts flowing when the grid volts are about -10, while with No. 3 valve, the current starts flowing when the grid potential is -4 volts. Again, No. 3 valve has a very much sharper bend at the point where the current is approaching zero than is the case with either No. 2 or No. 3 valve. The curves of valves Nos. 1 and 2 can be taken as typical examples of an ordinary general purpose receiving valve, in fact, they are actually plotted from the types R5V and R valves respectively; No. 1 valve, on the other hand, is a special valve designed for a particular method of rectification.

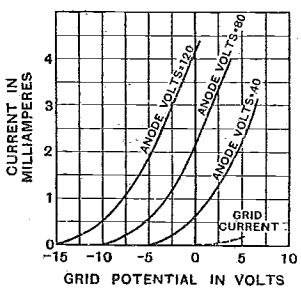


Fig. 3.—Showing the effect of applying different anode voltages.

There are one or two points disclosed by these curves to which particular attention should be drawn. The maximum change in the anode current for a given change in the grid potential is obtained when the latter occurs along the straight part of the anode current curve, because it is here that the curve is steepest. Thus, in the curve of valve No. 1, illustrated in Fig. 4, a change of grid potential of 2 volts, from 0 to -2 volts, causes a change of 0.8 mA. in the anode current, *i.e.*, from 2.1 mA. to 1.3 mA., while the same change of 2 volts in the grid potential of the same valve, from -5 volts to -7 volts, causes a change of only 0.3 mA. in the anode current. If, therefore, we assume that the *change* in current represents the useful energy released in the anode circuit, it is clear that the efficiency or sensitiveness of the valve is greatest when we work on the steepest part of the curve.

Straight Portion of the Curve.

Again, if the EMF applied to the grid is of an alternating character, and if it alternates about a point on the straight part of the anode curve, the change in anode current due to each successive half-cycle of the alternating current will always be equal. For example, suppose we apply an alternating voltage of 2 volts to the grid of the valve whose curves are shown in Fig. 3 when using an anode potential of 80 volts, the first half-cycle will raise the grid potential from 0 to 2 volts, causing a change in the anode current of 1 mA., *i.e.*, from 2.2 to 3.2 mA., and the second half-cycle in which the potential of the grid is raised from 0 to -2 volts will also cause an exactly equal change of 1 mA. in the anode current, *i.e.*, from 2.2 to 1.2.

On the other hand, if the alternating EMF applied to the grid occurs about a point near the bend of the curve, the changes in the anode current will be greater for the positive than for the negative half-cycle. This can be verified by referring to the anode characteristic curve of valve No. 3 in Fig. 4, where the change in current due to a change in grid volts from 0 to 2 is 6 mA., and for a change in grid volts from 0 to -2 is only 3 mA. Also it is easy to see that the sharper the bend in the curve the greater will be the difference between the change in current due to a positive half-cycle and that due to a negative half-cycle, provided, of course, that the variation of the grid volts occurs about a point on the bend of the curve.

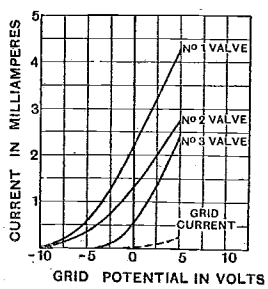


Fig. 4.—Curves of three different valves.

Effect of the Filament.

To avoid any confusion we have omitted in the foregoing explanation to take into consideration the potential of the filament. Obviously, the grid can only be connected to one end of the filament, and since there is a difference in potential between the two ends of the filament, the potential of the grid must always be different relatively from the two ends. If, therefore, the potential of the grid relatively to say the negative end of the filament to which it is connected is zero, and if the voltage across the filament due to the filament battery is, say, 4 volts, then it follows that the potential of the grid to the other end of the filament must be 4 volts. The characteristic grid volts-anode current curves are always plotted with reference to the negative end of the filament. Unless otherwise stated, therefore, it can always be assumed that the grid potentials are indicated with reference to the negative end of the filament. But if, in arranging a circuit, the grid were connected to the positive end of the filament, obviously zero grid volts will occur on a different part of both the anode and grid current curves. This point is illustrated in Fig. 5, in which it will be seen that the voltage figures indicated below the line refer to the negative end of the filament, and those indicated above the line refer to the positive end.

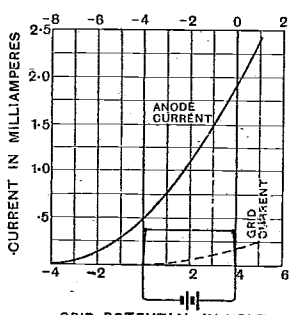


Fig. 5.—Explaining the effect of the filament voltage.

Returning once more to the simple receiver circuit illustrated in Fig. 1, let us see how the factors explained in the preceding paragraphs affect the arrangement of the circuit. The currents induced in the aerial circuit are feeble high-frequency alternating currents which induce a corresponding alternating voltage across the inductance L.

Valve Characteristics.—

If, therefore, we connect one end of the inductance directly to the filament and the other end directly to the grid as shown in Fig. 1, it follows that the alternating potential variations impressed on the grid must always occur about the point of zero grid potential. This point of zero potential, as we have just seen, may occur either on the straight part of the anode current curve as in No. 1 valve, Fig. 4, or near the bend of the curve as in No. 3 valve, Fig. 4, according to the type of valve used or according to the voltage of the H.T. anode battery employed. In practice the choice of both the type of valve and of the anode battery may be governed by other considerations, and therefore if we wish to work on some other part of the anode current curve than that which happens to occur at zero grid voltage, we must devise some method of adjusting the normal grid potential to the desired point independently of the alternating EMF derived from the induced oscillatory circuit.

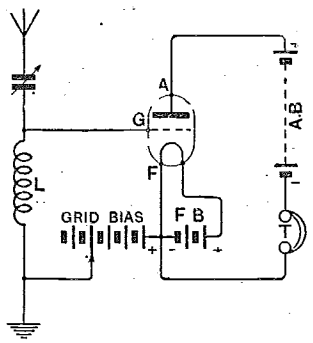


Fig. 6.—Method of connecting grid bias.

Grid Bias.

This is easily done by connecting some constant source of EMF, such as a dry battery, in series with the grid circuit in such a way that it impresses a negative "bias" voltage on the grid. There is only one place where it can be included without interfering with the proper functioning of the oscillatory circuit, and that is between the filament and the bottom end of the inductance as shown in Fig. 6. If, for example, the grid bias battery were connected in the aerial circuit, the internal resistance of the battery would interfere with the free oscillation of the aerial circuit and cause serious damping, and consequent loss of energy and selectivity; on the other hand, if it were connected between the grid and the top end of the inductance, it would provide a possible leakage path for the aerial current to earth. Even if the battery were highly insulated its capacity to earth would tend to upset the tuning of the circuit. Connected as shown in Fig. 6, however, it introduces none of these difficulties, and as this battery has only to apply the necessary potential and no current is taken from it it can be an extremely small one.

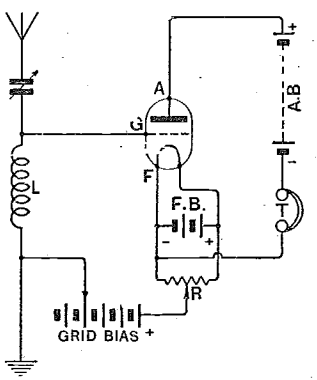


Fig. 7.—Connections when a grid battery and a potentiometer are used.

Obviously the signal voltage induced across the inductance L now occurs about a point on the curve corresponding to the steady bias voltage provided by the grid battery.

The amount of negative voltage required for any particular case can be regulated by tapping along the battery; this, however, only allows for a coarse adjustment in steps of about 1.5 volt at a time. For some purposes this coarse adjustment will suffice, but if a finer adjustment is required, this can be obtained by making use of the voltage drop along the filament as described below.

If a high-resistance potentiometer is connected across the filament as shown at R in Fig. 7, any required value of positive potential can be impressed on the grid up to the maximum equal to the filament voltage. The effective potential applied to the grid is, of course, the difference between the negative volts derived from the grid battery and the positive volts derived from the potentiometer, thus the rough adjustment can be made by tapping along the grid battery and the final adjustment by sliding the contact along the potentiometer.

SCHOOLS RADIO EXHIBITION.

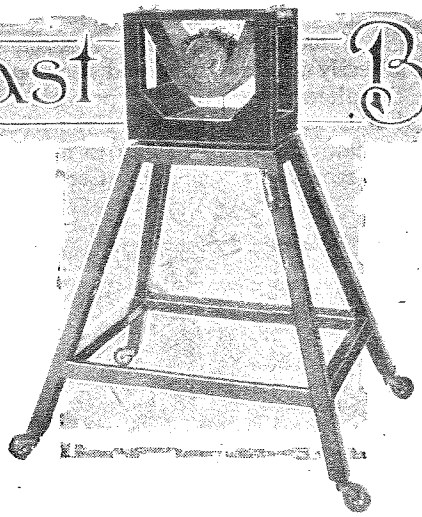
Results of the Competition.

IN the competition arranged in connection with the recent Schools Radio Exhibition, the highest marks were obtained by the Broadwater Road School, Tooting, which secured 67. The L.C.C. Beaufoy Technical Institute secured second place with 53 marks, the third position being gained by St. Paul's School, Dorking.

Commenting upon the result, the adjudicators, Messrs. L. F. Fogarty, G. G. Blake and Maurice Child consider that the Exhibition was of great value and demonstrated that interest in wireless science amongst boys is very considerable. In making the awards, the judges took into consideration the number of exhibits from each school, the number and quality of drawings, the standard of workmanship, points of originality and applications to general education. The greatest value lies in the last-named branch, but it was observed that with two outstanding exceptions (Broawater Road School, Tooting, and St. Paul's School, Dorking), very little attention appeared to be given to this point. On the other hand, the workmanship in many cases was of quite a high order.

The prize of five guineas given by J. H. Reeves, Esq., M.A., M.B.E., was presented to the winning school by Dr. W. H. Eccles, F.R.S., at a meeting of the Radio Society of Great Britain held at the Institution of Electrical Engineers on Wednesday, March 25th.

Broadcast Brevities



NEWS FROM THE STATIONS.

Plans for Second London Station.

If the B.B.C. can settle satisfactorily questions of finance, wavelength, and other problems that arise in connection with the building of a new main station, the company will willingly provide a second London station, of a power of, say, 10 kw., to give specialised programmes, and thus solve one of the chief complaints of listeners.

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A Double Choice.

There would then be no need for the listener who wanted the popular type of programme to be the involuntary victim of the lecturer and the classical musician, for he could tune in to the station that was catering for his needs, while his brother-listener in search of elevation and instruction could gratify his tastes with the programmes of the second station working on a greater wavelength. It may be stated definitely that London will not for long have only one broadcasting station.

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Licences.

The number of receiving licences now in force is approximately 1,400,000. The advocates of a reduction in the licence fee are not found among the general public alone, but even in official circles. It would be very difficult to regulate the amount of the fee by the value of the receiving set, for if that were done there would be no logical reason why the Government should not discriminate between, let us say, a dog licence for an animal of pure breed and one that had no pride of birth.

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And Revenue.

For the year ended December 31st last, the total receipts on account of wireless receiving licences were £613,309, of which £472,102 went to the B.B.C. by monthly instalments in arrear, and £141,207 was retained by the Post Office for administration. When the Wireless Bill comes up for second reading the Post Office is expected to state how the administrative costs are made up. Probably before that time the B.B.C. will give details of past expenditure and of the cost that will be incurred if their plans for the future are realised. It is interesting to note that the company has spent already about £100,000 on plant which, in view of the rapid strides which broadcasting is making, is becoming obsolescent.

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B.B.C. Lecturers.

Radio societies are making insistent demands on the officials of the B.B.C. to give lectures to their members. Many of these applications come from distant parts of the country. The officials themselves are crying out for mercy. When, for instance, a member of the B.B.C. staff is known to be giving a lecture in any locality, he is generally bombarded with requests from half a dozen other places within a radius of twenty miles to call in and lecture to them in passing, and it is very difficult in fairness to refuse these requests. The average working day of headquarters engineers is twelve hours, and when they go into the country their routine tasks are sadly neglected. If on such occasions anything were to go wrong with transmissions, listeners would naturally be the first to complain.

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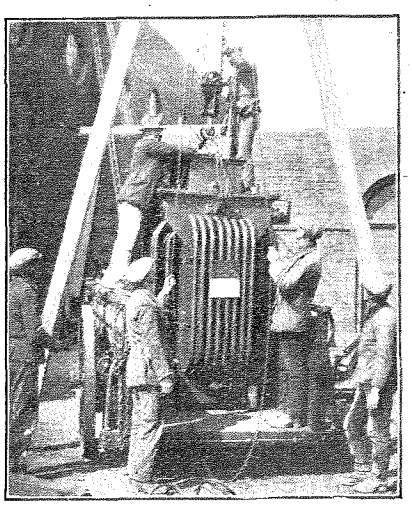
Broadcasting Parliament.

The Norwegian Parliament's adoption of the microphone and Great Britain's coming consideration of the same matter opens up the question whether in the future official reports of Parliamentary proceedings will be necessary. The well-known Hansard, by which name the official reports of the House of Lords and the House of Commons are still known, never tells Parliamentary stories exactly as they happen. Often things are said in the heat of political battle on the floor of the Houses which lose their flavour in cold print, or which, a few hours later, are not considered suitable for the information of constituents or the public. Obviously, with broadcasting, these remarks would go out in their undoctored state, probably to the delight of listeners in search of entertainment, but to the dismay of the speakers. Yes; we think that there should be a good deal of amusement in the broadcasting of Parliament.



A FOUR-TON TRANSFORMER. In point of size the transformer in the photograph affords an interesting comparison with the instrument to be found in the typical broadcast receiver. This four-ton transformer will form part of the apparatus at the new Post Office station at Hillmorton, near Rugby.

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Are we to be Gulled?

Listeners are responsible for many of the suggestions, novel and otherwise, which are made from time to time for "improving" the programmes. A Norfolk correspondent now suggests that the laughing gulls on Watton Mere should be broadcast. The B.B.C. has a long list of items in Nature's chorus which some day will be transmitted; but so far as bird noises are concerned nothing more will be done until the summer.

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The Women's Hour.

What subjects appeal most to women listeners? When the matter was debated before the microphone between a woman Cambridge graduate and another who had been in charge of various big canteens during the war, the alternatives discussed were:

(1) An ultra-feminine type of Women's Hour.

(2) A more amusing, as well as a more intellectual programme on topics of general interest; but with a special appeal to women.

The Cambridge graduate's argument was that she favoured amusing and intellectual talks of a non-domestic character, and the ex-canteen manager declared that she favoured practical subjects and ultra-feminine topics.

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Keep out of the Kitchen.

Listeners were invited to express their views, and some eighty per cent. of the letters received sided with the Cambridge graduate. The writers did not want talks on cookery, household management and child welfare, the general cry being: "Keep us out of the kitchen and

take us out of ourselves!" They wanted talks on music, literature, travel, women's movements, etc., with an occasional fashion talk or humorous reading.

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Temperamental Differences in U.S.

In nothing is the difference between the British and American women's temperament better demonstrated than in broadcasting. At least fifty large broadcasting stations out of the 600 which are transmitting in the United States have a regular service of appeal to the housewife and woman listener. Many large stations are owned by great companies having definite interests in better cooking, home education, or instruction along efficient housekeeping lines.

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A "Happy Homes" Club.

One station appeals to women with a "Happy Homes" Club, which specialises in a daily morning talk of home helps interest, instead of a broadcast lecture. The Director calls for a meeting of the club, thus trying to make the affair a social gathering. This is supplemented by the issuing of a booklet of sixty pages containing hints for happy homes. Here, again, is evident the diversity between the British and American temperament. For only the other day a navvy in the north assaulted his wife because she would not keep the baby quiet while he had the headphones on. "Happy Homes," indeed!

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Interference.

In a list of foreign stations and harmonics of Government and commercial stations which has been compiled recently a significant sidelight is thrown on the ever-present evil of wireless interference. Some of the stations using identical, or almost identical wavelengths are the following:—

Wave-length. Metres.	British Stations.	Foreign Stations.	B.B.C.
500	Cleethorpes, Devizes, Horsea.	—	—
495	—	—	Aberdeen.
494	Leafield.	—	—
475	Ongar.	Bilbao.	Birmingham.
470	Leafield, Cleethorpes.	Frankfurt, Stockholm (Svensk Radio).	—
450	Cleethorpes, Devizes.	Paris, PTT, Sunsval.	—
425	Aberdeen.	Rome, Reval, Barcelona.	—
400	Ipswich, Cleethorpes, Aberdeen, Horsea.	—	Newcastle.
382	Cleethorpes.	Oslo.	—
375	Cleethorpes, Devizes.	—	Manchester.
351	—	—	Cardiff.
350	Cleethorpes, Devizes, Ipswich.	Seville, Picin Midi (testing).	—
326	—	—	Edinburgh, Nottingham.
325	Howden, Cleethorpes.	Barcelona.	—
315	Air Ministry.	—	Liverpool.

The above are selected at random, but they serve to show how serious the problem of interference may become.

FUTURE FEATURES.

Sunday, April 19th.
London, 3 p.m. ... ... Ballad Concert.
London, 8.45 p.m. ... ... "Hymn of Praise" (Mendelssohn).
Birmingham, 9 p.m. ... ... Chamber Music Programme.

Monday, April 20th.
Birmingham, 8 p.m. ... ... "Old Memories."
Bournemouth, 8 p.m. ... ... "The Seasons."
Glasgow, 8 p.m. ... ... Band of 1st Bn. Royal Scots Fusiliers.

Tuesday, April 21st.
London ... ... Concert arranged by 'The News of the World."

Wednesday, April 22nd.
London, 7.30 p.m. ... ... Barclays Bank Concert, relayed from the Royal Albert Hall.
Birmingham, 8 p.m. ... ... "The Taming of the Shrew."
Cardiff, 8 p.m. ... ... "To the King's Navee."
Newcastle, 8 p.m. ... ... "Wagner."
Belfast, 7.30 p.m. ... ... "The Dream of Gerontius."

Thursday, April 23rd.
London, 8 p.m. ... ... "St. George's Day."
Birmingham, 8 p.m. ... ... St. George's Day Programme.
Glasgow, 8 p.m. ... ... "St. George's Day."

Friday, April 24th.
London, 8 p.m. ... ... Symphony Concert.
Manchester, 8 p.m. ... ... "The Chinese Puzzle."
Newcastle, 8 p.m. ... ... Ballads—Glees—Madrigals.
Glasgow, 8 p.m. ... ... Popular Night.

Saturday, April 25th.
Bournemouth, 8 p.m. ... ... "Samples of Humour."
Cardiff, 8 p.m. ... ... "Lohengrin."
Glasgow, 8 p.m. ... ... Listeners' Programme.

Duettists who were Miles Apart.

Congratulations have been received at the Johannesburg Radio Station (JB) from many parts of South Africa and Rhodesia, on a successful experiment in simultaneous transmission which was carried out recently.

Mr. Harold Ketelby, violinist in the station orchestra, and Miss M. Williams, station pianist, were heard on the ether in a joint instrumental selection, but in point of fact the violinist was playing in Pretoria, forty-odd miles away from the station studio, where Miss Williams was playing the piano accompaniment for him. Both instrumentalists used a pair of headphones attached to a crystal set tuned in to the JB wave, and each was thus able to synchronise perfectly with the other's playing.

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And Now a Trio?

The music from the violin was communicated from Pretoria to Johannesburg by means of a relay panel and a land line. The joint melody from the two instruments was picked up in very good quality by thousands of listeners. The test was the development of a similar experiment carried out in Johannesburg a short time ago, when music was broadcast simultaneously from different apartments in the studio buildings.

The scheme in the first place was conceived by Professor Kirby. In the light of the recent successful venture a further experiment is likely. It is, for instance, suggested that a trio be arranged with the piano in Johannesburg, the 'cello in Durban, and the violin in Cape Town, and all merging on the ether through JB's transmitting apparatus.

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Concert from a Liner.

Apropos the note announcing the intention to broadcast from a British liner when she is in dock, instead of from the local B.B.C. station, it is understood that the event has been fixed for April 22nd, when the Liverpool programme will be transmitted from the Cunard liner "Samaria." Listeners are supposed to be present at the concert which is being held in the first-class lounge of the liner to celebrate the last night at sea. Sea chanties and songs and orchestral music will be included, and listeners will also hear something of what is happening on the bridge of the liner.

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Broadcast Lectures.

At Easter the series of broadcast talks which has included such popular items as Sir Oliver Lodge on "Ether," Mr. Allan Walker on "Architecture," the British Drama League, and Mr. Ackerman's "Popular Fallacies in Engineering" came to an end. On April 20th a new series will begin, a special feature of which will be the inclusion of representative speakers from seven different stations.

NEWS from the CLUBS

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

Croydon Wireless and Physical Society.

A lecture on "Industrial Applications of X-Rays" was delivered at the last meeting of the Society by Mr. W. F. Higgins. The lecturer gave some idea of the enormously varied applications of X-rays. By means of diagrams and careful explanations he enabled all to grasp the construction of X-ray tubes, and the bombardment of electrons on what is known as the "target." A number of interesting X-ray photographs were shown affording comparison between the early work and modern practice and showing how the degree of penetration through material substances has increased so that almost anything invisible to the naked eye can now be made to appear "as clear as daylight."

Northampton and District Radio Society.

An exhibition of sets constructed by members of the Society was held at the County Café on Monday, March 30th. Prizes were offered, the sets being judged under the headings of efficiency, workmanship, and ingenuity and inventiveness. There were many entries and every set was tested and examined in its turn. After connecting up, the owner was given five minutes in which to tune in any station he chose. The sets entered ranged from the one-valve "straight" circuit to the four-valve special circuit. Where high-frequency valves were used, the coupling was, in almost every case, of the tuned anode type, resistance capacity coupling either for H.F. or L.F. being entirely absent. There were a few short wave sets tuning down to fifty metres. The prizes were awarded as follows:—For efficiency: Mr. A. J. Smith's two-valve set. For workmanship: Mr. Howe's four-valve set. For ingenuity: Dr. Stewart's two-valve and crystal reflex portable set with frame aerial and batteries self-contained. The prize for a component part was awarded to Mr. R. G. Turner for his wavemeter. Hon. secretary, Mr. H. L. Lewis, Kingsthorpe, Northampton.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 15th.

Golders Green and Hendon Radio Society.—At the Club House, Willifield Way, N.W.11. Lecture: "Measuring Instruments and their Functions," by Mr. F. McCabe.

FRIDAY, APRIL 17th.

Sheffield and District Wireless Society.—At 7.30 p.m. At the Dept. of Applied Science, St. George's Square. Lecture: "Electric Furnaces," by Mr. H. A. Greaves.

MONDAY, APRIL 20th.

Eastern Metropolitan Group Lecture Association.—At 7.30 p.m. At St. Bride's Institute, E.C.4. Lecture: "Short Wave Receivers."

Dorking and District Radio Society.—At 7.45 p.m. At 65, South Street, Dorking. Members' Evening with Apparatus.

WEDNESDAY, APRIL 22nd.

British Horological Institute.—At 6.30 p.m. At the Institute, 35, Northampton Square, E.C.1. Debate on "Wireless Time Signals." Open to all interested.

Streatham Radio Society.—Lecture: "DX Transmission," by Mr. H. J. Swift.

Manchester Radio Scientific Society.—Lecture by Mr. G. Harrison.

FRIDAY, APRIL 24th.

Radio Society of Great Britain (T. and R Section).—Dinner in honour of American visitors.

The South Croydon and District Radio Society.

On Tuesday, March 31st, a most entertaining and instructive lantern lecture on "The Theory and Construction of Loud Speakers" was given before about 50 members of the Society by Mr. W. J. Ricketts, of Messrs. Alfred Graham and Co. The lecture was preceded by a two-valve loud speaker demonstration, using the club indoor aerial.

The reproduction from the Amplion speaker was remarkable for its power and clarity, it being easily heard throughout the hotel.

The society now boasts of a membership of over 80, and all those interested in practical wireless are invited to become members.

Full particulars may be obtained from the hon. secretary, Mr. George H. Tozer, 218, Brighton Rd., S. Croydon.

Whitly and Monkseaton Radio Society.

The society's first annual dinner was held on April 1st at the Royal Hotel, Whitley Bay, under the presidency of Mr. H. F. Yardley.

After the various toasts had been honoured, a varied programme of songs was given by members and friends, and the proceedings concluded with a demonstration of broadcast reception.

The hon. secretary of the Society is Mr. Denham Turner, "Underwood," Windsor Gardens, Monkseaton.

Walthamstow Amateur Radio Society.

A determined effort is being made by the society to cope with the oscillation problem in the Walthamstow area. For this purpose all listeners in the district have been asked to make rough notes regarding any instances of interference during broadcasting and to forward particulars to the hon. secretary, Mr. H. J. Sarson, at the Y.M.C.A., Church Hill, E.17.

The society also offers to assist any listeners who believe that their sets may be oscillating but lack the necessary experience to be sure upon the point.

Sheffield and District Wireless Society.

Thursday, April 16th, was erroneously given in last week's *Wireless World* as the date of Mr. H. A. Greaves' lecture on "Electric Furnaces." The date of this fixture is April 17th.

Members and friends of the Wimbledon Radio Society who attended the Society's recent whist drive and dance. The value of developing the social side of club activities should never be overlooked.

THE "PITCH" SCALE APPLIED TO BROADCAST RECEIVING APPARATUS.

With Special Reference to Intervalve Transformer Characteristics.

By R. L. SMITH-ROSE, Ph.D., M.Sc., A.M.I.E.E.

AT a recent meeting of the Institution of Electrical Engineers, a paper entitled "The Measurement of Frequency and Allied Quantities in Wireless Telegraphy" was read by Lt.-Col. K. E. Edgeworth and Lt. G. W. N. Cobbold. The suggestion contained in this paper was that a "pitch" scale calculated in octaves would be more convenient than the wavelength and frequency scales at present in use, and in view of the tendency to change over the notation from wavelength to frequency for general purposes, it was considered to be opportune to inaugurate a discussion on the problem. The scale of pitch is defined by the equation

$$f = 2^P, \text{ or } P = \log_2(f),$$

P being thus measured in octaves in accordance with the practice in the art of music, and f being the frequency in cycles per second. It is evident that the frequency of any kind of oscillation can be expressed on this "pitch" scale, as it is not confined to electrical oscillations. For example, middle C on the usual pianoforte scale has a frequency of approximately 256, and since $256 = 2^8$, the pitch of this note is 8 octaves. On the same scale the range of frequencies commonly used in wireless extends over about 13 octaves from the thirteenth (corresponding to 36,620 metres, or 8,180 cycles, per second) to the twenty-sixth (corresponding to 4.47 metres, or 66.1 million cycles, per second). The well-known sodium "D" line in the visible spectrum is situated at about the forty-ninth octave, while, of course, the frequencies corresponding to ultra-violet and X-rays are at a still higher position on the scale. For further details on this "pitch" scale and the discussion of its advantages and disadvantages, the reader is referred to the published account in the Journal of the Institution of Electrical Engineers.

Characteristic Curves of Intervalve Transformers.

Whether this pitch scale will ever be adopted for wireless or any other purposes remains to be seen, but it is interesting to note here how the graphical representation of the performance of some types of broadcast receiving apparatus at audible frequencies appears on this scale. As an example, the voltage amplification of a single stage comprising a valve and an audio-frequency intervalve transformer may be taken. Some eighteen months ago the writer first plotted the results obtained on some intervalve transformers in this manner. In Fig. 1 is shown a selection of curves obtained for five different types of transformer when used with R-type valves under standard operating conditions. Two of these curves refer to transformers, which are considered to be among the best of those manufactured in this country at the present time. It may be mentioned here that these characteristic curves are subject to the usual limitations accompanying such measurements by audibility methods, since it is very difficult and trying on the observer to make observations outside the limits of 250 and 4,000 cycles per second. Alternative methods which are not subject to these limitations usually make use of the root-mean-square value of the output current. Unless, however, the wave-form of such output is recorded simultaneously, the form-factor is unknown, and serious errors are incurred by assuming the output to be of sine-wave form.

Now from Fig. 1 it is seen that the best type of curve (viz., *c*) approximates to a straight line for about seven-eighths of the frequency scale.

Shape of Curves when a Scale of Pitch is Used.

If, however, we are to attribute equal prominence to each note on the pianoforte scale, a scale of pitch should be adopted graduated in octaves, with middle C at a frequency of 256 cycles per second in the centre of the diagram. The bulk of the useful range of audible frequencies will then be comprised between the fourth and twelfth octaves, i.e., at frequencies from $2^4 = 16$ and $2^{12} = 4{,}096$ cycles per second. The result of replotting the curves in Fig. 1 in this manner is shown in Fig. 2. It is seen immediately that the appearance of the whole diagram gives an entirely different impression, in that whereas in Fig. 1 some of the curves appear as if they

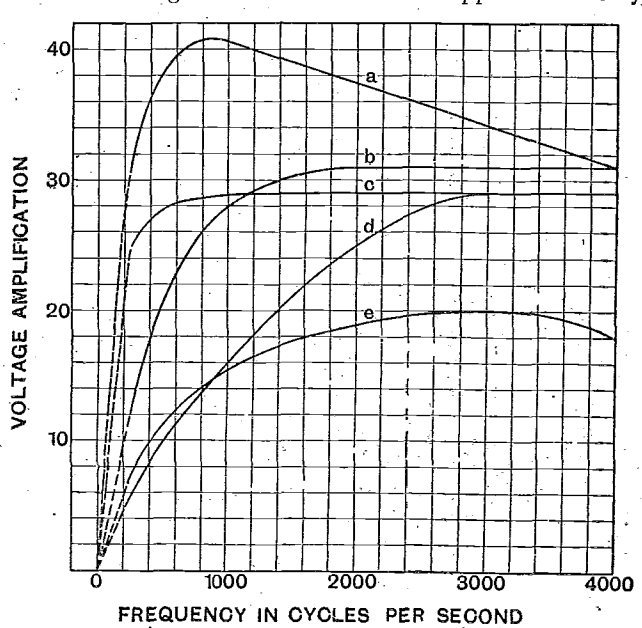


Fig. 1.—Characteristic curves of a number of intervalve transformers showing the relation between voltage amplification and frequency.

The "Pitch" Scale Applied to Receiving Apparatus.—

were possessed by moderately distortionless apparatus, in Fig. 2 it appears that the ideal is very far from being realised. The portion of curve (*c*) which is now parallel to the pitch axis extends for only three-eighths of the

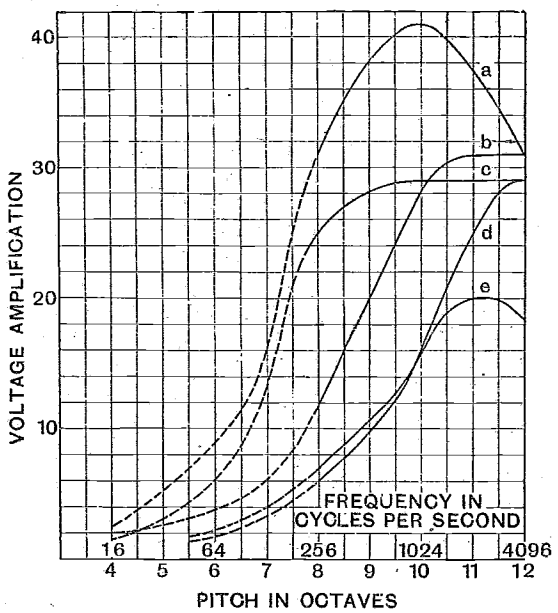


Fig. 2.—The result of replotting the curves of Fig. 1, using a scale of "pitch" instead of frequency.

width of the diagram. The limitations of the methods of measuring amplification are also brought out from this representation, since over exactly half the diagram indicated by the dotted portions of the curves, the values for the latter have had to be obtained by extrapolation.

Although it might be thought at first sight that the use of a scale in this manner is unjustifiable and serves to over-emphasise the lower tones by opening out the frequencies in this region, this is probably, if not entirely, due to the fact of our being so accustomed to a scale of uniform frequencies. It must be remembered, for example, that the important notes in many types of musical reproductions and in certain types of human speech are in the region below middle C. Since it is probable that the characteristics of receivers and loud-speakers are similar to those for transformers, it is a matter for wonder that the average broadcasting receiver gives a result which can in any way be considered pleasing to the human ear. It can only be concluded either that the human ear is much more accommodating to amplitude distortion than it is generally considered to be, or else that the low-frequency end of the musical scale is very much "boosted" at the broadcasting station before transmission. It is, of course, hardly to be expected that manufacturers will be very keen on representing the performance of their receiving apparatus in a manner which shows up the defects so well. Some time ago the writer noticed an advertisement of an audio-frequency intervalve transformer which had a characteristic somewhat similar

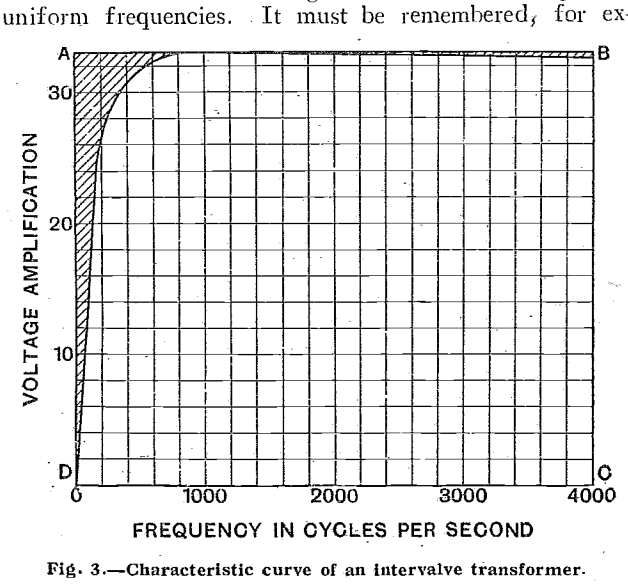


Fig. 3.—Characteristic curve of an intervalve transformer.

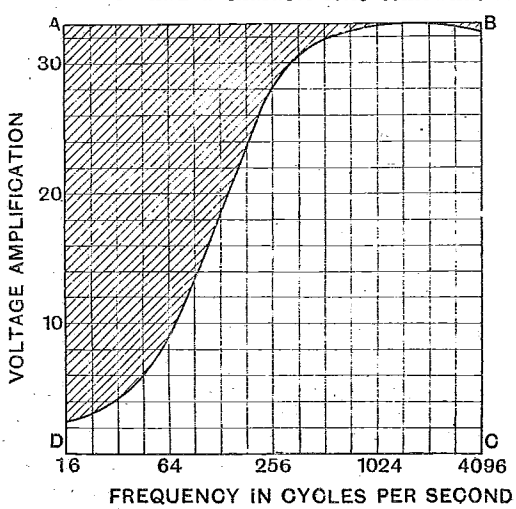
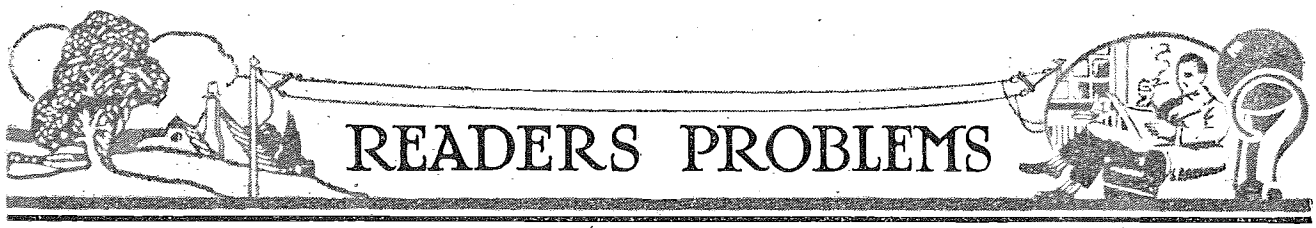


Fig. 4.—The characteristic of Fig. 3 replotted, using a scale of "pitch" instead of frequency.

to that shown in Fig. 3. A portion of the diagram was shaded as shown, and it was claimed that this represented a "loss in efficiency" proportional to the ratio of its area to the total area A B C D, which in the case of the given curve is 3.7 per cent. By replotting the curve on the pitch scale as in Fig. 4, the so-called "loss in efficiency" is seen to be about 34 per cent.!

WIRELESS IN ARCTIC EXPLORATION.

IN the course of a recent paper by Mr. F. G. Binney on the Oxford University Arctic Expedition, read at a meeting of the Royal Geographical Society, the proceedings of the expedition to North-East Land, near Spitzbergen, in 1924 were described in detail. The expedition, in addition to being equipped with wireless, carried a seaplane for survey purposes. It was taken to a temporary base in the North and there erected for use. Part of the time the expedition was off the east coast of North-East Land, and there found that they could pick up the British broadcast on a four-valve set so clearly that they could almost hear the shuffle of the dancers' feet at the Savoy Hotel, approximately 2,000 miles away.



Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Values of Lamps Required for Obtaining H.T. Supply from D.C. Mains.

A READER who is intending to utilise his 240 volt D.C. lighting mains for supplying the H.T. supply for his set, proposes to obtain four different values of H.T. by employing the circuit shown below, but he does not understand how to calculate the correct value of "candle power" needed for each lamp in order to secure the correct potential drop across each one of these components, and he seeks our assistance in this matter.

The candle power of a lamp, unless various other factors are known, does not, as many people erroneously suppose, indicate either its current consumption on a given voltage, or the voltage drop across it when a given current is flowing through it. Obviously, a carbon lamp of a certain C.P. will have a smaller potential drop across it when a given current is flowing through it than would a metallic filament lamp of similar C.P. having a current of similar value flowing through it. The important factor which we need is the resistance of the lamp, and provided we know the voltage and the wattage, or provided that we know the voltage, the C.P., and the material of which the filament is constructed, we can quickly ascertain its resistance. Once the C.P. is known, the wattage may be quickly

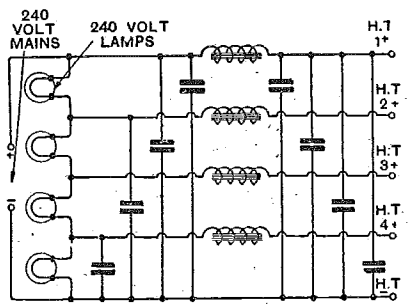


Fig. 1.—Method of obtaining anode voltages from direct current mains.

found, since in the case of metallic filament lamps, the wattage may be taken as equal to the candle power, and in the case of carbon lamps as four times the candle power. It is obvious on the face of it that if all the four lamps in the diagram are of equal voltage and wattage, their resistances will all be the same, and the potential drop across each of them will be 60 volts. It is immaterial what is the actual C.P. of each lamp, or whether they are carbon or metal lamps, provided they are all equal in these respects. From the point of view of economy in current consumption, of course, it is advisable that the lamps be of low wattage. If the lamps are all of unequal resistance, of course, such as would be the case with four 240 volt lamps of differing candle powers, the potential drop across each will not of course be the same.

To ascertain the potential drop across any individual lamp, it is necessary to calculate the resistance of each lamp. It will be found that this problem resolves itself into a very simple sum in proportion since the relationship of the potential drop across each lamp to the drop across the mains is equivalent to the relationship between the resistance of that lamp, to the total resistance of all the lamps.

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Advantages of a Counterpoise.

A CORRESPONDENT who has been using a crystal set with satisfactory results recently connected up several yards of electric lighting "flex" to the telephone terminals of his set in order to enable a pair of telephones to be used in a distant part of the house at the same time that reception was being obained on a pair of telephones connected directly to the set. To his surprise he obtained a considerable increase in signal strength over that obtainable beforehand. He then disconnected the second pair of telephones, and immediately signal strength fell again. During the course of further experiments with the long extension wires the earth lead was disconnected from the receiver, and a still further increase in signal strength obtained. Our reader seeks an explanation of this apparent anomaly.

If the diagram which we give below is carefully studied, it will be easier to understand the cause of this phenomenon. It will be seen at once that one of the extension leads to the telephones is acting as a counterpoise to the aerial. We are of opinion from the results obtained during the course of his experiments that our correspondent is using a long earth lead and a very poorly constructed earth connection resulting in a high resistance. This being so, the addition of the counterpoise renders the whole oscillatory system far more efficient than formerly, and the removal of the poor earth connection will render the whole circuit far more selective and sharper in tuning. In cases where readers are only able to erect a poor and badly screened aerial, and where circumstances militate against the erection of a short direct earth connection there are many experiments which can be carried out in order to see whether an improvement can be brought

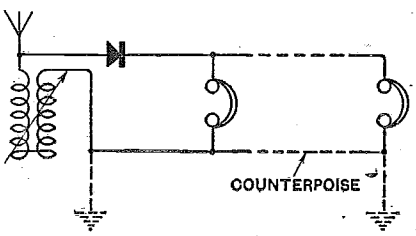

Fig. 2.—A crystal receiver with variometer tuning.

about in signal strength. One of these is to abandon the use of an earth connection in favour of some kind of counterpoise. Of course the ideal counterpoise consists of several wires suspended at a distance of about three feet from the ground, immediately under and parallel to the aerial. Unfortunately, however, the ideal counterpoise is no more accessible to the average amateur than is the ideal aerial, and, therefore, it is necessary to erect an indoor counterpoise in the best manner possible under the circumstances. This may consist of a length of insulated copper wire led away from the earth terminal of the set in the most convenient manner under the particular circumstances of the case, as in the case of the erection of an indoor aerial. The use of a counterpoise instead of an earth connection will also assist considerably in the elimination of extraneous noises from electric lighting mains or neighbouring tramway systems, which more often than not are due to earth currents rather than to direct magnetic induction. In the particular case we have referred to, the counterpoise is automatically provided by one of the long extension leads to the distant telephones. In cases where a long extension lead to the telephone leads is used and an earth connection is desired, it may be often more convenient to earth one side of the telephones rather than to connect an earth lead to the earth terminal of the set. Care must be taken, however, to earth the correct side of the

telephones, or they will be short-circuited. The correct method is clearly indicated in our diagram.

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Transformers for A.C. Mains.

FROM time to time we receive letters from readers stating that they have carefully constructed a small power transformer for the purpose of stepping down the voltage of their A.C. mains to some requisite value, and that, in spite of rigid adherence to theoretical calculations, they experience great trouble due to the heating of the transformer. Other readers find that they are unable to wind the turns of wire into the calculated area.

There are, of course, many contributary causes to the first named trouble, one of which is probably the use of too small a gauge of wire. It is necessary first to ascertain the maximum power which will at any time be taken from the secondary terminals, and then, since the voltage across both primary and secondary is pre-determined, the correct gauge of wire may easily be calculated.

The current density should not be allowed to exceed 1,000 amperes per square inch of cross-sectional area of wire. Actually a size larger gauge of wire than that which will barely carry the current should be used. It is probable, however, that most of the troubles experienced by constructors of transformers are traceable to the use of an unsuitable core. The flux density should be most carefully calculated, and a maximum density of 60,000 per square inch of cross-sectional area should be allowed in the case of stalloy laminations, this being reduced to 40,000 in the case of transformer iron stampings. Probably the best core to use consists of closed rectangular stalloy laminations, the primary and secondary windings being wound on opposite "legs" of the core. It is most important to allow ample insulation.

With regard to the space allowed for the windings and insulation, this should first be carefully calculated according to the gauge and covering of the wire used, and then at least twenty-five per cent. should be allowed over and above theoretical calculations to compensate for lack of skill in winding. Experience shows that this allowance is by no means excessive.

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A Frame Aerial Receiver for 5XX.

A READER living within a few miles of the B.B.C. high power station desires to construct a set for obtaining strong telephone signals from this station, using a frame aerial only. He particularly emphasises the fact that the receiver must have only one tuning control, and must not make use of reaction.

This can be accomplished by using the circuit given below. It will be noticed that we use one high frequency valve, which is coupled to the detector valve by means of resistance capacity coupling. This arrangement is found fairly effective on the wavelength of 5XX. The resistance should have a value of 100,000 ohms or greater, and of course a higher anode voltage than is customary will have to be used, in order to compensate for the voltage drop across the resistance. The second valve acts as a rectifier, and the third valve acts as a conventional transformer coupled low frequency amplifier. Readers will find that excellent results

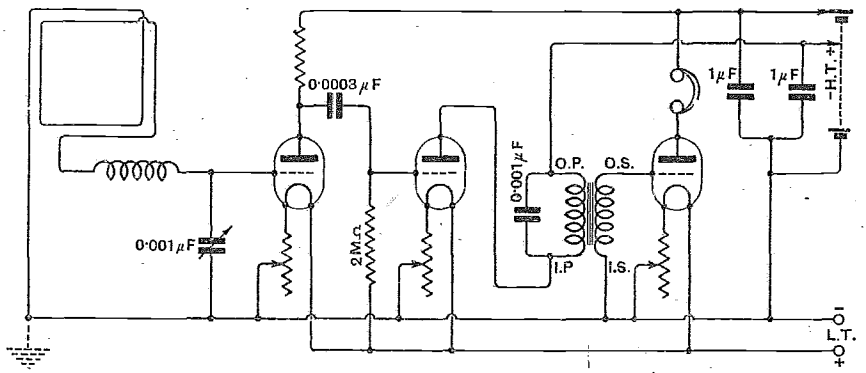

Fig. 3.—Connections of a receiver suitable for long-wave stations with one stage of resistance-coupled H.F. amplification, detector and note magnifier.

can be obtained with this circuit, even at a considerable distance from 5XX, if valves of the correct type are used. The high frequency valve should be one which has a high amplification factor, such as the D.E.5.B. The other two valves can be of the D.E.5. type, though it may be advantageous to use a D.E.5.B. as the detector, since we are not making use of reaction. It will be observed that an earth connection is shown in dotted lines, and when possible this connection should be used, as a considerable increase in signal strength may often be obtained by this means.

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Efficiency of H.F. Amplification on Low Wavelengths.

A READER wishes to know the reason why the efficiency of resistance-coupled H.F. amplifiers is very low on the broadcast band of wavelengths, and whether there is any particular reason for the value of 1,000 metres being given as the limiting point of efficiency for this method of coupling.

The reason for the non-effectiveness of this form of intervalve coupling on the lower wavelengths is solely due to the effect of the capacity existing across the resistance due partly to the capacity between the actual terminals or end caps of the resistance rod, and partly also to the capacity existent between the wiring attached to each end of the resistance. The actual value of this capacity measured in microfarads is, of course, precisely the same on all wavelengths, but the effect of it on the differing wavelengths is the point that matters. On the longer wavelengths this capacity, provided it is not too large, is fairly negligible, and if we increase our wavelength until the corresponding oscillation frequencies approach audibility, the effect of the capacity is quite negligible. On the broadcast band of wavelengths and lower, however, even the smallest capacity is quite fatal to good results, and the H.F. valves, if coupled in this manner on these wavelengths, will merely act as "passengers," giving little or no amplification. The reason for this is, of course, that the impedence offered by any capacity to the passage of high-frequency fluctuations of current is inversely proportional to the frequency of these fluctuations; this is expressed by the formula $Zc = \frac{10^6}{2\pi nC}$ where Zc is the impedance due to the capacity in a circuit, n is the frequency, and C the actual capacity in microfarads. Consequently it will be seen that the more we increase the applied frequency, or in other words, decrease the wavelength, the less is the impedance offered by the capacity to the passage of these high-frequency current variations. Consequently on the lower wavelengths where the frequency is very great, these high-frequency pulsations tend to be partially bye-passed by the stray capacity existent across the resistance rather than to pass through the resistance itself. As a result of this, very little difference of potential is set up across the resistance. In the longer wavelengths, however, the impedance offered by the condenser is much greater, and consequently fairly large potential differences appear across the ends of the resistance, and are available for passing to the grid of the succeeding valve by means of the usual grid stopping condenser. Although a wavelength of 1,000 metres is usually given as the point where resistance coupling commences to be effective, it must not be thought that even on this wavelength this method of coupling can approach the tuned anode for efficiency, and it is not until the four or five thousand metre band of wavelengths is reached that it really begins to be effective.

On the other hand, if great care is taken to use the low capacity type of valve and to exercise considerable ingenuity in the wiring of the set, resistance coupling will not be found to be altogether useless even on 300 metres.

The Wireless World AND RADIO REVIEW

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INTERNATIONAL WIRELESS.

IT is welcome news that an International Broadcasting Bureau is to be set up with headquarters in Geneva, and we wish all success to Mr. A. R. Burrows (Uncle Arthur) in his new post as Director of the Bureau.

We understand that the decision to set up such an organisation matured during the Conference between various European broadcasting interests which was held recently in London, although the necessity for the eventual establishment of some central office of control must have been recognised a considerable time ago.

Naturally, the principal duty of the new bureau will be to decide on the allocation of wavelengths to different stations in order to overcome the growing difficulty of fitting in the many stations so that their transmissions do not interfere one with the other.

The International Bureau has before it a truly serious task, but the problems which it may have to deal with at the moment are as nothing compared with the troubles which lie ahead, and if the B.B.C. policy of high-power broadcasting stations, which we criticised recently, is extended and adopted by all the European countries, then the problems of international control will indeed be perplexing.

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OVERCROWDING THE ETHER.

IT will be of great interest to watch the development of the broadcasting service throughout Europe in the near future. It seems quite certain that, although most of the Continental countries are at present behind our own country, at least in the number of stations, that the time will soon come when the public in the other countries will demand a service equally as efficient as our own. Whether it will be a practical possibility for so many stations to be in operation as such a scheme would necessitate is quite another question. There is no doubt that, apart from the care which will have to be taken to space the transmitting wavelengths, that an equal demand will be made for more selective receivers. By the provision of truly selective receivers much may be accomplished towards minimising the interference. There is, however, one type of interference which selectivity of receivers, however great, will be unable to overcome. We refer to the trouble which is caused by actual heterodyning of one transmitting station with another. We must remember that in actual telephony transmission a station does not confine itself to occupying the frequency of its particular wavelength allotted. For example, a wavelength of 365 metres corresponds to a frequency of approximately 810,000 cycles, but in actual transmission a band of frequencies on either side of 810,000 will be occupied; and in order to reproduce the whole range of sounds which may be imparted to the microphone, this band will probably extend to 8,000 or even 10,000 cycles on either side of the exact frequency corresponding to the wavelength.

We see, therefore, that unless a frequency gap corresponding to 10,000 cycles is left between each wavelength allotted, the risk immediately occurs of heterodyning

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taking place between the transmissions of the two stations. The heterodyne interference exhibits itself as an audible note in the telephones; sometimes it is almost steady, but more often it varies in pitch and intensity with the modulation of the transmitters. The phenomenon is most pronounced when the strength of the two interfering stations is approximately the same, so that the location of the receiver is an important factor. A correspondent's letter on this subject was published recently, and heterodyne interference was complained of from a number of pairs of stations which are not reported as interfering in this country. Our correspondent was so located on the Continent that he received the interfering pairs of stations at approximately equal strength, being situated at a point more or less equidistant from the transmitters.

As one goes lower in wavelength, the frequency is higher, so that, of course, the frequency difference per metre of wavelength also increases, and the wavelength spacing between stations can in consequence be reduced. It is, therefore, likely that, as the number of stations in a given area increases, so we shall find that the necessity will arise for going lower in wavelength in order to accommodate the new stations. No doubt this is one of the questions which the new International Bureau will have to consider at an early date, since the changes in wavelength will require to be made gradually, and it would be very inadvisable to wait for the problem to become an acute one before meeting it with the remedy.

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THE QUARTZ CRYSTAL WAVELENGTH STANDARD.

WE foresee that the time will come when, owing to the number and close proximity of broadcasting stations throughout Europe, the wavelength of the stations will have to be more precisely measured and adhered to more consistently than has been necessary in the past. It is by no means unusual for stations to be two or three metres on one side or the other of the wavelengths officially allotted, though, fortunately, in almost all cases there is only a small deviation from time to time. One of the difficulties met with in the past has, of course, been to make sure that the calibration of the testing instruments used at the various stations did not differ to any serious extent, but, with the more usual types of wavemeter, it is a very difficult matter to ensure the consistent accuracy which is desirable.

It is an interesting fact that, in almost all directions of scientific development, as new problems present themselves, so the means of solving them appears to take form almost at the same time. To take only one example in a sphere altogether outside wireless, we may remember that the aeroplane in the form of gliders was being developed to a high standard of efficiency whilst at the same time rapid strides were made in the perfection of the internal combustion engine, and it is the combination of the two in a highly developed form which gives us the modern aeroplane. So just at a time when the precise calibration of wavelengths was beginning to cause some concern amongst radio engineers, the quartz crystal as a frequency standard has been introduced.

Briefly the principle of the employment of a quartz crystal as a frequency standard is as follows: It has been discovered that pieces of quartz cut from large quartz crystals to certain dimensions expand and contract along their length when introduced into an oscillatory circuit clamped between two metal plates in the form of a condenser. When the condenser plates are charged the quartz crystal will expand and contract, but at a precise frequency this expansion and contraction is greatest, and when the frequency of the circuit in which it is introduced corresponds precisely to the natural frequency of the crystal, the effect is most marked and is distinctly critical. Under these conditions the crystal itself commences to generate an alternating E.M.F. of its own frequency, and this added E.M.F. in the circuit can be detected with suitable instruments, and, when observed, indicates that the tuned circuit is oscillating at precisely the same frequency as the quartz crystal. It therefore becomes possible to prepare quartz crystals in this way, the dimensions of which will decide their natural period of vibration, and since no variation can possibly take place unless the size of the crystal is altered, a very permanent and precise standard for frequency is obtainable.

The use of this method for radio frequencies standardisation will undoubtedly become of increasing value as the necessity for accurate wavelength measurement increases. In view of the probable large increase in the number of broadcasting stations in the near future, really stringent international regulations will have to be formulated to insist upon the tuning of broadcast transmitters being not only exactly carried out, but also strictly maintained. More especially is the method of importance in the measurement of very short wavelengths when the more usual types of wavemeter are unsuitable.

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OUR CORRESPONDENCE COLUMNS.

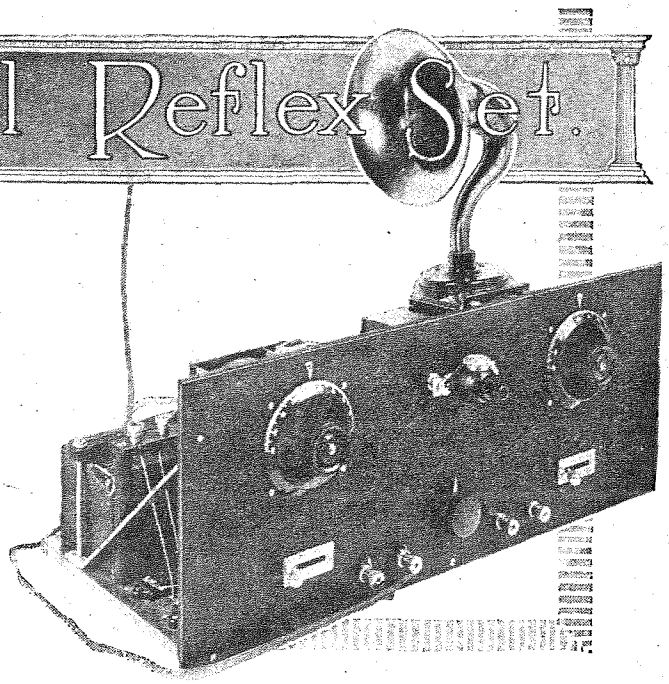
WITH wireless, as with every other new thing, progress is achieved largely through the interchange of ideas between those who are engaged in its development and those who are benefiting by the results obtained. We would like to see the views of our readers on each and every aspect of wireless, but particularly with respect to broadcasting, more freely expressed, and we remind readers that the Correspondence columns of this journal are open to all readers who have views of interest to put forward. It frequently happens that for some reason or another a correspondent does not desire to divulge his name and address, but would, nevertheless, like the opportunity of expressing his ideas and observing the comments which in due course would appear from other readers in the Correspondence columns. Wherever a reader expresses the wish that his name and address should be withheld from publication, that wish will be strictly respected, so that he need have no fear that the publication of his letter will lead to publicity which he may not desire.

In particular, we would like to receive from readers letters for publication dealing with the various topics which from time to time are discussed in our Editorial comments.

Valve-Crystal Reflex Set.

A Single Valve and Crystal Reflex Receiver for B.B.C. and Long Wave Stations.

Dry cells are used for filament heating, and these are fitted inside the case of the set. Good loud-speaker results can be obtained at ten to fifteen miles from a B.B.C. station.



By N. P. VINCER-MINTER.

THERE is undoubtedly a very great need for a receiving set capable of operating a loud-speaker from the local station and of giving good telephone reception from one or two of the other broadcasting stations, and at the same time capable of being operated *economically* from dry cells. There is also a real necessity for an instrument that, apart from fulfilling the conditions previously mentioned, is neat and unobtrusive in appearance, and is entirely self-contained, all batteries being housed in the cabinet of the instrument, the only external connections necessary being those for the aerial and earth, and for the telephones or loud-speaker.

It cannot be denied that the majority of receiving sets designed to fulfil the two conditions laid down above, namely, local loud-speaker reception and more distant telephone reception, fall very far short of fulfilling the other conditions enumerated. To take the question of economy in operation first, it must be remembered that the usual instrument designed for this purpose employs at least three valves, and even if dull-emitters of the 0.06 class are used it is impossible to use dry cells with any claims to economy in operation, since either very large and expensive types of dry cells have to be purchased, or, if dry cells of the "bell-ringing" type are employed, it will be found that with three valves operating three or four hours daily they will require renewal about every ten days.

The appearance of many valve receiving sets is usually extremely untidy, and they constitute an eyesore in the average living room. The usual set which is to be met with in the average household is of the sloping panel type, with the valves mounted on the face of the panel in a manner which, apart from endangering the lives of the valves, is singularly crude and inartistic in appearance. This, coupled with the usual medley of wires leading to untidy-looking accumulators and H.T. batteries, is usually quite sufficient to create a strong prejudice against wireless receiving sets in the mind of any person of æsthetic tastes.

An attempt has therefore been made in the instrument about to be described to produce a receiver in which all the above-mentioned defects are conspicuous by their absence, and at the same time to produce a set which is simple to operate, and which can be instantaneously adjusted to the wavelength of the high-power station without the necessity of plugging in loading coils. Since also all the batteries are contained within the cabinet, the set is singularly pleasing to the eye, and does not require to have any part external to the set other than the telephones or loud-speaker, the only terminals appearing on the panel being those for these two components, the aerial and earth connections being effected at the rear of the receiver.

The Theoretical Connections.

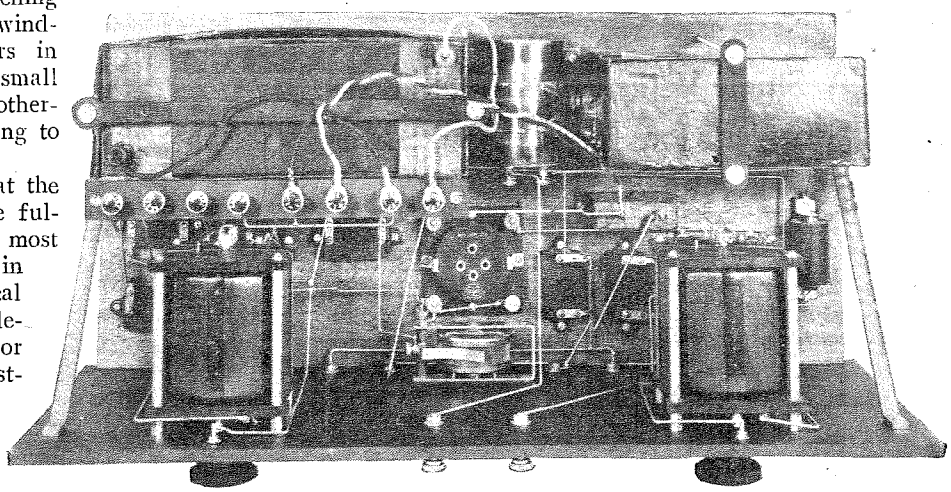
An examination of the theoretical wiring diagram given in Fig. 1 will reveal the fact that the circuit used is of the reflex type, the valve acting in the dual capacity of high and low frequency amplifier, rectification being carried out by means of a crystal. Since only one valve is employed, and this of the sixty milliampere type, it will readily be seen that the conditions of economy in running costs and neatness of appearance can be amply fulfilled. Owing to the small requirements of filament lighting current the set can be operated for a prolonged period in this respect by means of two dry cells of the "bell-ringing" type, whilst owing to the fact of dry cells being used throughout, they can be very compactly housed inside the cabinet. It will be noticed from the photographs of the instrument that it is pleasing in appearance, partly owing to the fact of everything, including the valve, being inside the cabinet, and partly because the so-called panel-and-baseboard form of

Valve-Crystal Reflex Set.—

construction is used—a design which, it is gratifying to note, is rapidly supplanting the untidy-looking sloping panel type of instrument in popular favour. No plug-in coils are used for raising the wavelength of the receiver to that of the high-powered station, this being accomplished by a simple switching arrangement which places the windings of the tuning variometers in series or parallel, and places small fixed condensers in parallel or otherwise with the windings, according to wavelength requirements.

It will be seen, therefore, that the only remaining conditions to be fulfilled are those which are the most important—namely, simplicity in operation and ability to give local loud-speaker reception and telephone reception on at least one or two of the more distant broadcasting stations, which conditions we shall now proceed to discuss.

Readers will undoubtedly wish to know what were the considerations which led to the adoption of this particular circuit rather than the more usual straightforward regenerative detector valve circuit, and some question will undoubtedly arise in their minds concerning the stability of the circuit, since dual amplification circuits have earned for themselves an unenviable reputation for bursting into oscillation at an audible frequency with discouraging consistency. Dealing with the first aspect of this question, it may be said that in the first place the single-valve regenerative circuit was abandoned in favour of this circuit because, all other conditions being equal, it is not productive of so great a signal strength from the local station, and is not capable of operating a loud-speaker at the same distance as is the circuit included in this receiver. This is due to the fact that a stage of transformer coupled low-frequency amplification is included in this circuit, and at the same time it must be remembered that the measure of H.F. amplification incorporated in this receiver does to a certain extent compensate for the absence of ordinary magnetic reaction.



View of the complete receiver from above. At the back are the plate (left), and (right) filament batteries.

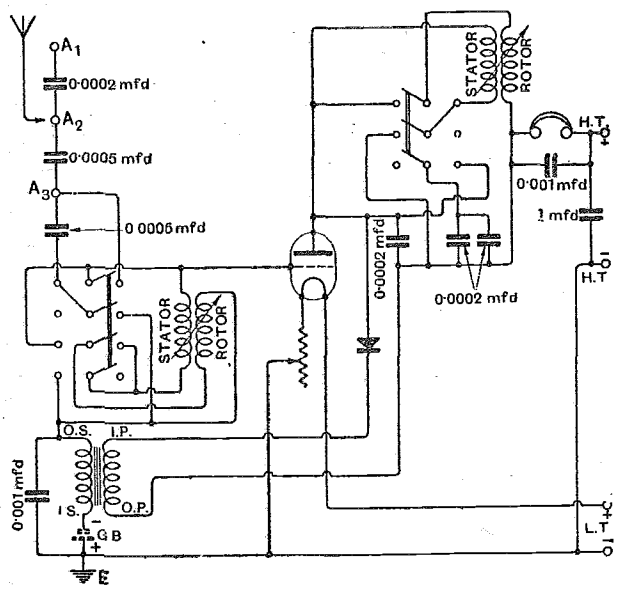


Fig. 1.—Theoretical connections of the set.

Another factor militating against the employment of a detector valve with the usual type of magnetic reaction was the fact that it was intended that this should be a set which could be placed in the hands of a person with absolutely no knowledge of wireless whatever, whose sole desire was to listen to programmes, with the knowledge that once the set had been adjusted for him on any given station he could note the dial adjustments and turn the dials to those settings on any subsequent occasion with the absolute certainty of being attuned to the wavelength of that particular station without any delicate "fiddling" with reaction control, variable grid leaks, etc. Of course, from the point of view of sheer distance-getting, regardless of quality or signal strength, the other type of receiver is to be preferred.

Dealing with the second aspect of the question, concerning the stability of the set, it will be noticed that no attempt has been made to incorporate magnetic reaction, which is always a stumbling block in circuits of the reflex type. It will invariably be found that the avoidance of deliberate magnetic reaction will transform an otherwise "untameable" dual amplification set into an instrument which is delightfully smooth to control. This particular instrument will be found perfectly stable, and, in fact, provided that it is made and operated in accordance with the instructions given, it is impossible to make it oscillate at either radio or audio frequency, whilst at the same time sufficient regenerative effects are inherent in the circuit to make it extremely sensitive. Many people doubt the efficacy of H.F. amplification when a valve is operating in a dual capacity, and while, of course, a valve operating in this manner does not perform the functions of an H.F. amplifier so efficiently as when it is used solely in this capacity, it is only necessary to test this receiver

Valve-Crystal Reflex Set.—

on the signals of a broadcasting station at a distance of one hundred miles or more to refute the argument that H.F. amplification is non-existent in a receiver of this type.

Choice of Components.

Before proceeding with constructional details of the receiver it is advisable to make a few remarks concerning the components actually used in this set. All the components actually used in this receiver are easily replaceable by components of other makes except in one or two instances where considerations of space necessitate adherence to the particular instruments actually embodied in the original model of this set. With regard to the H.T. battery, this is replaceable by a 60-volt H.T. battery of any reputable make, since the one used is at least as large as any of the ordinary H.T. batteries of similar voltage that are on the market. Similar remarks apply to the two dry cells used for lighting the valve filament; the only proviso that must be taken into account is that these batteries must be of the square and not of the round type, as otherwise it will be found impossible to mount them in the cabinet in the manner described. Siemens size *o* dry cells, among others, are equally as suitable for use here as the ones actually used. The actual dimensions of the H.T. and L.T. batteries embodied in this instrument are 9in. × 3½in. × 3½in. and 6¾in. × 2½in. × 2½in. respectively, and, provided that none of these dimensions is exceeded, any make of batteries may be employed. The voltage of the H.T. battery should not, however, be less than sixty, or signal strength will be greatly reduced. The dimensions of the transformer are another important point, and if this component is of greater bulk than the one used it will be found impossible to mount it in position. The only other components that need special attention are the two variometers and the crystal detector. The particular variometers used in this set will, when employed in conjunction with the switching arrangements and particular values of fixed condensers provided, be found to tune down, in the case of both aerial and anode circuits, to a minimum value of 250 metres, and up to a maximum value of 2,750 metres. Thus not only are the wavelengths of all the B.B.C. stations, including Chelmsford, easily covered, but the set will also tune up to the wavelengths of Radio-Paris and of the Eiffel Tower, which is a great advantage. Both switches are placed to the left when it is desired to receive any of the B.B.C. stations working between 300 and 500 metres, whilst Chelmsford or either of the two Paris stations can be received by merely moving both switches to the right and re-adjusting the two tuning dials. Other variometers may, of course, be used, but information concerning the values of fixed condensers necessary should be ascertained from the makers. It is, however, desirable to point out that many variometers designed to cover a large band of wavelengths are of considerable bulk, and would be unsuitable for use in this particular receiver, owing to questions of space limitation.

With regard to the particular crystal detector used, this was specially chosen from among many others in order to render the set as constant in its action as possible. The weak spot in any dual amplification receiver not employing valve rectification is undoubtedly the crystal detector, since this always requires adjustment at the commencement of any period of reception. In the particular type of detector used the whole of the detector is totally enclosed and screened from view, a small adjusting knob projecting through the casing. The actual crystal is fixed behind a very finely meshed gauze screen, through which the contact point passes before reaching the surface of the crystal. Thus it will be seen that, once adjusted, the contact is held against the sensitive spot by means of the gauze, which effectually prevents the detector being knocked out of adjustment by any movement accidentally imparted to the table on which the receiver stands. A small red spot will be found on the moving knob, and great care should be taken to see that this is always at the point most remote from the brass cap before this cap is withdrawn for the purpose of inserting a new crystal. If this point is not attended to, the gauze and also the wire contact point may become damaged. The whole detector clips on to two terminals on the face of the panel, and may be instantaneously removed and another crystal detector of any type attached to the terminals for experimental purposes.

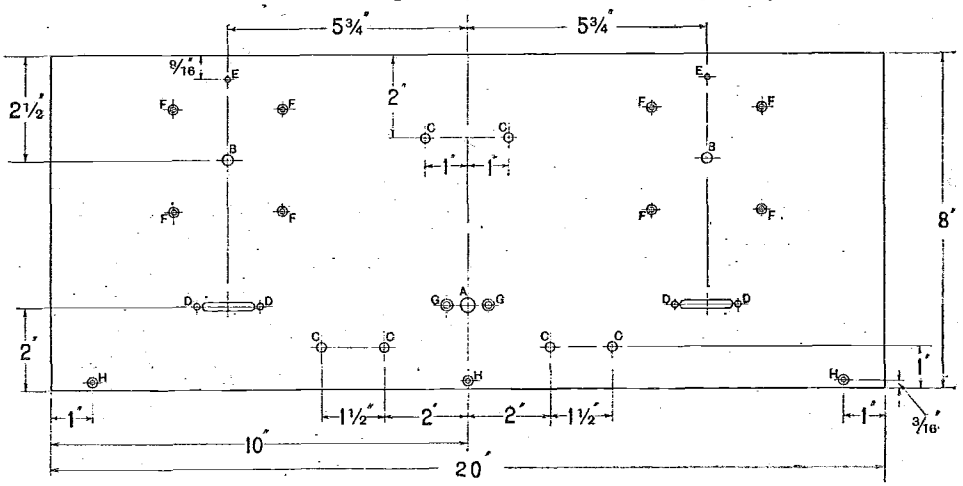


Fig. 2.—Details of the ebonite front panel. A, 5/16in. dia.; B, ¼in. dia.; C, 7/32in. dia.; D, 5/32in. dia.; E, ⅛in. dia.; F, ⅛in. dia., and countersunk for No. 6 B.A. screws; G, 5/32in. dia., and countersunk for No. 4 B.A. screws; H, ⅛in. dia., and countersunk for No. 4 wood screws.

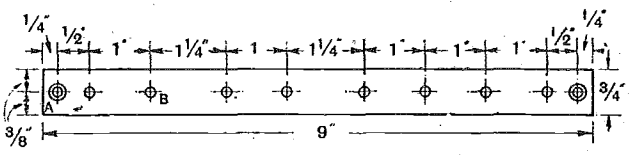


Fig. 3.—The ebonite terminal strip. A, ⅛in. dia., and countersunk for No. 4 wood screws. B, 5/32in. dia.

Valve-Crystal Reflex Set.—

It is essential that a valve-holder of the anti-vibration type be employed in order to eliminate the annoying "ringing" sound sometimes experienced with dull-emitter valves when the receiver is accidentally knocked. There are many types upon the market which are quite suitable. The particular one used is a very good specimen of its kind, and is of the same make as the variometers used in the set.

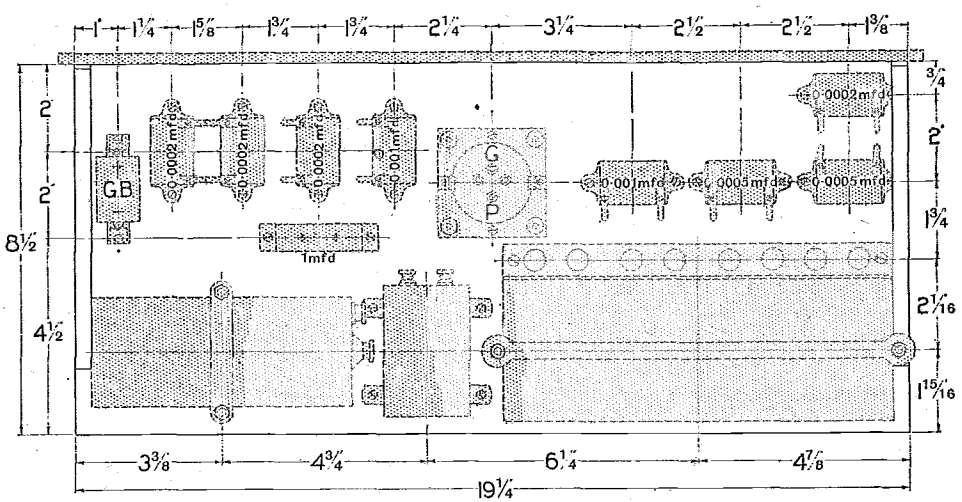


Fig. 4.—Layout of parts on base.

Constructing the Receiver.

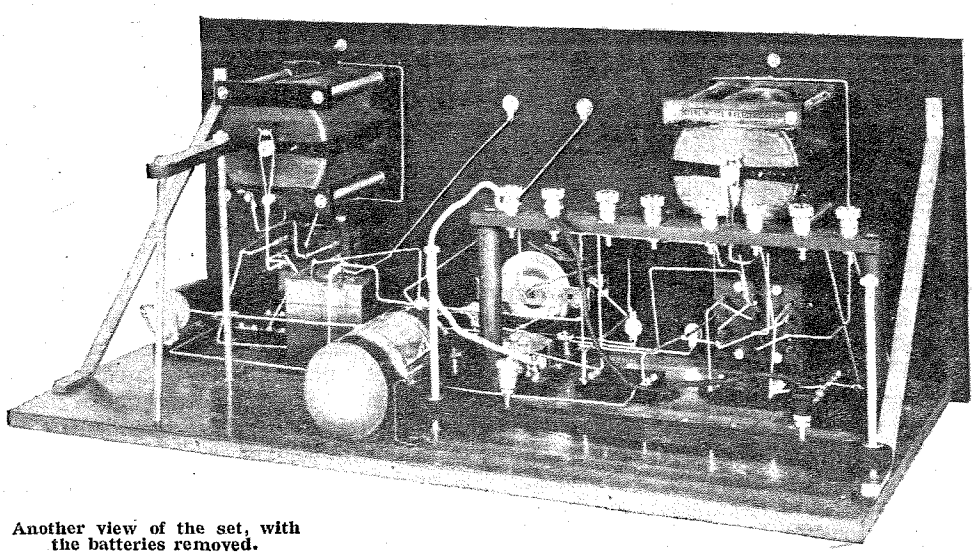
It is first necessary to obtain a panel and baseboard of the dimensions shown in Figs. 2 and 4. It cannot be too strongly urged that a "guaranteed" type of ebonite be used. As this panel is of a standard size, no difficulty should be experienced in this respect. If a guaranteed ebonite is not employed, it will be necessary to rub down the surface of the panel with fine emery paper in the usual manner in order to remove the shiny surface, which usually possesses very poor insulating properties.

The next step is the marking out and the drilling of the panel, which should be done strictly in accordance with the dimensions given in Fig. 2. The variometers, rheostat, the two switches, the two nickel indicators, and the six terminals may now be mounted on the panel, after which the valve holder, the holder for the grid battery, and the fixed condensers may be mounted on the baseboard in the positions indicated in Fig. 4. It will now be necessary to attach the panel to the baseboard. This operation is quite straightforward, and no difficulty should be experienced. Before mounting the other components on the baseboard, the set should be wired up as far as possible, wiring being carried out by means of No. 16 tinned copper wire of round cross-sectional area. The ebonite terminal strip, Fig. 3, and the L.F. transformer can now be mounted and the wiring completed.

The erection of the terminal strip is not difficult. Two 4-inch lengths of ebonite tubing should be obtained and their ends plugged with wood. They are fixed to the baseboard by means of a wood screw passing through from the under side of the panel, the ebonite bar being similarly fixed by a wood screw passing through each end of it to the plugged end of the tubes.

When wiring the two switches, care must be taken not to use too hot a soldering iron, or to keep it too long in proximity to the switches, otherwise the heat may cause one or more of the switch arms to become loosened in their ebonite settings.

The final operation is the affixing of the batteries. Four pieces of threaded 2 BA rod, 4in. in length for the H.T. battery and 6in. in length for the L.T. battery, should be obtained and screwed into the baseboard in the positions indicated in Fig. 4. The batteries are placed in position between their respective pairs of supports and held in position by ebonite strips having holes at either end, through which pass the brass rods. These ebonite strips are firmly clamped down by means of nuts in the threaded rods. A glance at the photographs will quickly clear up any doubts remaining concerning the exact method of fixing these batteries. No constructional details for a cabinet are given, since the dimensions necessary for this are quite obvious from Figs. 2 and 4. The cabinet may be home constructed or can be purchased ready made from advertisers in this journal. Two small holes



Another view of the set, with the batteries removed.

Valve-Crystal Reflex Set.—

should be bored in the back of the cabinet for the entry of aerial and earth wires, and another hole for the entry of external battery wires if these are used for experimental purposes. If these instructions are followed carefully in conjunction with the plans given, no difficulty should be experienced in reproducing a faithful copy of the original instrument.

Many persons may be in doubt concerning the reason for the employment of a 30 ohm rheostat, since only two dry cells are used for filament lighting. The reason that this component was used was so that the receiver might be made adaptable for the needs of certain readers who might like to try out different types of valves in conjunction with an external accumulator. By means of this rheostat any type of valve may be used in the set in conjunction with any accumulator. The same consideration dictated the use of a terminal strip instead of connecting the batteries direct to the wiring of the set by means of soldered connections. The grid biassing battery was included for a similar reason. It should be pointed out that when using this set in conjunction with the value of H.T. incorporated in the set, louder signals will be obtained by removing the grid biassing battery and short-circuiting the clips by means of the short brass rod, similar in appearance to a grid leak. When used care must be taken to insert it in the clips so that it imparts a negative and not a positive bias to the grid of the valve. Normally, however, its use is undesirable, since louder signals may be obtained without it, and provided the transformer is connected up properly, the valve will not tend to rectify in its absence, nor will instability be caused. It would be quite an excellent idea to obtain a spare holder for this grid battery and to mount it upon the baseboard for holding the grid battery when not in use, since this battery should only be brought into circuit at such times as a higher value of H.T. is being applied to the set from an extra external battery for experimental purposes. The grid battery then becomes necessary in order to stabilise the set.

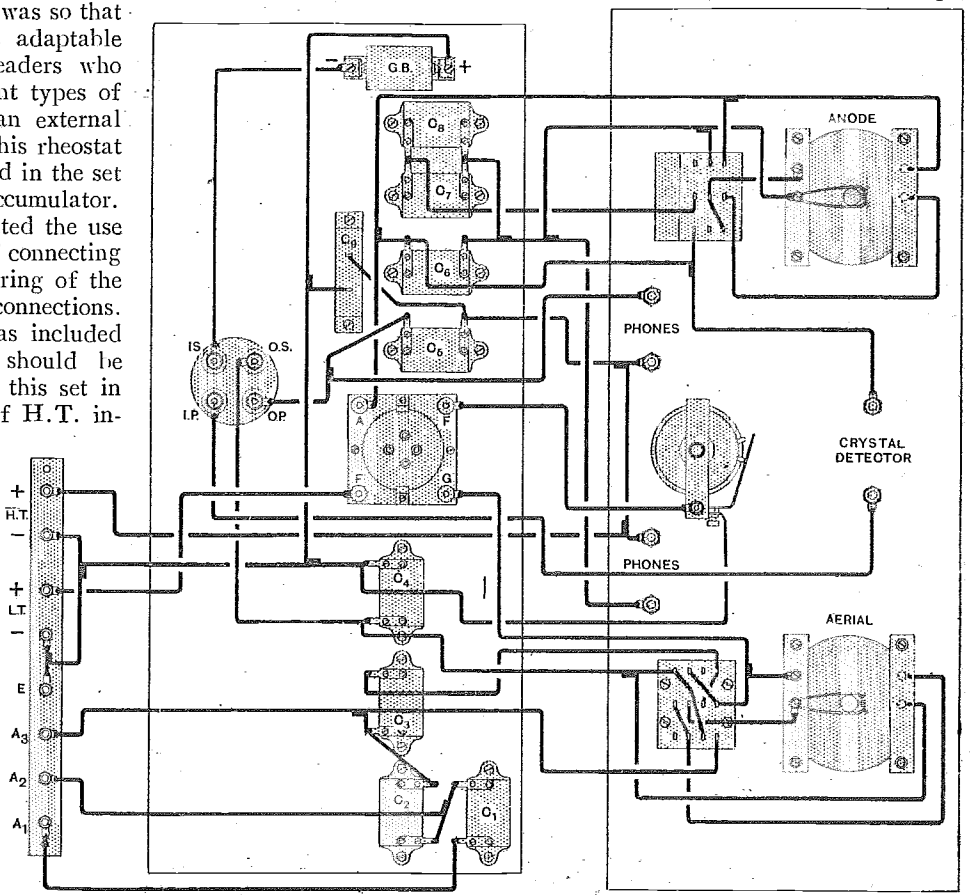


Fig. 5.—Wiring diagram. Special attention should be given to the wiring of the switches.

One of the points which must be stressed in regard to this receiver is the importance of the transformer connections. It is necessary that the O.S. terminal of the transformer be the end of the secondary winding which is, electrically speaking, nearest to the grid of the valve, the I.S. being connected to earth. Before the primary is connected up, experiments should be conducted to see which are the correct connections for the primary. In one method of connecting it the valve will tend to rectify badly, and both range and volume will be enormously reduced. When connected correctly this will not occur, and a great increase in efficiency will be obtained. No definite rule can be laid down, since this differs with various transformers. In the particular specimen of transformer used results were greatly superior when connection was made in accordance with Fig. 5. This point is of paramount importance, and cannot be too strongly emphasised.

It will be noticed that three aerial terminals are provided. Normally, the aerial should be connected to A_3, but when a large aerial is used, better results will be obtainable by connecting the aerial to A_2. This connection may also be used on a smaller aerial, but a readjustment of the aerial variometer will be necessary. When connected to A_2, greater selectivity will be obtained and the set will be somewhat more "lively," and if the aerial resistance is low, oscillation may be brought about. Both A_2 and A_3 should be tried, to see which connection yields best results. Terminal A_1 is only incorporated for the benefit of the experimenter. When this connection is used the set will usually be unstable, but the experimenter will find that the selectivity is high.

An important question which will naturally arise is the probable length of life which may be expected from the two dry cells. From actual practical experience extending over a period of several months with 0.06 type valves

LIST OF COMPONENTS.

1 Ebonite panel, 20in. × 8in. × ¼in.
1 Wooden baseboard, 19¼in. × 8½in. × ⅜in.
2 Brass strips for supporting panel.
2 Variometers (Sterling).
1 "Anti-vibration" valve holder (Sterling).
1 Four-pole switch ("Utility" nickel-plated).
1 Three-pole switch ("Utility" nickel-plated).
1 Transformer (Eureka No. 2).
1 Crystal detector (L'Excentro, Horne Bros.).
1 30 ohm rheostat (Igranic).
8 Terminals with indicating tops (Horne Bros.).
6 Nickel terminals (Horne Bros.).
2 Nickel dial indicators (Bulgin Ltd.).
3 0·0002 mfd. fixed condensers (Dubilier).
2 0·001 mfd. fixed condensers (Dubilier).
2 0·0005 mfd. fixed condensers (Dubilier).
1 0·0001 mfd. fixed condenser (Dubilier).
1 Grid bias battery with clip holder (General Wireless Co.).
1 66-volt H.T. battery (Eveready).
2 1½-volt square type dry cells (Eveready, Class W.).
2 4-in. lengths ebonite tubing.
3 Lengths ebonite strips, 10in. × ½in. × ¼in., 9in. × 1in. × ¼in., 3½in. × ½in. × ¼in.
2 6-inch lengths 2 B.A. threaded brass rod.
2 4-inch lengths 2 B.A. threaded brass rod.

and dry cells of the "bell-ringing" type, it can be definitely stated that these cells will operate this set for an average of three or four hours nightly for a period of eight or nine weeks before they require renewal. It may be thought from this that these cells would operate two valves for four weeks, but unfortunately this is far from being the case, since the life of a dry cell does not decrease in direct proportion to the current taken from it, and the life of the cells on two valves would be far less than four weeks. It may be argued that three dry cells used in conjunction with the 30 ohms rheostat might have been productive of better results, but actually in the case of a single valve this is not so. Valves of the sixty milliampere class are designed to operate on 3 volts, and are not harmed when two dry cells are connected directly to their filaments. Thus it will be seen that in this receiver there is not the slightest risk of damaging the valve by means of excessive filament current. This point far outweighs any problematical advantages that might be obtained by the use of three dry cells. This remark, of course, only applies in the case of a single valve set, and would not apply to a two or three valve set employing dry cells for filament lighting. It can be definitely said that two dry cells will efficiently operate this receiver for the period mentioned. These cells are, of course, of the ordinary domestic size, and cost but a few pence more than the more conventional cylindrical shape. The H.T. battery should last several months, since the demands on it are exceedingly small.

Operating the Set.

To operate this set the filament rheostat should be turned round to the right as far as it will go, and the crystal detector roughly adjusted, after which the two variometers are rotated until the local station is heard, care being taken that both switches are over to the left. The aerial should in the first place, be connected to A_3. Once signals are heard and tuned in to maximum strength, the crystal detector can be properly adjusted. With regard to this detector, some slight mechanical adjustment may have to be made to it when it is new, and it is strongly to be recommended that for the first time of using the set it be removed, and an ordinary "experimental" crystal detector be connected to the two terminals by flexible leads. Once signals have been tuned in, the proper crystal detector can be replaced, and provided that signal strength is the same as when using the experimental crystal detector, it will be evident that the detector is in order. *This point is most important.* When a station has been tuned in to its loudest, the aerial connection may be altered and the set re-tuned to see which connection is best suited to the aerial on which the receiver is to be used. Once this is found, the variometer readings can be noted, and all that will be necessary when this station is desired on a subsequent occasion will be to set the dials to the same readings and rotate the knob of the crystal detector very slowly until the station is heard. Changing over to 5XX is quickly effected by moving both switches to the right and re-tuning the variometers.

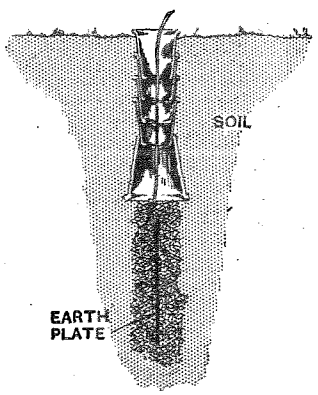
At the end of the programme the set is switched off and all batteries automatically disconnected by merely turning the rheostat to the left as far as it will go. Provided that due care is exercised in the construction of this receiver, it will be found to amply fulfil the conditions laid down for it at the commencement of this article. On actual test at a distance of a dozen miles from 2LO excellent loud-speaker reception was obtained, the tone being remarkably pure, and the volume amply sufficient to fill an ordinary living room. Excellent signal strength was also obtained from the high power station, and it was noticeable that the instrument was remarkably selective. Birmingham, Bournemouth, Petit-Parisien, and Radio-Paris were received at very good telephone strength, several pairs of headphones being connected to the set. The aerial used was an outdoor one of reasonable efficiency. On an indoor aerial, London was uncomfortably loud on telephones, and had to be detuned, Birmingham coming in at very pleasant strength. Finally, a short length of electric lighting flex was placed round the picture rail, 2LO and 5XX both being received with comfort by this means, thus indicating that the instrument is specially suited to the flat-dweller, and indicating also, in view of the approach of summer, its uses as a portable receiver. In this latter respect it may be noted that since all batteries are contained in the cabinet, the instrument is eminently suitable for summer use, an aerial being obtained by means of a length of insulated wire slung into the branches of a tree. To anyone possessed of ingenuity, the construction of a carrying case would present no difficulties. Owing to lack of time at the period when the set was tested, no attempt was made to tune in any of the more distant broadcasting stations, but these are by no means outside the capabilities of the instrument.

NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

A NOVEL EARTH CONNECTION.

The difficulty of keeping the earth connection moist may be considerably reduced by adopting the scheme illustrated in the accompanying diagram. The earth plate is surrounded with small pieces of coke, over which a large flower-pot is inverted. The bottom of this flower-pot is chipped out and a series of smaller pots are built up over it. The pots form a natural receptacle for rain, and during the summer months water can



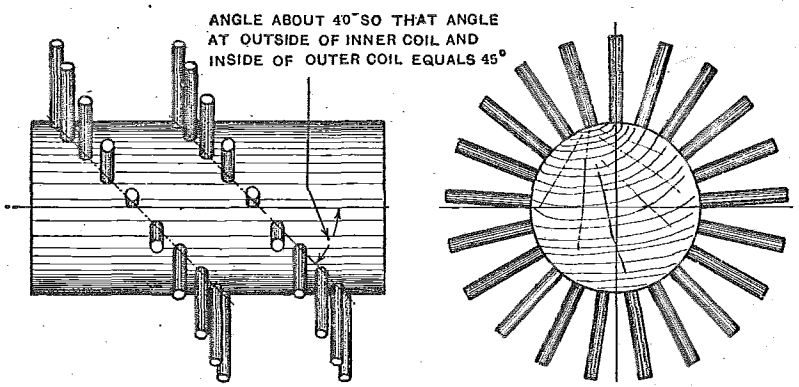
The earth plate is surrounded with coke, which is maintained in a moist condition.

be poured in periodically, with the certain knowledge that it will go direct to the earth plate without being absorbed by the surrounding soil.—D. T. B.

oooo

A NEW VARIOMETER DESIGN.

A novel design of variometer is shown in the accompanying drawings, and will be seen to consist of two honeycomb coils assembled at an angle of 45° to the spindle, so that in effect the moving inductance can be brought to lie in the same plane as the fixed inductance or by rotation can take up a position at right angles to it. A special former must be used for constructing the coils, and the pins are arranged on a line which makes an angle of about 40° with the axis of the former; thus when the wire is wound on, it will engage by the shortest path round the pegs,



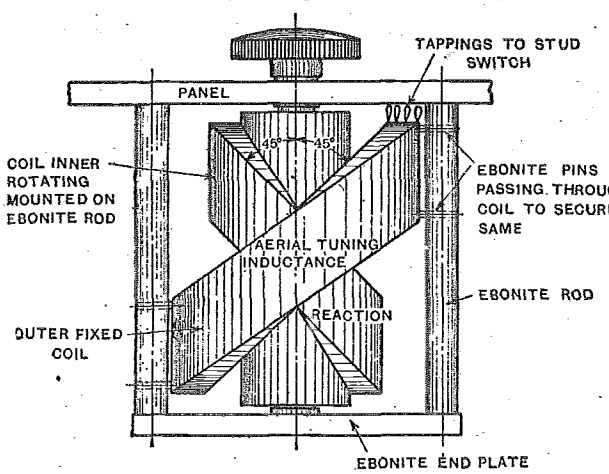
Details of former for constructing a variometer inductance possessing a tilted axis.

taking up a position at about 45° to the axis. Both coils can be wound on the same former, and after the smaller one has been finished two layers of string should be wound on to give support to the larger one and to produce the necessary clearance when removed from the former. The method of mounting is shown, and a good inductance variation is obtained when the operating knob is rotated through 90°, whilst the self-capacity between the fixed and moving coils is lower than many of the standard types consisting of ball rotor and closely fitting stator.—G. C.

oooo

BURNT-OUT VALVES AS RECTIFIERS.

The problem of rectifying step-up alternating current for use with a valve transmitter cannot be successfully solved by the use of chemical rectifiers, whilst a valve rectifier is expensive as regards initial outlay and costly to maintain. Certain of the French types of valves will make quite good power rectifiers when the grid wire is used as a filament. For this purpose the metal base must be removed and it will be found that two wires are brought out from the grid. To heat the grid wire a current of two or three amperes at 12 volts may be necessary, and a valve adapted in this way has been



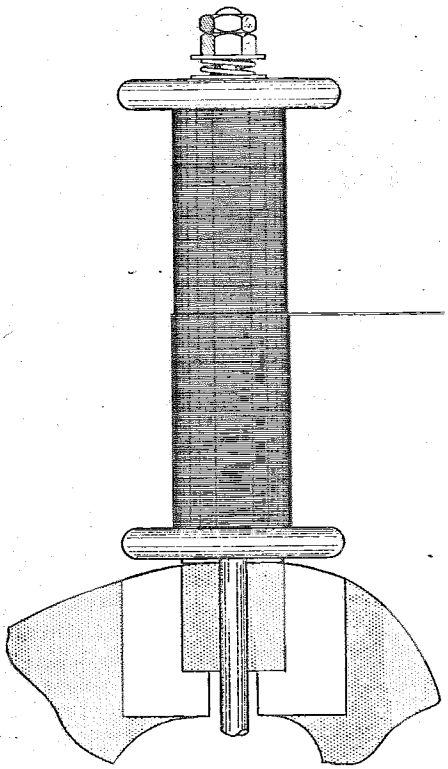
A form of variometer in which the maximum to minimum change of coupling is produced by a 180° movement of the spindle.

found to pass a plate current of 75 milliamperes when operating at a potential of 1,000 volts.—C. B.

oooo

WIRE TENSION DEVICE FOR COIL WINDING.

When winding cylindrical coils by hand, it is necessary to provide some means of keeping a constant tension on the supply reel if the turns on the coil are to be prevented from slipping off. A brass rod of a diameter slightly less than the centre hole in the wire spool is threaded at one end



Simple method of maintaining the tension on a wire when winding from a reel.

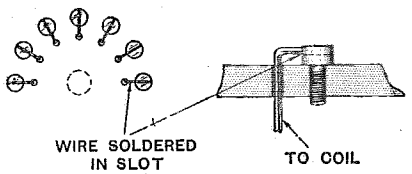
and clamped vertically in the vice at the other. The spool is slipped over the rod and held in position with a light spiral spring and two lock nuts. A spring washer is unsuitable as the pressure obtained is generally too great. Washers should be inserted between the spool and the vice and on both sides of the spring to ensure smooth working.—A. B.

oooo

CONTACT STUD CONNECTIONS.

The wiring at the back of rotary switches is apt to become congested when the wires to the contact studs are secured by nuts and washers. This difficulty can be avoided and the insulation considerably improved by using ordinary cheese-head screws for contact studs.

The screws are inserted in holes drilled and tapped in the panel. No lock nuts need be used at the back,



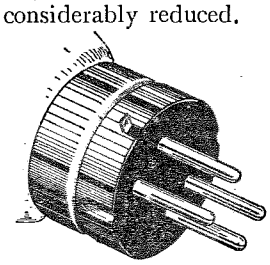
Using screws as contact studs, the slotted heads provide a means for making neat and reliable connection.

but the saw-cuts in the screw heads should be arranged radially. Tinned copper wire equal in thickness to the width of the slots should then be cut into 1½in. lengths, which are bent at right angles and passed through small holes drilled in the panel opposite each stud. Each wire is soldered into position in the slot and filed down flush with the top of the screw. The tappings from the coil may then be soldered to the projecting ends of the wire below the panel.—J. G. W. T.

oooo

MARKING VALVE CAPS.

As every amateur learns in the course of his experience, it is a very easy matter to insert a valve in its socket wrongly, in spite of the special arrangement of the pins. Costly mistakes of this kind can be avoided to a large extent by marking the position of the plate leg with some form of projection on the side of the cap. When inserting the valve in its socket, the position of this projection can be located with the fingers, and the chances of error will be considerably reduced.



By tuning up a small piece of the brass capping to give ready identity of the plate pin, errors of incorrect insertion of the valve in its socket are avoided.

The head of a screw may be soldered to the valve cap if care is taken not to melt the composition base, or a narrow strip of metal may be turned up from the edge of the cap by making two saw-cuts close together in the manner indicated in the illustration. A spot of sealing wax may be used to mark valves mounted in moulded caps, but in this case the position to be marked should be drilled or scratched to provide a firm hold for the wax.—H. J. L.

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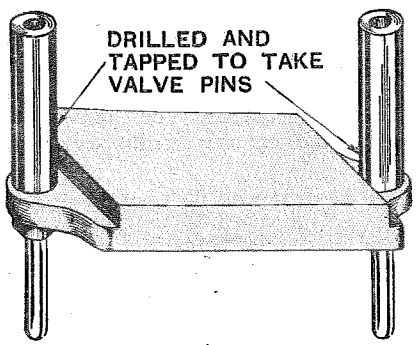
PLUG-IN CONDENSERS.

In experimental work, quickly interchangeable fixed condensers are a great convenience. Condensers of the Dubilier type in moulded ebonite cases can be fitted with valve pins and sockets arranged at each end in pairs, to which the condenser terminals are then connected.

With this method of mounting, condensers can be connected either in series or parallel.—J. G. W. T.



Fixed capacity condensers, fitted with valve sockets, provide for rapid connection in circuit and also for arranging a number of condensers connected in parallel.

A WIRING HINT.

When wiring up a set by soldering connections to terminals, it is very difficult to prevent the soldering flux from reaching the surface of the ebonite panel and producing high resistance leaks in most harmful places, *i.e.*, between the valve sockets. This can be entirely obviated and troublesome after-cleaning of the panel made unnecessary by completely covering the back of the panel after the components and terminals have been fitted with pieces of soft white blotting-paper. The paper is pushed over all terminal ends and valve sockets, leaving these ends exposed for soldering. Flux which runs down from the soldered joint (and amateurs frequently use far more flux for a joint than they should) is completely absorbed by the paper, and when this is pulled away at the completion of the wiring the ebonite will be found clean and perfect underneath.—H. W. M.

AN EFFECTIVE FRAME AERIAL.

An Efficient Frame Aerial, which is Easily Constructed, for Tuning over the Broadcast Wave-lengths.

By H. HOUGHTON.

THE need for a small and efficient frame aerial grows ever more cogent as time goes on and receivers become more sensitive, whilst as the number of broadcasting stations working on a limited band of wavelengths increases daily, the amateur may find that he will eventually be driven to use a frame aerial in order to obtain a high degree of selectivity.

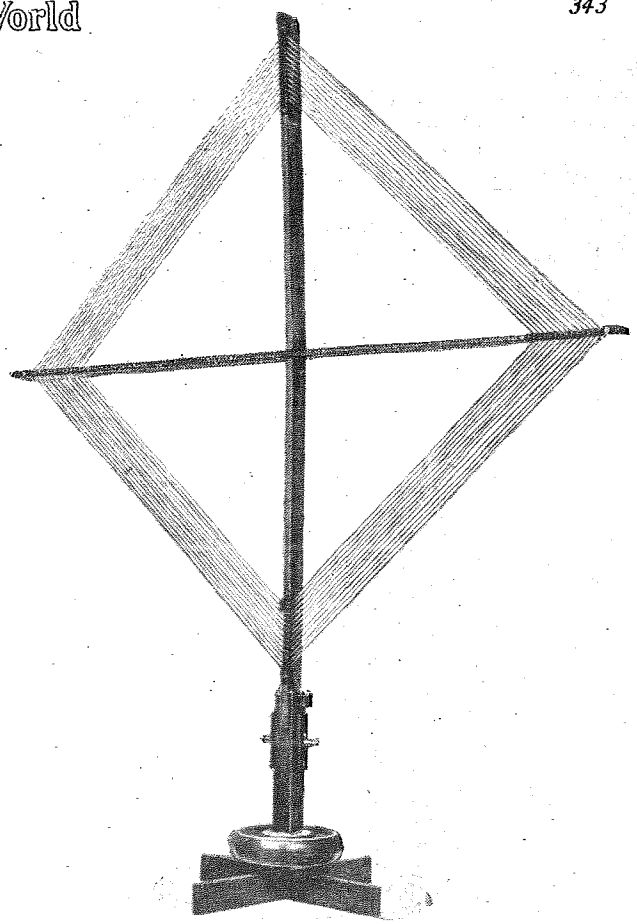
In the case of a superheterodyne receiver a frame aerial becomes a *sine quâ non*. Unfortunately, however, the price of a good frame aerial is unnecessarily prohibitive, and it becomes necessary to construct this component at home. Happily, this is not a difficult matter, but it is noticeable that the average home-made frame aerial is sometimes unnecessarily unwieldy and untidy in appearance.

It cannot be denied that more energy is picked up by a large frame than by a small one, but if constructors would pay greater attention to eliminating losses in a frame by using ebonite supports and air-spaced turns, rather than to the question of size, they would probably be surprised to note that they would obtain greater efficiency from a small "low loss" frame than from a larger and more unwieldy instrument using insulated wire wound slackly and haphazardly, as is the case with some instruments brought to one's notice. In any case, when using a correctly designed and constructed superheterodyne receiver, for which this frame aerial is primarily designed, it is quite unnecessary to use a large frame, and most excellent results will be obtainable with this instrument. A further advantage is that a small frame aerial is more easily portable, and is less conspicuous in an ordinary room. The frame which is described here is, as will be observed from the photograph, small and unobtrusive in appearance, but at the same time it is very easily and cheaply constructed with a few simple tools and materials.

Few Materials Required.

In designing a frame aerial, provision must be made for rotating the frame in a convenient and rapid manner without having recourse to moving the main stand of the instrument, and this has, in the present instrument, been accomplished in a particularly neat and simple manner which will be described later.

The materials required consist of two 3ft. lengths of 1in. × ¼in. wood, two 9in. lengths of 1in. × ⅜in. wood, 1 "skooter" wheel of 4in. diameter, a 3in. length of ¼in. brass rod, a piece of brass 2¼in. × ⅜in. × 8in., two terminals, 15 small brass wood screws, 70ft. of bare No. 20 tinned copper wire, and a small quantity of scrap ebonite.



The completed frame aerial.

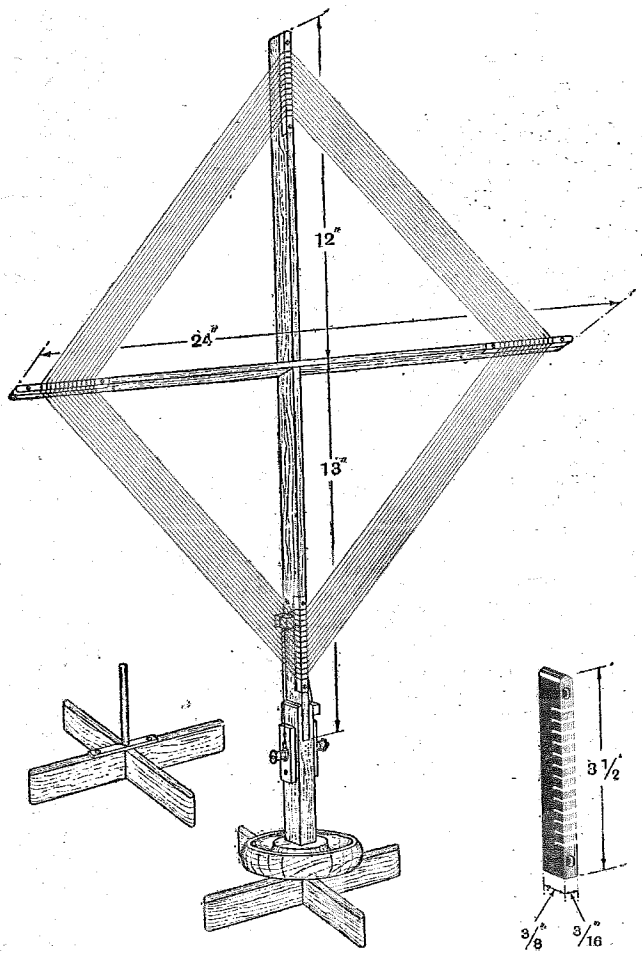
With the exception of the skooter wheel, all the woodwork may be obtained from "Hobbies," the particular wood used in this instrument being satin walnut, but this is, of course, a matter of individual choice. The skooter wheel may be obtained from any toyshop for a few pence. It is first necessary to saw up the 3ft. lengths of wood into five portions having lengths of 25in., 24in., and three 6in. lengths respectively. The ⅜in. wood will not require further cutting.

Constructing the Cross-pieces.

The 25in. strip should now be taken, and a section 3½in. long by ⅜in. deep be cut away from the edge, commencing at a distance of 1½in. from one end. This will be the bottom end of the upright of the frame. A 3½in. section of ⅜in. depth should now be cut away at the other end, but on the same edge, the cut-away portion commencing at the extremity. The 24in. length requires to have a section 3½in. × ⅜in. cut away from the extremity of the same edge at either end. The 24in. strip must now have a slot ¼in. in breadth by ½in. in depth cut away at the centre point of the edge opposite to that having the cut-away portion at its extremities. The 25in. strip has a similar slot which is 13in. from the bottom end previously mentioned, and is on the same edge as the cut-away portions at either end. The purpose of these slots is to enable the upright and horizontal of the frame to be fitted together in the manner known to joiners as "half and half."

An Effective Frame Aerial.—

It is now necessary to obtain a piece of $\frac{1}{4}$in. ebonite and cut small sections of dimensions such that they will just fit in to the small cut-away portions at either end of the upright and horizontal portions of the frame. These pieces of ebonite are secured to the woodwork by passing two small wood screws through each piece of ebonite and screwing into the woodwork of the upright. Fourteen slots spaced $\frac{3}{16}$in. apart are now cut into each of these four strips of ebonite with a hacksaw. These slots are



Sketch of the frame aerial with leading dimensions. The smaller drawings show the support for the frame and one of the ebonite strips.

$\frac{1}{8}$in. deep, and should be slightly enlarged at their bottom ends by boring them transversely with a fine drill. The purpose of these slots is, of course, to support the wires of the instrument.

An examination of the sketch above will readily make clear the constructional points which we have been discussing.

Fitting the Framework.

The three 6in. lengths of wood should now be taken, and $1\frac{1}{4}$in. should be sawn off one strip. The three pieces should now be firmly glued together, the shorter one being in the middle. All three strips have their ends flush at one end, thus leaving a gap $1\frac{1}{4}$in. deep between the two outer portions at the other end. Once the glue has set quite hard, a $\frac{1}{4}$in. diameter hole must be drilled into the "flush" end to a depth of three inches. Having done this, the centre of the skooter wheel should be cut away in the form of a rectangle having dimensions of 1in. × $\frac{3}{4}$in., and it should then be fitted tightly over the "flush" end of the three pieces of wood which have been glued together, the position of the skooter wheel being such that $\frac{1}{8}$in. is left protruding through the skooter wheel. Here, again, an examination of the sketch will clear up any points upon which the constructor may be doubtful. The end of the upright of the frame may now be dropped into the slot between the two outer pieces of wood and firmly glued there. The reason for mounting the frame in this manner will now be apparent, since if the length of the upright of the frame were extended so that the two side pieces of wood could be glued on either side of it, it would be extremely awkward to drill the 3in. hole in the butt end of it. Two small pieces of $\frac{1}{4}$in. ebonite having approximate dimensions of 1in. × $\frac{1}{2}$in. should now be screwed in a convenient position to either side of the bottom end of the completed upright (see illustration). These are for the purpose of mounting terminals.

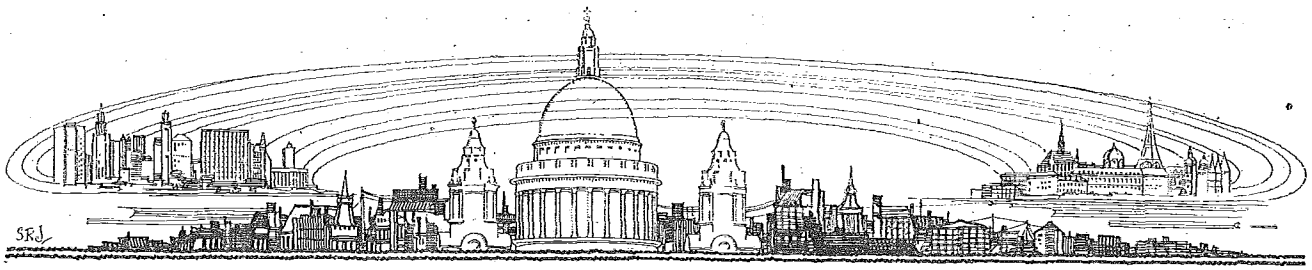
Constructing the Base.

The construction of the base may now be proceeded with. It is necessary to take the length of $\frac{3}{8}$in. wood, saw it into two equal parts, and affix the two parts into the form of a cross by means of the method known as "half and half," which has been previously referred to. The ends of the cross may be chamfered, the same remarks applying to the actual crosspieces of the frame. The whole of the woodwork of the instrument should, of course, be stained and polished before any of the fittings are attached to it. The $\frac{1}{4}$in. brass rod should now be taken, and a thread cut at one end of it. The small piece of sheet brass must now have a $\frac{1}{4}$in. tapping hole drilled in the centre, and a thread cut to receive the threaded end of the brass rod. The brass strip is now mounted on the top of one of the crosspieces of the base by two small screws, as seen in the illustration. The actual frame may now be mounted on the base by inserting the brass rod into the hole in the bottom of the butt end of the upright. It will be seen that the frame can now be very freely and easily revolved on its base.

Winding the Frame.

The instrument is now complete, except for winding on the turns of wire. This is quite simply carried out with No. 20 bare tinned copper wire, 13 turns in all being wound on to the frame. As seen from the illustration, it is necessary to mount two small pieces of ebonite with thin slots cut therein on the lower part of the upright, in order to "anchor down" the two ends of the winding at the point where the winding commences and finishes.

Provided that this instrument is carefully constructed in accordance with the instructions given, it will be found to be very compact and neat in appearance, and at the same time is extremely efficient and productive of excellent results when used with a receiver sufficiently sensitive to operate without the intermediary of an outdoor aerial.



CURRENT TOPICS

Events of the Week in Brief Review.

GENERAL FERRIÉ PROMOTED.

General Gustav Ferrié, the famous director of the Eiffel Tower wireless station, has been promoted to the rank of Divisionnaire. He is at present in command of the communication division of the French Army.

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ESPLANADE BRANLY.

Much deserved honour is being paid to M. Edouard Branly, the famous physicist and wireless inventor, by the city of Amiens, in which he was born. A delegation from the municipal council of the city recently journeyed to Paris to tell him that it has been decided to change the name of the Esplanade de Beauvais to the Esplanade Branly, in recognition of the fame which he has won for Amiens in winning fame for himself.

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THE ROYAL SOCIETY AT WEMBLEY.

Wireless will find a prominent place in the Royal Society's exhibit at Wembley this year. The Society announces that the wireless telegraphy section will be on very elaborate lines, and demonstrations will be given in the British Government Pavilion.

The complete exhibit, which also covers surgery, meteorology, terrestrial magnetism and seismology, and biology, will form the subject of a handbook which the Royal Society will publish, containing articles by recognised authorities, and an introduction by Sir Oliver Lodge on "Radiation."

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CAPE TOWN TO BUENOS AIRES.

Amateur two-way working was accomplished for the first time between Cape Town and Buenos Aires on April 6th. The Cape Town operator was Mr. L. S. Streeter, President of the South African Radio Society, who transmitted on a wavelength of 95 metres, the reply being received on 63 metres. Contact was maintained for an hour and cordial greetings were exchanged.

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25-METRE SIGNALS FROM AUSTRALIA.

Amateur transmissions from Australia on 25 metres were received by English amateurs on April 15th. A preliminary test on this low wavelength was carried out on the morning in question by Mr. C. D. Maclurcan (A. 2CM), of "The Sydney Sun," at Strathfield, N.S.W., and at 6.20, 6.50, 7.20, and 7.25 a.m. his signals were picked up by Mr. J. A. Partridge (G. 2KF), of Merton, and Mr. G. L. Morrow (G. 6UV), of Berkhamsted.

This interesting feat, carried out in broad daylight, affords further proof of the possibilities opened up by ultra-short waves.

Two-way working between this country and Australia is shortly to be attempted on the same wavelength.

WIRELESS ON NEW LINER. A glimpse into the operating cabin on board the new P. and O. Liner ss. "Ranpura."

COLOURED VALVE CARTONS.

In order to facilitate the quick selection of Marconi valves of different types, it has been decided in future to use cartons of varied colours. Valves leaving the Osram Lamp Works are now labelled as follows:—

"R.5" type valves	Yellow.
"D.E.R." type valves	Pink.
"D.E.3" type valves	Green.
"R" type valves	Blue.
"D.E.5" type valves	Orange.

DEATH OF MR. GODFREY C. ISAACS.

It is with very great regret that, as we go to press, we learn of the sudden death of Mr. Godfrey C. Isaacs at his residence in London on Friday afternoon, April 17th.

RADIO SOCIETY OF GREAT BRITAIN.

A lecture entitled "Communication on wavelengths other than those in general use," will be given by Mr. G. G. Blake, M.I.E.E., A. Inst. P., at an Ordinary Meeting of the Society at 6 o'clock this evening (Wednesday) at the Institution of Electrical Engineers. Light refreshments will be served at 5.30.

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FIRST TWO-WAY WORKING WITH ICELAND.

The first amateur to work with Iceland is Mr. Walter G. Sherratt (G5TZ) of Cowes, Isle of Wight, who picked up signals from Iceland BG1 at 11.50 p.m. on April 14th, and was able to reply. Although BG1 transmitted with a rough A.C. note, he was received at considerable strength on a two-valve (o-v-1) set.

The station is owned by Mr. B. Gurdarsson, Laufasveg, 53, Reyjavik, Iceland, and embodies a coupled Hartley circuit working on 500 volts with 150 milliampères on the plates of five Radiotron valves. In the course of communication, Mr. Gurdarsson stated that he transmits nearly every night at 1 a.m. on a wavelength of 98 metres.

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AUSTRIAN AMATEURS ORGANISE.

Austrian wireless amateurs are now represented by the "Freier Radiobund," an organisation which embraces the majority of the smaller societies and clubs, and has risen to a position of national importance.

The association maintains a well-equipped laboratory and has organised an information bureau, where amateurs may obtain both technical and legal advice. Officers of the association are invariably called to represent amateur interests in Government and municipal conferences, and, moreover, the association has a permanent representative on the board of management of the Vienna broadcasting station.

A year ago Austrian amateurs were entirely unorganised.

CHANGES AT RADIO LYONS.

Radio Lyons, the well-known French broadcasting station, will shortly change its location. At present it is situated in the centre of the city, but as soon as the new site is ready it will be moved to the heights of Rilleux. It is expected that the change will considerably extend the range of the station's transmissions.

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FRENCH ACADEMY ACCEPT "HAUT-PARLEUR."

At the last meeting of the French Academy, which decides what words may become officially adopted as part of the French language, "haut-parleur" was accepted as the recognised French for "loud-speaker." The word has been in use for some time in France, and has been used by nearly all loud-speaker manufacturers.

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BELGIAN'S 40-METRE WORKING.

The Belgian amateur P2 has worked on a wavelength of 40 metres with the American 1II. He employed a power of 50 watts.

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MEXICAN AMATEUR SEEKS TESTS.

In a letter received by Mr. T. A. Studley, of Harrow, Mr. Manuel Medina (Mexican 1N) states that he is ready to carry out two-way tests on about 90 metres with British amateurs between the hours of midnight and 2 a.m. (G.M.T.). 1N is using 20 watts input, and remarks that Mr. Studley's is the first report he has received from Europe. His postal address is Box 2295, Mexico City, Mexico.

AMATEUR WIRELESS IN TORNADO.

After the recent tornado in America, in which the stricken areas were completely cut off from telegraphic communication with the outside world, valuable service was rendered by amateur transmitters. Notable among these was Mr. J. R. Tate, whose station at Dorrisville, Illinois, was situated within 15 miles of the storm area. For an entire night Tate's station provided the only contact between this section of Illinois and Chicago, where help was sought. A relief train despatched from Chicago was directed to within a few miles of the tornado district by messages transmitted by Tate, who also despatched bulletins giving information regarding loss of life and damage to property. Throughout this period Tate was in constant communication with 9AAW, of Chicago.

Many amateurs' aerials were blown down or otherwise damaged during the storm.

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IDENTITY OF EIZA.

A number of readers have kindly supplied particulars regarding EIZA, in response to a recent query. The call sign of the station has recently been changed to EAR9, and the owner is M. Carlos Sauchez, Peguero,- Paseo de Plamplona, No. 11, Zaragoza, Spain.

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WIRELESS DOUBTS IN CHINA.

Despite existing doubts as to the legality of importing radio receiving sets into China, that country has twenty privately owned broadcast stations and 5,000 listeners, says a correspondent of the American Radio Relay League. *The Chinese Press,* after making a thorough investigation on behalf of its readers, admits frankly that it does not know whether the importation of completely assembled receivers is legal or not.

In order to keep up with the public demand, which is insistent, magazines and newspapers are printing circuit diagrams and instructions for building home-made sets.

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GROWTH OF WIRELESS STATIONS.

An idea of the increasing use of wireless on land and sea can be gained from the following figures taken from the annual summary issued by the Berne International Wireless Telegraphy Bureau. The particulars relate to ship and shore stations. At the end of 1913 the number of stations equipped was 3,998; at the end of 1919, 6,623; 1920, 13,694; 1921, 14,821; 1922, 15,730; 1923, 16,122; 1924, 16,971.

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WIRELESS ON APPIAN WAY.

A strange mingling of the old and new is provided by the news of the erection of a high-power wireless station at Frascati, on the historic Appian Way. The station is being built by the Italian Government for transoceanic communication, and the power employed will be in the region of 400 kw. The contract for the work was obtained by a German firm.

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GIANT STATION FOR RUSSIA.

The Soviet Government has made plans to build, in Moscow, one of the most powerful wireless stations in Europe. The projected station is to have a power of 400 kilowatts, and it is claimed that it will be capable of transmitting not only to all parts of Russia, Siberia, and Europe, but also to North America.

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CHANGE OF ADDRESS.

Messrs. Fullers United Electric Works, Ltd., have removed their London depot from 58, High Street, W.C.2, to Sparta House, 176, Tottenham Court Road, W.1, where large stocks of their well-known cable, accumulator, dry battery and radio manufactures will be available.

Their Leeds agent, Mr. F. Dawson, has also taken large premises at 7, Park Street, Leeds.

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CATALOGUES RECEIVED.

Wilkins and Wright, Ltd. (Utility Works, Kenyon Street, Birmingham). Catalogue of "Utility" wireless instruments.

U.S. Radio Co., Ltd. (155, High Street, Lewisham, S.E.13). Catalogue of efficiency components.

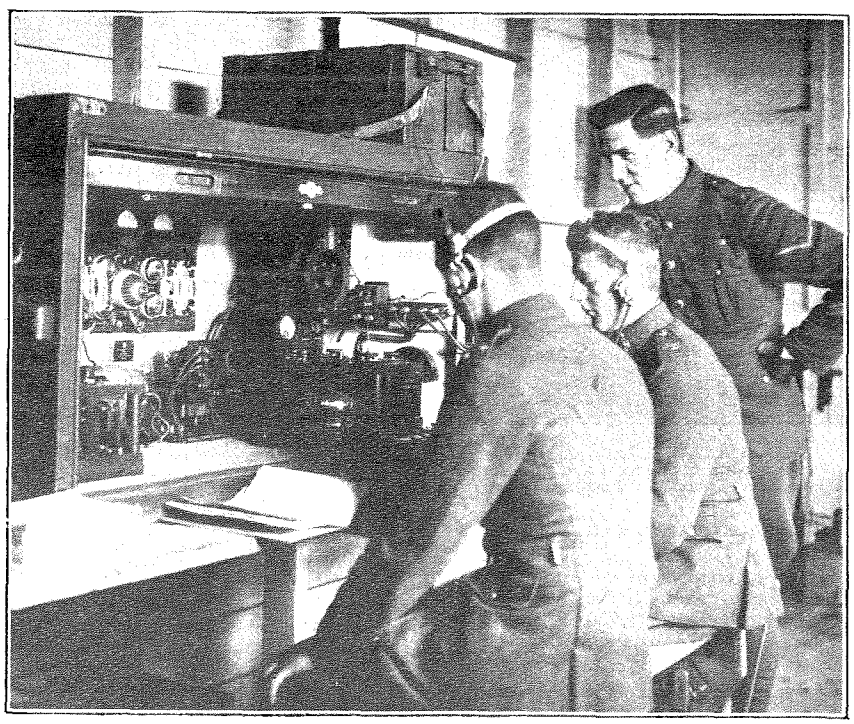
Brook Shaw Wireless Service (Norfolk Street, Sheffield). Illustrated catalogue of wireless apparatus and accessories.

Vyda Electrical Co. (St. Thomas' Works, Derby Street, Cheetham, Manchester). Illustrated list of switchboards.

Fuller's United Electric Works, Ltd. (Woodland Works, Chadwell Heath, Essex). List 315c, dealing with Sparta radio accessories.

Kent Bros. Electric Wire Co. and E. H. Phillips, Ltd. 15, Berners Street, London, W.1). Price list (trade only) of bare resistance wires and tinned copper wires.

Chase Electrical Mfg. Co., Ltd. (184, Fleet Street, E.C.4). 1925 catalogue of "Chaseway" wireless specialities.



WIRELESS TRAINING IN THE ARMY. A view in the transmitting room at Maresfield, Sussex, where operators are trained for the Royal Corps of Signals. The equipment seen in the photograph is a 120-watt transmitter.

THE TESTING OF DETECTORS.

Methods of Testing Crystal Rectifiers are Described, and Reference is made to their Damping Effect.

By E. MALLETT, M.Sc., M.I.E.E., and A. P. CASTELLAIN, B.Sc., D.I.C.

THERE are several things that it is desirable to know about a device for rectifying high-frequency currents—firstly, its sensitivity, or the amount of current rectified; secondly, its stability or constancy in operation; thirdly, the amount of auxiliary apparatus required with it; and, lastly, its selectivity, or influence on the damping of the circuit in which it is to be used.

The last point is quite often not considered at all, but is quite an important one, nevertheless—especially from the point of view of freedom from interference.

D.C. Characteristics.

Some idea of the sensitivity of a detector may be obtained from its direct current "characteristic"—*i.e.*, a curve showing the relation between the d.c. voltage applied to the device and the resulting current through it. Such a curve is obtained with an arrangement of apparatus as shown in Fig. 1.

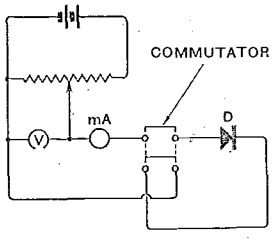


Fig. 1.—Arrangement of apparatus for finding D.C. characteristics.

The voltage applied to the detector D is supplied from a potentiometer across a battery of about 4 volts, and is measured by the voltmeter V. The resulting current flowing through the detector is measured by the milliammeter mA. Between the meters and the detector is a switch to reverse the direction of the voltage applied to the crystal—it is placed in this position and not in the battery circuit so as to obviate the necessity for reversing the meters when the voltage on the detector is reversed. It is also, of course, necessary to place the voltmeter on the battery side—not on the detector side of the milliammeter, as in the latter case the milliammeter would read the current taken by the voltmeter, which may be about 8-10 mA.—*i.e.*, much greater than the current passed by the crystal.

Testing Crystals.

In order to see if a sensitive spot has been found on the crystal, the method of procedure is as follows: adjust the potentiometer till the voltmeter reads, say, 1 volt, and note the mA. reading. Set the potentiometer to zero volts, reverse the commutator, and adjust the potentiometer again till the voltmeter reads 1 volt. Note the new mA. reading—if it is the same as before, then the detector is passing as much current in one direction as in the other, and hence will not rectify; but if these two readings are widely different, then a sensitive spot on the crystal has been found.

Curves of Perikon and Carborundum Detectors.

Specimen characteristics for zincite-copper pyrites (perikon) and carborundum are given in Fig. 2. From these two characteristic curves it is at once obvious that the perikon combination will make a more sensitive rectifier than the carborundum crystal, for while the latter passes only 0.22 of a milliamp more for 1 volt applied one way than for the same voltage in the opposite direction, the perikon combination passes 1.8 milliamps more under the same conditions.

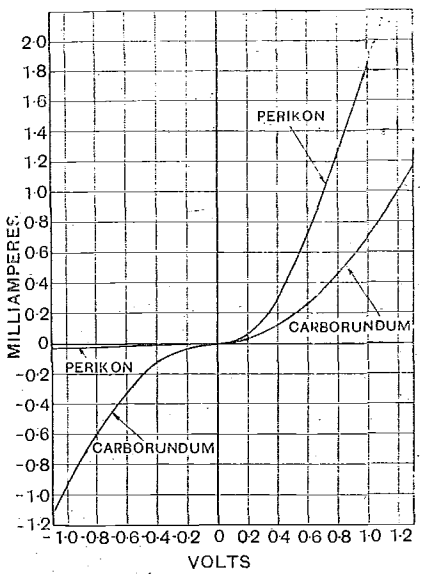


Fig. 2.—Specimen characteristics for perikon and carborundum detectors.

This perhaps will be made clearer on referring to Fig. 3, which shows these difference currents plotted against applied voltage for the same two crystals.

The curves plotted in Fig. 3 are obtained from the static characteristics of Fig. 2 in the following manner: A number of vertical lines, spaced equal distances apart, are drawn as shown in Fig. 4, the current axis being one of them. Consider, say, the fourth lines to right and left of the current axis—let them cut the characteristic and voltage axis at *a*, *b* and *c*, *d*. Then, since the lines are equally spaced, the voltages represented by Oa and Od are equal in magnitude, but are opposite in direction, and the corresponding currents are represented by *a b* and *c d*.

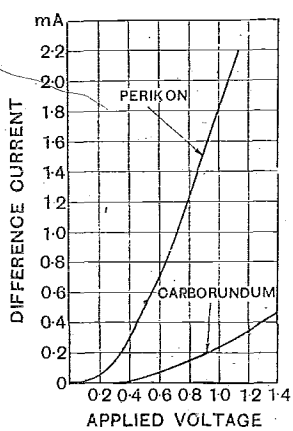


Fig. 3.—"Difference" currents.

Hence, the difference current for the voltage O*a* is given by (*a b*—*c d*), *i.e.*, a length *b k* equal to *c d* is cut off from *a b*, giving *k* a point on the Fig. 3 curve.

The Testing of Detectors.—

Other points are found in a similar way and joined by a smooth curve to give the whole Fig. 3 diagram.

The Voltage Bias.

Another interesting point brought out by difference current-voltage curves is the amount (if any) and direction of a steady polarising voltage which is required for any crystal. For example, in the case of carborundum, the difference current is practically zero up to about 0.4 volt, after which it rises quite rapidly. This shows that there is practically no rectification of signals up to 0.4 volt, so that it would obviously be an advantage to supply 0.4 volt from a local battery, so as to bring the operating point to a part of the curve where the curvature is marked.

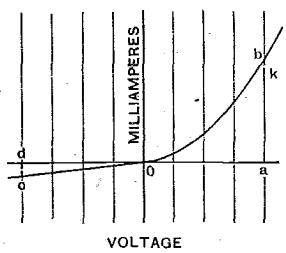


Fig. 4.—Method of obtaining the "difference" current.

It may be as well, perhaps, to point out that the difference current curve does not give the actual rectified current passed by the detector.

H.F. Characteristics.

Although some fair idea of the behaviour of rectifiers with low-frequency alternating currents may be obtained from their static (or direct current) characteristics, it is not always justifiable to infer the comparative behaviour of rectifiers at high frequencies from these characteristics, more especially in the case of crystals whose exact method of rectification is not yet understood.

A better way of comparing crystal and other rectifiers is to compare them at radio frequencies.

The method consists in measuring the rectified current in a standard receiving circuit for various settings of the tuning condenser when the circuit is loosely coupled to a valve oscillator which is supplying power at the required high frequency — see Fig. 5.

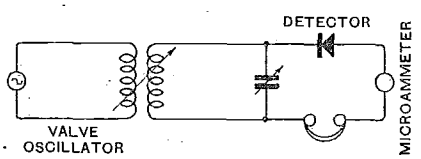


Fig. 5.—Arrangement of apparatus for comparing crystals in an H.F. circuit.

In fact, a current resonance curve is obtained for each rectifier — typical curves for perikon, galena, and a diode valve are shown in Fig. 6.

The maximum values of the crystal resonance curves are not strictly comparable with the valve curve, as better points may occasionally be obtained, but the shapes of the curves are quite comparable.

Amount of Damping.

In order to compare these curves without re-drawing them all with the same maximum amplitude, the widths of the curves at, say, 0.7 of their maximum height may be measured. It is obvious that the wider the curve at this point, the greater is the damping introduced by the detector.

These curves show how much damping is introduced by a crystal detector. The effect is the same as the insertion of quite large resistances into the coil. For instance, in the case of the perikon crystal this resistance is 62 ohms, so that it would appear that the coil resistance, which is about 15 ohms, is quite small in comparison, and could be considerably increased without very materially affecting reception.

A table showing the widths of the curves of various detectors and the effective inserted resistance is given below.

Detector.	Width of Curve in Condenser Degrees.	Total Circuit Resistance.	Effective Inserted Resistance.
Diode	6.3	25 ohms	10 ohms
Perikon	18.4	77 „	62 „
Galena with Catwhisker	16.3	68 „	53 „
Galena with Brush	25.4	100 „	85 „

When using a three-electrode valve with reaction the coil and condenser resistance may be annulled to any desired extent—going too far leads to distortion, and many go farther still—so that it seems, from this point of view, not of very great importance to have skilfully

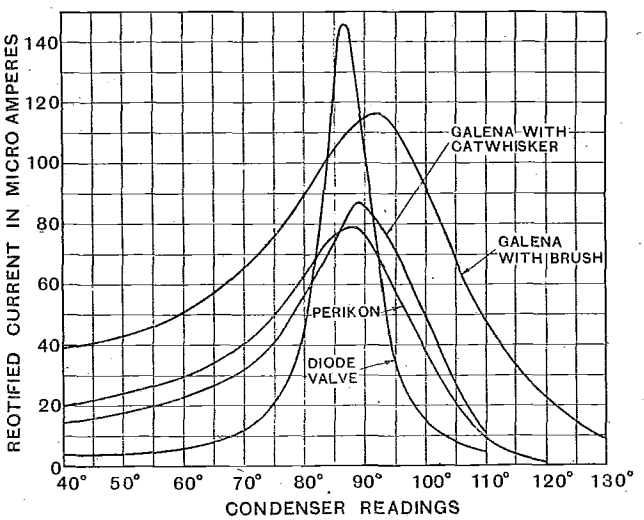
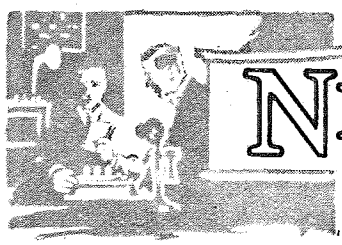


Fig. 6.—Specimen curves obtained with the circuit of Fig. 5.

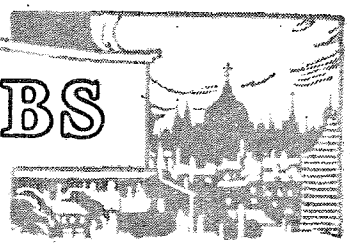
designed coils, as all of us who have wound up coils anyhow have found out.

It would seem that the only way of testing crystals satisfactorily is by some such means as here described, in which the crystal is used under conditions exactly similar to those met with in actual reception.

Not only can the experimenter obtain a good idea of the relative merits of various crystal detectors, but he can also determine the best type of circuit for the particular detector in use. The amount of damping introduced by the detector can be controlled by varying the amount of inductance in the circuit; hence experiments can be made to find the best detector and the most suitable circuit for it.



NEWS from the CLUBS



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

Barnet and District Radio Society.

An exhibition of sets and components made by members was held at the last meeting of the Society. This was followed by an interesting paper by a member on "Selenium," together with a practical demonstration.

A party of members have since paid a visit to the 2LO studio and the new transmitter in Oxford Street.

Hon. Secretary, Mr. J. Nokes, "Sunnyside," Stapylton Road, Barnet.

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Hackney and District Radio Society.

A very selective seven-valve receiver was demonstrated by Mr. Van Colle on April 6th. All stations of the B.B.C. were easily tuned in on a frame aerial. The latter part of the evening was devoted to the solution of difficulties and to reports of reception from 2LO's new aerial. It was apparent that a bad patch existed over the South Hackney and Dalston districts.

Hon. Secretary: Mr. G. E. Sandy, 114, Parnell Road, E.3.

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Norwich and District Radio Society.

An original lecture was given by Mr. Gates on April 7th, when he described what he termed the adventurous journey of the electro-magnetic waves in their passage from the transmitter to the receiver. In the course of his remarks, the lecturer gave clear descriptions of various circuits and exhibited a number of component parts. The lecture concluded with lantern illustrations depicting the workshops and plant of the General Electric Co.

Later in the evening Captain Hampson demonstrated the actual construction of a low frequency amplifier from the preparation and lettering of the panel to the completion of the instrument ready for use.

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North Middlesex Wireless Club.

A gratifying number of members attended the Club's meeting on April 1st, when Mr. W. Gartland gave a lecture on "A Universal Meter." After a brief allusion to moving iron ammeters and voltmeters, which he regarded as unsatisfactory in many ways, Mr. Gartland recommended the use of a reliable moving coil milliameter, and he proceeded to demonstrate that the one instrument, suitably mounted, can with the addition of two or three resistances be used to measure current as well as voltage and resistance over practically any range.

As a thorough appreciation of Ohm's law was essential to an understanding of the various uses to which the milliameter was to be put during the evening, the lecturer gave a short explanation of this fundamental law at the outset. He then explained how the range of the instrument for current measurement could be extended by shunting various resistances across it. The ammeter was then used to measure resistance. Taking a standard Leclanché cell as giving 1.47 volts, the lecturer showed how the resistance of transformer windings could be determined. The measurement of voltage by a similar method, but with a known resistance in series with the meter, was finally demonstrated.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 22nd.

Radio Society of Great Britain.—Ordinary meeting. At 6 p.m. (Tea at 5.30.) At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Communication on Wavelengths other than those in General Use." By Mr. G. G. Blake, M.I.E.E., A.Inst.P.

British Horological Institute.—At 6.30 p.m. At the Institute, 35, Northampton Square, London, E.C.1. Discussion on Wireless Time Signals.

Manchester Radio Scientific Society.—Lecture by Mr. G. Harrison.

Streatham Radio Society.—At 35, Streatham High Road, S.W. Lecture: "D.X. Transmission," by Mr. H. T. Swift (2WY).

FRIDAY, APRIL 24th.

Radio Society of Great Britain (T. and R. Section).—Dinner in honour of American visitors. To be followed by a Convention at 9 p.m.

Sheffield and District Wireless Society.—At 7.30 p.m. At the Department of Applied Science, St. George's Square. Elementary Class.

MONDAY, APRIL 27th.

Hackney and District Radio Society.—Illustrated lecture: "Some of the Continental Broadcasting Stations." By Captain L. Plugge.

Ipswich and District Radio Society.—At 8 p.m. At 55, Fonncreau Road. Lecture: "How to Use D.C. Mains for H.T. Current." By Mr. F. Meltor, B.Sc., A.M.I.E.E.

WEDNESDAY, MAY 6th.

Institution of Electrical Engineers.—At 6 p.m. (Light Refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Captain H. J. Round and Messrs. T. L. Eckersley, K. Tremellen, and F. C. Lunnon, of the Research Department, Marconi's Wireless Telegraph Co., Ltd. "Report on Measurements made on Signal Strength at Great Distances during 1922 and 1923 by an Expedition sent to Australia."

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Dublin Wireless Club.

A straightforward description of the construction of a single valve set was provided by Mr. E. Jackson on Thursday, April 2nd. Valuable hints were given regarding the use of different shapes of panel and the incorporation of various refinements such as vernier coil-holders. The lecture concluded with a demonstration of a novel single valve receiver embodying an original method of introducing reaction.

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Kensington Radio Society.

Owing to the regretted indisposition of Mr. L. F. Fogarty, whose lecture was to be given at the Society's April meeting, Mr. J. Reeves, M.A., M.B.E., and Mr. J. Macmillan kindly stepped in and filled the gap at short notice. They provided an interesting lecture dealing with a new cylindrical low loss coil for short wave lengths, upon which the lecturers had been experimenting for some time. The new method of winding the coil with twisted wires proved remarkably efficient when submitted to a practical demonstration.

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

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Golders Green and Hendon Radio Society.

A novel idea borrowed from the T. and R. section of the Radio Society of Great Britain was exploited on April 1st. A box containing counters was passed round, each member taking a counter. As a result, it was discovered that three members were called upon to discourse for a period not exceeding 10 minutes upon any of the five topics written on the blackboard. In this way a number of shy members found themselves eagerly participating in a lively discussion.

Hon. Secretary: Mr. W. J. T. Crewe (2AKS), 111, Prince's Park Avenue, N.W.11.

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Ilford and District Radio Society.

On Thursday, March 26th, the Society enjoyed a visit from Capt. P. P. Eckersley, Chief Engineer of the B.B.C. The meeting was held at the Town Hall. Dr. W. H. Eccles, F.R.S., occupying the chair. In the course of his entertaining remarks, Capt. Eckersley outlined the progress of broadcasting in this country and enumerated many of the difficulties with which the engineers have had to contend. He declared, however, that, in spite of all these troubles, he "lived broadcasting, ate broadcasting, slept broadcasting, and hoped to die broadcasting."

On Tuesday, March 31st, a lecture on "Wireless Valve Manufacture" was delivered by Dr. C. E. Hiatt, of the Edison Swan Electric Co., Ltd. The lecture was

illustrated by means of a model Edison receiving valve standing over 4ft. high. The lecturer's explanations of the manufacture and operation of the thermionic valve were thus easily followed.

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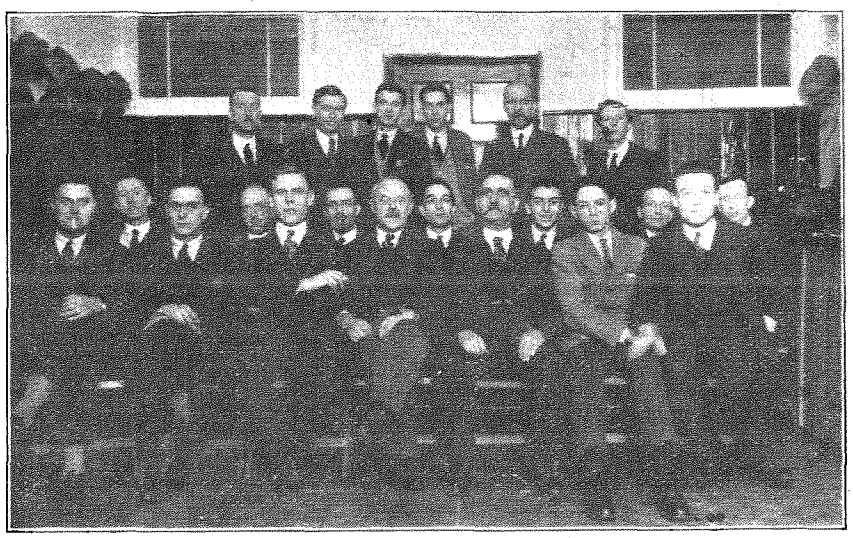
Belfast Y.M.C.A. Radio Club.

At the annual meeting of the Club, held on March 31st, it was decided to extend facilities for membership, hitherto confined to members of the Y.M.C.A., to include wireless enthusiasts throughout the Belfast district. An interesting report of the year's work was submitted by the hon. secretary, Mr. J. J. Cowley. During the period under review a loud speaker set was constructed, and the Club has run a series of weekly wireless concerts for the benefit of the Y.M.C.A. organisation. A number of helpful lectures were given during the winter by local experts.

Mr. J. White has been elected president for the next session.

Hon. Secretary: Mr. John J. Cowley, 4, St. Paul's Street, Belfast.



A group of members of the Wimbledon Radio Society photographed at a typical weekly meeting.

Calls Heard.

Extracts from Readers' Logs.

Edgbaston, Birmingham.

British:—2DX, 2FM, 2NB, 2GX, 2WY, 5LF, 5NN, 5MO, 5SI, 5UQ, 6FG, 6GH, 6UV, 6UZ. *French*:—8AG, 8AU, 8CPP, 8EE, 8EN, 8ENO, 8FI, 8FJ, 8GG, 9GK, 8LPR, 8MJM, 8OK, 8PL, 8RIC, 8RO, 8RQZ, 8SSB, 8SSU, 8TK, 8UT, 8UU, 8WU, 8XP, 8XR, 8ZM. *Dutch*:—OGC, OLL, ONF, OZN. *Italian*:—1CF, 1KX, 1MT, 1NO. *Belgian*:—4AS. *Finnish*:—2NM. *Swedish*:—SMXV. *Danish*:—7EC. *Luxembourg*:—OAA. *American*:—1AF, 1AMF, 1BKR, 1PL, 2AG, 2BY, 2CJX, 2CVF, 3CHG, 3TF. *Argentine*:—CB8. *Miscellaneous*:—1DO. *Unknown*:—3CM, 3DD, XOX, BIRB, 4LOV.

(0-v-0 and 0-v-1.) (Below 150 metres.)
A. Chick.

West Norwood.

British:—2AHJ, 2AUC, 2EG, 2JJ, 2HQ, 2MQ, 2WU, 2XV, 5CQ, 5EM, 5OK, 5TV, 5UV, 6DO, 6MX, 6SB. *Belgian*:—D2, K2, J2, P2, V2, 4AS, 4AU, 4AR, 4CH, 4SR, 4LOV, 4UC, 1RB, 2UU. *Italian*:—1AM, 1AF, 1CO, 1RT, 1WB, 3RM, 3WB, 3XE. *Dutch*:—OFL, OJS, ONF, PB3. *Swiss*:—9AA, 9AB, 9AD, 9BR, 9LA. *Danish*:—7BJ, 7BN. *Swedish*:—SMBL, SMSB, SMSX, SMXV, SMXX, SMYV. *Finnish*:—1NA, 2NCA, 2NCB, 2ND, 2NM, 2NS, 3NB, 5NQ. *Spanish*:—EAR2, EAR3, EAR6. *Unknown*:—OCDJ, OCTU, 3BN, J7XX, Z7, 1VR, YZ. L. H. Thomas.

Moen i Maalselv, Norway.

British:—2NG, 2OD, 5IG, 5PU, 5UQ, 6TD, 6UV. *French*:—8BF, 8GB, 8GO, 8HSO, 8JBL, 8SS, 8TK, YZ. *Dutch*:—OLL, ONL, ONTZ. *Danish*:—7EC, 7QF, 7XP, 7ZM. *Swedish*:—SMXX, SMXV, SMYY, SMYV. *Finnish*:—1NA, 2NCB, 2ND, 2NM, 2NS, 3NB. *Unknown*:—EAR6, I1AF, 1NTDN, PB3, PC1, OCDJ, A2ME calling 6CBB at 1425 G.M.T. Feb. 26th.

(0-v-1 Reinartz.) J. Diesen.

Maidstone, Kent.

American:—1AAP, 1AJO, 1AJX, 1AMF, 1ANA, 1ARY, 1ATJ, 1AUC, 1AZY, 1BES, 1BIE, 1BWX, 1BZP, 1BZW, 1CAB, 1CCX, 1CRI, 1DA, 1ER, 1GH, 1PL, 1RD, 1ZT, 2AAY, 2AG, 2ANM, 2AQH, 2BLM, 2BM, 2BR, 2BRC, 2BUM, 2CJB, 2CLA, 2CU, 2CXL, 2DD, 2GK, 2LD, 2NCB, 2ZN, 3AB, 3ADB, 3ACH, 3ADQ, 3AJD, 3AWA, 3BHY, 3BSB, 3BWT, 3CHG, 3CJN, 3HG, 3LG, 3LZ, 3MV, 3SD, 3SF, 3UX, 4BY, 4FZ, 4PD, 4TV, 5LH, 8VQ. *Canadian*:—1DD *Danish*:—7EC. *Dutch*:—OBA, OGC, OKV, OLL, ORE, OPV. *Finnish*:—2NCA, 2NM. *French*:—8ALG, 8BF, 8CT, 8EB, 8EV, 8EE, 8ED, 8GK, 8GP, 8HSG, 8JBL, 8LPR, 8NK, 8PL, 8QG, 8RV, 8UU, 8UT, 8WB. *Italian*:—1AF, 1AM, 1CO, 1FD, 1FP, 1MP, 1NO. *Swedish*:—SMPL, SMXV, SMZV, SMZZ, 1RAQ, GHHI.

(0-v-1, without earth connection.)
W. E. Usmar.

Nice, France.

Belgian:—4AS, 8SSC. *American*:—1BKR, 1BUL, 1CU, 1FD, 1KC, 1KX, 1PL, 2BUM, 2CXY, 2CYW, 2XAM, 3ADQ, 3CHG, 3CJN, 3JO, 4SA, 4SB, 4TW, 5CK, 8ATP, 8CUS, 8HV, 8XK, 9VC, KDKA, 7QF, NKF. *British*:—5IG, 5MO, 6GH. *Dutch*:—ONF, ONTZ, OZN. Léon Delov.

Norrvikon, Sweden. (Jan. 1st to Feb. 28th.)

British:—2AUC, 2EX, 2NB, 2SZ, 2UV, 5TZ, 6TD. *French*:—8AL, 8AZ, 8BF, 8CN, 8CS, 8CT, 8DP, 8EM, 8FK, 8FZ, 8GG, 8GJ, 8GK, 8GM, 8GO, 8GP, 8NK, 8PL, 8PS, 8RB, 8RL, 8RM, 8SG, 8SST, 8SSU. *Dutch*:—OAB, OJJ, OLL, ONF. *German*:—1CF, OAA. *Italian*:—1AA, 1AF, 1AM, 1MT, 1WB. *Belgian*:—4AS, 4NC, 4UC. *Finnish*:—1NA, 1NF, 2CF, 2NCA, 2NCB, 2ND, 2NM, 5NQ. *American*:—1AF, 1AR, 1ARY, 1AUC, 1NDO, 1PY, 1UW, 1XA, 2CQ, 2RK, 3AP, 8AU, 8BH. G. Fant (SMZZ).

Derby.

American:—1AF, 1AAO, 1BBE, 1SW, 2BQ, 2GK, 2LD, 4SA, 4UK, 4XE, 8XE, WGH. *Canadian*:—1AR. *Dutch*:—0GC, 0LL. *French*:—8AB, 8CO, 8GI. *Belgian*:—P2. F. Harrison.

TRANSMITTING NOTES.

SHORT WAVE TESTS AT SEA.

The co-operation of the members of the transmitter and relay section is invited in connection with a special series of experiments to be conducted at sea by Major Kenyon Secretan (5LF). Major Secretan will sail on board the Cunard liner "Samaria" on April 25th, and will transmit nightly on a wavelength of 90 metres, using the call sign G6YM. The times of transmission will be 9.30 p.m. (G.M.T.) to 3.30 a.m. (G.M.T.).

Members who hear these signals or succeed in working G6YM are requested to send reports, in duplicate, to Mr. Gerald Marcuse, at 53, Victoria Street, S.W.1.

A TRANSMITTERS' CONVENTION.

Following the special dinner to American amateurs on Friday, April 24th, a convention will be held at 9 p.m. at the Waldorf Hotel for the benefit of those who are unable to be present at the dinner.

THE "SQUARE LAW" CONDENSER.

A Comparison of "Square Law" and "Ordinary" Tuning Condensers.

By C. H. STEPHENSON.

THE use of a "Square Law" condenser has become so popular that it is interesting to see just what results this type of condenser gives compared with one of the ordinary pattern. In the majority of circuits the wavelength is adjusted to the desired value by means of a condenser, the dial of which is generally arranged to rotate through an angle of 180 degrees. It would obviously be useful if, throughout the range of the condenser, the same angular movement gave the same

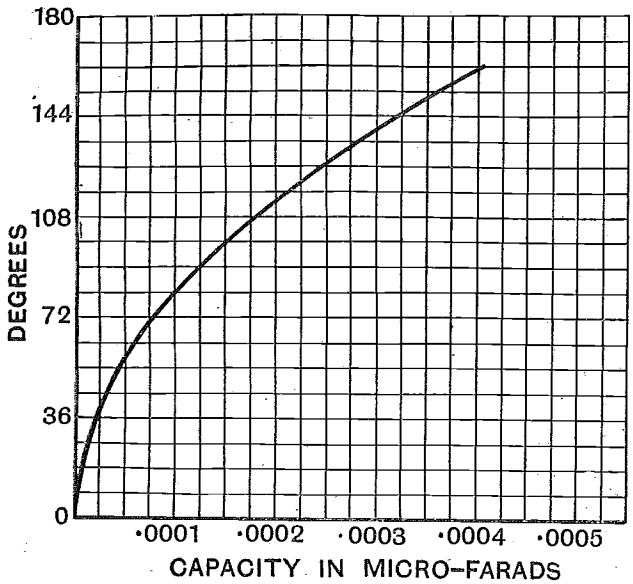


Fig. 1.—Relation between capacity and dial setting of a square law tuning condenser. In a practical condenser the capacity will, of course, never fall to zero.

change in wavelength. For example, if by moving the dial from 20 to 30 degrees the wavelength were altered from 350 to 370 metres, an adjustment equal to 10 degrees anywhere within the range of the condenser dial should change the wavelength by 20 metres. Expressed concisely, the change of wavelength per degree should be constant.

In order to secure this relationship between the wavelength and the condenser angle it is necessary to construct the condenser so that the total capacity of the circuit is proportional to the square of the angle through which the dial is turned. This is due to the fact that the wavelength of a circuit of constant inductance varies as the *square root* of the capacity. When the condenser is made so that its capacity varies more or less accurately as the square of the angle through which the dial is turned (Fig. 1), an error occurs owing to the presence of circuit capacities.

Now let us apply the "Square Law" condenser to two typical circuits and see just what the effect is of these added capacities.

The Tuned Anode Circuit.

Suppose, in the first instance, that the condenser is used to tune the anode coil in a tuned anode H.F. circuit (Fig. 2). We have a coil in parallel with the condenser, and in making calculations it is necessary to take into account all the capacities associated with the circuit in order to arrive accurately at the wavelength. In this case we will consider only the capacity of the condenser which is variable, and that of the coil which is fixed. The latter may be taken as being about 0.00002 mfd. (shown dotted in the figure), and this amount has to be added to the capacity of the condenser.

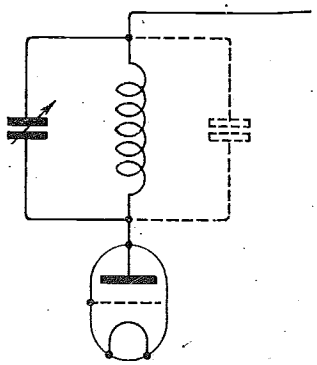


Fig. 2.—A simple tuned anode circuit.

If the variable condenser has a maximum capacity of 0.0005 mfd., the self-capacity of this particular coil will be small compared with that of the condenser when the latter is about 36 degrees "in" (Fig. 1), and at larger angles than this we should not expect its effect to be very marked. Below 36 degrees, however, the self-capacity becomes comparable with that of the variable condenser, and so the wavelength curve will depart from a straight line. The departure will become more and more noticeable as the capacity of the variable condenser diminishes. The curve obtained is shown in Fig. 3. The importance of keeping the self-capacity of the coil down to the minimum will be at once appreciated.

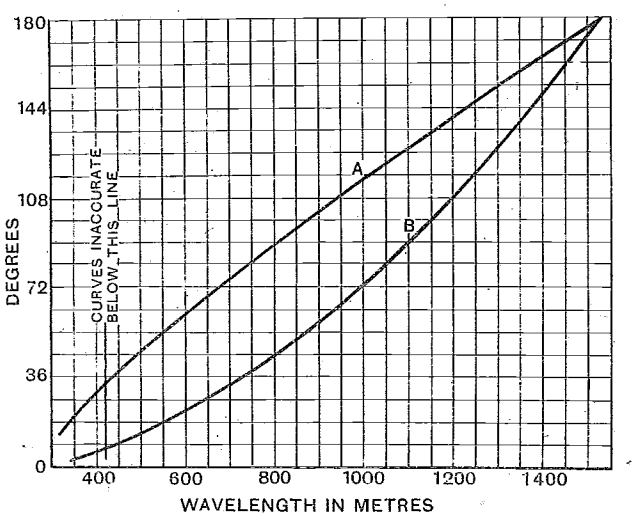


Fig. 3.—Curve A, when a square-law condenser is used, and curve B, when the condenser is of the ordinary type.

The "Square Law" Condenser.—

As an interesting comparison, the wavelength curve obtained with an ordinary condenser, in which it is assumed that the capacity is proportional to the angle, is also given in the figure. It does not commence to straighten out till the dial has been turned through about 90 degrees.

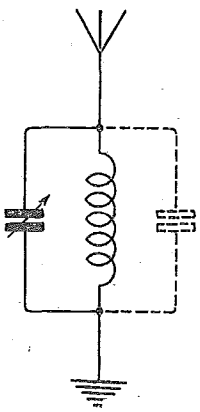
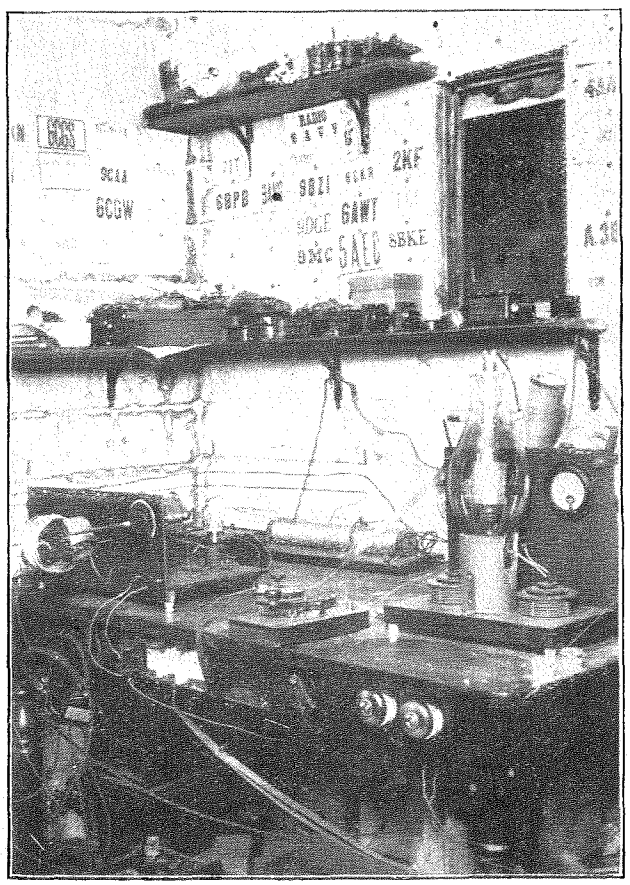


Fig. 4.—A parallel tuned aerial circuit.

The Aerial Circuit.

We now come to consider the case in which the condenser ("Square Law" type) is used to tune an aerial circuit (Fig. 4). The aerial capacity has now to be taken into account, its value being about 0.0002 mfd. This capacity may be reckoned as being in parallel with the tuning coil and variable condenser, and is shown dotted in the figure. There is also the self-capacity of the coil, but this may be safely neglected as being quite small compared with that of the aerial.

The wavelength curve obtained by calculation for the "Square Law" condenser is given in Fig. 5 (A), together with that for an ordinary condenser (B). In this application the "Square Law" condenser is very definitely inferior to the ordinary type.



The equipment at the Australian station 3BQ used for direct communication with English amateurs.

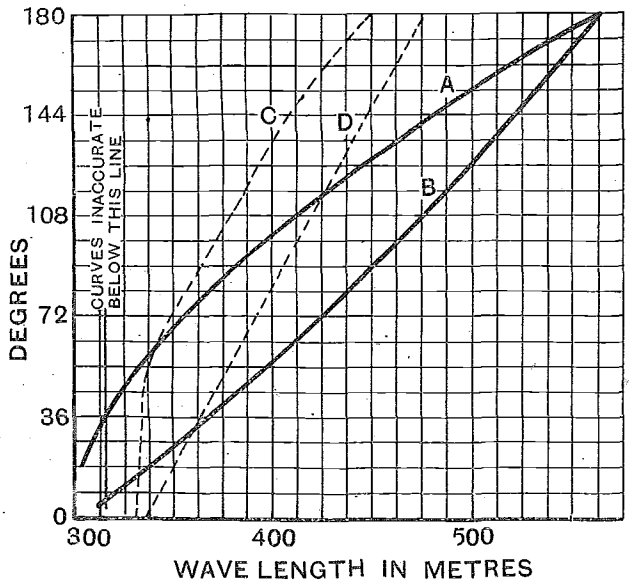


Fig. 5.—Curves A and B are theoretical tuning curves and curves C and D are practical ones obtained by experiment when condensers of the "square law" and "standard" types were used.

The dotted curves in Fig. 5 have been plotted from actual observed figures obtained by means of a wavemeter. The "Square Law" condenser was of a typical popular type having a nominal maximum capacity of 0.0005 mfd., whilst the other was also of standard make.

Conclusions.

The "Square Law" condenser will give an approximately straight line wavelength curve when used to tune a circuit having low self-capacity. Its use is indicated for the secondary circuit of a loose coupled tuner, for the anode coils in H.F. amplifiers, etc.

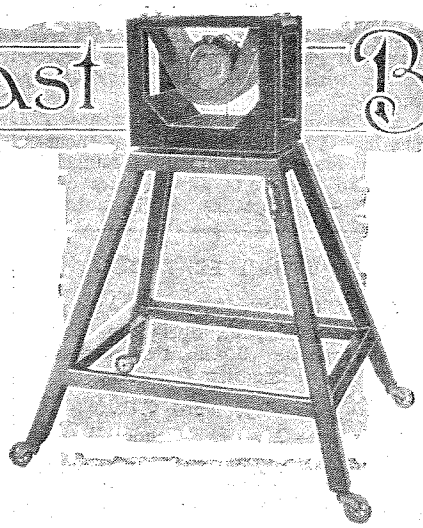
The ordinary pattern condenser is much to be preferred for aerial circuit tuning.

AUSTRALIA-ENGLAND TWO-WAY COMMUNICATION.

THE station 3BQ situated at Box Hill, Victoria, Australia, and operated by Mr. Max Howden, was the first Australian station to establish direct two-way working with England. The accompanying illustration is of particular interest, as it shows the complete station equipment. The transmitter makes use of the Meissner circuit operating with a plate potential of about 1,500 volts and a feed current of 100 milliamperes with a Phillips valve of the "Z4" type. The receiver is loose coupled to the aerial circuit, and comprises a detector valve followed by a single-stage low-frequency amplifier.

A fine wire cage aerial is supported between two masts each 80ft. in height and 50ft. apart. The leading-in wire, which is also of cage formation, is taken from the centre. Mr. Howden favours a counterpoise, and this is constructed by bunching together at the centre six wires each 100ft. in length to form a double fan.

Broadcast Brevities



NEWS FROM THE STATIONS.

£2,000,000 Station for Geneva?

With the question "Can wireless secure the peace of the world?" as his text, a writer in a contemporary gives publicity to the suggestion that the League of Nations should have its own broadcasting station—not just a mere high power affair like the B.B.C. has at Chelmsford, but a super-station such as few have even dreamed of as yet.

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Nullifying Propagandist Talks.

The proposal put forward is to erect a station ten thousand feet above sea-level near Geneva to operate on a wavelength of 5,000 metres and to have a power of 150 kilowatts. The effective reception range of such a station would, it is said, be 14,000 miles, and the cost of erecting and equipping it would be about £2,000,000.

One of the main effects of a League of Nations broadcasting station would be to nullify propagandist talks, and listeners would know that they were hearing summaries of the world's news every day, ostensibly unbiased.

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But Not Yet.

The idea is very interesting, but it may be said at once that the League of Nations Committee on Communications and transit had it under consideration more than a year ago. Nothing, however, is likely to be done just yet. If the fifty-five participating States were to share the cost in the proportion of their importance, some nation which was paying a greater share than its neighbour would expect to see its money back in the direct utilisation of such a channel of information for the purpose of pressing its national views.

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The Language Difficulty.

The problem of a universal language is another difficulty to be overcome. The League of Nations Committee discovered many other pitfalls and decided to shelve the subject; but with that unknown quantity of surprise which overhangs all wireless matters, the question may be raised again when the Conference on interference and general technical matters meets at Geneva.

Where Britain is Backward.

It is a curious fact that in the States thirty-six broadcasting stations are owned and operated by religious bodies. Baptists, Catholics, Methodists, Christian Scientists, Mormons and Presbyterians are numbered among these broadcasters, and now a new sect has applied for a licence for a big station. These are what are known as the Flat Earth Cranks, who believe that the earth is as flat as a pancake. America is the place to live in for wireless!

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Listening in the Dark.

A new form of economy is suggested by a listener, who adopted the plan on the occasion of the recent broadcasting of the "Westward Ho! Radioviews."

"When listening to a radio play," he writes, "the lights should be turned out, and listeners will then be better able to provide their own play scenery. I found that the imagination worked a good deal better when I was in darkness, and I could sense the atmosphere of Charles Kingsley's famous story in a realistic way."

One could hardly expect to imagine the seashore of Devon, the Spanish Main, or the Battle of the Armada while sight was engaged by the china dogs on the mantelpiece or the cat washing itself in front of the fire.

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India's Wireless Boom.

India is in the throes of a wireless boom. Continuous programmes are being given daily in the public parks in Bombay, and people flock thither in thousands. That form of listening is apparently preferred to the installation of receiving sets in private houses. The reason is probably that the licence fee is twenty shillings a year, and that evasion involves three years' imprisonment, plus a fine.

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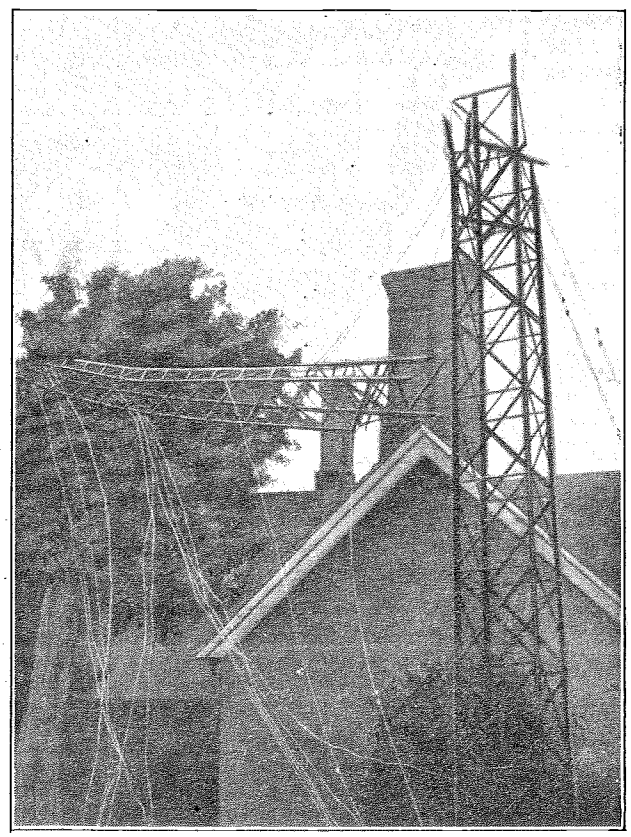
Honours for Birmingham Musician.

Mr. Joseph Lewis, the Musical Director of the Birmingham Station, who conducted the performance of Dr. Stillman-Kelley's musical miracle play, "The Pilgrim's Progress," at Covent Garden Opera House, London, recently, will probably go to the United States in the near future to conduct a similar performance. He has also received an invitation to conduct at Vienna. It will be remembered that M. Paul Klenau, conductor at the Singakademie, Vienna, directed a broadcast performance at Birmingham the other day.



THE STORM MENACE. One of the lattice towers, over 86 feet in height, at Mr. C. Keith Murray's station (6DY), which was brought down by the severe storms early in the year. The masts, made and erected by the owner, were probably one of the finest examples of home-constructed aerial equipment in the country.

Training the Agricultural Mind.

Something went wrong with Hodge's hearing the other night when he was listening to (and recording) the sheep and cattle prices broadcast by the B.B.C. Hence the following pathetic letter to headquarters :—

"I hev a complint tu makes tu you about the price of them there lams they wornt no such price as yu say a tall. Yu mead me a rare fule when yu say lams 28 shillens a pound last nite on the wireles. I ups & I go to my naybors and I bys orl the lams that ar born in the willage. Some wornt born so I lights my pipe and waits for them. I spent all my savings on lams thinkin as I shud meak a fortun a sellin lams at 28 shillins a pound. So I give a fare price I did for the little warmints and me and the mises settin up all nite a given them the bottle and a drop of wiske to in some was a waste as I had saved that wiske for 11 year and the lams dint like it.

"Hoping yu are well as this leves me not counting the lams."

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Horribly Dull.

We sympathise with the listener who has made a complaint with reference to the dullness of some recent after-dinner oratory, but this is a case where the B.B.C. have to put out many sprats in the hope of catching one good mackerel. The after-dinner speech cannot be censored or subedited. It has to be taken in all its naked glory, and sometimes, let us whisper, in *vino veritas*. After all, the results might be worse, as, for instance, an attempt to "stage" the juggler who went to 2LO and offered his services. In that case the result would have been, in more senses than one, an "airy nothing."

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Closing Down.

The B.B.C. is hoping that the new 2LO can now be regarded as permanently in service, but the old aerial will remain in position at Marconi House for the present in case of accidents. It will, however, be dismantled at the earliest possible moment, as it will mean a tidy saving in expense. The present, therefore, is too early to sing the "Swan Song" of the station, which in its short life has done yeoman service to disciples of the new science. It may, however, be recalled that 2LO was equipped for experimental use early in 1922, and was first used to broadcast a description of the Carpentier-Lewis fight on May 11th of that year. There were subsequently frequent concerts in support of charities. Much of the matter transmitted was very poor indeed; in fact, it would be an education for those who now complain of second-rate programmes if they could have some of the original concerts repeated for their moral chastening.

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Carbon Microphones.

The studio, which was at Marconi House, close to the transmitting station, was equipped with carbon microphones, and singers had to put their lips as close to the microphone as a person does to the mouthpiece of a telephone; but in those days the novelty retained its freshness and glamour, and listeners regarded things with a more benevolent eye (or ear).

During its three years' existence, 2LO has been visited by nearly two thousand people, among them many distinguished men and women in all branches of art, science and literature. The autograph album is rapidly becoming an historic volume. It contains the names of most members of the Royal Family, besides leaders of society and British and foreign statesmen.

FUTURE FEATURES.

Sunday, April 26th.

LONDON.—4 p.m., Springtime Programme. 9 p.m., De Groot and the Piccadilly Orchestra.

Monday, April 27th.

LONDON.—8 p.m., "London."
NEWCASTLE.—8 p.m., "Ships."
BELFAST.—7.30 p.m., Opera—Poetry—Drama.

Tuesday, April 28th.

LONDON.—8 p.m., Concert by the N.A.R.M. S.B. to all Stations except 5XX.
5XX.—8 p.m., "Carmen" (Bizet).

Wednesday, April 29th.

LONDON.—8 p.m., "From the Land of the Midnight Sun."
GLASGOW.—8 p.m., Beethoven Symphonies, No. 1.

Thursday, April 30th.

LONDON.—8 p.m., Chamber Music Evening.
BOURNEMOUTH.—8 p.m., "With Hounds."
NOTTINGHAM.—8 p.m., Inaugural Community Singing Concert.

Friday, May 1st.

LONDON.—8 p.m., Novelty Night.
BOURNEMOUTH.—8 p.m., May Day Revel.
CARDIFF.—8 p.m., Gems from Opera.
MANCHESTER.—8 p.m., The Crystal Set Concert Party.
EDINBURGH.—8 p.m., Birthday Programme.

Saturday, May 2nd.

LONDON.—8 p.m., The Selma Four. 9 p.m., Speeches at the Royal Academy Dinner. S.B. to all Stations.
BIRMINGHAM.—8 p.m., Community Singing Concert.

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B.B.C. Helps Concert Artist.

Miss Ruby Helder, an artist who is well known to listeners, has had an interesting personal experience of the effect of broadcasting on concert attendance, which is especially appropriate in view of the recent controversy regarding the small attendance at Madame Tetrazzini's concert at the Royal Albert Hall, following her broadcasting engagement.

Miss Helder says :—"I saw in the papers a notice by the B.B.C. relative to successful co-operation between the provincial concert managers and the B.B.C., so I thought an experience of mine at Plymouth might be interesting.

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A Splendid Attendance.

"I was singing there a few Saturdays ago, and when I was offered the engagement I was asked, and agreed, to cut my fee owing to the concerts having had such bad attendances. The afternoon concert was splendidly attended, as was also the evening. In fact, it was the best audience of the season, and the manager insisted on giving me the fee originally arranged without the cut, and admitted that it was due to the interest created by the broadcasting I had done."

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Chelmsford: A Misconception.

Some misconception exists as to the way in which programmes from the high-power station at Chelmsford are arranged and carried out. A large number of listeners apparently think that artists go to Chelmsford to take part in 5XX concerts, and many letters are addressed there with reference to specific items that are broadcast.

The Chelmsford programmes, however, are arranged and carried out in London, where Mr. Rex Palmer acts as Director of both the London and high-power stations, whose arrangements are closely related.

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Bonds to Pay for Broadcasting.

Wireless being yet in its infancy, new schemes are all the time under consideration for financing the enterprise, and Parliament will have a good deal of information to work on when next year it discusses the future of broadcasting.

Take the latest American scheme, which is creating a good deal of interest in official circles in this country. A licence is proposed of two dollars per annum on each valve, and fifty cents. per annum on each crystal. This would be paid by the manufacturers in the form of a stamp tax, and they would recoup themselves out of increased charges to the public. A revenue of eighteen million dollars a year is anticipated from this source, and it would enable the Government to buy up ten or twelve existing main stations and build an equal number of new stations.

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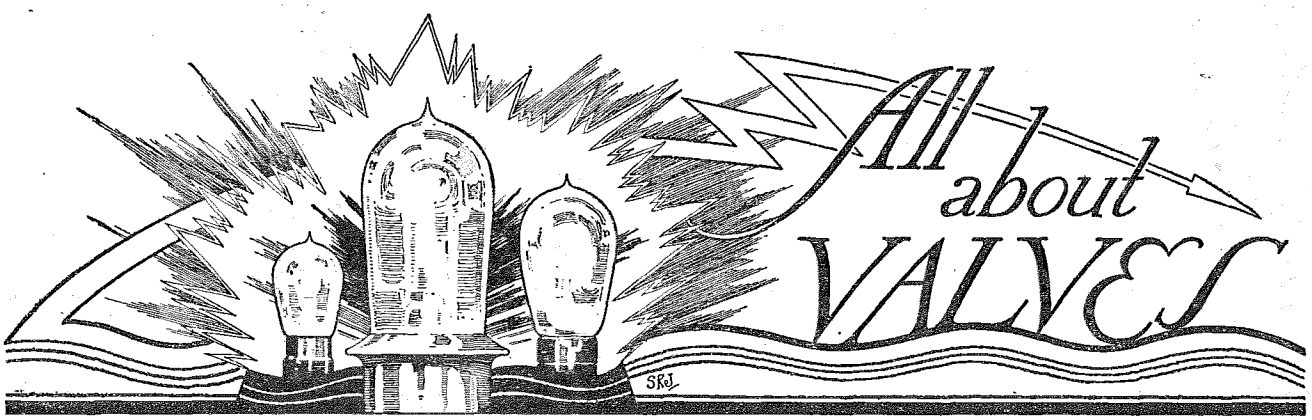
How About the P.O.?

Bonds could be issued forthwith to cover the amount of the prospective income, thus enabling the U.S. Government to put the scheme into operation immediately. Subscribers would be able to regard the transmitting apparatus as collateral security, and, being in the nature of shareholders, would be able to take a large share in the discussions on suitable programmes. It would probably commend itself to the B.B.C., but would the Post Office see things in the same light?



The Edison and Swan Co.'s A.R.D.E. H.F. and L.F. Valves.

THE well-known A.R.D.E. of the Edison and Swan Co., Ltd., is now manufactured in two forms, one for H.F. and the other for L.F. work, and sample valves have been forwarded to us by the makers for test.

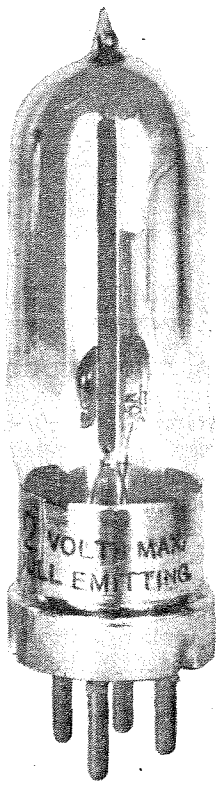
The manufacture of special valves for special purposes is, we feel, the correct policy, for although a valve designed for general purpose use will, under correct adjustment, give quite good results, yet it cannot, by reason of the different conditions prevailing in different parts of a circuit, be more than a compromise.

This change in the design of the A.R.D.E. is therefore of particular interest, and we are glad to have had an opportunity of trying out the new products.

In order to distinguish one type from the other a line has been placed on the bulb, red for the H.F. type and green for the L.F., and this distinguishing mark, it should be noted, has been so placed as to indicate the anode pin of the cap.

Dealing first with the H.F. This is rated by the makers as follows:—Filament volts, 1.8—2.0; filament amperes, 0.3; plate potential, 30-100. Our tests on the submitted sample provided the results shown in the table below.

The amplification factor maintains a constant value throughout the range over which the test was conducted, but we were disappointed to find it no higher than 10, and we incline to the belief that had it have been increased to, say, 15, it would have been an improvement.



The A.R.D.E. valve.

On circuit the valve gave quite good results as a H.F. amplifier and detector, but it was noticed that a rather close reaction coupling was required to get the set oscillating. This is probably due to the plate impedance, which is a little high compared with the amplification factor.

The filament rating of the L.F. variety is the same as in the preceding case, the anode rating being given by the makers as 20-100. Our tests yielded the results shown below.

Here, again, it will be seen that the magnification factor is very constant.

We tried this valve in both the first and second stages of a L.F. amplifier, where it gave excellent results. In the latter position, and using the full rated plate voltage, it is capable of dealing with relatively large inputs without fear of overloading. When used in the first stage of the amplifier the plate potential may, if desired, be lowered to 60 volts or so, at the same time, of course, reducing the grid bias. When the anode voltage is 60, a suitable grid bias is −4 volts; the normal anode current is then only 1.18 milliampere. If a second stage is used, with an anode voltage of 120, the current will be 2.56 milliamperes, and the total current only 3.74 milliamperes.

A.R.D.E. (H.F.).
Edison & Swan Electric Co., Ltd.

Filament Volts 2.0. Filament amperes 0.285.
Emission (total) milliamperes 13.3. Efficiency 23 milliamperes per watt.

Plate Volts.	Plate Current Milliamps.	Grid Bias.	Plate Current.*	Amplification Factor.	Plate Impedance.
20	0.3	0	0.3	10	46,200
40	0.76	−1	0.53	10	45,000
60	1.31	−2	0.75	10	38,500
80	1.9	−3	1.06	10	35,000
100	2.52	−4	1.37	10	33,700
120	3.15	−5	1.67	10	33,000

* Plate current when grid is biased to the value of Column III.

A.R.D.E. (L.F.).
Edison & Swan Electric Co., Ltd.

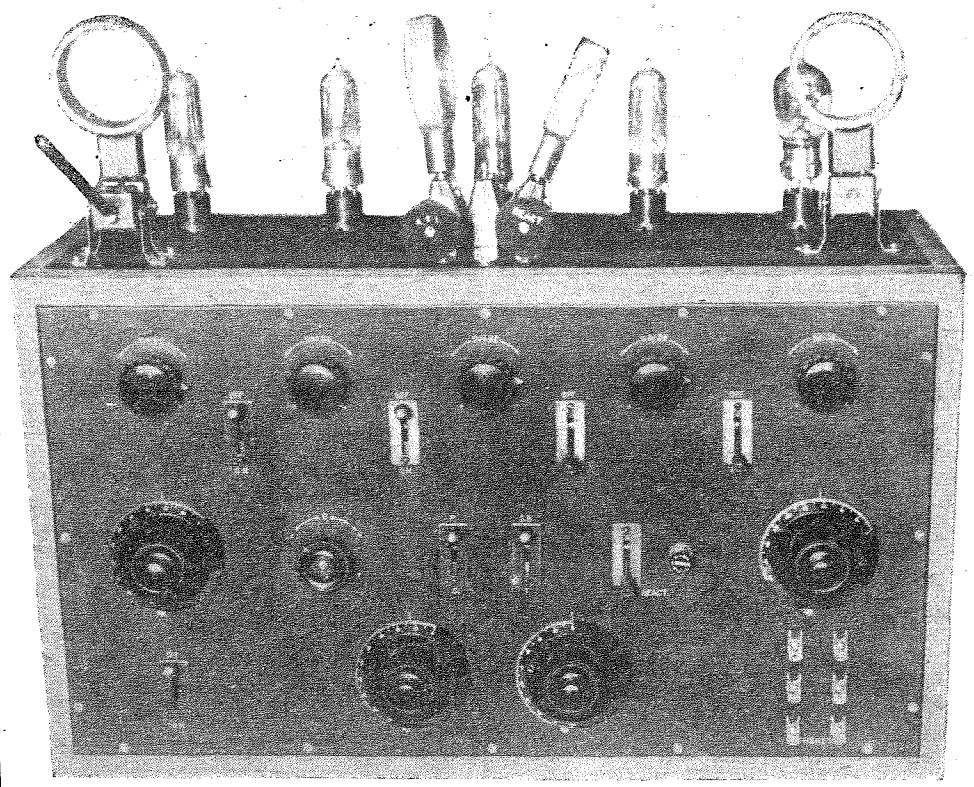
Filament Volts 2.0. Filament amps. 0.285.
Emission (total) milliamperes 12.9. Efficiency 22 milliamperes per watt.

Plate Volts.	Plate Current Milliamps.	Grid Bias.	Plate Current.*	Amplification Factor.	Plate Impedance.
20	0.57	−1	0.36	6.1	26,000
40	1.47	−2.5	0.75	6.2	24,000
60	2.6	−4	1.18	6.2	22,000
80	4.0	−6	1.58	6.2	18,800
100	5.6	−8	2.0	6.2	16,400
120	7.0	−10	2.56	6.2	16,000

* Plate Current when grid is biased to the value of Column III.

A Receiver Suitable for Broadcast Reception over Long and Short Distances.

Numerous circuit changes can be made with the switches provided, and the detector can be supplemented with two stages of high and two of low-frequency amplification.



A FIVE-VALVE BROADCAST RECEIVER.

By T. W. RIDGE.

PROBABLY the most useful all-purpose receiver is one having five valves, two high-frequency for distant stations, and two low-frequency to operate the loud-speaker properly from the local broadcasting station. The set described here was designed to give the greatest efficiency combined with the convenience of having switches to make all desirable circuit changes.

All tuning coils are of the "plug-in" type. The aerial coil is tuned with a 0.001 mfd. square law vernier condenser, and a "series-parallel" switch is provided. A closed circuit coil tuned by a 0.0005 mfd. condenser can be used to make the set more selective if desired, and is brought into operation by the "tune-standby" switch. Reaction coils can be coupled to either or both the aerial coil and the first anode coil, and they can be reversed or cut out by a lever switch and a push-pull switch mounted on the panel.

The high-frequency valves are tuned anode coupled. Square law condensers of 0.00025 mfd. capacity are used to tune them, and a potentiometer is provided to control the tendency to oscillate. Any number of valves may be used by merely operating their respective lever switches, and when the set is finished with the batteries can be entirely disconnected by a movement of the five-pole main switch seen at the lower left-hand side of the panel. All the terminals except those for telephones are fixed on an ebonite strip at the back of the set.

To obtain all the components at one time means a considerable outlay, but there is no reason why the panels should not be obtained and drilled as far as possible and just sufficient material for one or two valves bought and put to work at first, and the others added at convenience. Cheap, shoddy components should be avoided, as trouble is bound sooner or later to develop, even if the set works properly at first. The switches used in the H.F. circuit must be of a type designed for high-frequency circuits if they are not to be the cause of serious losses.

Building the Framework.

As can be seen in the photographs the set is arranged on a framework, which is intended to slide into a cabinet. This form of construction renders wiring more simple, and enables all wires to be kept well apart, as there is plenty of space and the whole of the back of the panel is accessible. The arrangement, and dimensions of the wood framework are shown in Fig. 3; most amateurs will have sufficient knowledge of woodwork to make this at home, for as long as it is strong its appearance is not of importance, as only the front edges show when in its cabinet.

The panels should be cut to fit the frames. If desired, the front edges may be chamfered slightly, and the rebates in the frames made $\frac{3}{16}$in. deep, instead of $\frac{5}{16}$in., leaving the face of the panel $\frac{1}{8}$in. above the frame. This

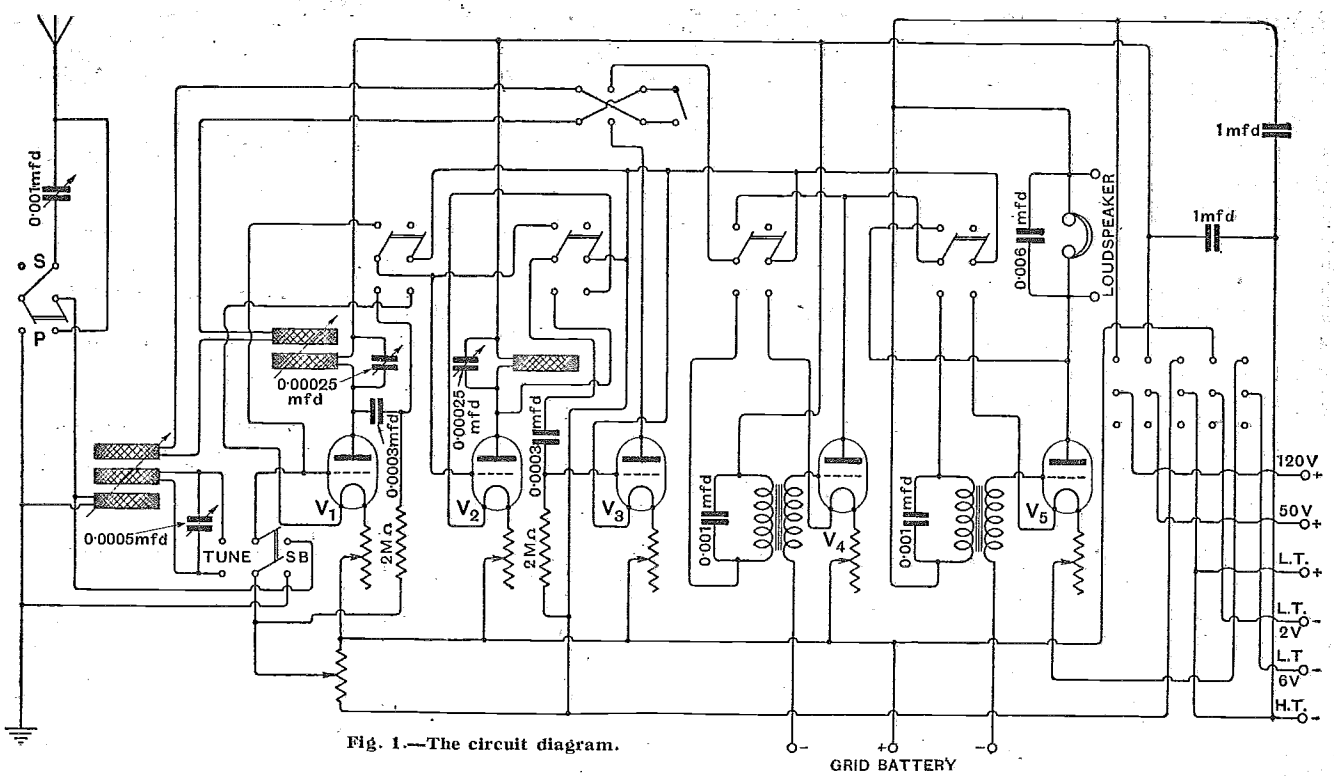


Fig. 1.—The circuit diagram.

makes a more simple and better looking job than trying to get the face of the panel and the frame flush. The panels should now be carefully marked out for drilling, according to the dimensions given in Figs. 4, 5, and 6.

To fit the lever switches the two holes for the fixing screws should first be drilled, then the top plate can be secured in position with its screws and two nuts, to act as a template for the cutting of the slots. A drill should be selected slightly less in diameter than the width of the slot, and as many holes as possible drilled through. If a small round file is now taken and the holes filed one into the other a small flat file can be inserted and the slot quickly shaped up, the top plate acting as a guide. The condensers are provided with a cardboard template for drilling, and the remaining components on the front panel are "one hole fixing" and will be found quite easy to fit.

For the flanged valve holders 1in. diameter holes should be drilled to clear the contacts. This is best done with an ordinary carpenter's centre bit working half-way through from each side, a hole about $\frac{1}{8}$in. diameter

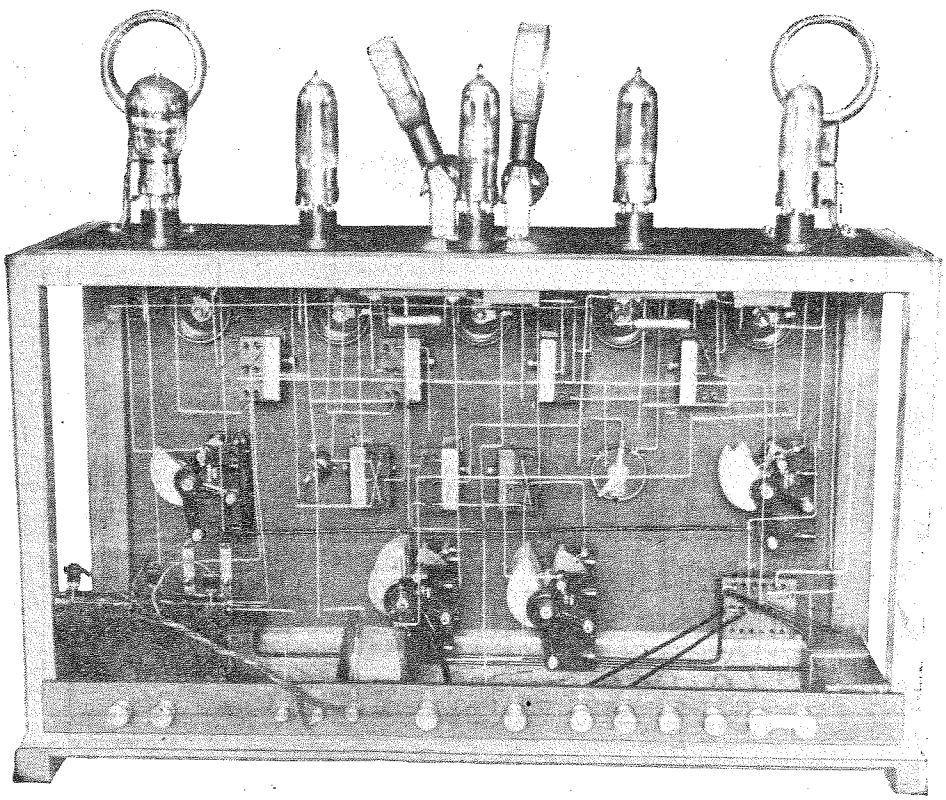


Fig. 2.—A view of the back of the finished receiver, showing components and wiring.

A Five-valve Broadcast Receiver.—

having been first drilled to take the point of the bit. The holders should now be held in position, and the three fixing holes drilled for 6 B.A. countersunk screws and nuts. For mounting the coil holders (Igranic), 4 B.A. cheese-head screws and nuts are used, the position of the holes being shown in the drawing, Fig. 5. To the three-coil holder in the middle of the panel two $\frac{3}{16}$in. diameter spindles and knobs are fitted. The handles provided are *not* suitable for use in this position, but it was desirable to have the holders of uniform design for the appearance of the set. For the amateur who has no workshop, it would be better to get coil holders that do not require any alteration, but in any case the anode coils should be mounted at right angles to the aerial coil.

The Ebonite Panel.

Before finally fixing the components, the front panel requires engraving, or transfers can be used; and if the ebonite is not specially prepared to prevent surface leakage, it must be rubbed down with emery-paper.

To make the set look well, all the heads of the screws and other metal parts showing should either be lacquered or nickel-plated.

A strip of ebonite 1½in. wide by 24in. long should now be prepared and fixed to the two uprights at the back of the set to take the terminals. As can be seen in Fig. 2, two terminals are provided for the loud-speaker, three for the grid bias, a pair for aerial and earth, and six for batteries. To these terminals are connected the main filament battery; an extra L.T. battery when a 6-volt power valve is used in the last stage; a 120-volt H.T. battery for the L.F. valves, and 50 volts for the detector and H.F. valves.

A spring clip should be made to hold the grid bias battery; and the transformers, condensers, and grid leaks should be fixed in their most convenient positions for

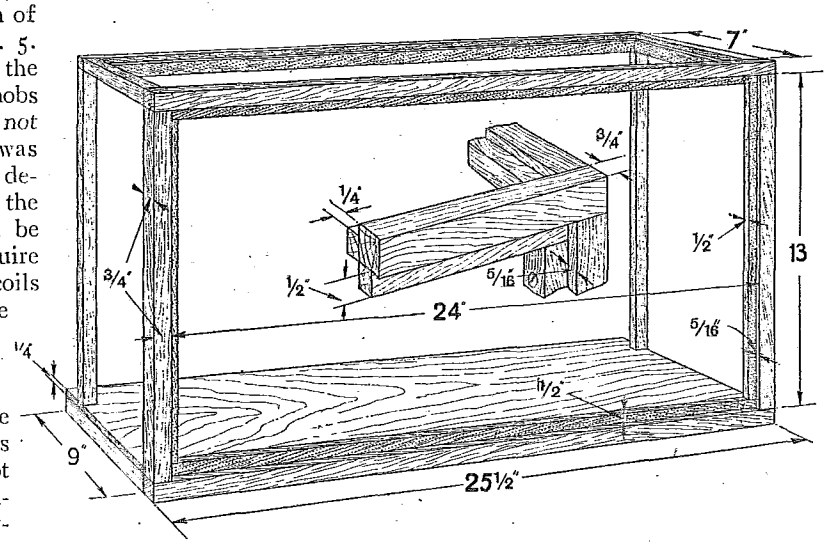


Fig. 3.—Dimensions of the framework supporting the panels.

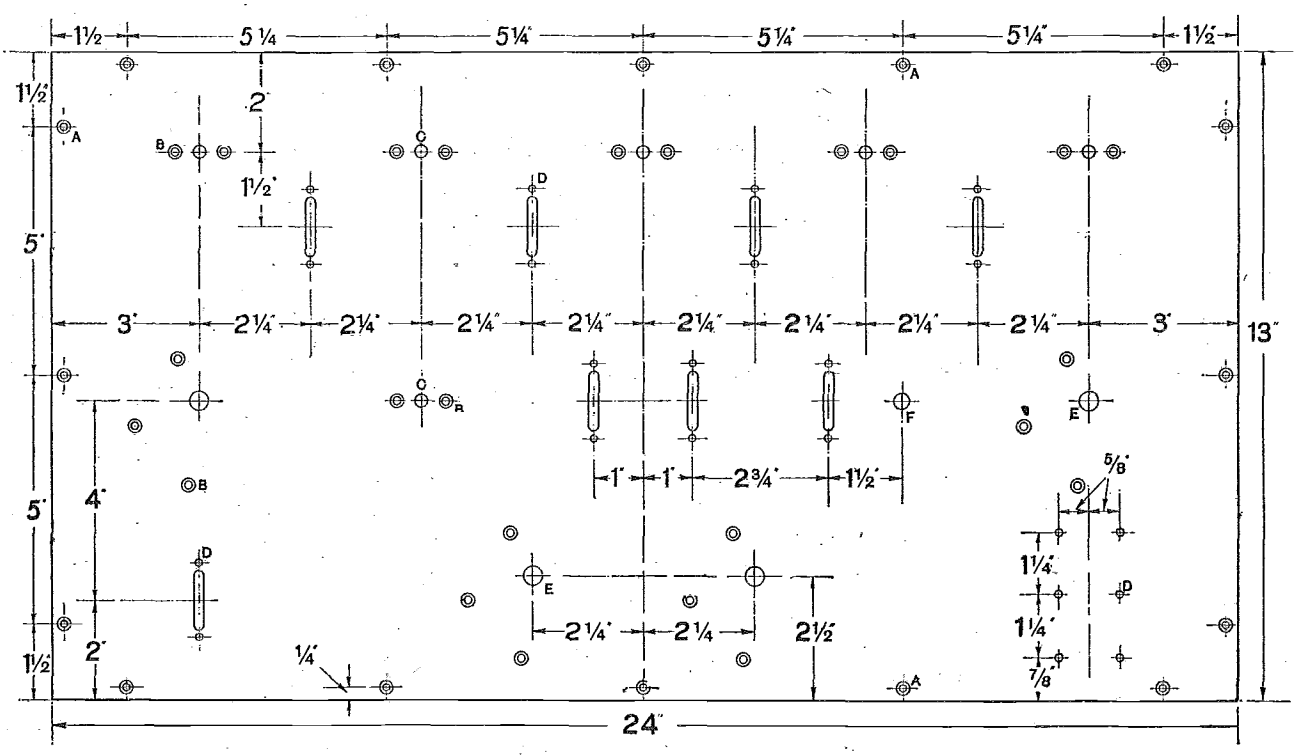


Fig. 4.—Dimensions of the switch and condenser panel. The holes should be drilled to the following sizes: A, ¼in. dia., countersunk for No. 4 wood screws; B, $\frac{5}{32}$in. dia., countersunk for No. 4 B.A.; C, ¼in. dia. clearance; D, $\frac{5}{32}$in. dia.; E, ⅜in. dia. clearance; F, $\frac{7}{16}$in. dia. clearance.

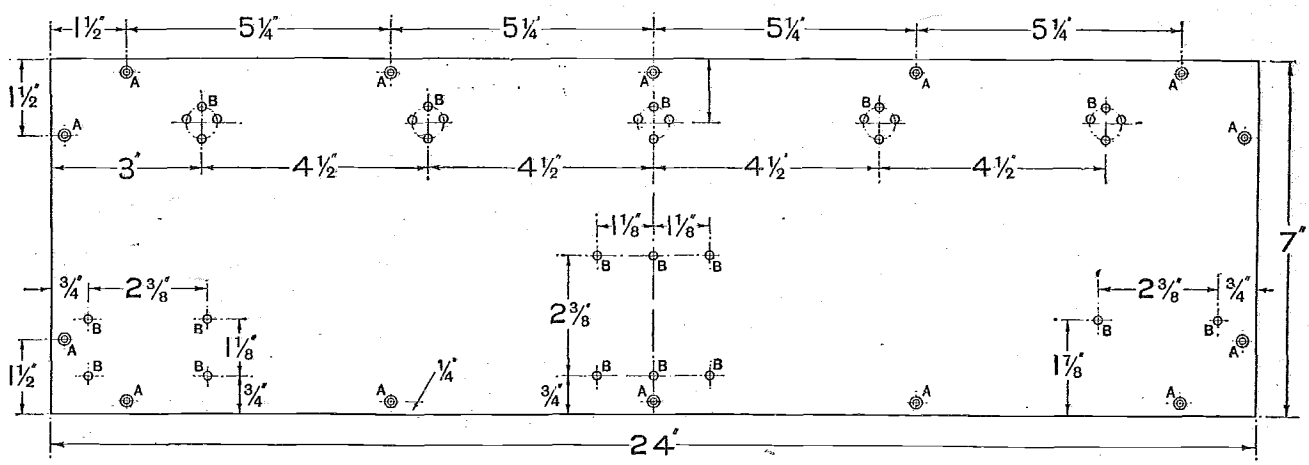


Fig. 5.—Dimensions of the valve panel. The drilling sizes are as follows: A, ⅛in. dia., countersunk for No. 4 wood screws; B, 5/32in. dia.

wiring. The wiring should be carried out with No. 16 square or round tinned copper wire, and, although from the diagram, Fig 7, it appears rather complicated, when the work is started it will become quite straightforward.

In this set the valves used are four A.R.D.E. and one D.E.6, the latter being used in the second stage of low frequency, but there is no reason why any other make should not be used. For good loud-speaker results a power valve is necessary in the second L.F. position.

A brief description of the transformers may be of interest, as they are the result of a considerable amount of experimental work, and from the local broadcasting station they give rich-toned, distortionless, loud-speaker results with ample volume for the garden. The first transformer has a ratio of 3 to 1, the primary being wound with 7,000 turns, and the secondary with 21,000 turns of No. 42 enamelled wire, every thousand turns being separated with a piece of tissue paper. The primary is wound on first, and is separated from the secondary by several layers of tissue paper and one layer of Empire cloth. The second transformer has a ratio of only 1.5 to 1, the primary having 10,000 turns, and the secondary 15,000 turns of No. 42 enamelled wire, separated by tissue paper at every thousand turns. In this case, the secondary is wound on first, and is separated from the primary as before. The bobbins of both transformers consist of ebonite ends on ebonite tubes, bored to take ¾in. diameter cores, consisting of the usual soft iron core wires, which are bent round the outside of the coil to form a closed magnetic circuit and held in position with tape.

Although the ratios of these transformers may appear low, even that of 1.5 to 1 gives more amplification than many of 5 to 1, and it is quite distortionless.

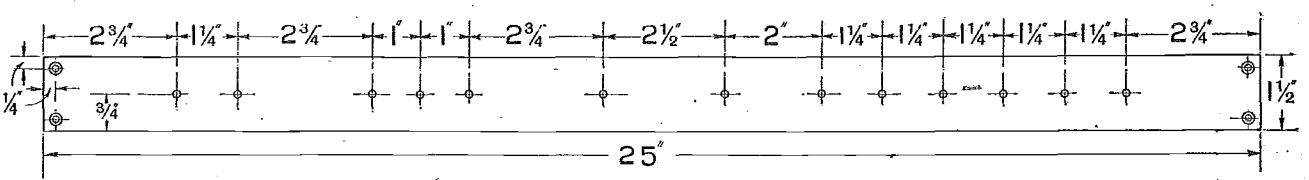


Fig. 6.—Dimensions of the terminal strip.

When complete, the set may be fitted into a cabinet which can have accommodation for H.T. and L.T. batteries, but could be of any design to suit the taste of the maker.

Operation.

In testing the complete instrument it is advisable to commence with the detector valve alone, with telephones connected to the output terminals. The four valve switches should be in the lower position, when it will be seen that the grid condenser and leak of the detector valve will be connected through to one of the centre contacts of the "tune—standby" switch. The grid wire, in passing through the H.F. switches, acquires a

THE FOLLOWING IS A LIST OF THE COMPONENTS USED IN THE SET.

Top ebonite panel, 24in. × 7in. × 5/16in.
Front ebonite panel, 24in. × 13in. × ¼in.
Ebonite terminal strip, 24in. × 1½in. × ¼in.
5 Flanged valve holders.
5 Filament resistances (King).
2 Three-way coil holder sets (Igranic).
7 Two-pole switches (Utility).
1 Five-pole switch (Utility).
1 Two-way push-pull switch (Lissen).
1 0·001 mfd. Sterling square law vernier condenser.
1 0·0005 mfd. Sterling square law vernier condenser.
2 0·00025 mfd. Sterling square law vernier condensers.
1 Potentiometer (Sterling).
13 Terminals.
2 0·0003 mfd. fixed condensers (Dubilier).
2 2 megohm grid leaks (Dubilier).
2 0·001 mfd. fixed condensers (Edison Bell).
1 0·006 mfd. fixed condenser (Edison Bell).
2 1 mfd. condensers.
1 9-volt grid battery.
2 L.F. transformers.

A Five-valve Broadcast Receiver.—

capacity to earth, comparable with the zero capacity of a tuning condenser; but this will not seriously affect the operation of the set, as it is in parallel with the capacity across the tuner. The same capacity, if associated with an H.F. valve, however, would considerably reduce the voltage amplification obtainable, and the switches have been so arranged that the first H.F. valve to be switched removed from the holder, otherwise undesirable resonance and absorption effects may occur.

With regard to the operation of the low-frequency amplifying valves, the ear must be relied upon in effecting a compromise between quality and signal strength. The maximum volume that can be obtained without distortion is predetermined by the characteristics of the amplifying valves, but it will be found that the theo-

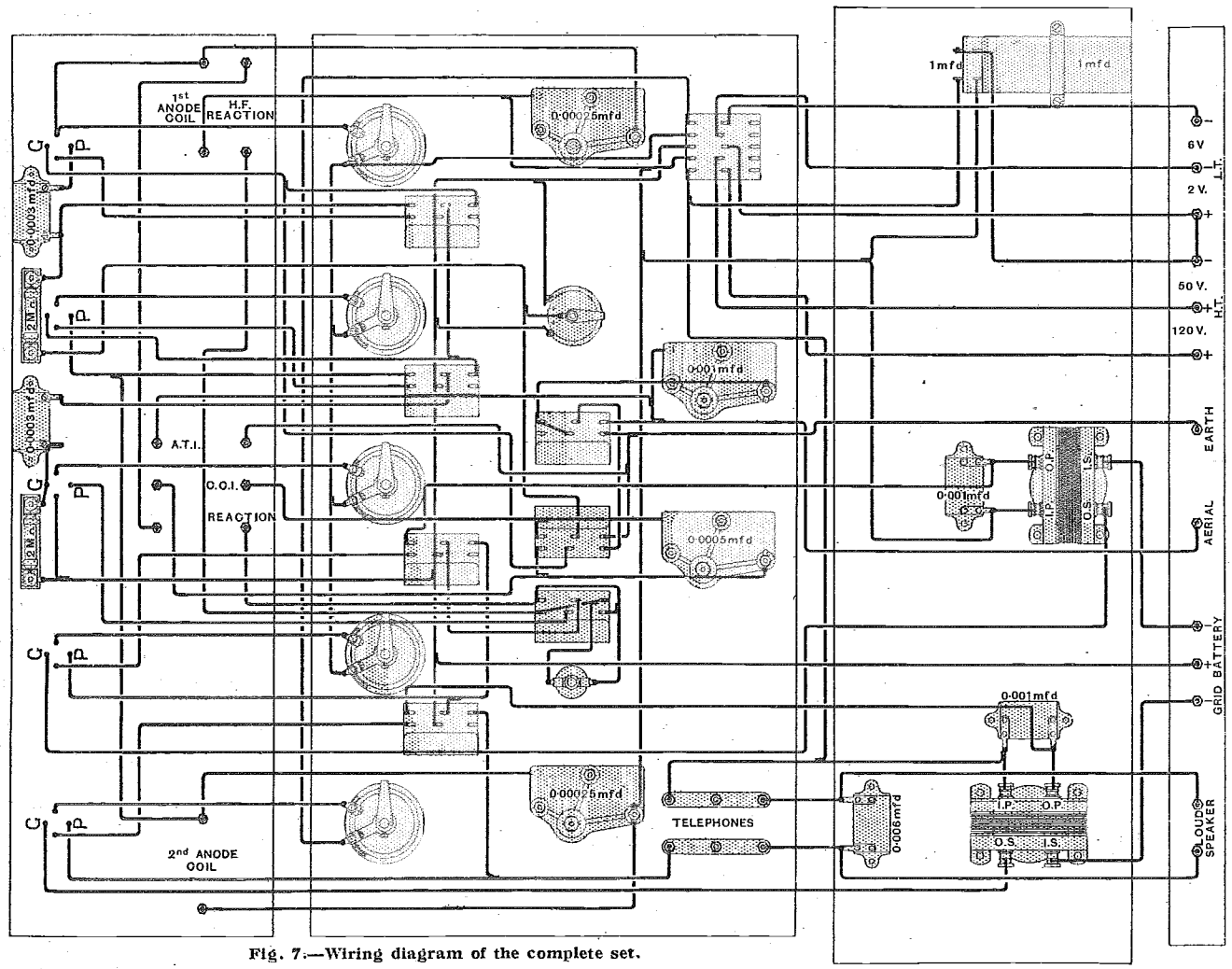
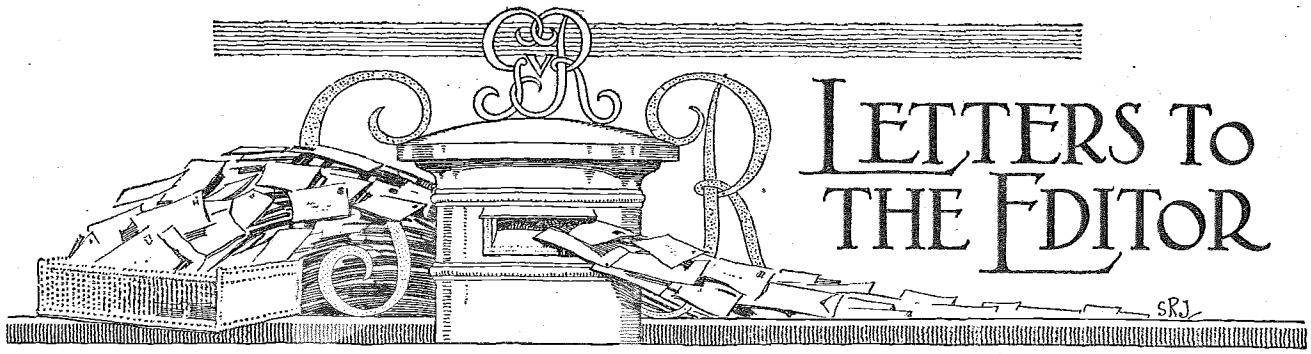


Fig. 7.—Wiring diagram of the complete set.

into circuit is V_2. Thus most of the grid wire capacity is kept associated with the tuner. The remaining H.F. stage, V_1, should be switched into circuit only for very weak signals. If both H.F. valves are used to amplify strong signals, the amplitude impressed on the detector valve may cause distortion in view of the fact that grid condenser rectification is employed.

Tuning should be carried out first with the receiver coupled directly to the aerial circuit. If greater selectivity is required, the secondary circuit may be brought into operation by putting the switch into the "Tune" position. On short wavelengths the aerial tuning condenser may be connected with advantage in series with the A.T.I. When working in the "Stand-by" position, the secondary coil must be detuned, or, better still, retical limit may be exceeded before distortion becomes objectionable. It is worth while remembering that there are two ways of amplifying moderately strong signals up to loud-speaker strength. Either the amplification may be done at high frequency before rectification, or at low frequency; and there is a certain relation which gives best results for any given signal strength. Thus the quality obtained with the detector valve and reaction followed by two low-frequency amplifiers might be compared with that given without reaction by one H.F., detector and two L.F.; or two H.F., detector and one L.F. Systems of modulation vary with different stations, and it may be found that whereas reaction is favourable to the reception of one station, another is received better with H.F. amplification unaided by reaction of any kind.



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

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

SHORT WAVE RECEPTION.

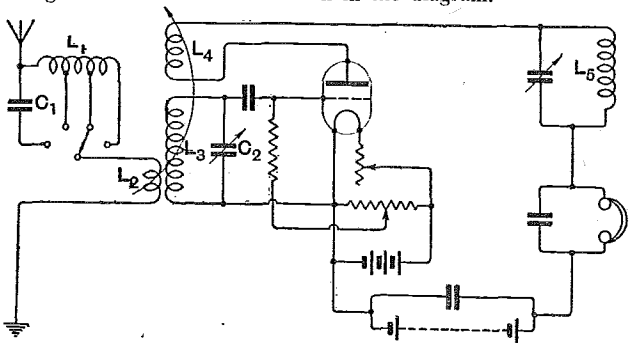
Sir,—Mr. W. James's article entitled "A Short Wave Receiver," on page 23 of your issue of February 11th, prompts me to make a few observations concerning short wave receivers in general.

Mr. James very rightly emphasises the importance of critical reaction control, and I should like to describe what I believe to be the best method of securing this.

All who have experience of working with waves below 100 metres will know that a moving reaction coil causes considerable alteration to tuning, and will recognise that if critical reaction control can be obtained without moving this coil, tuning would be much simplified.

The "Reinartz" tuning arrangement was designed to meet this difficulty, and is, of course, effective, but many who are used to the standard Armstrong regenerative circuit arrangement prefer its simplicity, and I think that most people came back to this well-tried circuit after experimenting with greater or less success with other devices.

The beautifully smooth reaction control characteristic of Reinartz circuits may be applied to the standard regenerative arrangement in the manner shown in the diagram.



Showing how smooth reaction control can be applied to the standard regenerative arrangement when tuning to short wavelengths.

Between the reaction coil and the telephones insert a coil L5 (for waves from 50 m. to 120 m. I use 75-turn multilayer plug-in type). The value of this is not critical. This is then shunted by a .0005mfd. variable condenser. *That is all.*

To operate, one sets the reaction condenser full in and couples the reaction coil to the closed circuit inductance until oscillation is obtained over the whole range of the closed circuit tuning condenser—that is to say, when coupling is only just tight enough to ensure oscillation with the tuning condenser at maximum. By now reducing the capacity of the "throttling condenser" regeneration will be found to be perfectly smooth, and the circuit will go in and out of oscillation or "hang on the edge of oscillation" without movement of the reaction coil. Tuning is thus largely independent of reaction control, and a C.W. signal on 80 metres will be readable over quite a wide angle of rotation of the "throttling" or reaction condenser.

As a matter of fact, I use my reaction condenser as a vernier adjustment, which, I think, speaks volumes.

I should like to call attention to the potentiometer, which I find a great advantage. The fixed grid leak is connected between the moving arm of this and the grid. By judicious use of this, "overlap" troubles can be entirely eliminated. I use a .0001 mfd. grid condenser and 2 megohms leak for the short wave band.

The Reinartz method of aerial loading in order to shift the wavelength of the aerial is worthy of mention, and is a great feature towards ease of manipulation. Coil L_1 consists of 50 turns on a 2½in. tube tapped every 10 turns; C_1 is 2ft. of flex with free ends "open"; L_2 is 4 turns on a 3½in. tube: L_3 is 23 turns of No. 12 bare copper wire formed on a 3½in. glass jar and then string spaced by "lacing" waxed twine of same diameter as wire between turns at four places (equidistant, of course); L_4 is 20 turns on 3½in. tube tapped every 5 turns (10 turns is generally sufficient for 50-120 m.); C_2 is .00015 mfds. L_2, L_3, L_4 are all mounted on two parallel glass rods spaced about 1½in. The coils are thus free to slide, and coupling can thus be adjusted.

All condensers are mounted 6in. behind the panel and connected to dials by ebonite tubes. This obviates hand capacity effects, which are apt to be most annoying on these ultra-short waves. Using a D.E.V. valve, the Z stations have been heard on this receiver without a note magnifier, while U.S. "hams" are profuse after 11 p.m. KDKA, on 68 metres, comes in well on an indoor aerial and can be put on the loud-speaker with the addition of a 2-valve amplifier.

By mounting a pick-up coil from a local oscillator upon the same glass tubes and coupling to the reaction coil, and by replacing the telephones with a pair of connections to an intermediate frequency amplifier, the arrangement becomes the Rolls-Royce of receivers—the superheterodyne.

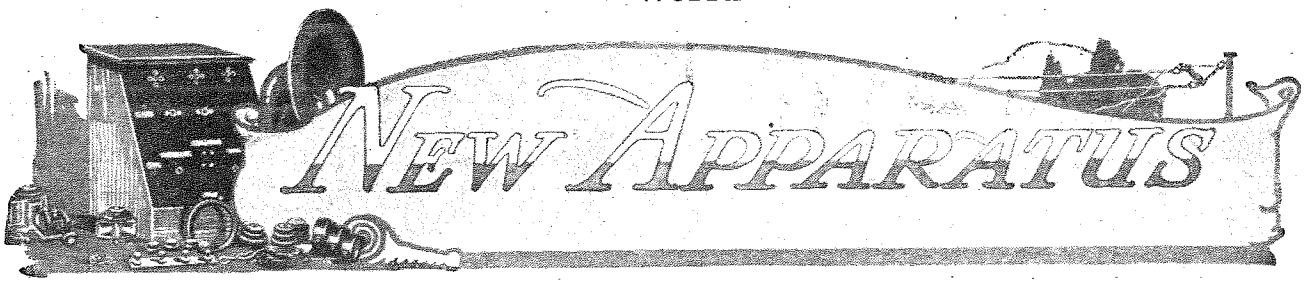
Norwich. HUGH J. B. HAMPSON. (G6JV.)

RECEPTION OF AMERICAN AMATEURS.

Sir,—In your issue of March 4th Mr. Butement claims a record for the number of American stations logged at one sitting. On December 16th last I logged 187 different American amateurs between the hours of 0300 and 0810. These included three 7th district, several 5th and 6th, and calls from every other district.

With reference to your note in the same issue *re* broadcasting in Brazil, I had the fortune to be in the Special Service Squadron last year, and we visited several of the South American capitals. At that time there were two broadcasting stations in Santiago, Chile, at least four in Buenos Aires, two in Montevideo, and two in Rio de Janeiro. All these stations had a power of half to one kilowatt, and operated on a wavelength of 300 to 450 metres. One of the Brazilian stations was broadcasting remarkably good opera when we were there on a wavelength of about 360 metres. I often listened for this station from Jersey when I was on leave last, but never heard it. D. GROVE-WHITE.

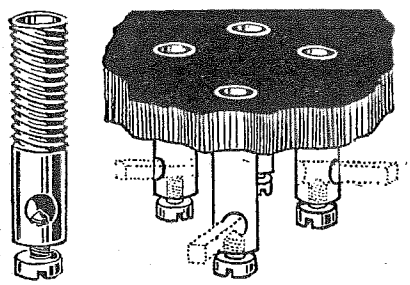
H.M.S. Royal Oak (G2AWO.)
At Gibraltar.



A Review of the Latest Products of the Manufacturers.

A.C. VALVE SOCKETS.

These valve sockets are designed to screw directly into the receiver panel. A metal drilling jig is sold with the socket and also a special size of twist drill. If this drill is used, tapping is unnecessary, though the holes may be drilled and tapped for No. 2BA if desired. The connections are screwed to the base of the



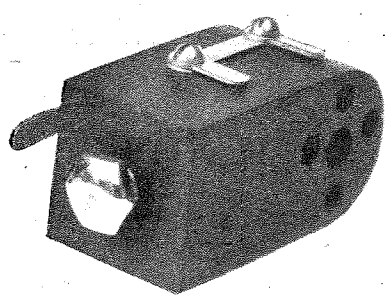
Valve sockets for panel mounting.

sockets, and softening of the ebonite panel through heat during soldering is avoided. The sockets and accessories are obtainable from Messrs. Sparks Radio Supplies, 43, Great Portland Street, London, W.1.

oooo

A VALVE HOLDER FOR PANEL MOUNTING.

When the main components of a receiver are mounted on a vertical panel it is customary to mount the valves on a narrow platform secured at right angles to the back of the panel. The valves will occupy the same position when the "Decko" valve holder is employed, but more space will be left between the valves for the mounting of components such as intervalve transformers. The



A valve holder for mounting valves behind the panel.

valve sockets are fixed in a pure ebonite block which is secured to the main panel by a single screw. The sockets are sunk below the surface of the ebonite, and the valve cannot be forced on to the sockets until the pins are inserted correctly. Double terminals are provided for the grid and plate connections, but if only one connection is to be made the connecting link between the two screws may be removed to reduce capacity effects. As one side of the link is slotted it could be used as an improvised switch in experimental work.

The manufacturers are Messrs. A. F. Bulgin and Co., 9-11, Cursitor Street, Chancery Lane, London, E.C.4.

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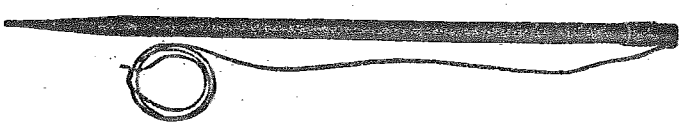
THE GECOPHONE TUBULAR EARTH.

A very satisfactory earth connection can be obtained by driving into the ground a metal rod or tube, to which the earth lead from the receiver is soldered at the top. An earth connection of this kind is particularly useful when the receiver is situated near a window overlooking the garden, and may be even more efficient than a connection made to the water system.

The Gecophone (Killingworth Hedge's Patent) Tubular Earth, manufactured by



The Gecophone tubular earth connection.

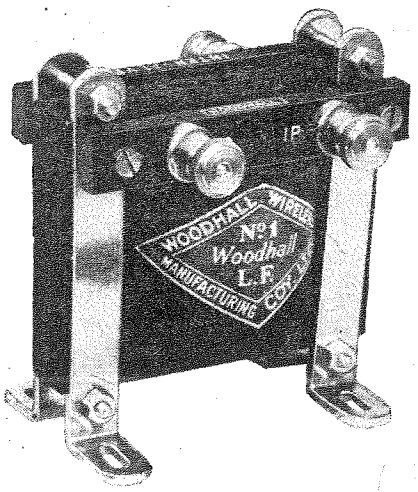
the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2., consists of a pointed tube fitted with a special cap soldered to the top. A length of 7/22 bare copper wire is fitted into this cap, and, to prevent damage when the tube is being driven into the ground, a groove is provided into which the wire may be bent. The tube is filled with carbon to ensure intimate contact with the earth in the event of corrosion of the tube. The tube is thick walled, and it is unlikely that the carbon will be called into use until several years have elapsed.

oooo

THE WOODHALL LOW FREQUENCY TRANSFORMER.

We have recently had an opportunity of examining the Woodhall No. 1 intervalve transformer supplied by Messrs. Pressland Electric Supplies, Ltd., Hampton, Middlesex.

The transformer is provided with a



The Woodhall intervalve transformer.

laminated core of a large size, and great care is taken in the insulation of the windings, which consist of silk-covered enamelled wire. The ratio of the No. 1 transformer is 1 : 2.8, and may be used to couple valves of both high and low impedance. The construction is sound and the finish good.

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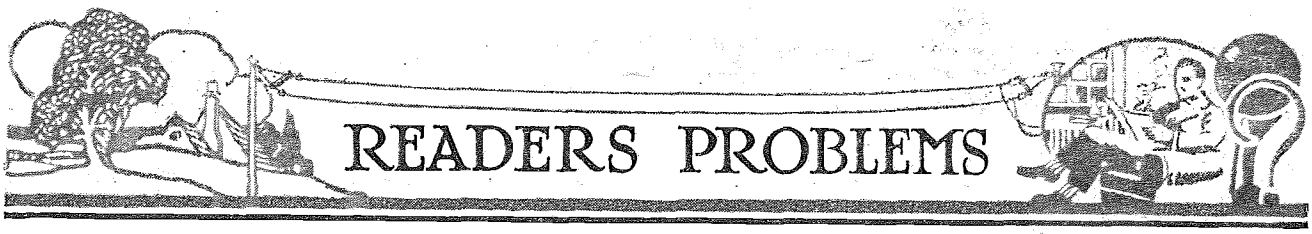
EBONITE.

We have received two specimens of ebonite produced by The Electrical and Chemical Ebonite Co., 180, Southampton Row, London, W.C.1, which are of exceptionally good quality. The quality No. 104 sells at 3s. per lb., and the No. 105 at 2s. 2d. per lb.

The samples were tested for insulation and machining properties, and our opinion is that both qualities can be used with confidence for wireless apparatus. Sheets, tubes, rods, etc., are obtainable in both grades.



Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Electrolytic Rectifying Cells.

A CORRESPONDENT seeks information concerning the size of electrodes, etc., necessary for constructing electrolytic rectifiers. In calculating dimensions for the construction of these instruments, a current density not exceeding 0.1 amp. per square inch of electrode should be allowed, and an allowance of three quarts of electrolyte per ampere should be made. The difference of potential across each cell should not be allowed to exceed 70 volts, and it is better to restrict the voltage to 50 volts per cell. Thus it will be necessary to connect cells in series according to the voltage of the current which they are to be called upon to rectify. For dealing with heavy currents it may be more convenient to construct several small cells, and use them in parallel rather than to construct one large cell. The electrolyte may consist of an almost saturated solution of ammonium phosphate, the electrodes being lead and aluminium respectively. It is advisable to pour a thin layer of paraffin on the surface of the electrolyte to prevent creeping of the solution and evaporation.

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Production of an Electric Current by Thermo-Electric Means.

A READER wishes to know the principles underlying the production of electric currents by thermo-electric means, which method of producing a D.C. current was embodied in an instrument recently described in this journal. The instrument was designed to enable H.T. and L.T. supply for a valve receiver to be obtained from either D.C. or A.C. electric lighting mains with the utmost simplicity without the usual annoying hum, and without any risk of damaging the valves.

The production of an electric current by this method is by no means a new discovery, as many readers are inclined to think. Actually thermo-electric batteries were extensively used on the French railway telegraph system over a quarter of a century ago. If a piece of antimony and a piece of bismuth be joined at one end and heat applied at this junction, it will be found that an electric current will flow if an external circuit embodying a measuring instrument is connected across the two far ends of the bismuth and antimony rods. Several pairs may be connected in chain formation, and every alternate junction heated, care being taken that the intermediate junctions are kept at a lower temperature. In this manner, by employing very many thermo-electric "pairs," a considerable difference of potential will appear at either end of the chain. The greater the difference of temperature that can be maintained between alternate junctions, the greater is the potential difference produced by the whole battery. If every junction is heated, no potential difference will appear between the two terminals of the battery, since the potential differences set up at each junction balance each other. There are many other combinations which may be used besides bismuth and antimony. If a length of copper wire is connected across the terminals of a very delicate electrical measuring instrument, and heat is applied at one point of the wire by means of a Bunsen burner, a very feeble electrical current will be indicated by the measuring instrument.

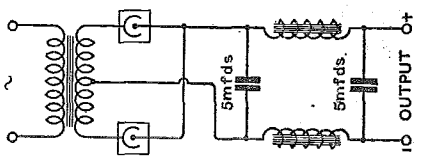
In the "Thermoformer" previously referred to in the issue of this journal for Nov. 26th, 1924, no actual electrical connection exists between the lighting mains and the circuit supplying the receiving set with H.T. and L.T. current. The electric current from the mains is used solely for the purpose of heating up the junctions of various elements, the heating process generating the currents necessary for the receiver in the manner described. Thus, not only is there no risk of the lighting mains coming into direct contact with any part of the receiver, but at the same time the annoying hum usually inseparable with electric lighting mains is entirely eliminated, since, of course, the necessary heating effect is produced entirely independently of whether the current is D.C. or A.C. Such an instrument is equally suitable for any type of electric lighting mains.

oooo

Obtaining H.T. Supply from A.C. Mains.

AS a result of an article which recently appeared in this journal giving particulars for the utilisation of D.C. mains for supplying H.T. to valve receivers, many readers have written to us asking if it is possible to make use of their A.C. mains for this purpose.

This is, of course, quite feasible. It will be necessary first of all to reduce the A.C. by means of a suitably designed transformer to a voltage decided by the maximum voltage required by the receiver plus that lost in the rectifier, and then to rectify it by some device such as a two-electrode valve or an electrolytic rectifier. The output of the rectifier will then have to be passed through a suitable filter circuit before finally reaching the receiver. In the diagram below we give an outline of a suitable apparatus for this purpose. It will be noticed that the secondary winding of the transformer is tapped at the midway point in order to provide full wave rectification. No details of the actual transformer windings are given, since these are determined by the voltage and periodicity of the supply mains on which the instrument is to be used, which, of course, vary in different districts. In order to provide full wave rectification it will be necessary that the total number of secondary turns be double the number that would be required for half-wave rectification.



Arrangement for obtaining direct current for anode circuits from A.C. mains.

When designing a small power transformer from theoretical calculations, ample allowance must be made for lack of skill in constructing, points to be carefully attended to being ample cross sectional area of iron core in order to safely carry the calculated flux density, ample insulation, care being taken that no two turns of greatly differing potential are adjacent, and ample space being allowed for insulation and winding. In the case of anyone with absolutely no previous experience in transformer construction it would probably be better to purchase this component. The rectifier used is of the electrolytic type. This type will not rectify efficiently if too large a voltage is applied to it. The voltage per cell should never exceed fifty, consequently it will be necessary to connect several cells in series, according to the voltage to be applied to them. The smoothing circuit is of the usual type, employing condensers of large capacity shunted across each supply lead and with high impedance chokes in series with each lead.

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Reception on Short Wavelengths.

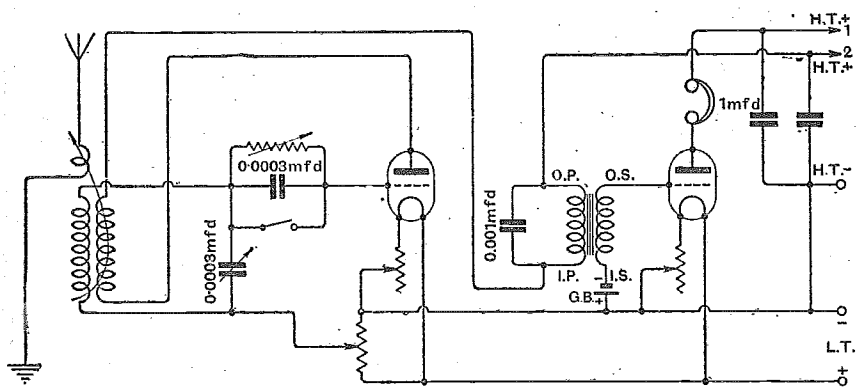
WE receive a number of requests from readers for a receiver suitable for receiving KDKA, and the American amateurs operating on a band of wavelengths between 40 and 100

metres. Many readers appear to think that five or more valves are necessary to accomplish this end, and there are still a great many who hope to cover efficiently a band of wavelength from 40 to 20,000 metres, using a standard four or five valve set with plug-in coils or plug-in H.F. transformers.

It may be said at the outset that sets which may be highly efficient on 300 metres are usually practically useless on a wavelength of 40 metres, since apparently trivial details, such as the capacity existing in the plug-end of a conventional duolateral coil, which are negligible on higher wavelengths, are absolutely fatal to good results below 100 metres. It becomes necessary then to use a suitable type of low loss coil, the turns of which are air-spaced. It is essential also for good results that we make use of a closed circuit employing an aerial coil of from three to five turns, aperiodically coupled to it, the degree of coupling being, of course, variable. The aerial coil can contain ten turns of bare wire wound in the form of a solenoid, each turn being spaced $\frac{3}{16}$ inch, the aperiodic aerial coil containing four turns similarly spaced. A suitable diameter is $3\frac{1}{2}$ inches.

The reaction coil can consist of fifteen turns of No. 20 D.C.C. wire wound in the basket weave form, the mean diameter being, of course, the same as that of the secondary coil. The aerial and reaction coils are mounted on either side of the secondary coil.

When receiving on low wavelengths, it is highly desirable to make use of a valve of the tubular type having a low capacity mounting. A valve of the D.E.Q. type is recommended, having its grid return lead connected to the slider of a potentiometer. A grid condenser and leak of the ordinary pattern are used, but it is desirable that the leak be of a higher value than the customary one of 2 megohms, a value of three or four megohms being correct. If a reliable grid leak of the variable type can be obtained this will be found very useful. Many experimenters prefer also to use a grid condenser having a lower capacity than is customary, such as a 0.00015 or 0.0002 mfds. It is useful also when using a valve of the type suggested to have a switch by which the grid condenser and leak may be short-circuited for experimental purposes, and in the circuit which we give, provision is made for this. The second valve is quite conventional, but it is preferable to use a high ratio transformer and a valve having a high amplification factor when receiving American amateurs' Morse transmissions, rather than to use two stages of low frequency. In this manner a more advantageous ratio of signal strength to extraneous noises will be obtained. The low frequency valve, of course, does not require to be of the low capacity type.



Connections of a receiver for short wave reception.

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Accumulators Damaged whilst Charging.

WE receive many enquiries from readers concerning the liability for damages incurred by a shopkeeper in a case where he accepts an accumulator for charging, and it becomes damaged or destroyed whilst in his possession, either through culpable neglect or through causes beyond his control.

We would like to take this opportunity of pointing out to readers that such queries are entirely outside the scope of this department. Similar remarks apply to other queries having a legal aspect, such as the vexed question of the erection of aerials exterior to flats and other buildings.

o o o o

Connections of the H.T. and L.T. Batteries.

WE are constantly being asked by readers to compare the respective merits of connecting H.T.− to L.T.− or to L.T.+.

This question was dealt with very fully in this section of the journal a few months back, but in view of the fact that many queries continue to be received on this matter, and that these readers may not have had the opportunity of consulting this particular issue, we again take the opportunity of referring to this matter.

When the H.T. negative terminal is connected to the L.T. positive terminal, the voltage of the L.T. battery is added to that of the H.T. battery, and we thus have four or six extra volts, according to the voltage of the L.T. battery we use, available for applying to the anodes of our valves without actually increasing the number of cells in the H.T. battery. With this method of connection, however, the anode current, most of which returns to the valve through the negative side of the filament, is made to traverse the L.T. battery, and it will be found in the majority of cases that better results will be obtained, especially on short waves, when the anode current returns directly to the negative lead. For this reason readers will notice that in the pages of this journal the H.T.− terminal is always shown connected to the L.T.− terminal. In this manner, of course, the few extra H.T. volts are sacrificed, but this is a small matter, especially in view of the fact that the tendency nowadays is to use dull-emitter valves having only a two- or three-volt L.T. battery.

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Supply of Filament Current to "One-volt" Valves.

A READER desiring to make use of a valve requiring a filament voltage of 0.8 to 1.1 volts in his single-valve receiver wishes to know if it is possible to use a primary cell giving this voltage exactly, since he does not wish to make use of a $1\frac{1}{2}$-volt dry cell, or a 2-volt accumulator in conjunction with a variable resistance.

It is quite possible to construct a wet primary cell whose voltage is constant between the limits of 1.07 and 1.17 volts, and which is capable of giving out a steady current to a valve of this type over a prolonged period. The cell is, however, rather expensive and troublesome to set up in the first place, but at the same time it must be admitted that it is very reliable and extremely constant in its action. It will be necessary to obtain an outer receptacle of copper into which is placed an inner receptacle of some porous material. The inner receptacle should be filled either with sulphuric acid diluted with twelve parts of water or with dilute sulphate of zinc, an amalgamated zinc rod being placed in this electrolyte. The outer receptacle is filled with a saturated solution of sulphate of copper. If the inner electrolyte is of sulphuric acid, the E.M.F. will be approximately 1.7 volts, but if it is of zinc sulphate, the voltage will not rise above 1.1 volts. In either case, the voltage is extremely constant. It will be necessary to add more copper sulphate from time to time in order to replace that which is used when the battery is in operation. It is customary to effect this automatically by placing some spare copper sulphate crystals in a perforated container at the top of the outer receptacle, in order that they may dissolve and so replace the copper sulphate as it is used up in the normal course of working.

This type of cell is extensively used in electrical laboratories where a reliable article is required, and is usually known under the name of the Daniell's cell.

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THE PARIS CONFERENCE.

THE International Conference of Amateurs which met in Paris during the week following Easter to discuss various matters affecting the welfare of the amateur has reached conclusion. A number of subjects have been discussed at some length, and certain important resolutions have been carried by the Conference.

The five principal matters put before the Conference for discussion were:—

(1) The proposal for the establishment of an International Amateur Radio Union.

(2) Arrangements for international amateur tests.

(3) The allocation of definite wave-bands for international amateur work.

(4) The advisability of adopting an international auxiliary language for the use of amateurs.

(5) The use of intermediate letters in amateur call-signs to indicate the country of origin.

Each of these questions was considered by a separate sub-committee, composed of delegates from the country's representatives at the Conference, with the exception of the first, which was placed before the Conference as a whole. The resolutions of each sub-committee were reported to and debated by the Conference.

1. A complete draft organisation for the proposed International Amateur Radio Union was submitted by the American Radio Relay League, and, with various modifications, a large part of the draft was adopted. The decision was made that membership of the Union would be open to any person seriously interested in amateur experimental wireless work. National sections will be formed in those countries where there are not less than twenty-five members, and each such section will have a national president. The Union will be headed by a President and Vice-President, with an Executive Committee and a Secretary-Treasurer.

The names of those elected are given in a report of the Conference elsewhere in this issue.

2. The sub-committee dealing with international tests made only general recommendations, adopting the view that the matter would require more detailed investigations than the time available permitted. Recommendations made included the proposal that each country should prepare a report to be submitted to headquarters that definite times should be arranged for tests and that some definite scheme should be prepared for rating signal strength.

3. The sub-committee on wavebands prepared a schedule of wavelengths suitable for international work conforming to the existing licence bands authorised in the various countries as follow:—

	Normal waveband.	Extra short waveband.
Canada and Newfoundland ...	120-115	43-41.5
Europe	115-95 and 75-70	47-43
U.S.A.	85-75	41.5-37.3
Other countries	95-85	37.3-35

It was recommended that amateurs should use other wavelengths than these for short-distance communication,

CONTENTS.

provided that such wavelengths came within the licence bands, in order that certain wavebands might be expressly reserved for international work.

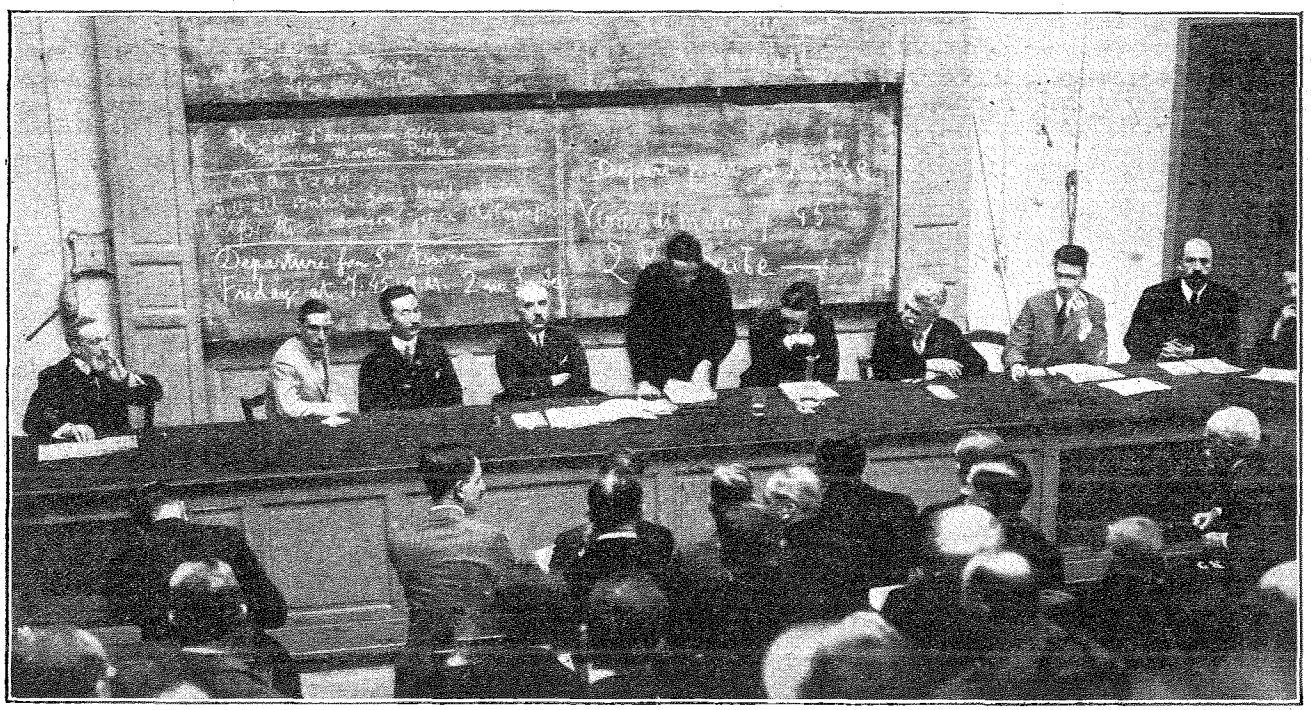
4. Esperanto was recommended by the sub-committee on international language as a standard auxiliary for telephony, abstracts and translations from periodicals, and for use at congresses. It was also suggested that Esperanto should be used between two international correspondents having no national language in common.

5. In considering the adoption of distinguishing letters for use with amateur call signs for international working, the sub-committee compiled a series of letters to replace the official "de," indicating the nationality of the countries calling and called. It was also recommended that initial figures to all amateur call-signs in Europe should be allotted, and the International Amateur Radio Union was asked to take such steps as were possible to induce the Governments concerned to consent to the allocation of these figures. The initial figures for the various European countries were as follows:—

1, Italy; 2, 5, 6, Great Britain; 3, Finland; 4, Germany; 7, Denmark; 8, France; 9, Switzerland; 0, Luxemburg.

The conference is, in our opinion, to be congratulated on the work accomplished, particularly in view of the fact that this was the first conference of its kind to be held, and there was necessarily a great deal of spade work to be done before the actual business of the conference could be dealt with. It will be realised, of course, that the majority of the decisions arrived at by the conference can only be regarded in the light of recommendations until ratification by the respective Governments concerned is obtained, but the recommendations made are so reasonable that there seems little doubt that they will be found acceptable and duly approved by all Governments which permit amateur work. Unfortunately many Governments have not yet conceded to the principle of allowing international amateur communications to be carried out, and certain European Governments still entirely prohibit the employment of wireless by amateurs.

The calling of this conference in Paris, indicating as it does the great enthusiasm and interest which the amateur displays in his work, must go far towards persuading Governments that the cause of the amateur is one which is worthy of sympathetic consideration, and we feel sure that the formation of an International Radio Amateur Union will go a long way towards achieving this desirable object.



The International Radio Conference in Paris, presided over by M. E. Belin seated in the centre.

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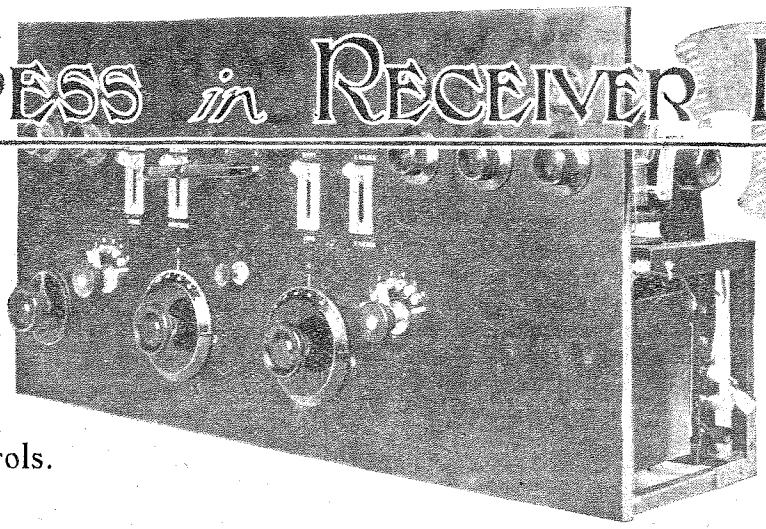
ANOTHER AMATEUR RECORD.

GREAT achievements in long-distance amateur working are not looked for here as the English summer approaches. It is therefore all the more interesting to note the further record in amateur achievement which has been made within the last few days. We refer to the reception of the Australian station, A2CM, operated by Mr. C. D. Maclurcan, which, working on a wavelength of approximately 20 metres, has been received in England by Mr. J. A. Partridge, 2KF, and Mr. G. L. Morrow, 6UV. When we consider that this reception, reported in our issue of April 22nd, was carried out in broad daylight between 6.20 and 7.25 a.m., and that the reception has been repeated since, the achievement affords further striking proof of the possibilities of short wavelengths.

Progress in Receiver Design

The Construction of a Receiver Fitted with Tone Controls.

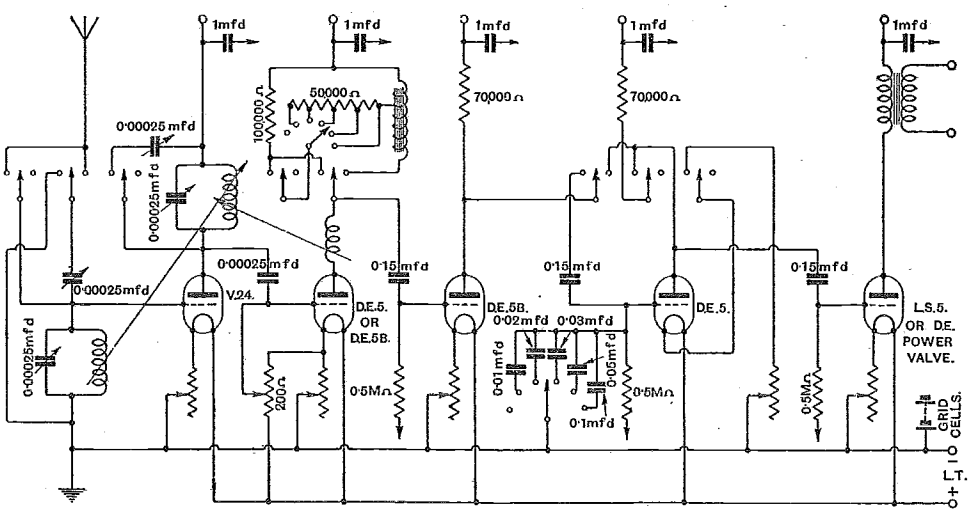


By F. H. HAYNES.

THERE is a universal need for a receiving set which is capable of operating a loud-speaker with the signals from the local station and maintaining a high standard of speech and music reproduction, and which is capable of bringing in distant broadcasting stations at loud-speaker strength with reasonable purity. This being the aim, a circuit for a tuning range of approximately 200 to 3,000 metres was developed and its merits discussed in a recent article.[1]

Embodying the theoretical considerations outlined in a recent article,[1] we come to the practical interpretation, into instrument form, of the circuit arrangement discussed. It is with the object of producing a design involving well tried practice and applying it with effectiveness that this somewhat elaborate instrument has been built by the author. The article does not give the actual processes of construction, but brings forward practical points in design.

The general layout of the receiver comprises three sections, the high-frequency and detector valve with its associated apparatus, the tuning equipment, and the low-frequency amplifier. By building in three units in this manner compactness is obtained and the wiring is kept short and efficient. Symmetry is often a feature of panel layout, sometimes at the expense of efficiency, though rarely do the components, owing to their positions in the circuit, lend themselves to a balanced and uniform distribution on the face of the instrument. Where the circuit is a complicated one it is advisable to assemble the apparatus in a sequence more or less corresponding to the positions taken in the diagram, though it is possible to make slight adaptations that will provide convenient operation. For instance, final tuning is always carried out on condenser dials, and these should therefore be arranged near the lower edge of the panel so as to permit of critical adjustment with the wrists resting on the table, and avoiding the hand capacity effects which result when reaching over other apparatus. Filament resistances which require no adjustment in the process of tuning may be in less accessible positions, and it is good practice to accommodate each immediately in front of the valve which it controls, and with the valve window exactly centred on the filament. The tuning inductances must necessarily be of the plug-in type for tuning over a wide wavelength range and for durability and to



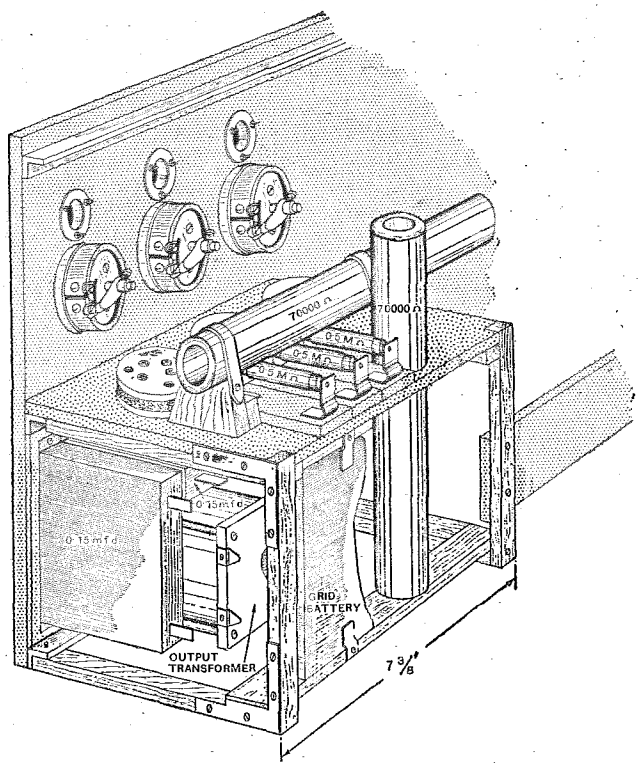
The circuit makes provision for altering the value of the tuning capacities as required when tuning over a wide band of wavelengths. Tone-raising apparatus included in the plate circuit of the detector valve consists of a comparatively low impedance iron core choke brought into action to a varying degree by a tapped resistance. The higher note frequencies develop greater potentials across the ends of the small coil than those frequencies representing the bass notes. A high impedance choke coil giving comparatively even amplification can be switched into operation. Condensers of various capacities are arranged in shunt with the input to the second low-frequency amplifier, and these have the effect of reducing the intensity of the higher pitched notes, causing the lower frequencies to predominate. Resistance coupling is employed whilst switches provide for removing one of the low-frequency amplifiers from the circuit and in the actual set for reversing the connections to the reaction coil.

[1] *Wireless World and Radio Review*, December 24th, 1924, page 405.

Progress in Receiver Design.—

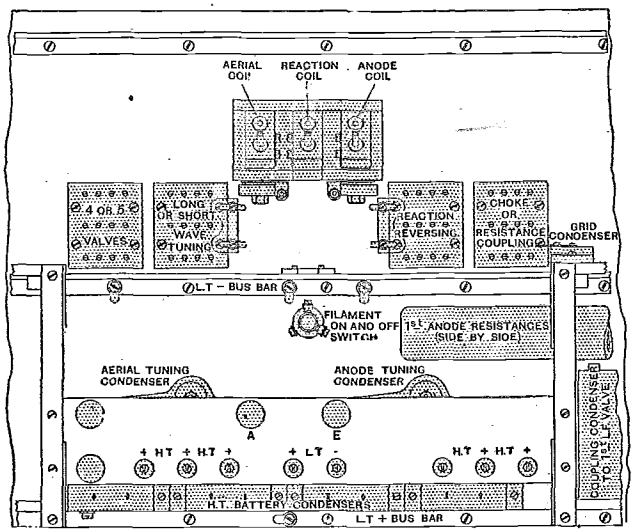
eliminate the effects of stray capacities, are best accommodated behind the panel. The coil-holder must, of course, be geared to provide critical adjustment, and the Sterling holder to be seen in the illustrations has been mounted with its rods reversed. The tilt given to the coils by this coil-holder is a useful feature, for the inductances will not only have clearance, but can be easily plugged in when the cabinet work is only provided with a lid.

The high-frequency and detector valve unit is built into a wooden framework, and as this may be subjected to some strain it is strengthened at all corners with brass L brackets. Its circuit includes the tuned plate of the high-frequency valve, the reaction circuit, and the low-frequency coupling equipment of the detector valve.



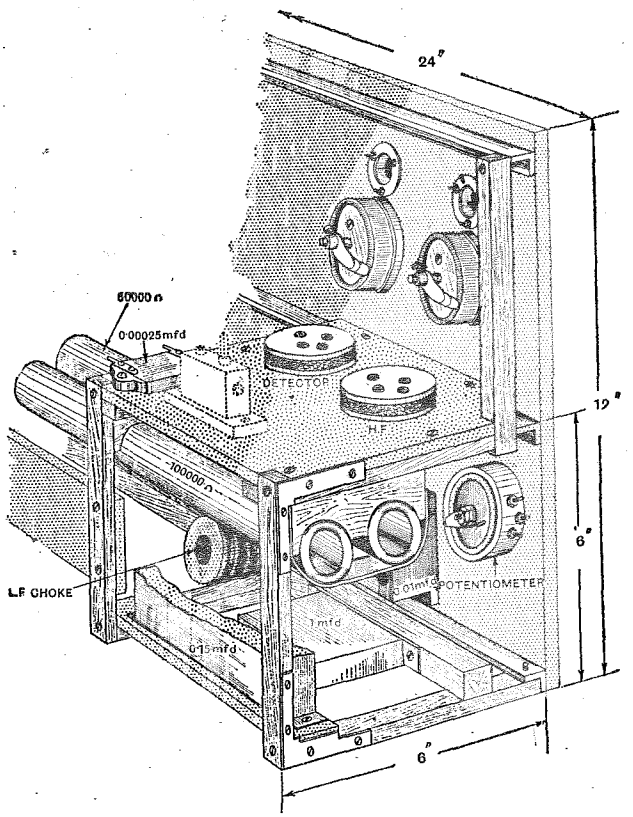
The low-frequency amplifying apparatus is assembled as a unit on a wooden framework in order that the wiring may be compact and not interlaced with that of the tuned circuits. The grid coupling condensers have mica dielectric and are constructed from old transmitting condensers reassembled in tin containers. To prevent self-oscillation at low frequency, the two anode resistances are assembled at right angles to each other and at right angles to the field of the output transformer.

The plate tuning condenser, the plate coil, the switch for reversing the connections to the reaction coil, the switch for providing alternative resistance or choke coupling, the first tone-control switch and the potentiometer, appear on the face of the panel alongside this unit. The filament resistances are bolted to the panel with windows immediately above and valves directly behind them. It is advisable in multivalve receivers to render the valves non-microphonic by supporting them on soft india-rubber. In the receiver shown tuned anode high-frequency amplification is employed owing to the difficulty of providing any form of tuned transformer coupling which will operate over a wide wavelength



The general arrangement of the switches and tuning equipment. Four-pole switches have been fitted to provide for subsequent modifications, though two and three pole switches only are needed to bring about the necessary circuit changes.

range by interchanging inductances, and which is capable of giving variable coupling with the reaction coil. One successful method of employing the transformer, however, consists of arranging a fixed coil-holder to support an inductance to be the primary, and which is coupled

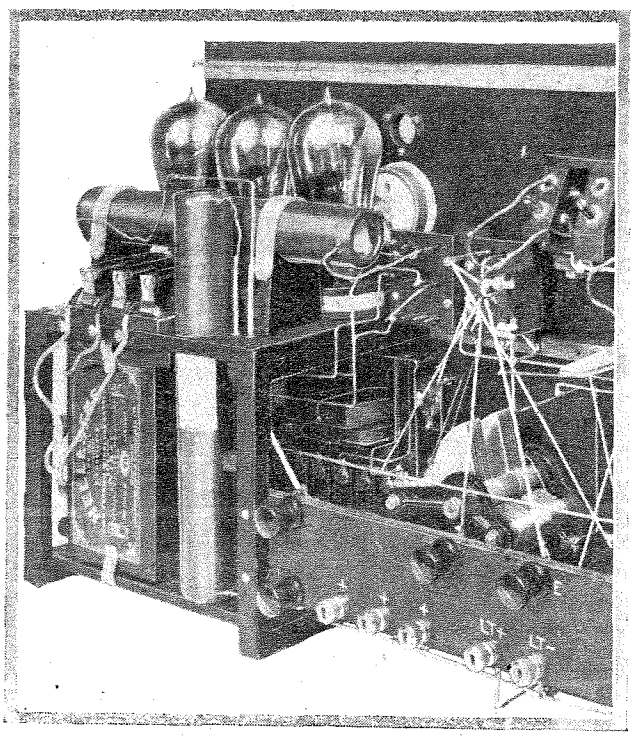


The high-frequency and valve detector unit. The framework gives support to the apparatus associated with the detector valve. Most of the connecting leads will be found to be quite short with the exception of the grid connection which connects to the L.F. amplifier, and this can be well spaced from other leads and run directly to the L.F. unit. A condenser is connected between the potentiometer slide and negative L.T.

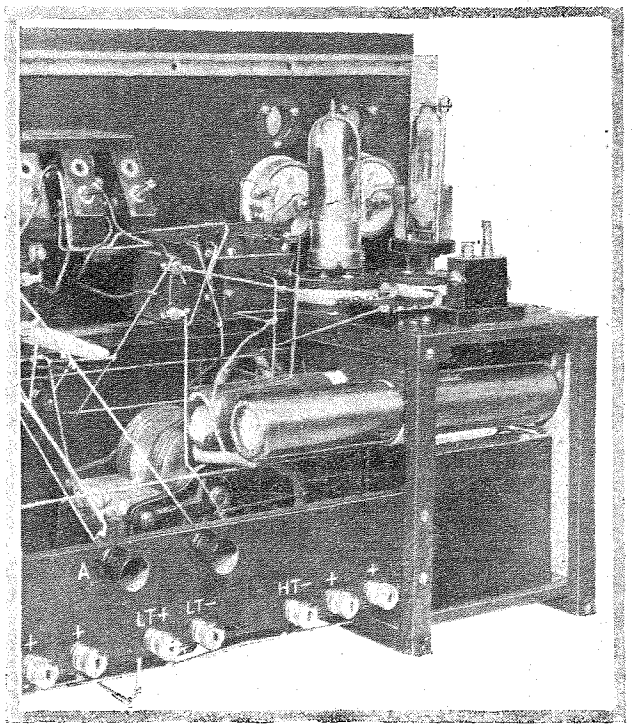
Progress in Receiver Design.—

to the secondary carried in one of the mounts of the coil-holder by means of a small spool about 1½in. in diameter and consisting of two layers each of about ten turns of wire. The two layers must be well insulated from one another, preferably with mica, for it will be seen that any slight low insulation between them may render the receiver very noisy by bringing the high and low potentials together and influencing the grid potential. The resistances in the plate of the detector are mounted side by side, and although differing in resistance are made up to be similar in dimensions. The iron core choke coil, if it is to be variable, must be home constructed, though it is possible, of course, to substitute an intervalve transformer with primary and secondary in series, and to connect in series with this a small home-made coil having an inductance of between 3 to 5 henries. This small coil might have a core of wires 1⅞in. in length and ⅜in. in diameter wound with about 800 turns of No. 42 D.S.C. The choke coil used in this receiver is 3¼in. in length with a core ⅓in. in diameter. The wires are carried in 10 slots ⅛in. wide by $\frac{5}{16}$in. deep, each being wound full with No. 44 S.S.C., a tapping being taken from the end of the first section.

The equipment of the tuning circuit, which is arranged across the centre of the panel, requires little reference. The short and long wave switch occupies a position near the centre, for it is linked into both tuned circuits. In the input circuit of the fourth valve is connected the bank of condensers to provide tone lowering control. These are not carried by the framework of the amplifier, but are held by means of 6B.A. screws to the main panel and



The receiver will be seen to be compact and apparatus almost uniformly distributed over the entire space behind the panel. The condenser shunt circuit for tone control can be seen adjoining the tuning condenser.



The high-frequency and valve detector unit. By using the V24 valve special methods need not be adopted when receiving on broadcasting wavelengths to control self-oscillation. Clearance must be provided for the coils which swing round to positions parallel with the face of the panel.

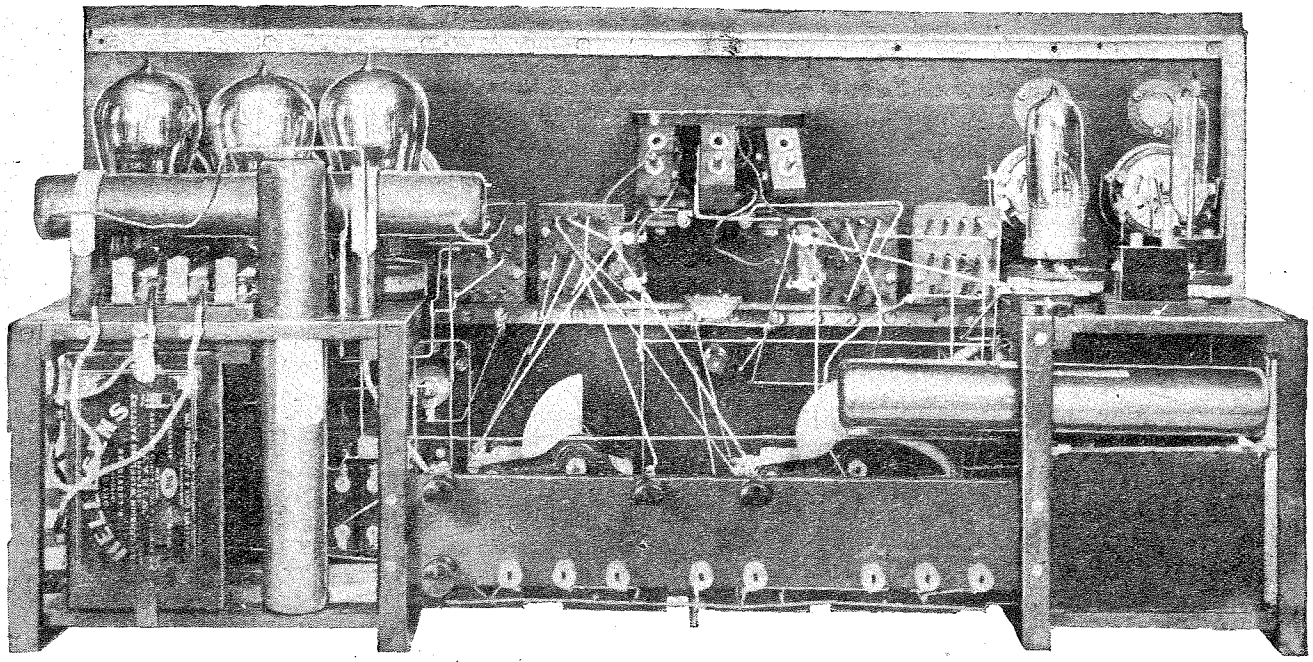
fitted up when assembling the tuning equipment. The lower values are obtained by connecting in parallel Dubilier condensers, type 620, of 0.01 mfd. capacity, while the two large capacity condensers are of the Mansbridge type.

The low-frequency amplifier is straightforward in its construction, and the three valves carry in their plate circuits the anode resistances and the output transformer. The latter has a 1, to 1 ratio, is of high inductance, and section wound. It is screwed to the face of the panel so that its core is at right angles to the two anode resistances which are at right angles to each other. The grid leaks are mounted side by side on the top of the wooden framework, and short leads connect with the grid battery, which exactly fits at the back and is held by wooden stops.

A strip of ebonite is secured across the frames of the high and low-frequency units, bracketing them together to give rigidity to the woodwork. This ebonite piece carries the terminals, which are distributed in the most convenient positions for wiring.

A wooden bar is also screwed in position behind the terminal strip, and gives support to the fixed condensers which are connected to the H.T. battery.

With so much heavy apparatus all taking its support from the front panel, some form of strengthening is necessary. Three angle brass strips, ⅛in. in thickness and with ½in. faces, run across the panel and are attached with 4B.A. screws at intervals. Except for small work ebonite panels must be $\frac{5}{16}$in. in thickness to make the instrument reasonably robust, yet this dimension must be regarded as a maximum even for large panels

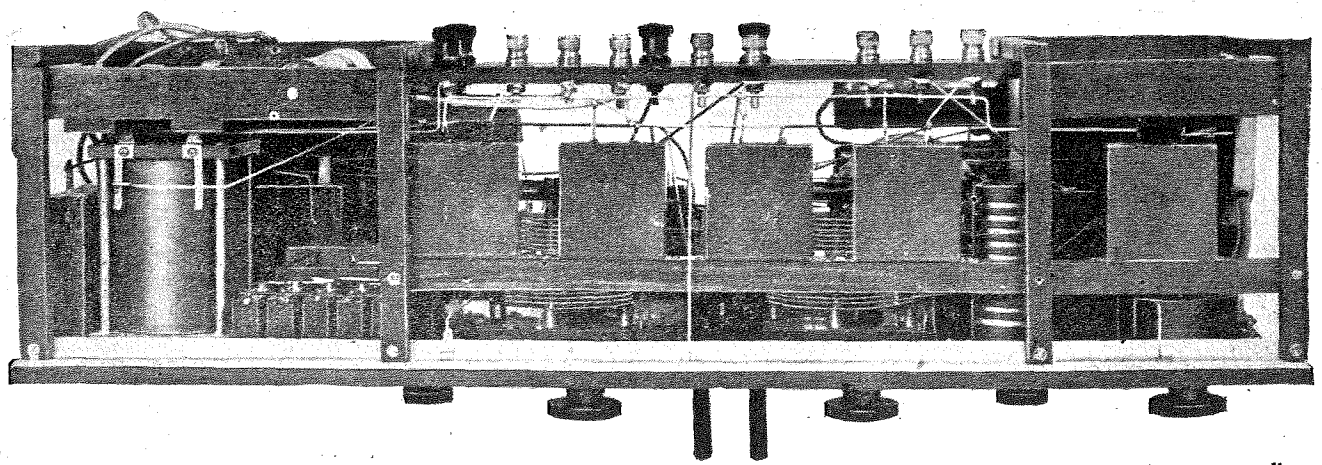


In the complete instrument the brass angle strips used to strengthen the panel serve also as bus bars for the leads to the low-tension circuit. The lead from the negative battery terminal to the centre strip of angle brass is broken through an "On and Off" switch, which appears in the centre of the panel. Ebonite strips carrying connecting tags are fitted to the inside of the valve platform to pick up connection with the short flexible leads from the rubber-supported valve holders. The box work must be provided with a lid so that valves and coils can be inserted from the top, whilst the terminals are accessible through a hinged flap.

and strengthened in this manner with angle brass where necessary to avoid the extravagance and unworkmanlike appearance of heavy $\frac{3}{8}$in. ebonite. In this instrument the two lower strips are used for attaching the wooden framework, and before being fitted to the panel are tapped at frequent intervals and fitted with 4B.A. cheese-headed screws so as to serve as bus bars for the low-tension leads. The centre angle brass is the L.T. minus, and saves a large amount of wiring.

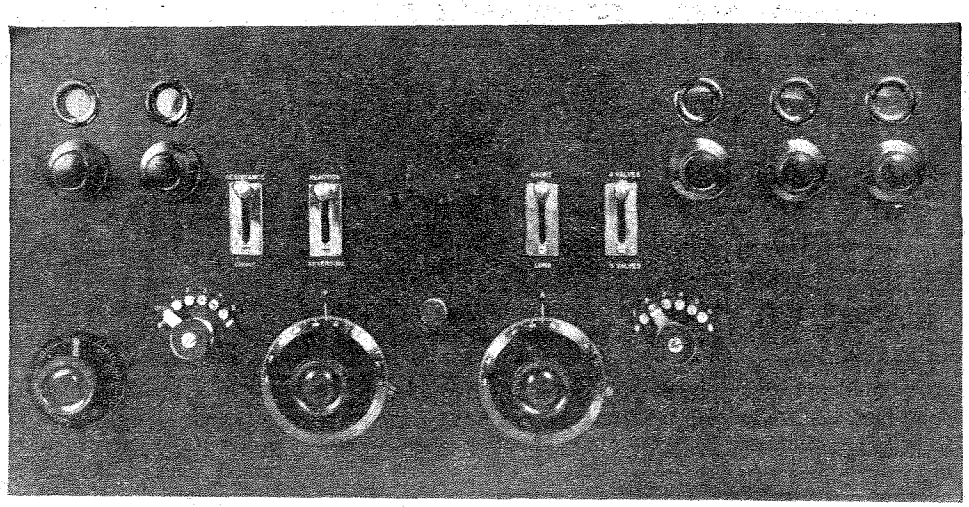
The completed set, which is included in a space of 12in. × 24in. × $6\frac{1}{2}$in., is contained in a plain teak case, and is thus reasonably compact. The entire top, excepting a 1in. strip along the front to give required strength, is removable for the interchanging of coils and the insertion of valves. At the back a flap is provided for giving access to the terminals. In this form the instrument is suitable for stowing away, say, perhaps in the loft, and when joined up to a loft aerial can be brought into operation by remote control by leads connected in series with or across the plunger switch.

The first valve is of the tubular type, having low capacity between its electrodes, and the form of mounting adopted adds relatively very little capacity compared with that present in valves where the glass work makes them suitable for four pin mounting. By the use of this "V24" valve the capacity coupling between the aerial and plate tuned circuits is kept sufficiently low to prevent the receiver breaking into uncontrollable oscillation on the shorter broadcasting wavelengths. The detector valve may be of the "QX" type with high amplification factor, or of the ordinary "R" pattern, when using leaky grid condenser rectification. When the receiver is



In this view, taken from the underside of the instrument, the construction of the low-frequency choke coil can be clearly seen as well as the arrangement of the wooden strip used for supporting the high-tension battery condensers.

Progress in Receiver Design.—



Front view of the finished instrument. Although not perfectly symmetrical in the layout the panel possesses a workmanlike appearance. The dials requiring constant adjustment are placed near the lower edge so that they can be operated without raising the arms from the table, whilst the lever switches and filament current controls, needing only occasional re-setting, occupy the uppermost portion of the panel. By housing the plug-in coils behind the panel they are less likely to damage.

used in a non-oscillation condition for local reception, a valve of the "DE5b" type may be inserted as the detector and the H.F. valve switched off, the incoming oscillations being by-passed by the coupling between the tuning inductances. The first low-frequency valve is a "DE5b," giving high amplification, and this is followed by a "DE5," or equivalent type of other manufacture, while the last is a low impedance, low amplification power valve capable of operating with liberal grid potential fluctuation input. For controlling the grids a 9-volt battery is employed, and will be found suitable with moderate plate potentials.

The range of the receiver when giving satisfactory loud-speaker reproduction includes most of the British broadcasting stations and those Continental stations commonly heard in this country. For distant stations reaction is introduced which, in stimulating self oscillation, improves the selectivity and is used in conjunction with choke coupling. The potentiometer control when operating through the grid leak resistance is not critical in its adjustment, but must be rotated from positive to negative bias when switching over from choke to resistance coupling. The tone raising selector switch produces a most interesting effect, and with certain types of transmission gives a most pleasing tonal change. It is very effective in its operation, even on the first stud, and a considerable change is produced in the predominance of the higher pitched notes when first accentuated and then cut down by the condenser shunt circuit connected to the input of the second low-frequency valve. This condenser shunt or tone lowering control is an almost essential part of a receiver used for loud-speaker work. In action it assists in giving prominence to the bass notes, perhaps previously inaudible, and creates a most pleasing "roundness" of tone.

WIRELESS IN THE IRISH FREE STATE.

How Apathy may be Overcome.

By H. LYNTON FLETCHER.

A PECULIARLY apathetic attitude with regard to wireless reception seems to have manifested itself in the Irish Free State. This is undoubtedly the outcome of being forced to listen to the various interruptions attendant upon the long-distance or "freak" reception of broadcasting stations intended primarily to cater for listeners within a radius of fifty miles. We in Ireland cannot hope to eliminate such troubles as atmospheric disturbances, Morse interruptions, fading, and the distortion produced by the use of excessive low-frequency amplification, until we have a station of our own.

That radio-telephony is fast becoming a factor of industrial, educational, and social importance throughout the civilised world is already patent, and yet in the Free State, where our staple industry—agriculture—and our most urgent necessity—education—lend themselves so readily to development through this channel, it would seem that we have no use for it.

Without attempting to discuss the great possibilities of a broadcast service, from an industrial and educational standpoint, it is worth while noting that a single high-power station in Dublin would enable farmers in the most remote and outlying districts to keep in touch with the weather forecasts, market prices, and many other matters vital to their business, whilst the dissemination of musical programmes, etc., would go far to lighten the greyness of the winter countryside—if it did not eventually prove the solution of the rural problem.

A Medium for Development.

Even were it necessary, this is not the place to sing the praises of the Royal Dublin Society; let it suffice to say that there could be no better medium for the development of broadcasting in the Free State than the Society which has, for so many years, in the face of industrial chaos and social upheaval, ploughed steadily and reconstructively onwards towards national prosperity, and has fostered and encouraged the growth and development of our great agricultural activities.

One thing is quite certain, whatever scheme is finally adopted must be a scheme in the interests primarily of the country, and, in the words of Tennyson, had "Better not be at all than not be noble."

THE INTERNATIONAL BROADCASTING BUREAU.

Some Comments on the Work Before the New Organisation.

By G. ROLLAND WILLANS.

THE significance of broadcasting as a matter of international importance, alluded to by the writer in a recent article in these columns on the subject of British broadcasting, has recently received material attention from the Press following on the appointment of "Uncle" Arthur Burrows to the post of manager of the recently constituted International Broadcasting Bureau in Geneva.

Nine broadcasting countries, amongst them Great Britain, are subscribers to the Bureau, which has been set up to deal with international broadcasting matters, Mr. Burrows being reported as stating that the Bureau will have executive power over the broadcasting organisations in all subscribing countries, and that the costs of administration will be met by them.

"Executive Power" of the Bureau.

Until further information becomes available as to whether the words "executive power" mean what they imply, it might be reasonable to assume that broadcasting in this country is to be developed along lines agreeable to our European neighbours, but it seems more probable that these new activities in Geneva will be confined to matters outside the scope of any individual broadcasting organisation.

Those of us who endeavour to receive Continental as well as British programmes are fully aware of the chaotic conditions which now exist as the result of interference between the large number of stations now engaged in broadcasting, these conditions tending to become rapidly worse as each new station commences operations. Apart from the fact that the wave bands for broadcast purposes are usually allotted by the various governments concerned, there should be no insuperable difficulty in effecting an agreement under this heading, as no one country can be said to be entirely unaffected by the activities of its neighbours, and as a result there is common ground for a joint policy.

The B.B.C. must be keenly alive to the prospects of materially improving conditions of reception by an international adjustment of wavelengths, and they have once again contributed to the systematic development of the art by taking the lead in this matter.

Interchange of Broadcast Items.

A possible regular interchange of broadcast items is another matter which is to receive attention, and, as our national bill of fare is the subject of considerable criticism, the introduction of Continental tit-bits should appeal to dyspeptic listeners for whom our own *chefs* have not been entirely successful in catering. If certain technical difficulties can be overcome listeners in this country who, under normal circumstances lack the facilities for a dip into the Continental lucky bag, will be able to form a more accurate comparison between the entertainment offered abroad and that made available through our own broadcast services.

If the I.B.B. are able to effect a solution of the problems involved in the particular cases above mentioned, there is no doubt that the listener in this country will materially benefit thereby.

There is, however, at the moment of writing, no particular indication that the activities of the Bureau will be confined to matters of this description, and sooner or later other considerations will no doubt make themselves felt in connection with which no international agreements should be allowed to militate against us. The I.B.B. as a means of dealing with more or less routine matters is one thing, but becomes something quite different when viewed in the light of an executive authority in connection with European broadcasting.

Broadcasting and Propaganda.

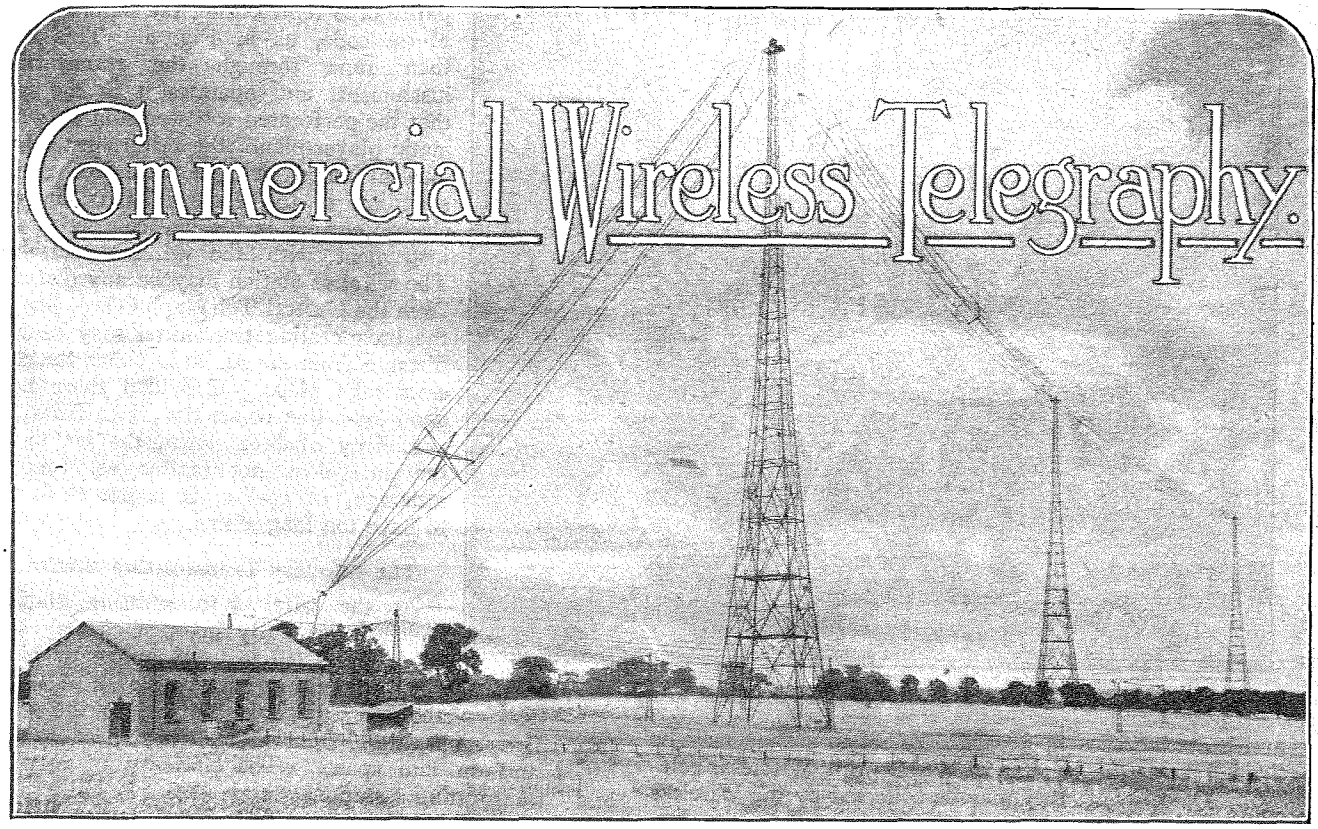
Owing no doubt to the basis upon which our own services are founded, we do not appear as yet to be sufficiently alive to the importance of broadcasting as a vehicle for all forms of propaganda. Certain Continental countries, on the other hand, are actively aware of this fact, and will undoubtedly endeavour to make use of the Bureau to further the commercial and other interests of their own nationals. The whole question is fraught with pitfalls, and in view of its obvious importance it is essential that the widest possible publicity should be given to the proposed activities of the I.B.B., and that these activities should be restricted to a degree which must be impossible if, in fact, the autocratic powers at present claimed for it actually exist.

The British listener will no doubt desire to be informed as to these activities, the more especially as he provides a measure of financial support towards their furtherance, and in addition will be interested to learn the extent to which he has been committed by the B.B.C. as the direct subscriber.

Wireless receivers can now be classified in the same category as telephones, electric light, and baths. Broadcasting, however, unfettered as it is by national boundaries, is something more than a household necessity, a means for recreation and amusement, and must be regarded as one of the vital factors which will play an important part in our relations with other countries.

Viewed from this angle, the activities of the I.B.B. are a matter of more than passing interest, and its choice of Geneva as a suitable headquarters may not be entirely inappropriate.

Commercial Wireless Telegraphy.



The aerial system and the earth screen at Ongar.

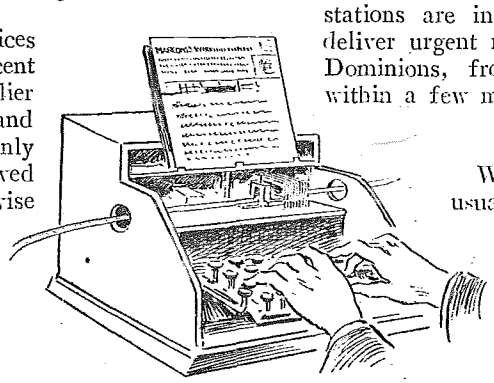
How Organisation Speeds Up the Wireless Message.

By WILLIAM REECE.

AS the most modern means of communication, commercial wireless may fairly be expected to incorporate the latest and most efficient methods at telegraphic practice. This it does. The great speed at which a wireless message travels through the ether would give it little advantage unless the handling of the message, both before it reaches the wireless transmitter and after it passes the wireless receiver, were speeded up to the highest possible degree. It is by this combination of organised human efficiency and the natural velocity of ether waves that the high speeds now possible on some wireless circuits, and the still higher speeds that are foreshadowed, can be achieved.

Those responsible for wireless services which have been organised during recent years have had the experience of earlier telegraph practice to guide them, and have, therefore, been able to choose only those methods which have been proved in the light of experience. That a wise choice of these methods has been made can be seen by the veriest novice who walks through a wireless telegraph office.

Messages handed in at the counter are despatched by means of automatic carriers to the circulation table, and, after a halt of only a few seconds, pass on again by automatic carrier to the telegraph circuit. At the circuit another machine—the keyboard perforator—comes into operation, and, as the telegraph operator types out the words in London, another man is reading the message as it runs out of a machine, as near, it may be, as Paris or Vienna, or as far distant as Montreal. Within a few months all the capitals of the world will be brought within direct range of the British wireless stations, and as far as written communications are concerned, the world will shrink, in effect, to the size of the smallest mediæval state. When the British Imperial wireless stations are in operation, it will be possible to deliver urgent messages in the capitals of all the Dominions, from 3,000 to 12,000 miles away, within a few minutes.



Operating the keyboard of the perforating machine.

"Handing-in" a Message.

When one speaks of efficiency one usually thinks of something that acts quietly and smoothly with no apparent effort. That is just how modern wireless telegraph organisation strikes one. Everything seems to go on its appointed way with the minimum of visible effort. Messages for transmission abroad

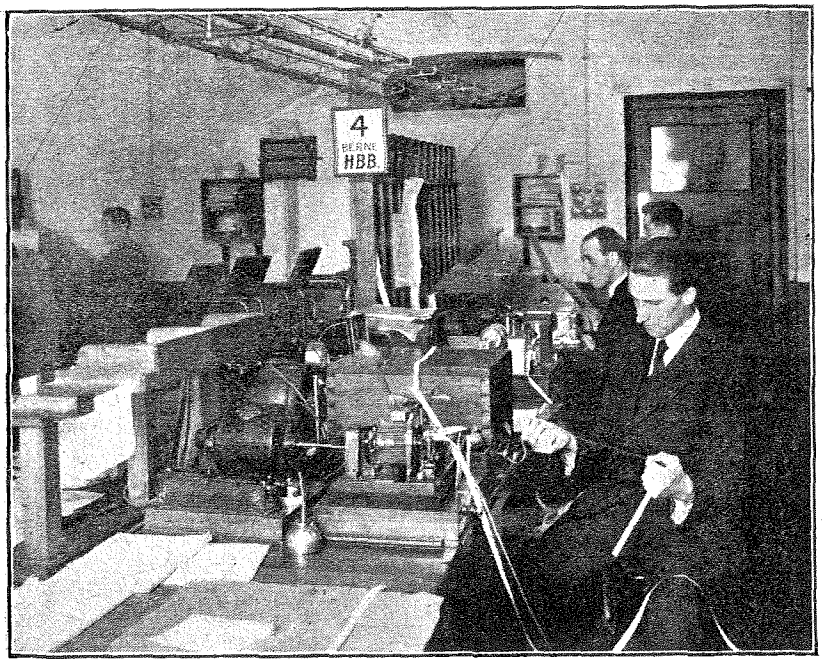


Fig. 1.—Keyboard perforator in use on the Berne Circuit at Radio House, London

arrive at the office in a variety of ways. They may be handed in at the counter of the Central Wireless Telegraph Office itself, they may be collected by the Wireless Company's messengers, or they may be sent to the office over the telephone or private telegraph line. In some businesses, such as banks and stockbrokers' offices, the saving, even of seconds, is of such importance that it is worth while to link up with a telegraph office by means of private telegraph or telephone lines so that no avoidable moment shall be lost.

Phonograms.

If a message is telephoned, it is taken down by one of a special staff of telephone operators in what is known as the " Phonogram " Room, and then handed direct to the circulation table. If a private telegraph line is used the message can be typed out in the city office on a machine similar to an ordinary typewriter, and it will appear in the wireless office in the form of a typewritten message; or it may be sent by Morse code by one of the skilled telegraphists which some city offices employ for the purpose. By whichever means it reaches the wireless office it finds its way immediately to the circulation table where it is checked, numbered, assigned to its proper circuit, and hurried on its way by automatic carrier.

Automatic Transmission.

It has now reached the telegraphist who operates the typewriter keyboard of a perforating machine by means

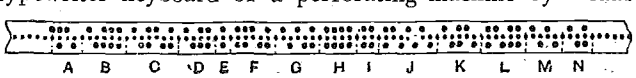


Fig. 2.—Perforations on a paper tape representing the letters of the Morse Code.

of which the plain English words are transposed, at speeds up to 80 words a minute, into perforations on a paper tape representing the letters of the Morse code, as in Fig. 2. This tape then runs through the transmitting instrument, and operates it in the way that the perforated roll works in an automatic player-piano, the result, instead of musical notes, being a variation, corresponding to the Morse signals, in the electric current in the line connecting the instrument with the wireless stations. The wireless station may be any distance from the Central Telegraph Office, just as the broadcasting transmitter may be any distance from the studio in which the concerts take place. Provided there is a good land line connection, free from the possibility of breakdown, the length of the line does not matter very much, although, of course, it is not desirable to have too long a line.

The Wireless Transmitting Station.

At the wireless transmitting station, which is generally in open country, the land line is led in to an automatic high-speed signalling key, by means of which the Morse signals are fed to the wireless valve transmitter, from which they pass to the aerial and on into space. The efficiency of a wireless transmitting station, and the legibility of signals under bad atmospheric conditions, depend largely on the steadiness of the transmitted wave. This steadiness is attained in modern wireless stations by the employment of what is known as an " independent drive " unit. This is an intermediate circuit between the high speed signalling key and the main transmitter. It consists of a separate oscillation generator, which, once adjusted to the required wavelength, maintains its adjustment with perfect constancy and so keeps the main oscillations steady under all conditions. In a modern wireless station the aerial itself is usually not connected directly to earth, but to an earth screen consisting of a number of

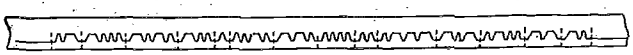
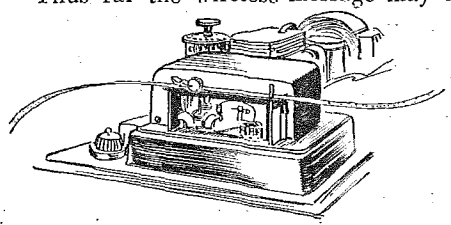


Fig. 3.—Paper tape record made by an Undulator.

insulated wires supported on low masts. The provision of this metallic conducting screen between the aerial and earth results in many instances in greatly increased radiation efficiency and in stronger signals being produced at the receiving stations than would be the case with a buried earth.

Thus far the wireless message may have travelled 20 miles, and it may have taken two minutes to do it. Its next stage, and its longest in terms of distance, will take, perhaps, a quarter of that time, an



The automatic transmitter instrument.

Commercial Wireless Telegraphy.—

in half a minute the whole message may be lying on the desk of the Central Telegraph Office in New York. In two minutes more it will have been registered and delivered over the telephones or private wire to the addressee.

The Receiving Station.

Now for the returning message. Despatched from some distant country as we have seen the original message sent from London, the ether waves pass the aerials of the receiving station and produce electric currents in the receiving system. These signals reproduce accurately those sent out from the transmitting station.

The receiving station—which is usually several miles away from the transmitting station and in open country free from tall buildings and electrical disturbances—may be regarded purely as an automatic relaying station. The receiving apparatus is so designed as to maintain its adjustment with the minimum of attention, and as the duty of the attendant in charge is merely to adjust and maintain the sets in such condition that clear signals of suitable strength are passed to the land lines for operating the recorders at the Central Control Office in London, there is no need for telegraphists at the actual wireless station. In the Marconi receiving station at Brentwood, Essex—20 miles from the Central Telegraph Office in London—the receivers are compactly constructed on a unit system, each unit being electrically screened, so that there can be no interference between the different parts of the set, and any number of sets can be housed close together, in one room if necessary.

Directional Reception.

Directional reception on the Marconi-Bellini system is used, and at Brentwood the reception of traffic from eleven stations is carried out simultaneously, six receivers, each tuned to a different transmitting station, being installed in one group and operated from one aerial system.

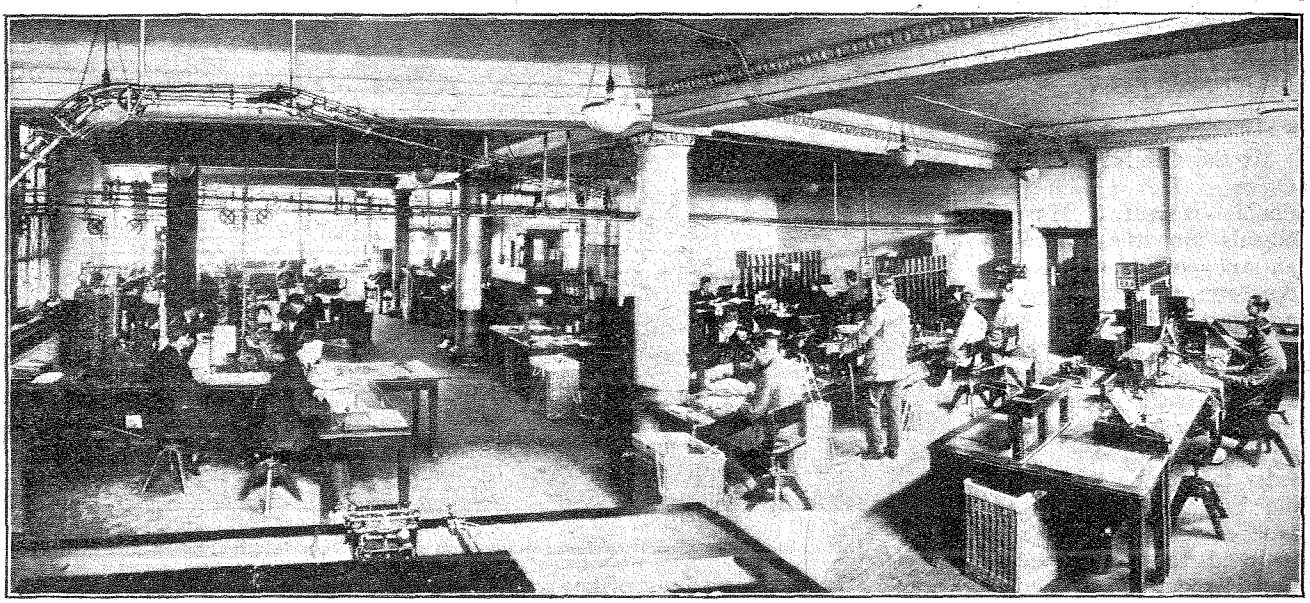


Fig. 4.—Part of the busy central office in London where the Continental traffic is handled, and on the left in the background the Trans-Atlantic section.

Underground telegraph and telephone circuits connect the wireless receiving station with the Central Telegraph Office and also with the transmitting station. At the receiving station a constant check is kept on the signals being sent along the line from the Central Telegraph Office to the transmitting station, and also upon the wireless signals sent out. In this way faulty transmission is immediately observed and can be put right without waiting for the distant receiving station to draw attention

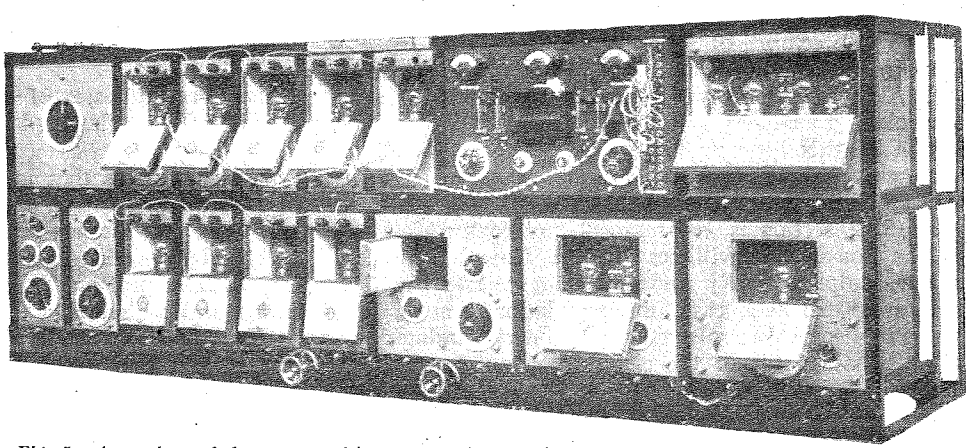


Fig. 5.—A receiver of the type used in commercial working.

ABCDEFGHIJKLMNOPQRSTUVWXYZ

Fig. 6.—The product of the automatic printer which translates a Morse message into plain language.

to it. The processes of reception may shortly be stated to be as follow: The radio-frequency signals are received on a selective directional system. These high-frequency signals are filtered and amplified. They are then heterodyned, and the resulting beat frequency is rectified. The low-frequency signals are filtered and amplified and then converted into direct current for working the relays to line.

Translating the Message

At the Central Telegraph Office the high-speed double-current Morse signals are transformed by an automatic machine into the form of perforations on a paper strip in the same way as they were prepared for transmission. They are simultaneously recorded in plain Morse characters on undulator tape, Fig. 3, in order to provide a check on the automatic perforated tape translation which can be used for hand translation if required. The perforated tape is caught up by an automatic printer, and again, following the example of the player-piano, translates the signal perforations into plain English, typed on another piece of tape, as in Fig. 6.

This printed tape is drawn through a gumming machine and gummed in suitable lengths to a form ready for delivery. The message is then delivered to the addressee in one of three ways—by telephone, by private telegraph wire, or by messenger.

From the moment a message is accepted until it is finished with, its passage through the Central Telegraph Office is timed at various stages by automatic electric time stamps, controlled by a master clock. By means of this and other systematic methods of checking, the history of any message is easily traced if it should ever be called in question.

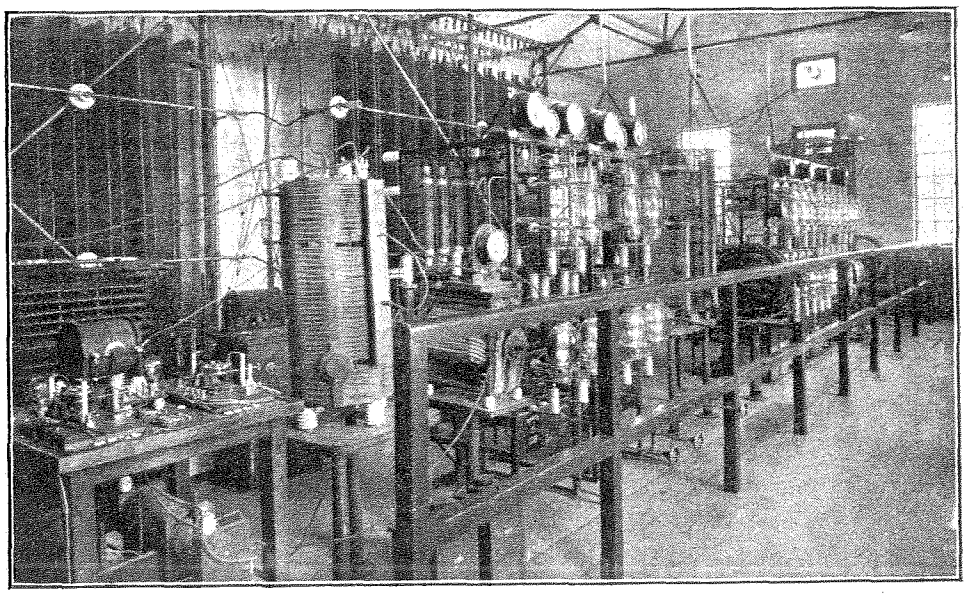


Fig. 7.—Marconi wireless transmitting plant at Ongar station, Essex.

As will have been evident, absolute control of the whole wireless service is centred in one office, which has full power over the automatic operations at the transmitting and receiving stations. This control is one of the most valuable features of wireless communication.

KELLY'S DIRECTORY OF THE WIRELESS TRADE.

THE growth of the wireless industry during the past year is indicated by the increased size of the second annual edition of Kelly's Directory of the Electrical Industry, Wireless and Allied Trades, which, while retaining the same convenient form and arrangement that made the first edition of this book so handy for reference, has been thoroughly revised, and the information given considerably amplified.

The first section is geographical and comprises a list of the towns and villages of the United Kingdom arranged alphabetically under their respective counties, and giving, in each case, the population, source, and nature of electrical supply, market and early closing days, and a classified list of the electrical manufacturers and dealers. This is followed by an alphabetical list of public lighting, power, and traction undertakings, giving the systems and consumer's voltage.

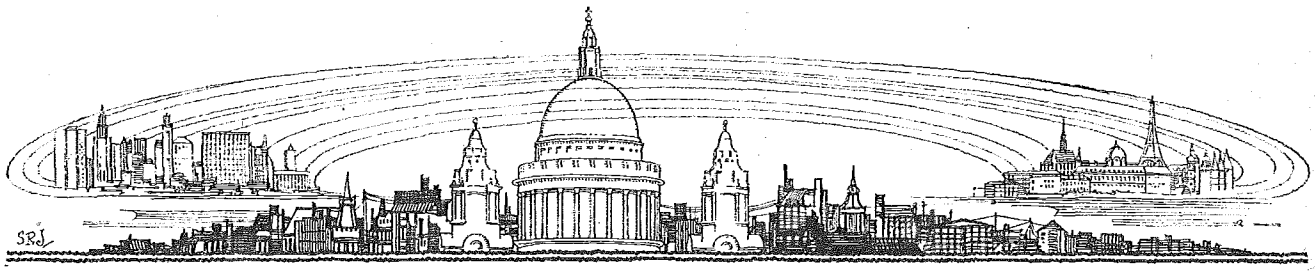
The Directory proper is divided into three sections, Greater London, the rest of the United Kingdom, and Ireland, and each of these main sections contains an alphabetical list of the names and addresses of manufacturers and dealers and a similar list classified under the headings of their respective trades.

It is noticeable that in addition to the manufacturers and wholesale dealers, the Directory contains the names of over 3,500 wireless retailers.

The final section comprises a useful list of proprietary articles and trade names, with the manufacturers' names and addresses.

The three-fold method adopted in classifying the names renders the book invaluable for quick reference.

"Kelly's Directory of the Electrical Industry, Wireless and Allied Trades, 1925." 1,260 pp. 30s. post free. 186, Strand, W.C.2.



CURRENT TOPICS

Events of the Week in Brief Review.

WIRELESS A LUXURY IN HOLLAND.

Wireless apparatus is included among the list of luxuries which find a place on a new tax Bill under consideration by the Dutch Government. The Bill proposes to tax wireless apparatus on a five per cent. basis.

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M. DELOY'S DAYLIGHT SIGNALS TO U.S.

M. Léon Deloy (8 AB), of Nice, is probably the first French amateur to transmit to America in daylight on a wavelength of 20 metres. He carried out this feat on March 27th, and has now received a letter confirming the reception of his signals from Mr. Elmer Easton, of Newark, N.J.

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A WIRELESS GHOST?

The Warwickshire village of Fenny Compton is at present the rendezvous of numerous ghost hunters, who are seeking to elucidate the mystery of a phantom light which appears nightly on the Burton Dassett hills. Three theories are advanced to account for its origin. One of these holds that marsh gas is responsible; a second proclaims that it is merely the emanation from a phosphorescent owl. But the most original hypothesis is that the mysterious light is produced by wireless waves from the Birmingham broadcasting station *striking sparks from the ironstone of which the hills are formed.*

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PITTSBURG HEARD IN AUSTRALIA.

Principally because plans were kept secret and "howling" valve sets were thus absent, experimenters in Sydney, Australia, picked up a complete concert from KDKA, 9,000 miles distant, on April 18th. Reception is stated to have been exceptionally clear, and the greater part of the programme was rebroadcast from the local station.

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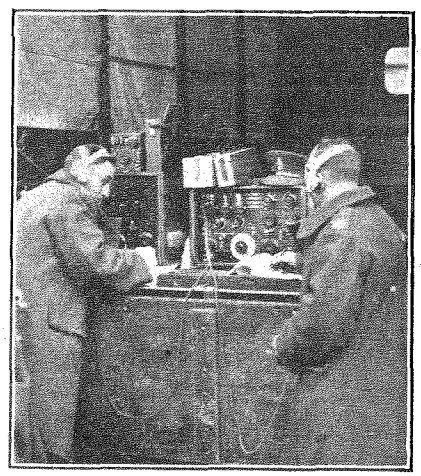
20-METRE SIGNALS FADE AT NIGHT.

No fewer than seven American amateurs, working on 20-21 metres, were heard by Mr. J. Gordon Ritchie, of Glasgow, on Sunday, April 12th, between 6 and 8 p.m. These stations were :—1 CCX, 1 CMP, 1 OW, 1 MY, 8 GZ, and 9 ZT. It is interesting to note that, while signal strength was at first good, it faded as night came on.

AUTOMOBILE ASSOCIATION AND WIRELESS.

Three questions are being addressed by the Secretary to members of the Automobile Association on the subject of wireless. The questions are asked in view of the possibility that wireless in some form or another will be utilised in the interests of A.A. members. Each member, therefore, is asked to signify which of the following is the appropriate reply in his particular case :—(1) I have a wireless set; (2) I contemplate installing a wireless receiver; and (3) I am not interested in wireless.



WIRELESS IN RELAY RACE. During the London to Brighton Relay Race, which was won by the Birchfield Harriers, the progress of the runners was signalled by wireless. The photograph shows members of the Royal Corps of Signals at Horley picking up the latest news.

We should imagine that the last-mentioned will apply in very few cases. Wireless developments in the A.A. will be watched with interest.

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U.S.—AUSTRALIA TRANSMISSION.

A silver cup, awarded by Sir George Barlow, of the Broadcasting League of Australia, has been won by WAHG, the broadcasting station at Richmond Hill, Long Island, which transmitted to Australia the sound of a locomotive bell. The distance covered by the transmission is approximately 12,100 miles.

AMERICANS OVERCOME SPARK INTERFERENCE.

A concerted effort on the part of New York listeners to overcome Morse interference with broadcast reception has met with success. For some time past reception has been spoilt in the New York area by the spark transmissions from the Government mail boat "President." The American Radio Association, representing listeners-in, has approached the Postmaster-General on the question, with the result that the obsolescent apparatus on the "President" is to be scrapped.

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HONDURAS CALLING.

An amateur in Honduras, using the call sign BW, was heard at fair strength on Thursday, April 9th, by Mr. J. Gordon Ritchie, of Glasgow. We believe he is the first Honduras amateur to be heard in Great Britain. Mr. Ritchie picked up Cuban 2BY on March 30th, and Portuguese 1AJ on April 14th, the latter calling CQ on 80 metres.

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THE COUNTERPOISE AT HILVERSUM.

A typographical error crept into the description of the Hilversum Broadcasting Station in our issue of April 15th. The height of the counterpoise is 15 feet, and not 115 feet, as stated.

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THE R.33's WIRELESS OPERATOR.

Not the least noteworthy feature of the dramatic adventures of the R.33 when she broke away from her mooring mast at Pulham was the performance of the wireless operator, Mr. S. T. Keeley. During practically the whole of the time the ship was adrift he remained at his apparatus transmitting and receiving messages which assisted the crew in their efforts to bring the monster back to land.

"Keeley's is a feat which would test the most seasoned operator," said Major Scott, commandant of the R.33, "but for a youngster the strain must be terrific. He must certainly be regarded as one of the heroes of this eventful flight."

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MILAN'S WIRELESS SCHOOL.

A wireless school has been opened by the Italian Government at Milan. State wireless schools, giving free training, have existed for many years in France.

AN ADJOURNED CONFERENCE.

For a reason at present unexplained, the International Wireless Congress to have been held at Madrid during May under the auspices of the Spanish Society of Authors has been postponed. It will probably be held during the autumn.

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MISUSE OF CALL SIGN.

The apparent misuse of his call sign by another transmitter is reported by Mr. J. B. Kaye (5BG), of Huddersfield. Reports of signals on 92 metres, said to have emanated from his station, have reached Mr. Kaye from Belgium. 5BG has been inoperative during the present year.

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P.M.G. AND TRANSATLANTIC TELEPHONY.

The Postmaster-General made the following announcement on April 16th :—

Statements have recently appeared in the Press on the subject of Transatlantic wireless telephony, to the effect that two-way telephonic communication has already been established between England and America by means of a new and secret system. The Postmaster-General desires it to be understood that this is not the case. The experiments so far made are a continuation of those announced to the Press in May, 1924, and the system in use, with which wireless experts are familiar, was fully described in a paper read before the Institute of Electrical Engineers in London in February, 1923.

Similar experiments in the transmission of speech to America have not been, and cannot be, undertaken until the Post Office transmitting station at Rugby, where experimental telephone plant is being installed, has been completed. A further announcement will be made when the experiments have reached a more advanced stage.

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AMATEUR EFFORTS IN INDIA.

Strenuous efforts to popularise radio in Bengal are being made by the Calcutta Radio Club. Indian and European broadcast programmes are regularly received and reproduced on loud-speakers at the club's headquarters. The committee has decided to install a 500-watt transmitter in the near future, and it is hoped later to increase the power to 1,000 watts.

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MACMILLAN EXPEDITION AGAIN.

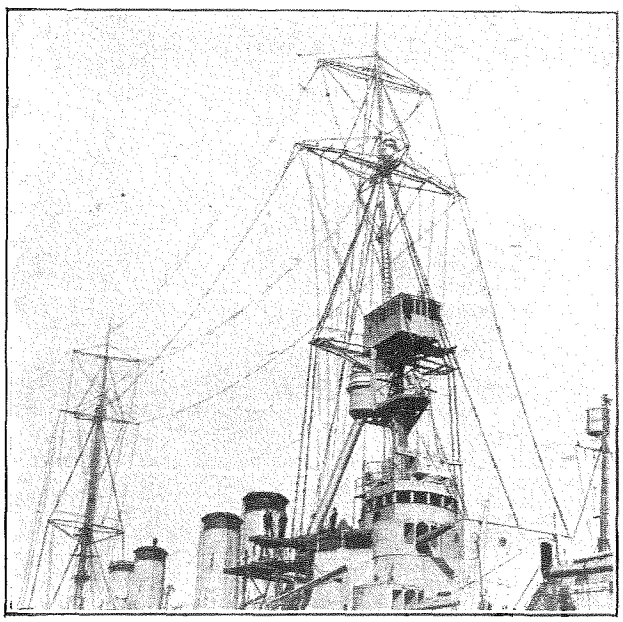
Commander Donald B. MacMillan, the Arctic explorer, whose use of wireless in conjunction with the A.R.R.L. was a feature of his expedition during 1923 and 1924, is planning a new expedition this year in which he will place still more reliance on wireless.

At a meeting recently held in the laboratories of the Zenith Radio Corporation, Chicago, it was decided that Commander MacMillan will take with him transmitters capable of four wavelength ranges, the lowest being approximately 20 metres, the others being 40, 60 and 180.

From the standpoint of radio transmission and reception, the objective of the expedition, viz., the Davis Straits, will be among the most inconvenient in the world.

The expedition during its entire voyage of June, July, August and September, will be in 24-hour daylight after passing 60° north latitude. The 40-metre wavelength will in all probability be used during the hours surrounding midnight, which will still be daylight in the Arctic, but dark in the lower degrees of latitude.

Members of the American Radio Relay League will again be called upon to establish communication with this expedition. The time elected for the regular weekly messages from the expedition will be between the hours of 10 a.m. and 2 p.m. Sunday (E.S.T.), when all American amateurs are at home and available.



RADIO IN THE U.S. NAVY. Of the many kinds of aerial on American warships, the cage type is the most favoured. This illustration depicts the cage antennæ system on the latest American scout cruiser "Memphis."

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R33's SIGNALS JAMMED.

A serious statement has been issued by the Postmaster-General, who calls attention to the fact that during the recent flight of the R33 communication between the airship and the Croydon and Pulham aerodromes was seriously impeded by oscillation from wireless receiving sets.

In view of the very grave consequences likely to follow interference with aircraft communication, the Postmaster-General warns owners of wireless receiving sets that the use of reaction to such an extent as to cause interference is an offence which directly contravenes one of the conditions of their licences.

MARCONI OFFICE FOR MANCHESTER.

A new Marconi telegraph office was opened at 9 and 13, Miller Street, Manchester, on April 20th, for the acceptance and delivery of Marconigrams. The office is in immediate communication by private line with the Company's main telegraph office at Radio House, London.

ITEMS FROM THE TRADE.

Manchester readers will be interested to learn that owing to increasing business the Manchester depot of Fuller's United Electric Works, Ltd., has been moved to larger premises at 19, Chapel Walks, Cross Street. Their telephone number is City 857.

* * *

Burndept Wireless, Ltd., the new company whose issue of capital was largely over-subscribed, is required by the terms of sale to take over the collection of all accounts and the discharge of all liabilities in connection with Burndept, Ltd., which will be continued without interruption under the same management, but with the new name.

* * *

"Three Reasons why 1925 is a *General Radio* Year!" is the title of the latest folder issued by The General Radio Company, Ltd., of Radio House, 235, Regent Street, London, W.1. Copies can be obtained on application.

* * *

The Chloride Electrical Storage Co., Ltd., are justifiably proud of the fact that *Exide* batteries were used in connection with all the wireless equipment on board the R33 during her recent adventurous voyage. To no small extent the safety of the crew depended on the perfect functioning of the wireless transmitting and receiving apparatus.

* * *

The reception in South Australia of 5XX is reported by a client of Messrs. G.W.I., Ltd., in a letter regarding the renewal of wireless valves. The company numbers several Australians among its clients.

* * *

Some of our readers may already have seen the novel delivery van now added to the Mullard Radio Valve Co.'s fleet of vehicles. The body of the van has been cleverly built as a huge model of a Mullard Master valve, embodying the well-known features of this popular component.

* * *

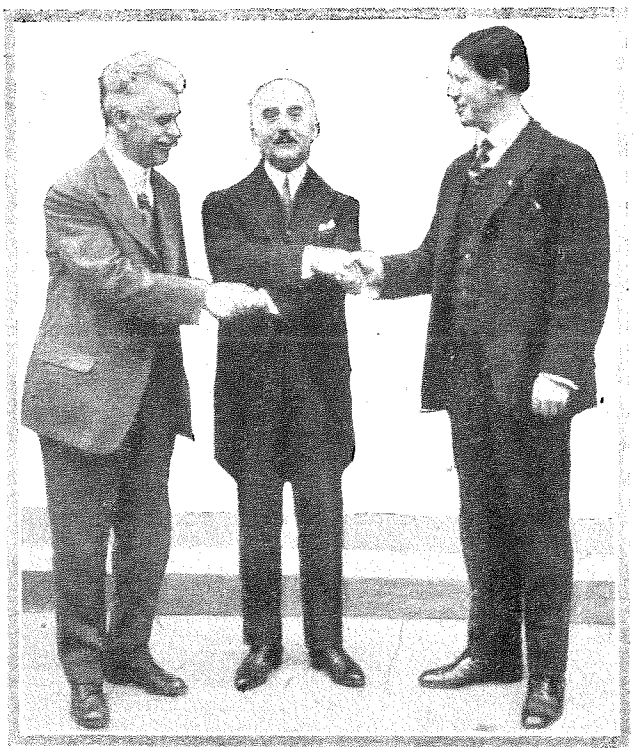
The sole distributing agents for the "Anvil" duolateral coil former, covered by provisional patents Nos. 15022/24, are the Burwood Electrical Supplies Co. (1924), of 41, Great Queen Street, Kingsway, W.C.2.

FIRST INTERNATIONAL AMATEUR CONGRESS.

A Record of a Strenuous Week.

FOR the express purpose of uniting the world's wireless amateurs, the International Amateur Radio Congress met for the first time in Paris during the week of April 14th to 18th. It has proved, perhaps, the most important single step in international wireless organisation ever taken, the Congress being called at the suggestion made last year by Mr. Hiram Percy Maxim, President of the American Radio Relay League. The aim is to set up a world organisation that will not only look to the interests of wireless amateurs but will create a spirit of goodwill and co-operation among experimenters in all countries.

The matters to be dealt with by the Congress were divided under two headings and separately discussed in the assembly halls placed at its disposal by the French Academy of Science. One group devoted attention to the discussion of international legislation as applied to wireless transmission and reception. The other group drafted proposals for the co-ordinating of amateur interests throughout the world. Delegates representing twenty-four different countries attended and represented such distant lands as Japan, Argentina and Brazil, and included even Russia and Germany, while in accordance with the proposals voiced by Mr. Maxim, representatives of broadcast listeners were also present. It was noticeable that the transmitting amateurs were in a great majority.



AMERICA, FRANCE AND BRITAIN. The genial spirit which characterised the proceedings of the first International Amateur Radio Congress in Paris is typified in the above photograph. Left to right: Mr. Hiram P. Maxim, America; M. Belin, France; and Mr. Gerald Marcuse, Great Britain.

From Great Britain twenty-two amateurs attended, headed by Mr. Gerald Marcuse. Among the Americans present were Mr. Hiram Percy Maxim and Mr. K. B. Warner, secretary of the American Radio Relay League. Canada was represented by Major Borrett and Newfoundland by Mr. Loyal Reid. Representatives were also present from Denmark, Spain, Austria, Luxemburg, Holland, Portugal, Switzerland, Uruguay, Yugo-Slavia, Czecho-Slovakia, Italy, Poland, Belgium, Monaco and Siam.

M. Edouard Belin, of France, presided over the Congress. Owing to the language difficulty, it was deemed advisable for Committees to formulate propositions to be voted on by members of the Congress with the privilege of brief discussion. The drafting of final recommendations to be presented to any of the various Governments or to be further developed and worked upon were assigned to committees, consisting as far as possible of a representative from each country or at least permitting each country to have the power of voting.

The Committee set up to deal with the assignment of wavelengths recommended that private stations should occupy wavelength bands between 115 and 95 metres, between 75 and 70 metres and between 47 and 43 metres.

The Committee on the organisation of international tests and communication recommended the adoption of Greenwich mean time for all tests, the standardisation of abbreviations regarding signal strength and weather conditions, and the drafting of regular schedules of communication between all countries.

In putting the resolution that the International Amateur Radio Union be brought into existence, Mr. Maxim outlined the proposed constitution. It was suggested that temporary headquarters be set up in America and that an official publication be instituted or appointed; furthermore, it was stated that the new Union calls for an independent formation outside the already existing amateur organisations, and should be headed by a president and vice-president and have a specified number of members, twenty-five being suggested as the minimum. A membership subscription of $1 a year was recommended.

The International Committee would be elected from among the representatives of the national organisations who would convene in all uneven years (1925, 1927, 1929, etc.) to deal with the business of the Union.

Existing national organisations will, as hitherto, carry on negotiations with their respective Governments on matters of amateur interest, whilst the International Union will aid in any way it can with suggestions touching directly on the international situation. The proposed

First International Amateur Congress.—

constitution was unanimously adopted by the Congress.

The Committee dealing with the draft of international call letters recommended for the most part that the present call letter system be maintained with the exception of the cases of Scandinavia and S. America, where the present two letter call signs might be altered to only one. These recommendations were unanimously adopted.

Election of Officers.

The following officers were elected :—

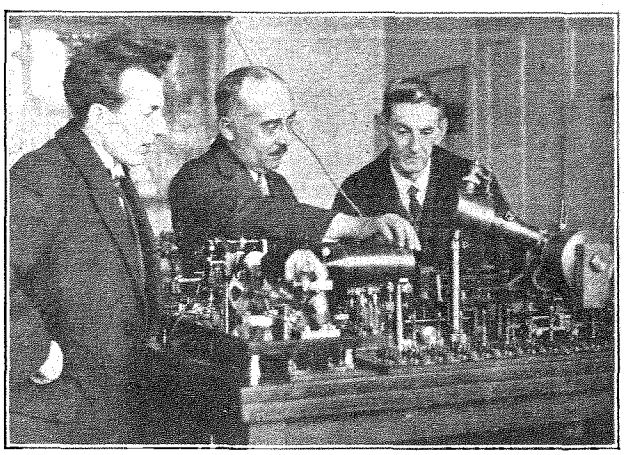
HIRAM PERCY MAXIM (United States), International President.
GERALD MARCUSE (England), International Vice-President.
K. B. WARNER (United States), International Secretary and Treasurer.
J. G. MEZGER (France) } International Councillors.
FRANK BELL (New Zealand) }

Commandant Mesny, who acted as Treasurer to the Congress, in rendering his report, showed a total expenditure of 13,500 francs against total receipts of 16,300 francs, leaving a surplus of 2,800 francs. He suggested that the residue might be devoted towards the publication of the proceedings of the Congress, or alternatively, it could be handed over to the International Treasurer as a balance to help defraying the expenses of the next Assembly.

International Language.

Another item which received consideration was the report of the Committee deputed to deal with the adoption of an international auxiliary language. After reviewing some twenty artificial tongues, and also one or two national languages, it was unanimously decided to adopt Esperanto, since it is one of the oldest-established of the artificial tongues. The Committee recommended that Esperanto should be used as an auxiliary language for telephony work and for publications. In addition, telegraphic transmissions would be carried out in Esperanto when the station operators have no other national language by which they could understand each other. It was also decided that Esperanto should be adopted by the Congress as an auxiliary tongue in addition to the national languages. The discussion of this subject brought forth several interesting points.

The Scandinavian group held out strongly for English as an auxiliary tongue, claiming that it was the easiest of languages to learn, while those based on Latin or other



During the Congress week, the President, M. Belin, entertained delegates at his home at Malmaison. M. Belin (centre) is here seen explaining a new device to delegates from Manchester.

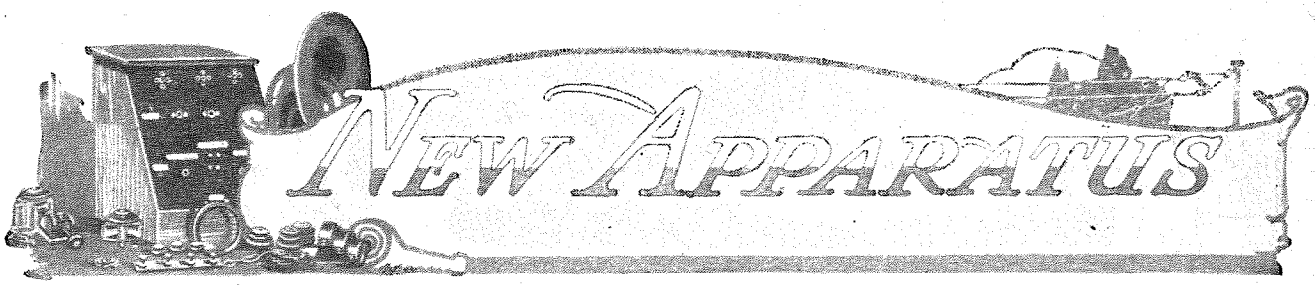
derivatives were found to be difficult to acquire. A discussion on this point between the Polish, Japanese and Belgian delegates was conducted in Esperanto.

Although the motion for the adoption of Esperanto was carried, Mr. P. K. Turner (England) and Mr. K. B. Warner (United States) voted against certain of the proposals, while the Scandinavians voted against its adoption.

At the conclusion of business the Russian Delegate stated that even at the present time he represented several thousands of amateurs, though he was not authorised to vote on any of the questions. He hoped, however, that in future deliberations of the Union the Russian organisation would be counted as one of its branches.

Delegates expressed their appreciation of the work that had been carried out by certain sections and members of the Congress, and in particular tendered their thanks for the hospitality arranged by the French representatives, who had made arrangements for excursions to the Eiffel Tower, St. Asise, M. Belin's teleautographic plant, and other sight-seeing tours.

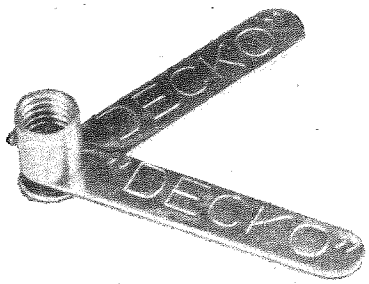
A group of British delegates. Several well-known amateurs will be recognised.



A Review of the Latest Products of the Manufacturers.

A SIMPLE BATTERY TESTER.

Those amateurs who build up their own high-tension batteries by connecting together a number of flashlamp batteries will find the "Decko" tester useful in detecting faulty cells. Two adjustable metal arms are fitted to a flashlamp bulb holder, one to the barrel and one to the centre contact. By inserting a lamp in



The "Decko" lamp holder for testing the sections of a high-tension battery.

the holder, and bridging the arms across each battery unit in turn, the voltage may be estimated by the brightness of the lamp filament.

This accessory is made by Messrs. A. F. Bulgin and Co., 9-11 Cursitor Street, Chancery Lane, London, E.C.4.

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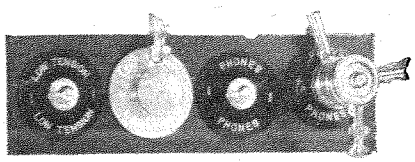
THE NEWEY SNAP TERMINALS.

We have recently had the opportunity of examining a set of the snap terminals made by Messrs. Newey Bros., and supplied by Messrs. Pettigrew and Merriman, 124, Tooley Street, London, S.E.1. These terminals are extremely well made, and have evidently been designed with a full



Rapid connection of a number of leads to a single point can be effected with the Newey snap terminal.

knowledge of the requirements of the experimenter.

A small metal knob forms the foundation of the terminal, and may be obtained ready for fixing direct to the panel or in a form adaptable to existing terminals. The snap fasteners are held to this knob by an internal steel spring, which pulls the fastener firmly down on to the knob. On each fastener a projection similar to the terminal knob is formed on the side opposite to the spring fastening. This enables an indefinite number of connections to be built up on a given terminal. For the sake of appearance, a special covered fastener is made to terminate the pile. Connecting lugs for the connections to the terminal are fitted to the side of each fastener.

This snap terminal is a component which we have no hesitation in recommending as being mechanically and electrically sound.

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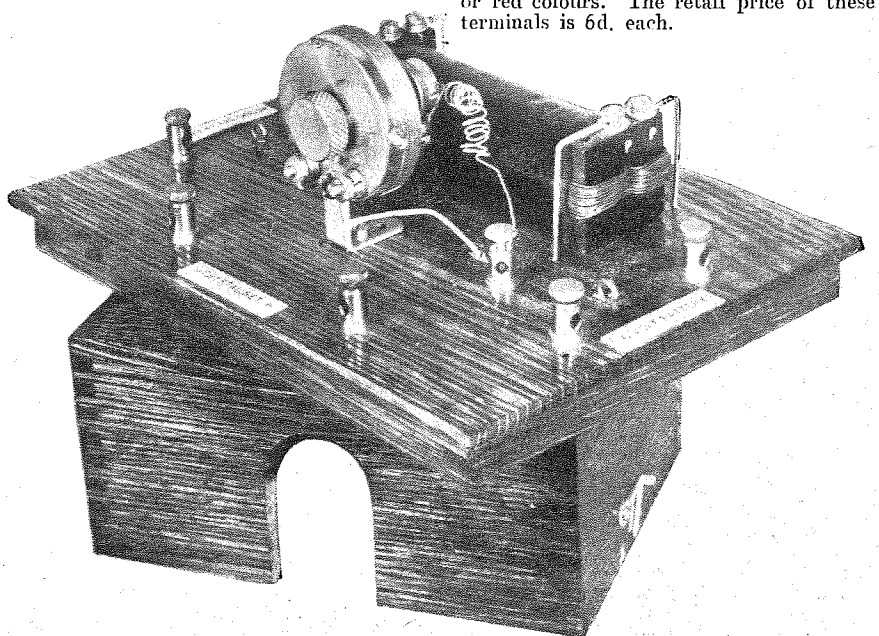
A MICROPHONE AMPLIFIER.

Users of crystal sets who would like to operate a small loud-speaker, and for whom the use of amplifying valves is prohibited from considerations of cost or



The "Micro" amplifier in which a microphone relay consisting of an adjustable telephone earpiece movement and microphone is used to control the current passed through the loud speaker from a local battery.

battery maintenance, will find in the microphone amplifier a possible solution of their problem.

In the instrument manufactured by Messrs. Micro, Ltd., 32, Craven Street, London, W.C.2, a microphone button is mounted on the vibrating reed of an adjustable telephone earpiece connected in the crystal circuit. The microphone is supplied with current from dry batteries through the primary winding of a telephone transformer, and the loud-speaker is connected to the secondary terminals of the transformer.

It is advisable to place the instrument in a position where it will not be subjected to mechanical vibration.

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G.E.C. GRIP TERMINALS.

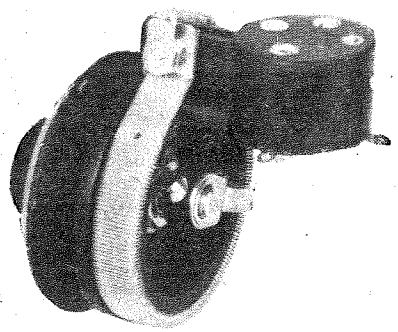
The new terminals introduced by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, are extremely well-made and give a neat appearance to telephone, aerial, and earth connections. The wire is firmly held by hinged jaws which are closed together by a sleeve of insulating material. Both spade and pin type terminals are supplied, and the insulators can be obtained in either black or red colours. The retail price of these terminals is 6d. each.

THE "MACITONE VALVESTAT."

Under this name Messrs. H. Clough & Co., Ltd., Yorkshire Street Mills, Bacup, are marketing a combined valve-holder and filament rheostat. The design is sound and the workmanship and finish good. A single moulding comprising the

valve-holder and the body of the resistance forms the foundation of the component. The resistance element is wound on a flat strip of insulating material which is clamped round the outside of the moulding. The contact spring is well-designed and is smooth in operation. It is secured to the plain spindle through the medium of an adjustable collar and grub screw.

The Valvestat can be obtained with a



The combined filament resistance and valve holder of Messrs. H. Clough & Co., Ltd.

6 ohm resistance for bright emitter valves or a 30 ohm resistance for dull emitters. Filament resistances of similar design without the valve-holder are also available.

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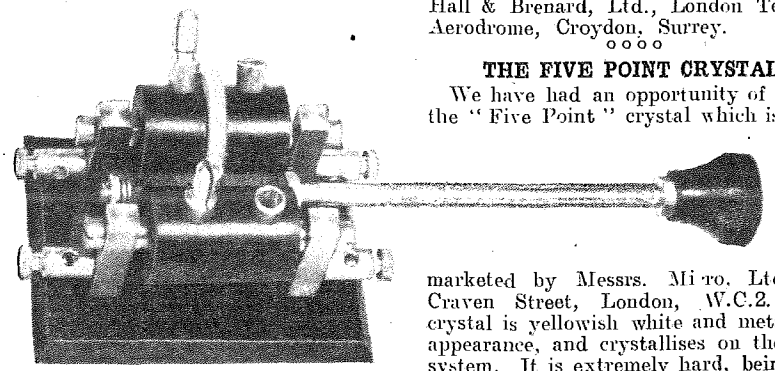
H. & B. COIL HOLDERS.

The H. & B. system of mounting basket coils has many ingenious features which will appeal to experimenters. Chief among these are the ease with which coils may be changed and the economy effected in the number of coil plugs required.

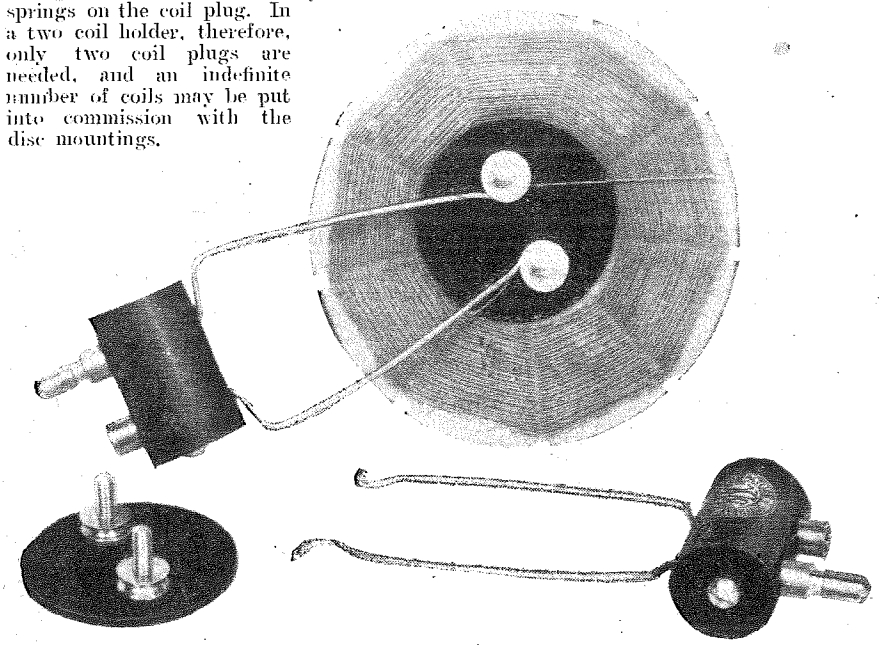
Each basket coil is clamped between two fibre discs and the ends connected to the terminal screws. The terminal nuts are grooved and are held by the wire springs on the coil plug. In a two coil holder, therefore, only two coil plugs are needed, and an indefinite number of coils may be put into commission with the disc mountings.

A very neat and compact variable coil-holder is also available. The coil-holders are cylindrical in shape and are actuated



The H. & B. geared two-coil holder.

by a friction drive on an annular rubber ring between the sockets. The mounting and construction of the holder is sturdy, and the movement is consequently free from "back-lash," and responds instantly to any movement of the controlling knob. Terminals are provided on the bearing posts, and flexible connections have been eliminated.



A convenient plug-in coil mounting for basket type inductances.

Both two and three-coil holders are available at very reasonable prices. The address of the manufacturers is: Messrs. Hall & Brenard, Ltd., London Terminal Aerodrome, Croydon, Surrey.

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THE FIVE POINT CRYSTAL.

We have had an opportunity of testing the "Five Point" crystal which is being marketed by Messrs. Mi-ro, Ltd., 32, Craven Street, London, W.C.2. The crystal is yellowish white and metallic in appearance, and crystallises on the cubic system. It is extremely hard, being capable of scratching glass, and is unaffected by the heat applied when setting in fusible alloy. Indeed, the crystal may be set in ordinary solder or lead if desired. This resistance to heat is undoubtedly a very valuable property, which suggests that the crystal should prove very successful in reflex circuits.

The crystal may be used in conjunction with a metal point or with a zincite crystal. The catwhisker contact was rather sensitive to pressure, but gave results equal to synthetic gelena when properly adjusted.

The average resistance of the crystal under normal operating conditions is of the order of 3,000 ohms. This is rather low, and the damping effect on associated circuits will be well marked unless special precautions are taken.

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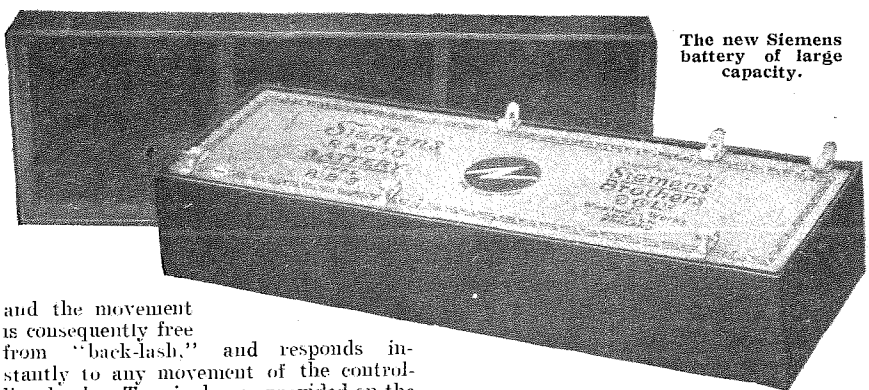
LARGE CAPACITY H.T. BATTERIES.

Messrs. Siemens Bros. & Co., Ltd., of Woolwich, are introducing a new type of high tension battery larger in size than the usual pattern now in such general use. The steady growth in the use of multivalve receiving sets fitted with amplifying valves requiring heavy plate currents has created a demand for batteries of liberal ampere capacity, the batteries made up with small size cells being, if not useless for the purpose, exceedingly expensive to maintain. The individual cells with which these new batteries are constructed are almost double the diameter of the small patterns used hitherto.



The new Siemens battery of large capacity.

NEWS from the CLUBS

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

Dorking and District Radio Society.

"The Care and Maintenance of Accumulators" was the title of an instructive lecture recently delivered by Mr. G. E. Taylor. Useful information was given on the composition of accumulators and methods of charging and testing them. Mr. Taylor also provided some valuable hints on how to prolong the life of accumulators.

The new headquarters of the Society are at St. Paul's School, Dorking. Hon. secretary, Mr. A. J. Child, High Street P.O., Dorking.

Hornsey and District Wireless Society.

A cinematograph lecture on "The History and Uses of Electricity" was delivered at the Society's last meeting by Mr. Westgate. The lecturer gave a summary of the most important discoveries in electricity, and drew diagrams on the blackboard of the early types of electrical apparatus. The uses of electricity were illustrated by cinematograph films kindly lent by the British Thomson-Houston Co., Ltd.

Wireless Transmission of Photographs.

An interesting lecture on the above subject was delivered by Mr. A. Clements before the Winchester Photographic Society on April 14th.

Mr. Clements said he made his first experiments in wireless 25 years ago, with spark transmission and a Branly Coherer. He dealt in detail with some of the systems invented for the successful transmission and reception of photographs, black-and-white pictures, writings, etc., during recent years, particularly those of Monsieur E. Belin, of France, and Mr. R. H. Ranger, of the Radio Corporation of America. Mention was also made of the remarkable show of wireless photographs by Dr. Francis Jenkins at the last exhibition of the Royal Photographic Society in London.

The original work of Belin was outlined, diagrams and explanatory sketches being given on a blackboard. The stylus or point method consisted of working over the uneven surface of a gelatine negative of the subject, and the variations thus caused were transformed into electrical pulses by the connected diaphragm of a sensitive microphone. This method was used in the case of half-tone photographs. For black-and-white drawings and manuscripts a simpler relay circuit was employed for the transmission. In the receiving instrument of Belin's an extremely delicate mirror galvanometer was used, damped with oil, the mirror throwing every pulsation of current on to a graduated wedge, the transmitted light being collected by a lens and concentrated as a spot of light on to a sensitive film.

The problem of synchronisation was cleverly solved by the action of a clock pendulum opening and closing a relay circuit. This system had been successfully used for sending messages from aircraft to stations on the ground.

The work of Caselli, Korn, and Thorne-Baker was briefly dealt with, also the working with half-tone photographs printed in fish-glue on metal foil attached to a spirally rotating drum, the electrical current being broken when the metal stylus passed over the insulating screen-formation of glue squares and lines.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 29th.

Manchester Radio Scientific Society.—Open meeting.

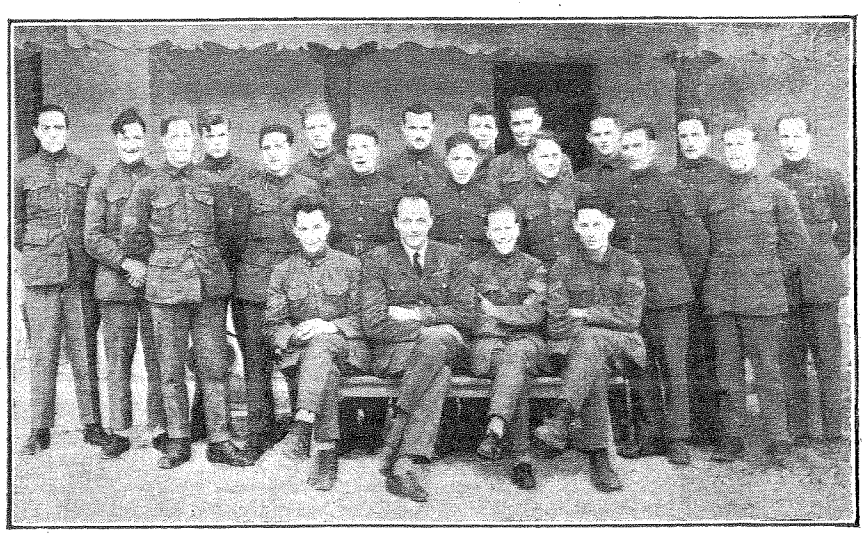
WEDNESDAY, MAY 6th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30 p.m.). At the Institution, Savoy Place, W.C.2. Captain H. J. Round, M.C., and Messrs. T. L. Eckersley, K. Tremellen and F. C. Lunnon, of the Research Dept., Marconi's Wireless Telegraph Co., Ltd. "Report on Measurements made on Signal Strength at Great Distances during 1922 and 1923 by an Expedition to Australia."

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, Golders Green, N.W.11. Informal meeting.

THURSDAY, MAY 7th.

Kensington Radio Society.—Lecture: "The Manufacture and Uses of Condensers for Radio and other Purposes." By Mr. H. Andrewes, B.Sc., of the Dubilier Condenser Co.



THE WIRELESS STAFF AT MOSUL, IRAQ. Special interest attaches to this photograph which reached us with the message, "From the staff at Mosul, who devour the new *Wireless World* with great zest each week." Flight Lieut. R. F. Durrant, A.F.C., is seen in the front row with his N.C.O.s, Flight Sergt. Hall, Sergt. Adams, and Corporal Pride. GH1, the Mosul station, was the first to establish direct communication between Iraq and England. It will be remembered that Lieut. Durrant was the wireless officer on board the R34 on her Atlantic voyages.

Golders Green and Hendon Radio Society

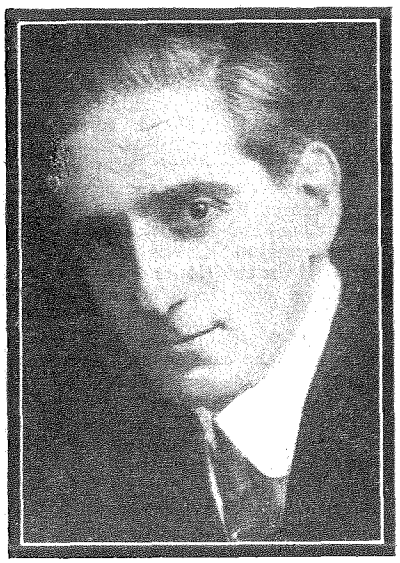
Mr. F. McCabe delivered a valuable lecture on "Measuring Instruments and their Functions" at the Society's meeting on April 15th. The lecturer described numerous types of moving iron, moving coil, and hot wire instruments, and dealt with the advantages and disadvantages of each type. Later in the evening Mr. McCabe dealt with the Wheatstone Bridge and the potentiometer, and explained how the latter, one of the most reliable of instruments, was used as a standard for the measurement of current, E.M.F. and resistance by opposing an unknown by a known E.M.F.

The Society now boasts of a membership of over 150. There still exist a few vacancies, however, and all interested should obtain particulars of membership from the hon. sec., Mr. W. J. T. Crewe, "The Dawn," 111, Prince's Park Avenue, Golder's Green, N.W.11.

THE LATE MR. GODFREY C. ISAACS.

The Passing of a Great Wireless Personality.

THE death of Mr. Godfrey C. Isaacs, which took place on Friday, April 17th, and was referred to briefly in these columns last week, removed one of the most forceful personalities in the field of wireless development.



The late Mr. Godfrey C. Isaacs.

Mr. Isaacs' association with wireless dated from 1910, when, at the invitation of Mr. Marconi, he became Managing Director of Marconi's Wireless Telegraph Co., Ltd., and subsequently of the Marconi International Marine Communication Co., Ltd. From that time until within a few months of his death, Mr. Isaacs laboured without intermission for the advancement of the two companies.

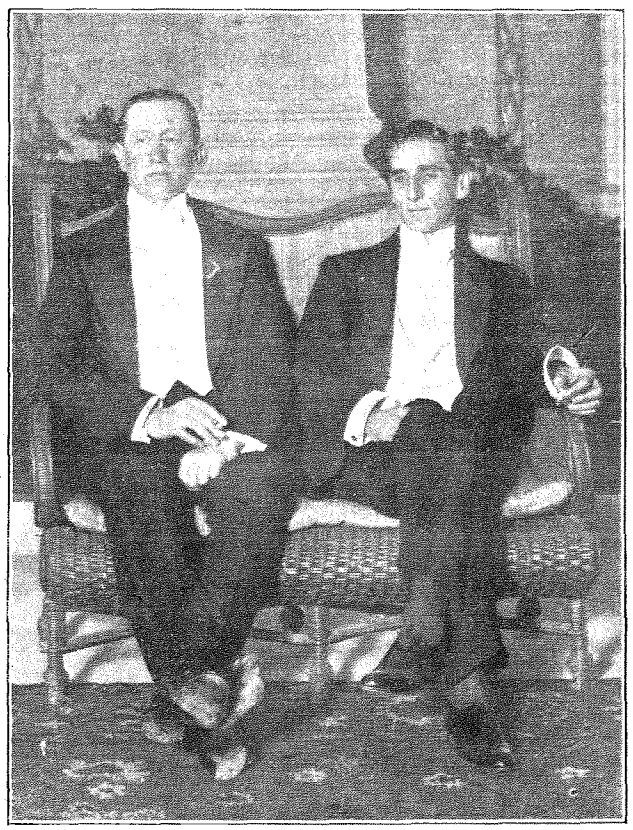
During Mr. Isaacs' tenure of office with the Marconi Company, many outstanding changes occurred in wireless theory and practice, all tending to revolutionise the existing administration and thus add to the difficulties of management.

In 1910 the Marconi Company's work was mainly confined to the installation of wireless on ships, a department which has now grown to immense proportions. Under the *régime* of Mr. Isaacs, however, the Company soon had an international network of agencies in many foreign countries, and moreover its authorised capital was nearly quadrupled. Shortly after Mr. Isaacs assumed the Managing Directorship of the Company he was called upon to face a controversial political enquiry which has now happily been forgotten, but this and the many collisions which, on behalf of his Company, he sustained with the Post Office, must have involved no small physical and mental strain. Such must also have been the effect of his long and strenuous efforts to further the Imperial Wireless Chain, which is at last nearing fruition Finally came broadcasting, which opened up a new set of problems, bringing with them questions of patents, contracts and business rivalries.

Those who were intimately acquainted with the early stages of the development of broadcasting in this country will always associate the name of Mr. Isaacs with the formation of the British Broadcasting Company. Mr. Isaacs was a dominating personality in commercial wireless circles, and he foresaw the hopeless situation which would arise if the privilege of broadcasting were to be granted to a number of individual concerns with conflicting influences. No doubt Mr. Isaacs' interest and attitude towards the introduction of broadcasting was dictated by his concern for the welfare of his company; but no one can deny that in serving his company in this respect he also served the best interests of the public in helping to bring into being the broadcasting organisation which, in principle at least, is unequalled in the world.

In his business aspirations Mr. Isaacs recognised no boundaries; he was a determined and fearless fighter in the cause of his convictions, and, with his unlimited capacity for work and his devotion to the interests of the concern with which he was linked up, he earned the esteem of all those who had the privilege of working in association with him and the respect even of those whose business interests were opposed to his ambition.

At the time of his retirement in November, 1924, on the insistent advice of his doctor, Mr. Isaacs remarked that he had been working for forty-three years without a holiday. "All I want for the moment," he said, "is sleep, rest and peace. I may not be away a year."



Mr. Godfrey C. Isaacs photographed with Senatore Marconi, with whom he was so long associated.

Mr. Isaacs was one of a distinguished family, his illustrious brother being Lord Reading, Viceroy of India.

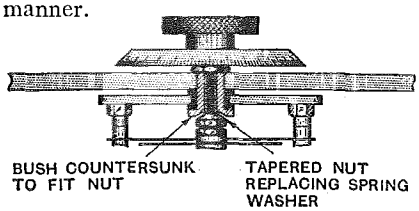
He married Madame Perelli, the opera singer, and she and two sons survive him.

NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

IMPROVING CONDENSER BEARINGS.

There are on the market at the present time many cheap variable condensers the performance of which is marred only by badly fitting bearings. The use of spindles threaded throughout their entire length is often the cause of trouble. The defect can be cured, however, in the following manner.



Remedying a badly fitting condenser spindle by means of a tapering nut and bush.

The spring washer employed to give friction to the movement should be replaced by a lock-nut specially tapered in the lathe. If the bush is, at the same time, chamfered to fit the taper on the nut, a self-centring bearing will result. By careful adjustment a suitable tension can be imparted to the movement of the vanes.—J. G. W. T.

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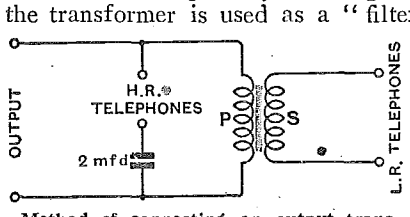
TELEPHONE TRANSFORMER CONNECTIONS.

When a telephone transformer is used to supply a low-resistance loud-speaker, high-resistance telephones or a high-resistance loud-speaker may be used without disturbing any connections if the primary winding of the transformer is used as a "filter feed" choke coil. A suitable arrangement of the connections is given in the accompanying diagram. This system is particularly useful when a loud-speaker has to be operated at a considerable distance from the receiver, as telephones can be connected temporarily in the circuit for tuning purposes without disturbing the loud-speaker connections.—D. B.



Method of connecting an output transformer for using high or low resistance telephones or loud-speaker.

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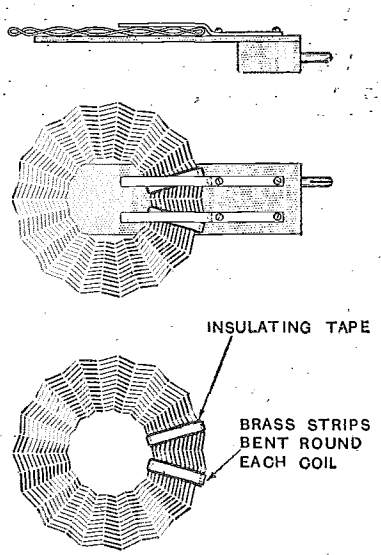
MOUNTING BASKET COILS.

A simple method of mounting basket coils is illustrated in the accompanying diagram. The ends of the coil are soldered to brass or copper bands clipped over the coil itself. Strongly made coils, preferably bound up with thread, are essential to the success of this method, and they should be protected with strips of black adhesive tape where the contact bands are fixed.



Brass strips bound on to the coil provide for making contact with the winding. The simple ebonite mount facilitates the changing of coils.

The coil holder consists of two parallel spring clips screwed at a suitable distance apart to a strip of thin ebonite. The clips are connected to the plug and socket holder screwed to the lower end of the ebonite strip.

The holder is quite cheap to make, and it will be found that coils can be changed with great facility.—S. S.

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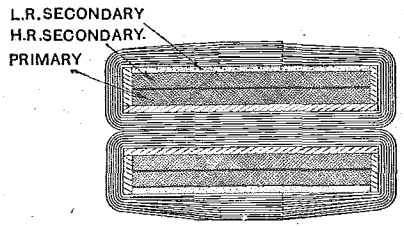
A TELEPHONE TRANSFORMER FOR H.R. AND L.R. TELEPHONES.

When telephones of both high and low resistance are to be used in a circuit it is customary to connect the high-resistance telephones in series with the primary winding of the transformer used to feed the low-resistance telephones. A far more efficient method, and one which eliminates the D.C. component of the anode circuit from the H.R. telephone circuit, is to construct a special telephone transformer with separate secondary windings to suit both types of telephones.



Transformer with double secondary to suit high or low resistance telephones.

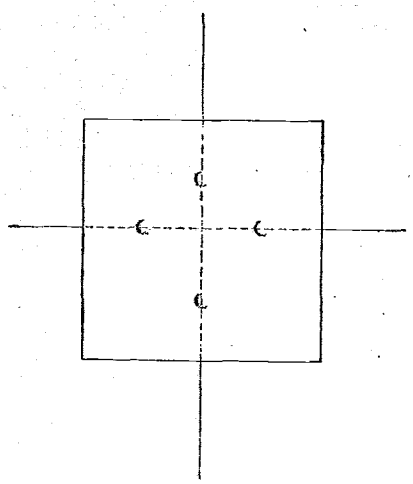
Constructional details of a transformer that proved very satisfactory are as follows. The former consisted of two square ebonite end plates fixed to a tube $\frac{1}{2}$in. in internal diameter and $4\frac{1}{2}$in. long. The primary was wound on first and consisted of 11,000 turns of No. 42 D.S.C. copper wire. After insulating with several layers of waxed paper, an equal number of turns of the same gauge of wire were

wound on to form the secondary winding for H.R. telephones. The low-resistance winding consisted of 145 yards of No. 38 D.S.C. wire wound over wax paper insulation on the high-resistance winding. An iron wire core 14in. in length was used and bent back over the windings to form a closed magnetic circuit.—A. F. R.

oooo

MARKING OUT VALVE SOCKETS.

The positions of the four holes for the socket of a valve holder can be marked without the aid of a special template by the following simple method. Mark on the panel with a scriber two lines at right angles over the position to be occupied by the valve holder. Then take a piece of



Setting out the positions for valve holder drilling by means of a soft paper template.

blotting paper 1¼in. square and impress upon it the four pins of a standard valve. The paper can now be placed over the centre lines and adjusted by eye until the marks made by the valve legs coincide with the lines. The diagram shows the final position occupied by the paper, and it only remains to mark the position of the holes with a sharp point pressed through the centre of the valve leg marks.—R. B.

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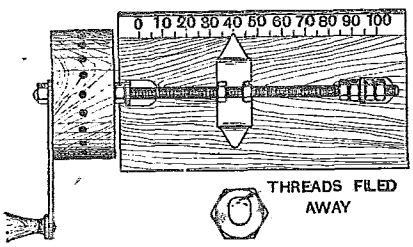
A COUNTER FOR COIL-WINDING MACHINES.

When winding basket or honeycomb coils, the attention is fully occupied in guiding the wire, and attempts to make mental note of the number of turns are generally unsuccessful. The total number of turns in a finished coil may be estimated in the case of simple basket coils by doubling the number visible on one side of a spoke. The estimation is not so easy where complex windings are used and a turn-counter becomes a necessity.

The diagram shows the construction of a counter that can be assembled at small cost. The coil former is mounted to rotate on a long screwed spindle. The rotation of the screw causes a spring pointer to travel over a paper scale, which is calibrated by a trial run. The pointer is carried forward by two nuts which are filed in such a way that the pointer may be returned to the commencement of the scale without disturbing the process of winding.—J. G. W. T.

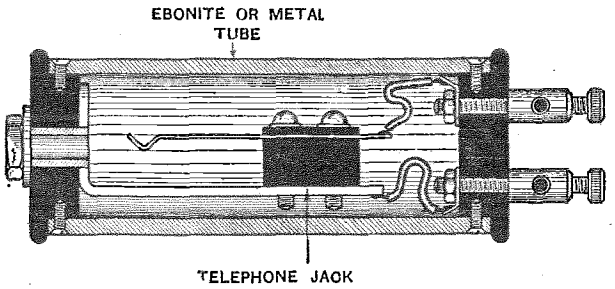


An easily constructed revolution counter for use in the construction of basket coils.

oooo

TERMINAL CONNECTIONS FOR TELEPHONE PLUGS.

When only one pair of telephones is available, and the connections are made permanently to a telephone jack, considerable inconvenience is experienced when it is desired to use the telephones in an experimental circuit not fitted with jacks. The difficulty may be solved by fitting a special jack with terminals in the manner indicated. The circuit connections are then attached to the two terminals and the telephone plug inserted in the ordinary way.—L. H. T. C.



Useful adapter for use with telephone receivers fitted with plug connector.

oooo

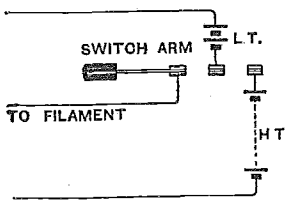
A PLUG-IN AERIAL TUNING UNIT.

It is convenient, when employing an aperiodically coupled aerial circuit, to mount the aerial and secondary coils on a four-pin holder that can be plugged into an ordinary valve holder. The same system of connections should be employed throughout the series; the secondary coil may be connected between what are normally the grid and plate pins, while the filament pins may serve as the aerial and earth connections. For very short wavelengths the pins may be inserted in an ebonite platform carrying some form of low-loss coils, while for longer wavelengths high-frequency transformer bobbins are useful. When only one slot is available, the secondary winding should be wound first with the aerial turns on the outside, separated by a few layers of waxed paper.—P. R. M.

oooo

VALVE SET SWITCH.

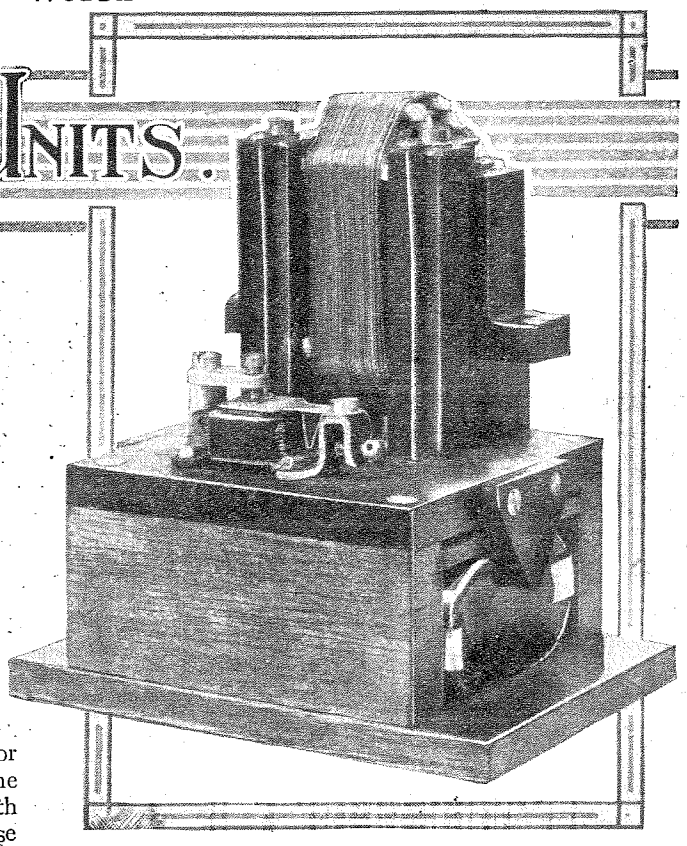
A single pole switch fitted with two contacts assembled in line can be made to disconnect both filament and high-tension batteries, for taking the receiving set out of operation. The arm of the switch is connected to the common H.T. and L.T. negative leads, and the contacts are joined to the negative terminals of the two batteries. It is advisable to arrange the connections so that the filament circuit is closed first. The application of a single pole battery switch can be further extended by fitting it with contacts on both sides of the centre, so that, by throwing over, voltages can be changed to suit various types of valves.—H. M.



Switch for disconnecting both H.T. and L.T. batteries.

WAVELENGTH UNITS.

The Construction of a Buzzer Wavemeter.

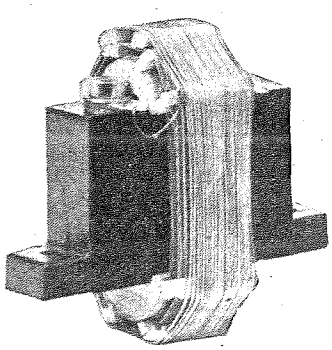


For adjusting a crystal receiving set the use of a buzzer is almost indispensable. Several commercial receivers are provided with buzzers, and the home constructor is here given a design for a simple testing wavemeter which can be fitted as an auxiliary to his receiver. By the insertion under spring tags of a condenser overwound with wire which forms a complete closed oscillatory circuit, the attachment is brought into operation.

By F. H. HAYNES.

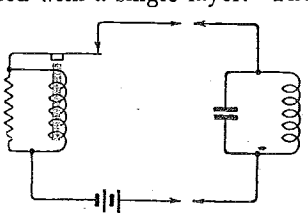
WHEN valves are used in a receiver solely for broadcast reception, there is little need for the use of a testing buzzer, owing to the ease with which tuning adjustments can be effected by making use of the local broadcast transmission. Thus, whilst not an essential for valve reception, a tuned buzzer does provide a means for making tuning adjustments to a given wavelength, and affords a test that everything is in order prior to actual reception. In the case of a crystal set the use of a tuned buzzer will obviate the need for making adjustments during reception.

A buzzer wavemeter consists of a battery and buzzer connected in series in a circuit which is completed through the turns of an inductance across which is joined the tuning condenser. In the usual form of construction the wavelength of the oscillations which are set up is rendered continuously changeable by the use of a variable condenser, while the inductance may be tapped in order to give a wide tuning range. When adjusting a receiver to one wavelength only, there is no need to provide these variables, and the wavelength of the oscillations emitted may be determined by a unit comprising inductance and condenser both fixed in value. This permits of the simplified form of construction shown in the accompanying illustrations.



A 400 metre unit wound with No. 30 double silk-covered wire around a 0·0002 mfd. condenser.

The tuned unit which governs the wavelength is made up from a Dubilier type 620 condenser, and, by means of a pair of wooden arched pieces, can be overwound with the wire forming the inductance. The screw terminals of the condenser carry tags on which the ends of the winding are terminated, whilst they also serve to engage under the spring contacts which are connected to the battery and buzzer. When the condenser has a capacity 0.0002 mfd. it will be found that with a winding of No. 30 D.S.C., an optimum wavelength of 400 metres cannot be reached with a single layer. The space on the wooden pieces allows for winding on about 27 turns, and the required inductance must therefore be produced by winding on additional layers. Successive layers are best separated with small wooden pegs; pieces of match stick serve the purpose quite well, and these may be held in position while winding by overwinding with a piece of spare wire. When a layer is completed, the wire may be temporarily held in position by a touch of sealing wax. The wire should be taken across the winding so that all layers commence from the same side. Three layers wound in this manner on a condenser of stated capacity of 0.0002 mfd. produced a moderately sharply tuned wave of roughly 390 metres.

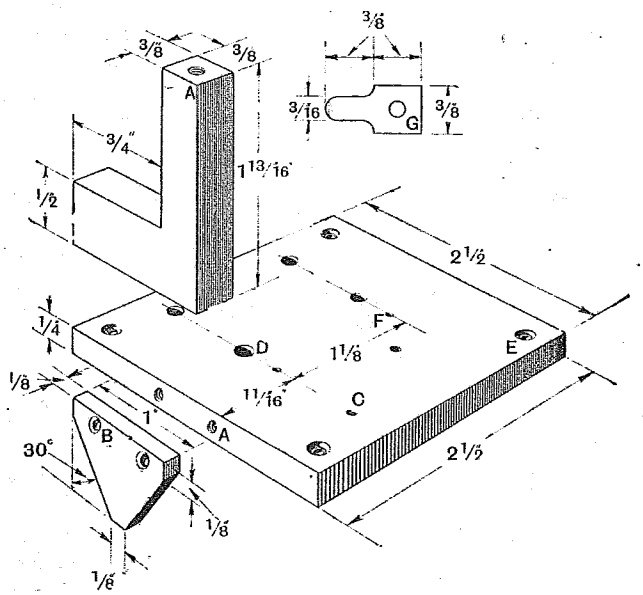


Typical buzzer wavemeter circuit.

Wavelength units built in this manner may evoke criticism. Firstly, the unit is not robust, and, in consequence, may not be constant, owing to the liability of mechanical damage, and, secondly, that the metal plates of which the condenser is composed form a centre core

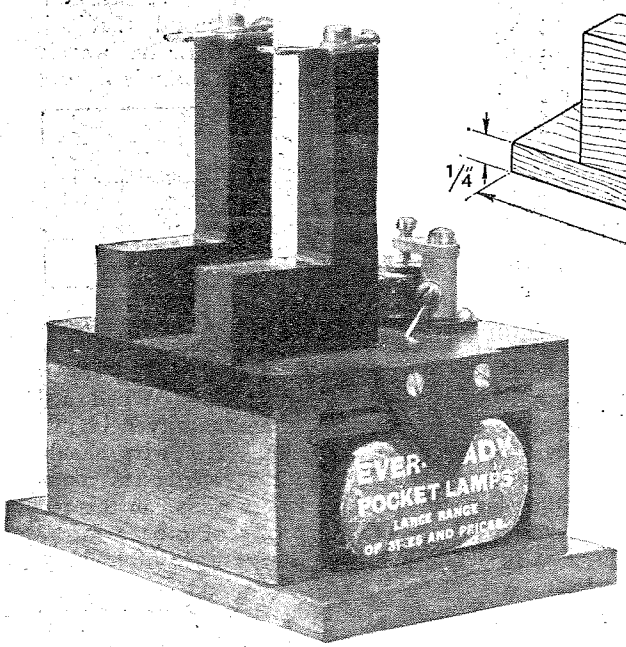
Wavelength Units.—

to the winding. With ordinary care, however, a slip-in unit will be found sufficiently durable for practical use without the windings becoming deranged, whilst the influence of the metal plates in the centre of the coil,



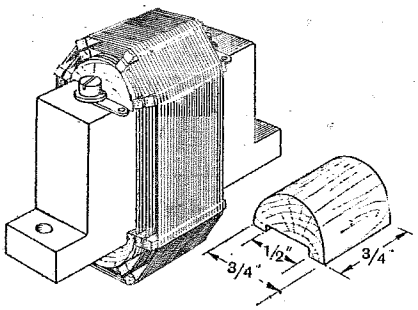
Constructional details of the ebonite pieces and spring clip. Sizes of holes: A, 6 B.A.; B and D, clearance hole for 6 B.A. screw and countersunk. C, 8 B.A. E, ¼in. and countersunk. F, 1/16in. hole to pass connecting wire. G, clearance hole for 6 B.A.

although appreciably controlling the inductance of the winding, does not produce any observable flatness of tuning when used for adjusting a crystal receiver, particularly as the latter, in itself, invariably consists of a flatly tuned circuit.



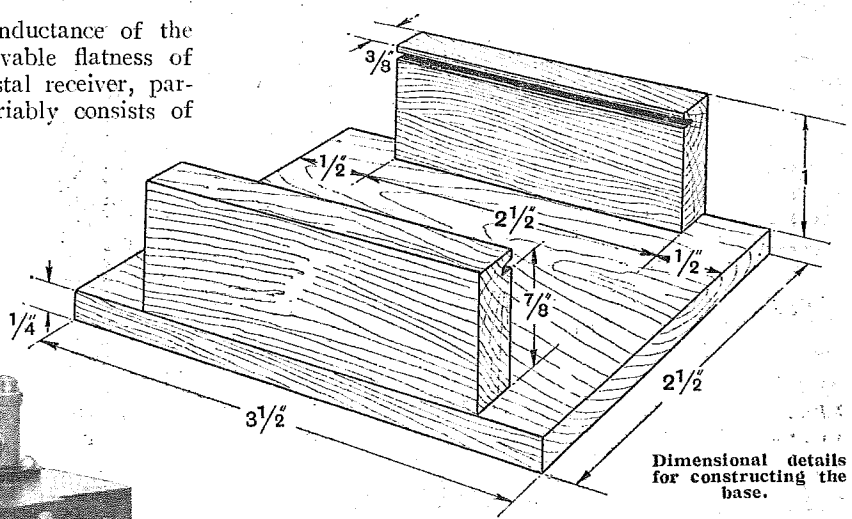
The box work carries the two-cell battery, and a thin wooden or cardboard separator protects the wiring on the underside of the panel. The ebonite uprights should be carefully adjusted as to height, so that reliable contact is made with the screw terminals of the condenser.

Turning to the construction, a wooden framework with ebonite top is made up to support a two-cell dry battery and for which all necessary dimensions are given. The pieces of wood must be accurately made to size, and, being small, most of the work is accomplished with a file. A slot in each of the side pieces is made to carry a thin piece of wood, ebonite, or even cardboard, to protect the wiring on the underside of the ebonite piece from the almost inevitable corrosive action of the dry battery. Pieces of thin brass or copper about ¾in. × 1in. are attached by means of screws to the inner faces of the wooden side pieces. By means of these, contact is picked up with the battery, and its spring tags are bent back to make reliable connection.



Pieces of wood of semi-circular section support the winding, the layers being separated by small wooden pegs

The buzzer must be a good one, for it must be capable of operating through the several layers of moderately fine wire which form the tuning inductance and which possesses appreciable resistance. An Erricsson buzzer was used in the instrument shown, and was a standard type having a resistance of 25 ohms. The non-inductive

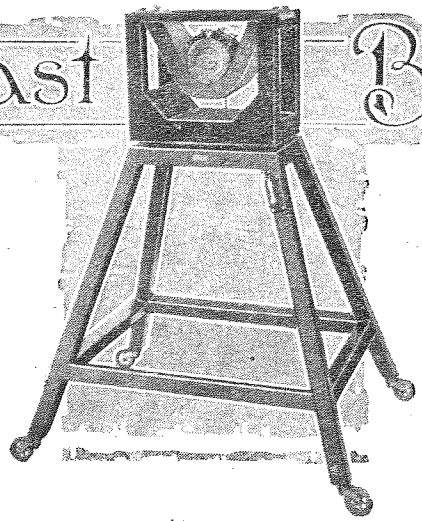


Dimensional details for constructing the base.

shunt across its windings was made from 4 yards of No. 44 D.S.C. Eureka wire wound on a slip of cardboard covered with empire cloth and packed in under the base when screwing down. An alternative arrangement might consist of a small ebonite or wooden spool secured to the upper face of the ebonite. The non-inductive winding is, of course, produced by measuring off the required length of wire, doubling it, and winding on the two strands together.

As a testing set, it may be permanently attached to the side of the receiver with the two spring prongs projecting upwards, so that the wavelength unit rests on the ebonite uprights.

Broadcast Brevities



NEWS FROM THE STATIONS.

Summer Programmes.

The B.B.C. has been considering the best means of catering for listeners during the summer months. The balance of opinion among the wireless public is in favour of music and still more music—not melodies of the classical variety, but honest-to-goodness jazz and foxtrot music. Listeners are, therefore, to get what it is believed the bulk of them want, and negotiations are proceeding for the incorporation of a bigger share of dance entertainment. Meanwhile it is singular to remark that from a musically inclined area such as that round Newcastle, should come to the B.B.C. a demand for more lectures and public speeches than are given to-day.

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Broadcast Chats.

The new series of Talks which has just commenced should go a long way towards satisfying Newcastle listeners, for during the next three months many distinguished people will discourse on Sport, Finance, the Drama, Natural History, Books, Music, and Films.

Admiral Davidson, who broadcast on April 25th, the anniversary of the landing on Gallipoli, was able to speak authoritatively, for he personally took part and landed with every available man from H.M.S. "Cornwallis" to support the landing party on the South Beach.

oooo

Canterbury Cathedral.

In transmitting a special service from Canterbury Cathedral on June 5th, the B.B.C. will add another to the growing list of places of worship where the value of broadcasting has been realised.

Llandaff, Liverpool, and Birmingham are among the Cathedrals from which services have been broadcast, and on some recent Sundays as many as three Bishops have been broadcast from various stations during the same evening.

oooo

A Congregation Rehearses.

Prior to the beginning of the service at St. Martin's, Trafalgar Square, the other Sunday, when the Bishop of London broadcast an address, the organist came down from the organ loft and placed himself in front of the choir stalls, from which point he conducted a full dress rehearsal with the assistance of the waiting congregation, which numbered about 3,500 persons. His idea was to get everybody to keep time in the singing of the hymns, and he compressed within the space of ten minutes a useful little musical lesson, the result being evidenced in the reception of the subsequent service in the homes of listeners throughout Great Britain and Europe. Many reports afterwards reached the B.B.C. headquarters stating that no religious service had ever before been so perfectly received.

oooo

Savoy Bands on Mount Olivet.

To turn to the other side of the picture, a story is current that a prominent English peer listened to the Savoy Bands the other day from Mount Olivet, of all places!

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"Duettists Miles Apart."

The services of distinguished musicians will become available to a greater extent as the B.B.C. perfects its plans for broadcasting duettists, or even a greater number of performers, who may, owing to other engagements, be unable to attend simultaneously at the same hall or studio. It is practicable to transmit a violinist from, say, London, at the same time as a pianoforte accompaniment is being broadcast from, say, Birmingham or Cardiff. Much of the trouble of arranging dates convenient to all the artists required for a performance, to say nothing of the expense or travel, would thus be eliminated. The only technical difficulty of any importance would be an alternative to the employment of identical wavelengths. Reception would probably be undertaken at a central B.B.C. station and the music re-broadcast thence for the benefit of listeners.

oooo

A Contented Listener.

It is due to the inexplicable twist in human nature that the majority of people never take the trouble to write to the B.B.C. unless they have a complaint to unload on headquarters, and it is only when the Company comes within easy distance of its third anniversary that a letter arrives from a listener saying: "I and my family are completely satisfied with the B.B.C. programmes." Mark the compliment contains no reservation. This is the first letter received expressing unqualified approval, and as such it deserves to be hung in a frame of gold—if the Company could afford the necessary outlay.

oooo

The Radioviews.

Of recent items broadcast from 2LO the "Westward Ho! Radioviews" have come in for a large share of praise, much of it from listeners who say that they first read the book thirty or forty years ago. One writer says: "The background noises were most realistic. For instance, the sea-water was wonderful. How *do* you do it?" To which the B.B.C. replies: "That is a trade secret and may not be divulged."

FUTURE FEATURES.

Sunday, May 3rd.

ALL STATIONS.—11 p.m., Military Sunday Service, relayed from York Minster.

LONDON.—4 p.m., Organ Recital relayed from the National Institute for the Blind.

BOURNEMOUTH.—4 p.m., The J. H. Squire Celeste Octet.

CARDIFF.—9 p.m., Old Masters—II.

Monday, May 4th.

LONDON.—8 p.m., Band of H.M. Scots Guards.

BOURNEMOUTH.—8.30 p.m., Speeches relayed from the Dorset Dinner, Holborn Restaurant, London.

CARDIFF.—7.30 p.m., Concert relayed from Central Hall, Newport.

ABERDEEN.—8 p.m., Ballad Concert.

Tuesday, May 5th.

5XX.—9 p.m., All Arts Week Concert, relayed from Grosvenor House.

LONDON.—8 p.m., Symphony Concert. S.B. to all stations.

Wednesday, May 6th.

LONDON.—10.40 p.m., "The Coronation Anthem" (Handel) in commemoration of the Coronation of His Majesty the King. S.B. to other stations.

BIRMINGHAM.—8 p.m., Opera: "The Magic Flute" (Mozart).

GLASGOW.—8 p.m., Symphony Concert. S.B to other stations.

Thursday, May 7th.

LONDON.—8 p.m., Chamber Music: Brahms and Tchaikovsky. S.B. to other stations.

BELFAST.—8 p.m., Springtime Programme.

Friday, May 8th.

NEWCASTLE.—8 p.m., Symphony Concert.

Saturday, May 9th.

LONDON.—8 p.m., Community Singing Concert, relayed from the Albert Hall.

MANCHESTER AND 5XX.—8 p.m., "Old Masters."

The fact may, however, be revealed that in the early days of broadcasting, when it seemed certain that future development would be to a large extent in the direction of giving the public a reproduction in sound of events which took place outside the studio, an attempt was made to relay the noise of the surf breaking on the sea-shore "somewhere down South" but on that particular night the sea was calm and the relay was far from being a success.

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Sea Battle by Microphone.

By the way, the most ambitious effort yet attempted in conveying sounds by wireless is promised to listeners shortly. The noises will include those made by a submarine travelling on the surface and below the water, hydrophones, depth charges, and all the tumult of modern warfare at sea. The performance is certain to cause listeners a good deal of astonishmert by its realism.

oooo

Education by Radioview.

Reverting to the "Radioviews," one correspondent declared that he would have all chamber music wiped out and "Radioviews" substituted as a regular feature of the programmes. That, of course, would not suit the main body of listeners; but we may prophesy that "Radioviews" and drama generally will receive greater attention from those responsible for the arrangement of programmes in course of time, as it is realised that educational lessons should include representations of great episodes in history along dramatic lines.

Was it Niagara?

Another effort in realism which may be recalled while we are on the subject of radioviews and sound effects was the transmission from Radio-Paris, a month or so ago, of the "Maremoto" scenario, composed by Messrs. Pierre Cusy and Gabriel Germinet, and relayed to all B.B.C. stations from Chelmsford. Several hundred listeners wrote to the B.B.C. with reference to the errors which had been intentionally introduced into the scenario. One listener hazarded the guess that it must indeed be a terrifying experience to be shipwrecked in "Darkest Africa!" Another wanted to know whether it was not the case that signals of distress were made in the universal code—in Morse, and added: "The drowning episode sounded remarkably like the final 'one' before going home."

A third correspondent, forsaking levity, gave as his impression that the "sea and wind were really being transmitted—if not it was a realistic imitation." And yet a fourth thought that the catch was that the "sea rushing" effect was produced by broadcasting the Niagara Falls.

oooo

Penny-in-the-Slot Wireless.

In an article just published, a well-known London journalist asks: "Why should not wireless, which in due course will be in every house, be treated as we now treat gas and electricity? Why not, say, a meter in every house by which the user could pay as he used?" The idea of wireless in every house was put forward in these notes several weeks ago, and now comes the news that a Sheffield builder is erecting the first real wireless equipped house. He has provided an aerial and earth, properly connected up to a central switchboard, from which wires are run to every room; all the wires are hidden in the same way as the electric light wires and gas pipes. All that can be seen are the switchboard and a plug in each room. The householder will merely provide earphones and plug in from any or every room simultaneously as required. (He will, of course, also provide his own receiving set.)

oooo

Meter Difficulties.

As regards the meter idea, this sounds impracticable. It would probably cost a good deal more per annum in the long run if a coin of the realm were inserted in the slot for a measured period of entertainment than the annual cost of the licence fee. The present average cost of a penny per programme is surely far better value than a penny-in-the-slot for an hour's listening.

oooo

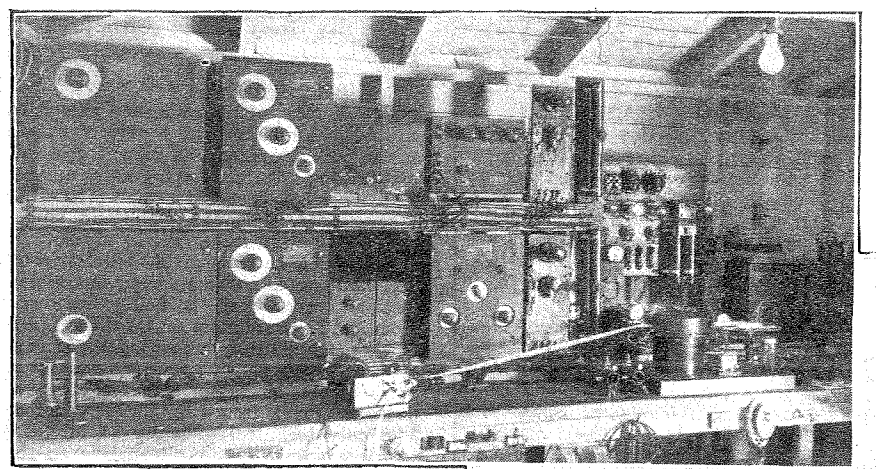
All the Winners!

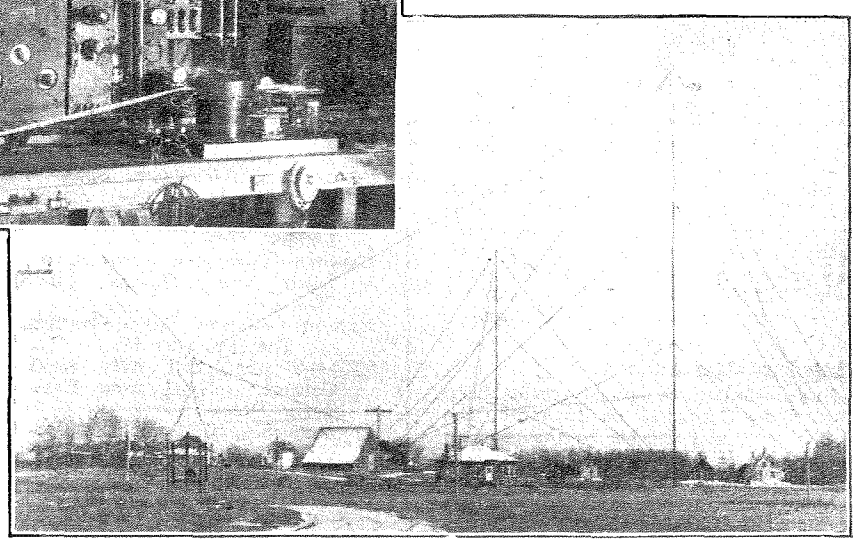
The class-paper which in its last issue requested the B.B.C. to give results of certain sporting events, directed its appeal to the wrong quarter. The B.B.C. only broadcasts news supplied to it by the news agencies.

oooo

Licensing the "Flat Earthers."

As mentioned in these columns last week, one of the several religious bodies who have their own transmitting station in America believes that the earth is flat. When they applied for a licence they were asked to give the latitude and longitude of their station. They refused, saying that latitude and longitude did not exist. A licence was forthwith refused, and they only obtained one eventually by stating that they were informed that the latitude and longitude were said to be so-and-so.





RELAYING BRITISH PROGRAMMES IN U.S.A. These photographs were taken at Belfast, Maine, and depict the apparatus and antennæ of the powerful receiving station which picks up programmes from 2LO and 5XX. From Belfast the transmissions are relayed on a short wavelength, intercepted by WJZ, New York or KDKA, Pittsburgh, and re-broadcast by those stations.

INTERFERENCE.

PART III.

An Examination of some Miscellaneous Cases of Interrupted Reception.

By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

IN a certain laboratory there are a number of d.c. machines, some of whose wave forms are probably worse in contour than the Bay of Biscay on a stormy day. Reception on almost any wavelength from 100 to 20,000 metres—particularly on short waves, due to the disposition of the aerial—is accompanied by the usual noise concomitant with such conditions.[1] A very appreciable improvement is obtained by putting 4 mfd. condensers across the terminals of each machine. Low resistance chokes, as shown in the first article of this series,[2] have a profound effect, but are generally large and costly.

With a *short* low open aerial and the usual earth—which is none too good—the machine noise is still there. An earth mat removed as far as practicable from the vicinity of the machines makes conditions better, whilst a frame aerial away from the machine is better still, provided it has no earth connection. This indicates varying potential on the earth system.

The degree of interference depends largely on the selectivity of the circuit. The receiving circuit comprised reaction with or without filter circuits, according as the reception was long or short wave, but these were used primarily for reducing jamming stations and atmospherics, although they assisted

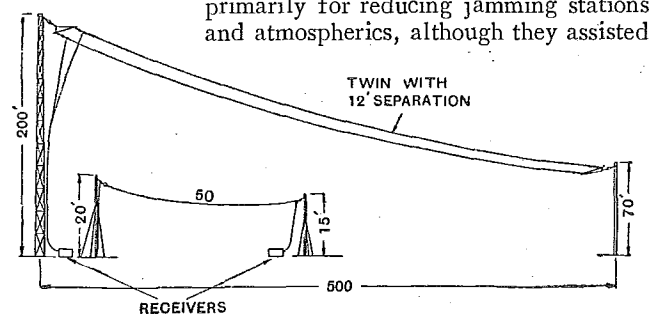


Fig. 1.—Diagram showing dimensions of large and small aerials. The bulk of the latter was situated in a region subject to machine induction.

very materially in attenuating the machine noises. The machine interference on short waves was worse than on long waves, chiefly due to the fact that the greater portion of the short wave aerial—it was only 20ft. high at the upper extremity (see Fig. 1)—was situated in the vicinity of the machines, whilst by far the greater portion of the long wave aerial was well removed from them (200ft. high, see diagram). Thus the average potential gradient on the aerial due to interference for the long wave aerial was much less than that for the short wave aerial. This was corroborated by using a frame aerial 3ft. 9in. square, when the interference was much in excess of that with the large open aerial, due mainly to the frame being in the machine locality.

From these two extremes, viz., long and short wave, it will be seen that the interference in the case under examination is due to (1) induction and radiation from the machines, (2) earth currents causing a varying potential on the earthing system. Nos. 1 and 2 affect an open aerial, and the nearer the aerial to the source of disturbance, the greater the interference. No. 2 alone (neglecting capacity or antenna effect of a frame to earth) affects a frame. Whether an open aerial or a frame is better depends upon the average voltage gradient of the interference down the aerial, *i.e.*, upon the proportion of the aerial near the disturbing source. In this must also be included the effect of earth currents. The effect on the remainder of the receiving circuit has been tacitly ignored, but for simplicity it can be regarded as being screened. The type of circuit, of course, modifies the result, but we were mainly concerned with the problem of interfering potentials at the aerial.

Finally, with the short wave aerial, there was an unpleasant hum from the 100 cycle lighting and power supply. This was due chiefly to one branch of the aerial running parallel with the flexed lighting wires. When this branch was removed the hum diminished very perceptibly. Also, the hum was found to be greater with an earth mat than with a direct earth. This was due to the mat being parallel and near to the light supply wires (mat on floor). Incidentally, it may be mentioned that even though space is limited in a laboratory, the experimenter should not stand on an earth mat.

Smoothing D.C. Machines.

It sometimes happens that attempts to cut down machine noise by the use of large condensers are only attended with partial success. Apart from faulty commutation, a possible explanation is to be found in the action of the condenser. Let a large condenser be shunted across a machine of zero resistance and zero inductance. Since there is no internal volt drop in the machine, any fluctuation in the machine voltage due to ripple, etc., which sends a current into the condenser, does not reduce the voltage of the ripple, *i.e.*, there is no smoothing. But when a choke coil (of small resistance so that the d.c. voltage is not diminished too much) is inserted as shown in Fig. 2, the A.C. which passes from A to C undergoes a considerable voltage reduction across AB, whilst there is little across BC, since, at a frequency of, say, 200 cycles, it acts, relatively, as a short circuit. This does not apply, of course, when the choke and condenser

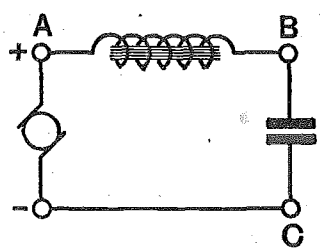


Fig. 2.—A simple filter.

[1] The allowable degree of interference depends upon the ratio $\frac{\text{signal strength}}{\text{interference strength}}$ and decreases as the amplification increases.

[2] *Wireless World*, February 25th, 1925.

Interference.—

resonate, and, moreover, the condition to be fulfilled is that the impedance of the choke shall be *many* times that of the condenser. For example, at 200 cycles the impedance of 20 henries is about 130 times that of 4 mfd. Thus a ripple of this frequency would be reduced to 1-130th its initial value. It will be clear also that a resistance can be substituted for the choke, but as this also reduces the d.c. voltage it may be impracticable. If, however, a drop in d.c. voltage is immaterial, a resistance or a choke of high resistance is serviceable, particularly where, say, 40 volts is obtained from a 100- or 200-volt main supply. In a smoothing system for using the d.c. mains as H.T. supply to a bank of valves, a tell-tale lamp is useful in case of condenser failure, whilst it assists in smoothing out ripple.

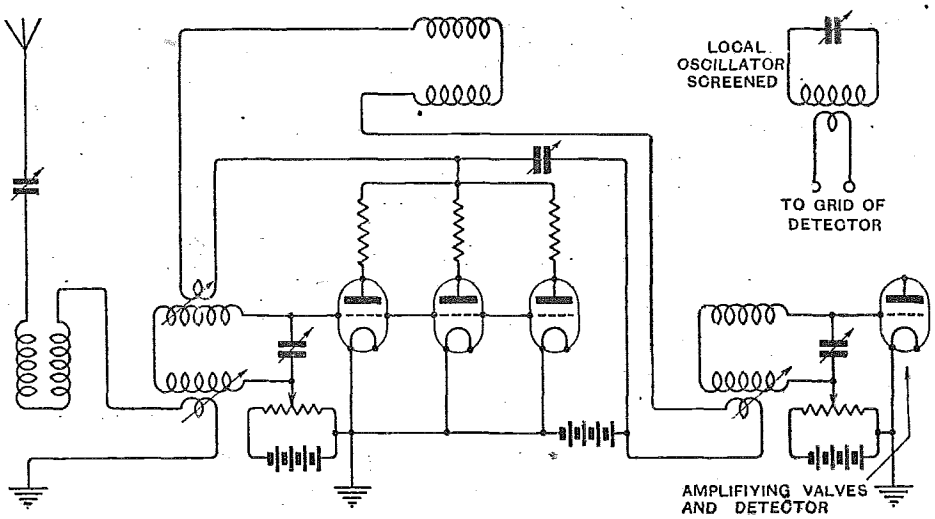


Fig. 3.—Screening boxes should be used, if available, or some form of screen to prevent capacity coupling between units and aerial. The three valves, which will usually be of fairly high impedance, may be replaced by one low impedance valve and an appropriate resistance, say an L.S.5 or a D.E.5. The H.T. should not be less than 130 volts to avoid grid current with strong atmospherics. Common filament and plate batteries are used throughout.

Filter Circuit.

Since the machine disturbances have a definite frequency spectrum, a filter circuit can be inserted in the mains to suppress the greater part of the spectrum. The problematic issue with large d.c. currents is chiefly one of expense, since the resistance must be low and the inductance high, although, of course, the limits of the interfering frequency band must be found. Where large currents are involved, the most economical choke is one with an air gap in the iron core (avoids saturation). Filter circuits for this class of work require careful design. In order that a filter circuit shall fulfil as nearly as possible the desired conditions, the input and output (terminal) impedances must be correct to avoid reflection. General principles of filter circuits are highly mathematical and outside the scope of this article.[1]

[1] See G. W. Pierce. "Electric Oscillations and Electric Waves."

Where the disturbance is very violent, filter circuits may be of little avail, for in general they are oscillatory and liable to be impulsed. Thus they may remove one portion of the spectrum only to introduce another. A concrete instance is to be found in the magneto. The discharge through the sparking plug is intensely impulsive, the damping abnormally large, and the spectrum broad. Short lengths of wire, *e.g.*, plug leads, or any form of electrical oscillator which comes under the spell of the discharge, is set into oscillation (damped). This is the origin of the well-known short wave emissions from magnetos. Their suppression is secured by complete screening of magneto and leads. An insulated return wire from the plug is preferable to an earthed frame to avoid H.F. currents in the engine framework as far as possible.

An Interesting Example.

A peculiar case of interference on a short wave circuit (125 metres) may be cited. The receiver operated a large relay whose winding was shunted by a non-inductive resistance to prevent sparking. This relay controlled a magnetically operated gas inlet valve. The current through the relay was adjustable by a variable sliding contact inductively wound resistance. When the relay was operated, the receiver was temporarily put out of commission owing to heavy shock excitation. The reason was simply that the variable resistance had a natural wavelength of the same order as the receiving system and impulsed it heavily. The remedy for this trouble is fairly obvious.

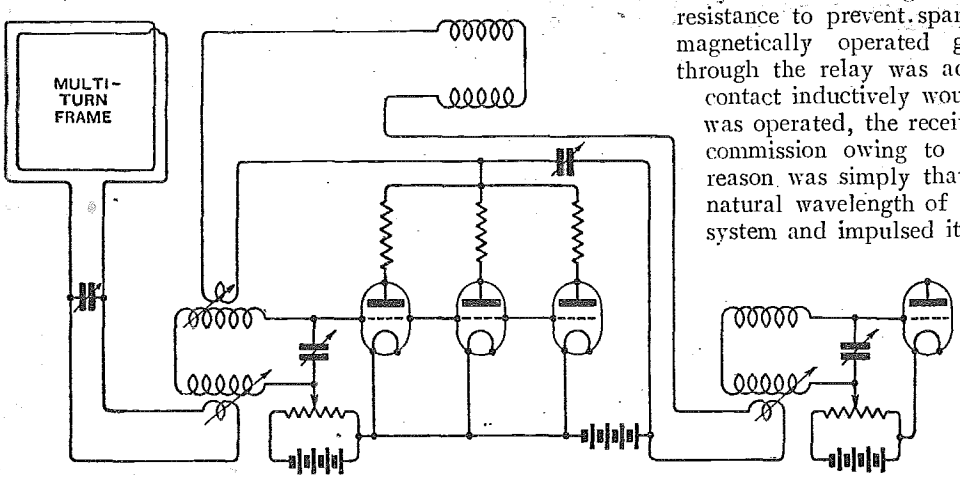


Fig. 4.—An open aerial may be added to get a heartshape diagram. Local oscillator to go in grid circuit of detector.

Interference from 5XX.

At Chelmsford, when receiving 2LO on 365 metres, there is sometimes interference from a harmonic of 5XX, the reception being effected at a distance of about 1 mile. This occurs

Interference.

even when reaction is used. It is, however, of no importance when the reactive circuits are *in tune* with 2LO. The jamming is therefore due to slight mistuning. Good reception from 2LO can be obtained much closer to 5XX than 1 mile by using a frame aerial with reaction followed by a super-heterodyne circuit. The various components must, of course, be properly screened.

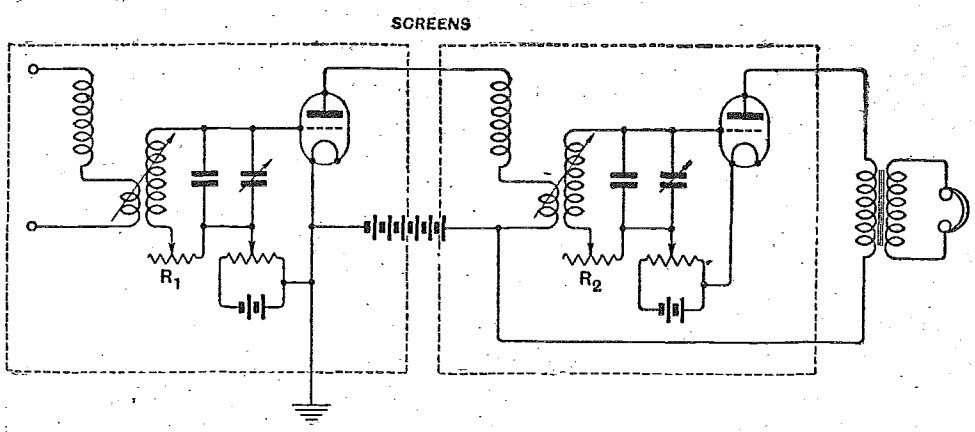
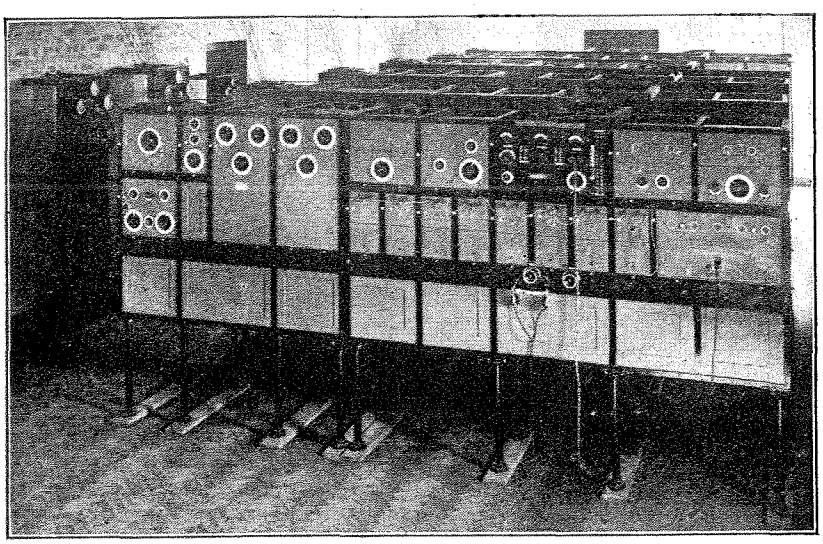


Fig. 5.—Two stage air cored note filter which can be added after the detector valve of figs. 3 and 4 for telegraphic reception. The coils can be wound astatically and screening boxes used. The degree of selectivity is varied by the coupling and the resistances R_1, R_2. A touch of reaction may be employed if desired, or the selectivity and signal strength may be enhanced by additional stages. Note frequency 1,500 to 2,500 cycles. The fixed condensers should have mica as a dielectric, and the variable condensers air.

Long Wave Jamming.

The *clean* reception in this country of long wave telegraphic stations, *e.g.*, New Brunswick, WII, Marion, WSO, Long Island, WQK, etc., usually requires a highly selective circuit owing to jamming from Stavanger, Lyons, Leafield, Nauen, etc.



By courtesy of Marconi's Wireless Telegraph Co.

Fig. 6.—Part of a commercial station. The units are housed in screening boxes.

A circuit suitable for coping with interference on a long or a short distance telegraph system will be treated in detail. There are two aerial systems which can be used, viz., open aerial or frame aerial (with or without heartshape). In general, a frame with heartshape is essential to reduce the atmospherics as much as possible. However, as a matter of interest, both open and frame aerial systems are shown in Figs. 3, 4. An open aerial is preferable, of course, since the voltage applied to the first valve of the amplifier is very much greater than that with a frame.

Taking the open aerial circuit of Fig. 3 first, the aerial is coupled to a special reaction unit consisting of several valves in parallel, each having an anode resistance from two to three times the valve resistance, whose effect is to improve the linearity of the valve characteristic. Instead of a resistance for each valve, a single resistance may be used whose value is

$$\frac{\text{two to three times valve resistance}}{\text{number of valves.}}$$

The effect of the resistance is also to reduce the tendency to oscillation due to the volt drop across it if the feed current increases. The valves are adjusted to their proper point on the characteristic by means of a potentiometer. The grid circuit is coupled loosely to the aerial, and there are two astatic coils with tuning condenser. The anode circuit is also tuned and coupled reactively to the grid circuit.

When the proper conditions are secured, fine tuning is obtained with the anode or grid condenser, and it should be possible to swing past the tune point without any signs of oscillation. The grid or anode circuit is loosely coupled to a tuned circuit with astatic coils which goes to the grid and filament of a high-frequency amplifying valve. The amplifier may have several valves and a rectifier or

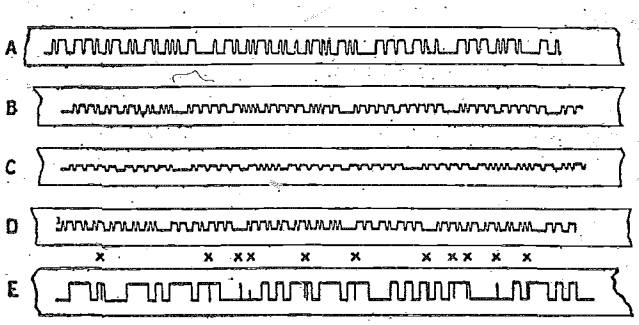
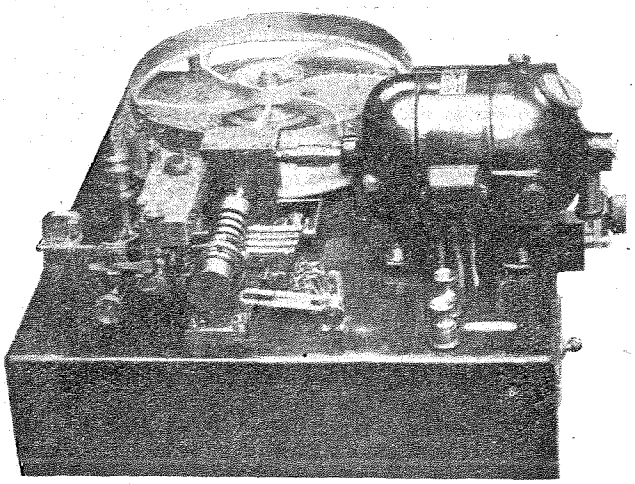


Fig. 7.—A portion of an actual message taken with one of the author's magnetic Drum Recorders.

Interference.

detector. The local oscillation can be coupled to one of the tuned circuits, but it is better to insert it in the grid of the rectifier. After detection, amplification can be effected at note frequency. All the valves should be operated with a suitable grid bias to avoid grid current with heavy atmospherics. The signal strength at the reaction unit must be small, so that the valves are operated on the linear part of the characteristic, thereby maintaining a constant negative resistance effect on atmospherics. This circuit when properly handled will give good selectivity and the reaction can be adjusted till the signals



By courtesy of Marconi's Wireless Telegraph Co.

Fig. 8.—The magnetic Drum Recorder (Transoceanic pattern).

merge together and give a " sustained " effect. Further, more, the effect of moderate atmospherics is reduced appreciably *provided the reaction unit is absolutely tuned to the incoming signals.* Otherwise the atmospherics will take charge of the situation.

In operating the reaction unit, the whole arrangement from aerial to amplifier input must be treated as a composite circuit, because of the coupling between units which throws damping from one to the other, *i.e.*, the reaction reduces the resistance of the whole circuit due to coupling. Moreover, a variation in tuning of one component will affect the others.

With a circuit constituted on the preceding lines, it should be possible to get any of the long wave[1] stations comfortably. If there is any jamming, a low resistance note filter circuit of the form shown in Fig. 5 can be added after the detector valve. In fact, it is possible to dispense with the H.F. reaction unit if a note filter unit is adopted. This latter can be used with reaction if desired, since in this way the selectivity is enhanced.

The circuit in which a small or large frame aerial is employed is given in Fig. 4. For commercial work, where reliability is the main consideration, it is customary to dispense with reaction and use two or three high-frequency filters, followed by a series of four to six note filters. The filters may be valve coupled if desired. It is convenient to valve couple the note filters, as shown in Fig. 5, the magnification per stage being about two. The adjacent units are housed in screening boxes, see Fig. 6, and by using a small magnification factor per stage and a large number of stages, a greater overall amplification can be secured without the occurrence of spurious oscillation.

In general, it is possible to read telephonic signals when atmospherics are fairly severe and are too troublesome for satisfactory recording. Where commercial operation is in question it is imperative to keep a tape record of each message—as far as possible—and this is always accomplished unless the atmospherics decree it undesirable. A mode of rendering tape legible even when atmospherics are about has been briefly described elsewhere.[1] The complete receiver is arranged to have a high degree of selectivity, but not sufficient to make an atmospheric last too long in the circuit. For example, on a 20,000 cycle circuit, the overall width of the top of the selectivity curve as measured at the last note filter might be about 100 cycles. The atmospheric will then, if it is not too strong, be registered on the tape as a thin vertical line. An example showing a small portion of an actual message is exhibited in Fig. 7. A frame aerial was used—no machines running to cause interference—since the tape with an open aerial was unreadable, owing to a rapid succession of strong atmospherics, which were sufficiently directional for a frame to be employed with advantage. The tape was secured with one of the author's magnetic Drum Recorders (Transoceanic Pattern, No. 1 of Fig. 8), whose transit time for $\frac{1}{8}$ (0.125) inch amplitude on the tape is about 2 milliseconds (1-500th sec.). Since the duration of the atmospheric in the recording circuit is sometimes very short, the recorder must respond very rapidly to avoid an area or triangle being formed instead of a vertical stroke. In cases where the atmospherics are very severe, the formation of areas is unavoidable, since the selectivity of the circuit has generally to be augmented to allow for satisfactory aural reception.

[1] It must be understood, of course, that there are other methods and circuits which can be used. The circuit of Fig. 4 was used to obtain the tape of Fig. 7.

PERSONALITY AND CAREER.

A straightforward talk by Mr. J. C. W. Reith, managing director of the B.B.C., to the senior boys of his old school, has been published by Messrs. George Newnes, Ltd., with a brief foreword by Sir Auckland Geddes. The author frankly states that the discourse was not originally delivered with any idea of publication, and that he has not altered the simple and direct diction used to the boys. Nevertheless the sound advice given is well worth the consideration of old and young alike. Mr. Reith strongly advises a ruthless and searching self-cross-examination early in life to determine the mental and moral assets to be cultivated or discouraged with a view to the formation of character and the choice of a suitable career, and points out that even youthful faults, if rightly guided, may become powerful factors in the ultimate achievement of success. Though there is nothing strikingly new or original in the advice given it is sound, clearly expressed and calculated to guide the expanding and changeable mind of the average boy along safe paths.

" Personality and Career," by J. C. W. Reith, published by George Newnes, Ltd., 30 pp., price 1s.

[1] Journal I.E.E. Vol. 62, page 370, April, 1924.

CONSTRUCTING SETS FROM UNITS.

The "Polar Blok" Equipment.

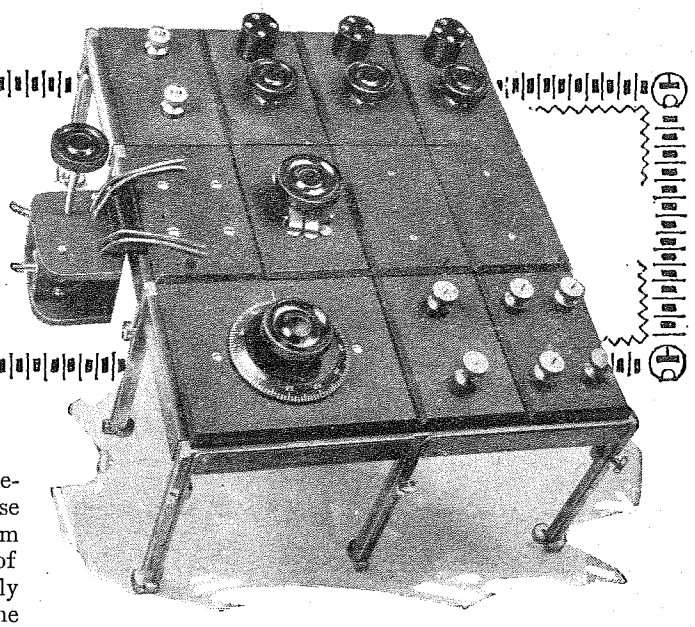


Fig. 1.—The appearance of the top of the unit system when built up as a three-valve set.

ONE of the reasons why home construction of wireless receivers is so popular is no doubt because of the desire to change the circuit in use from time to time so as to try out the relative merits of different arrangements. A home-made set is frequently taken down and rebuilt to a different design where the owner of a complete receiver which he had bought would hesitate to tamper with it to introduce modifications.

We had heard a good deal of the flexibility of the "Polar-Blok" system of building up sets, and recently we acquired an equipment of this type so as to test for ourselves the claims made for it.

The arrangement is distinctly ingenious, and there are many features attaching to the system which makes it of interest to those who want to experiment with various circuits, and especially to those who have not had a great deal of experience, and would therefore be likely to waste a good deal of time and money if they constructed separate experimental receivers for each circuit to be tried out. The "Polar-Blok" system we found enabled different units to be interchanged rapidly, and with every new set built up the outfit looked neat and compact.

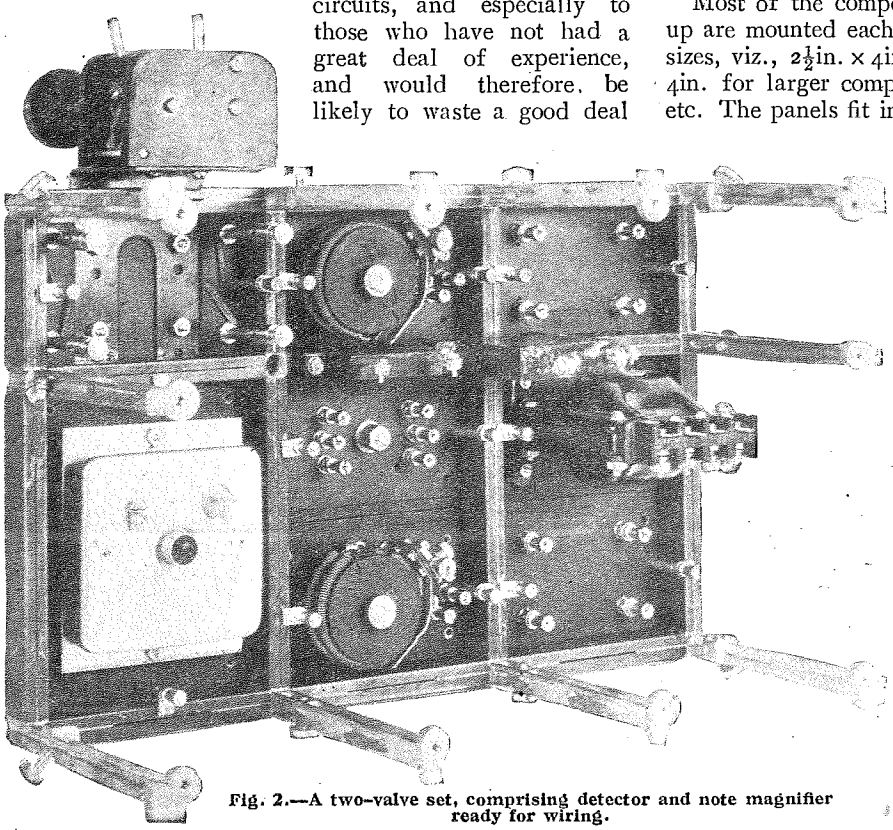


Fig. 2.—A two-valve set, comprising detector and note magnifier ready for wiring.

How the Sets are Built Up.

Most of the components comprising the set to be built up are mounted each on ebonite panels, which are of two sizes, viz., 2½in. × 4in. for small components, and 5in. × 4in. for larger components, such as variable condensers, etc. The panels fit into a framework which is ingeniously designed so that it can be built up to accommodate a large or small number of panels as the type of the receiver to be built may decide. Each panel is secured in place by clips on the underside of the panel which grip the edges of the framework.

The Framework.

The framework is constructed entirely of metal, and consists of cast metal angle pieces with supporting legs and rectangular frame tubes of suitable size to form frames into which the panels fit. There are, in addition, cross-shaped cast metal pieces to support the junction of four frame tubes.

When assembled the top panel of the set is made up of a number of small panels (5in. × 4in. or 2½in. × 4in.), which fit side by side and are supported in the metal frames, which measure approximately 5in. × 4in., and contain one large or two.

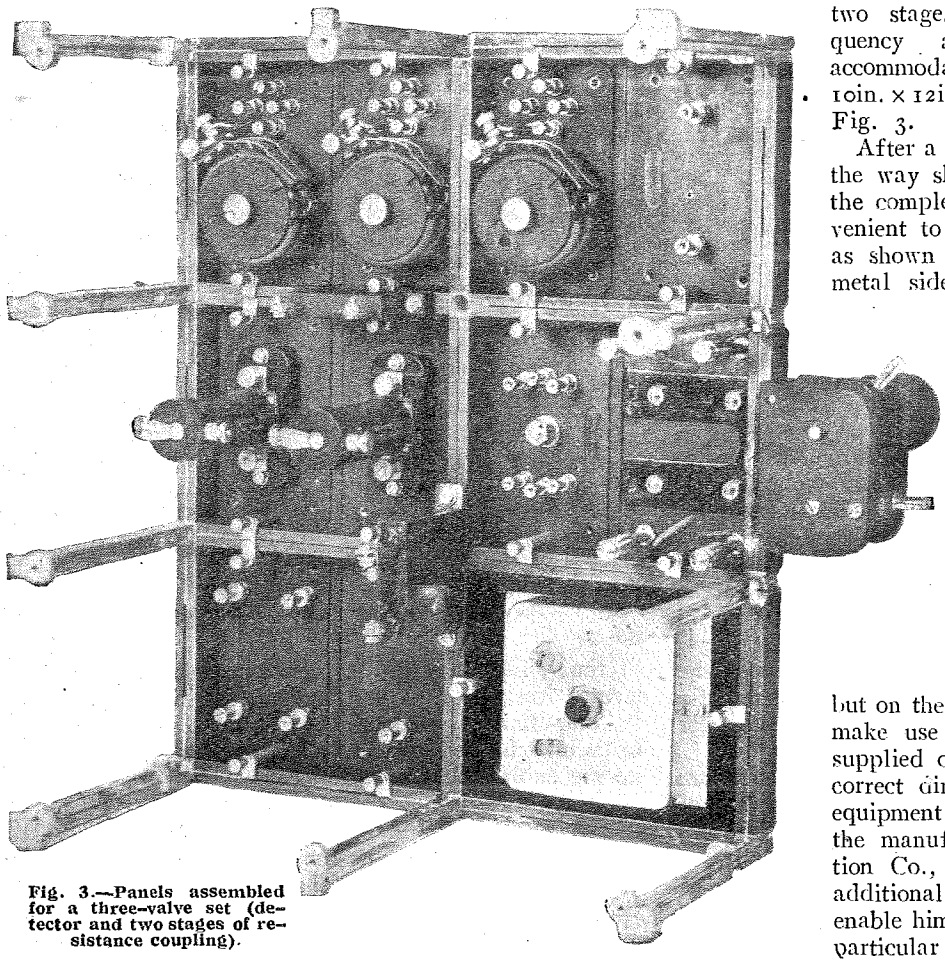


Fig. 3.—Panels assembled for a three-valve set (detector and two stages of resistance coupling).

of the small panels. The photograph, Fig. 1, shows the finished appearance of the top of a panel built up in this way.

The smaller components, such as fixed condensers, instead of being mounted on a separate panel, are provided with clips and clip on to the cross sections of the framework at any convenient points. This is illustrated in Figs. 2 and 3.

Wiring a set is a simple matter, since all the components are on the underside of the panel. Most of the terminals to which the wiring is to be fixed are of special type so as to facilitate the wiring process.

It might be thought that sets of any elaboration built up in this way would be very bulky, but this we found was by no means the case. The components arranged for a three-valve set, consisting of detector and two stages of resistance-coupled low-frequency amplification are conveniently accommodated in panel space occupying 10in. × 12in., as shown in the photograph, Fig. 3.

After a set has been wired and built up in the way shown in the illustration, Fig. 4, the complete set is rendered neat and convenient to handle by fitting the side pieces as shown in the same illustration. These metal side panels completely box in the apparatus, and are secured in place by means of the screws shown.

Additional Panel Units for the Experimenter.

The system is one which is likely to achieve a well-deserved popularity. From the point of view of the amateur one might criticise the fact that there is not such a choice of components as is often desirable in experimental work, but on the other hand anyone who desires to make use of components other than those supplied can mount them on panels of the correct dimensions for assembling with the equipment. In this connection we think that the manufacturers, the Radio Communication Co., Ltd., would do well to supply additional plain panels for the amateur, to enable him to mount components of his own particular choice should he desire to do so.

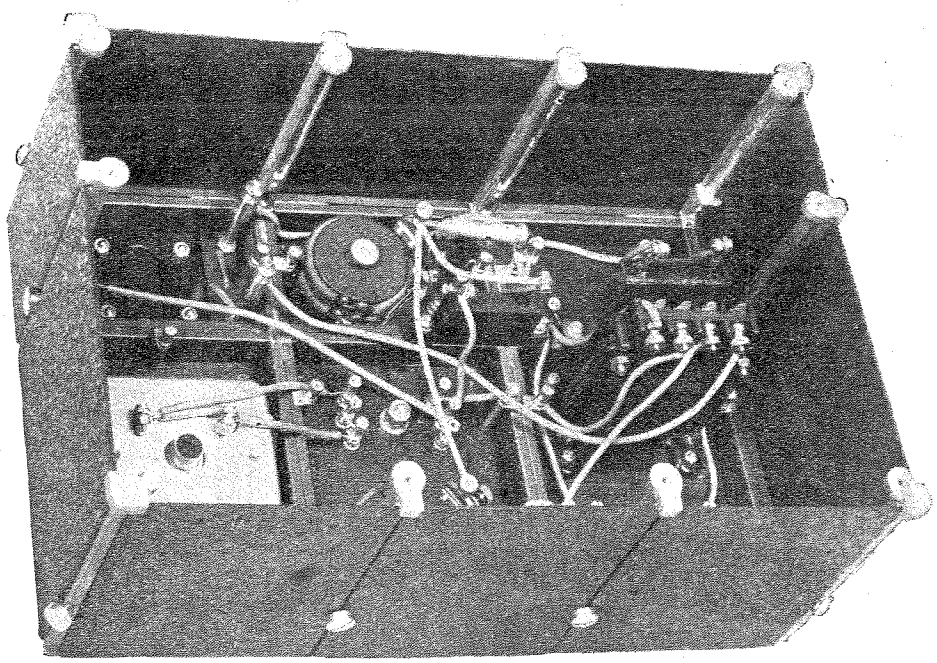
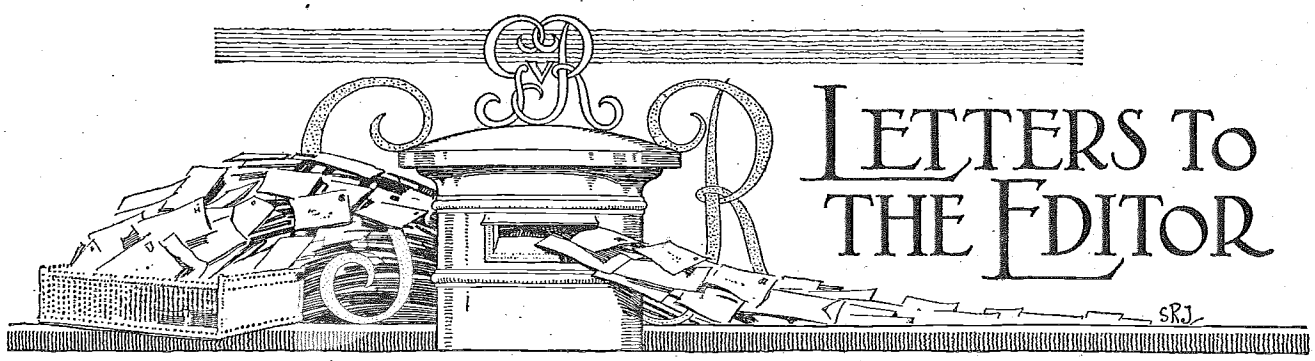


Fig. 4.—The arrangement of Fig. 2, after wiring, and with the side panels fitted in place.



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

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

GOOD WORK WITH A SUPER-HET.

Sir,—With reference to the letter from Mr. Jas. MacIntosh, published in your issue for April 1st, may I submit my log of American broadcasters for the late winter? The set used is a detector using a modification of the Ultra-Audion circuit followed by one or two L.F. stages. The stations received are as follow :—

WGY, WBZ, KDKA, WOR, WTAM, WJAX, WEAF, WIP, WFI, WMAF, WHAZ, WEAN, WJAR, WPG, WNAF, KGO, KWH, CKAC.

Using three valves, many of the above came in on the loud-speaker, and WGY has many times been received before the B.B.C. stations have closed down—*i.e.*, onwards from 9.30 p.m.

Market Harborough. "D.X."

SIMULTANEOUS RECEPTION OF THREE STATIONS.

Sir,—I note with interest Mr. T. E. Webster's letter in your issue of March 4th, in which he claims to have received two stations simultaneously on the same aerial with two sets—the stations being of fairly widely separated wavelength.

May I add that I have been in the habit of receiving two and three stations in this manner for the last twenty months here in Croydon. For instance, it is possible to put three sets—say two valve panels and a crystal set—in parallel with the aerial and receive, say, London, Aberdeen and Radio (Paris), each with faultless reception either on the phones or loud-speaker. It is purely a matter of some ten minutes' careful tuning—using each set in the manner of a wave trap. Personally, I do not see why any number of stations may not be received in this way.

I have many times during this period demonstrated this to fellow wireless enthusiasts in this neighbourhood. The ease with which two stations can be received is remarkable.

Croydon. R. F. LAMPORT.

FERRO-SILICON DETECTORS.

Sir,—With reference to the paragraph in the issue of *The Wireless World* for April 1st, announcing experiments with ferro-silicon alloys as crystal rectifiers made by M. Felix Thuad.

It may interest you to learn that some two years ago I, together with another metallurgist, thoroughly investigated ferro-silicons with varying silicon and iron contents, and also numerous other ferro-alloys, with respect to their rectifying properties. As a result, a specially treated ferro-silicon has been on the market in this country for the past eighteen months. J. CROSS (Assoc. Met.).

Sheffield.

20-METRE TRANSMISSIONS.

Sir,—It may not be generally realised what surprising results are being obtained at present on wavelengths of 20 and 40 metres. I have recently heard with great ease the following American stations working on about 20 metres between the hours of 17.00 and 19.00 G.M.T. :—U1XAM, NKF, U1PL, U9CIP, U1CMP, U1CKP, and U9EK. The receiver is a perfectly ordinary regenerative detector and one stage of L.F., and most of the above stations have been heard in broad daylight. Two-way communication is almost bound to become an accomplished fact as soon as the P.M.G. permits experimental work on this wavelength.

The 40-metre band is also proving useful. With only three occasions of casual listening on this wavelength, and without any attempt to log a maximum number of stations, I have easily heard the following between the hours of 21.30 and 24.30 :—1ALK, 2ACH, 1RD, 1CCX, 2ANM, 1ZS, 1YB, and 1RR (all U's).

There is considerable fading on 20 and 40 metres, but signals are frequently sufficiently consistent for long messages to be copied with few omissions. E. H. ROBINSON (G2VW).

London, N.W.3.

Sir,—With reference to the letter from Mr. E. A. Dedman, published in *The Wireless World* for April 1st, I received American stations on 20 metres a short time ago.

On Sunday, March 22nd, two stations were heard calling CQ U on that wavelength. Both were very weak, and one was probably U21O. The time was 15.30 G.M.T.

On Sunday, March 29th, the following were heard :—U1CX calling CQU1CX, 18.00 G.M.T., signals weak. U1XAM calling G5LF, 18.30 to 19.00, easily readable. UNKF calling G5CU, 19.00 G.M.T., stronger than U1XAM.

I have now improved my receiver, and on April 5th I heard the following :—U1AVK calling G2OD, 18.40 G.M.T., weak. U8GZ calling Test 4DU U8GZ, easily readable, slight QSS. U1OW calling CQ, 19.15 G.M.T., very easily readable. U1CI calling CQ, 19.30 G.M.T., very easily readable.

After dark, signals improved slightly, and U8GZ became strong; however, some of the stations faded every five or six seconds. At one time G2OD was heard, very weak; he was jammed by U8GZ, who was twice as loud!

The receiver used is one described last autumn in *The Wireless World*; the aerial is 10ft. long, vertical, and the earth lead 10ft. long and also vertical.

I have also been listening with this receiver on 5 metres, but so far have heard nothing better than motor traffic!

Bedford. F. CHARMAN.

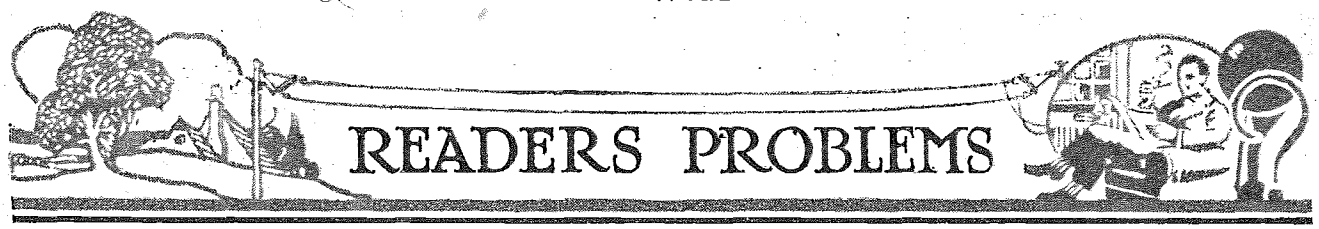
H.T. AND L.T. CURRENT.

Sir,—With reference to Mr. John Kennedy's letter in your issue of April 1st, I would inform you that in conjunction with Mr. G. G. Blake, M.I.E.E., A.Inst.P., I am manufacturing a board for the supply of anode current from D.C. lighting mains. This is the circuit described by Mr. Blake in your issue of January 21st, 1925.

Also, I am manufacturing battery charging boards for radio purposes. These boards are arranged to switch the L.T. battery either "on charge" or "to the set."

As to Mr. Kennedy's suggestion re price, I would assure him that our British prices compare most favourably with those of any imported instrument. L. RUSSELL-WOOD.

17, Thurloe Place Mews,
South Kensington, S.W.7.



Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Relationship of the H.F. Resistance of a Wire to its D.C. Resistance.

SEVERAL readers have enquired in what manner to determine the high-frequency resistance of a length of copper wire, and whether this bears any relationship with the ordinary resistance offered to the passage to D.C. current.

The high-frequency resistance of a wire which runs straight and is not wound in the form of a coil, and at the same time is isolated from other objects bears a very definite relationship to its D.C. resistance. In the case of wires wound into the form of a helix, the calculation of high frequency resistance becomes more complicated.

The actual method of determining the relationship between the D.C. resistance and the H.F. resistance cannot be conveniently detailed within the limited space at our disposal, and readers are advised to consult "Tuning Coils and Methods of Tuning," by W. James, where full information is given concerning this matter.

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Correct Connections of an Intervalve Transformer.

A CORRESPONDENT is in difficulty concerning the correct manner of connecting up a L.F. intervalve transformer, since in various sets he has noticed that this is accomplished in different ways.

No definite rule can be laid down concerning this point, as it differs in various makes of transformers. Probably the best method of procedure is to first connect up the secondary windings by connecting the O.S. terminal to the grid of the valve following the transformer, the I.S. being connected to the L.T.—or to the negative terminal of the grid battery if one is used. The connections of the primary should now be made, first with the I.P. to the anode of the preceding valve and then with the O.P. connected to the anode, the other connection in each case of course going to H. T. positive. The method which yields best results on test should be carefully noted and the permanent connections made accordingly. This is doubly important in sets of the dual amplification type, since the difference between the two is usually very marked, one method of connection causing the valve to rectify, thus producing a great falling off in efficiency, whilst the other method will be found free from this defect.

In many cases manufacturers definitely mark the terminals of their products so that the novice should have this difficulty eliminated, but even where this is the case, it will usually be better, in the case of sets of the dual amplification type, that the experiments we have indicated be carried out. It will usually be found that once the correct method of connection has been found, if the connections of *both* windings are reversed, equal results will be produced, since the disposition of the connections for obtaining best results are relative to each other rather than to the remainder of the set.

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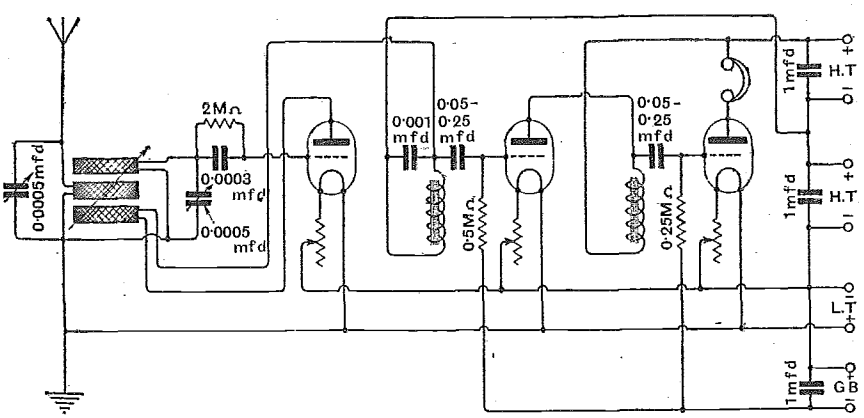
Problems of Selectivity in a Receiver.

WHEN living under the shadow of the aerial of a broadcasting station, it is often a matter of great difficulty to cut this transmission completely out and to receive the "high-power" station at full volume on the loud-speaker, even though the respective wavelengths of the two stations differ so greatly, and a reader situated in this manner seeks our aid in this respect. He desires that full volume be obtainable from the "high-power" station without interference from the local station, and at the same time is emphatic in his desire for high quality reproduction, but does not wish to employ the extra valve and the high anode voltage necessary with resistance coupling.

The circuit given below will be found to fulfil both these requirements. Ample selectivity is provided by the loose-coupled tuner, and it should be possible to receive the "high-power" station and eliminate the local one, even if the latter is in very close proximity to the receiving station. The question of good quality reproduction is overcome by using the choke method of intervalve coupling. The chokes should have as high an inductance as possible, a value of 100 henries being suitable. If the chokes have only a low impedance, the quality will be poor. Other points requiring attention in this respect are the values of the coupling condensers and grid leaks which, for the best results, should not go outside the limits indicated in the diagram.

It will be noticed that two pairs of H.T. battery terminals are provided. A sixty volt battery should be connected to each of these terminals, a $4\frac{1}{2}$ volt battery being connected to the grid battery terminals. In this manner excellent quality will be obtainable, especially if power valves of the correct type are used. If at any time quality is not important, such as when the reception of morse signals is desired, the topmost H.T. battery in the diagram and the grid battery may be removed, and the respective pairs of terminals short-circuited. In this case, of course, the quality in speech and music will be exceedingly poor, but for the reception of morse signals it is quite suitable.

With regard to the $4\frac{1}{2}$-volt grid battery, it will be found that the ordinary flashlight battery, which has exactly this voltage, is quite suitable for this purpose. It is important to note that the long strip on the ordinary flashlight battery is invariably the negative one. Should the battery be reversed, of course not only will distortion be caused but the drain on the H.T. battery will be considerable.



A three-valve receiver with two stages of choke coupled note amplification. This circuit is a selective one, as a loosely coupled secondary circuit is employed.