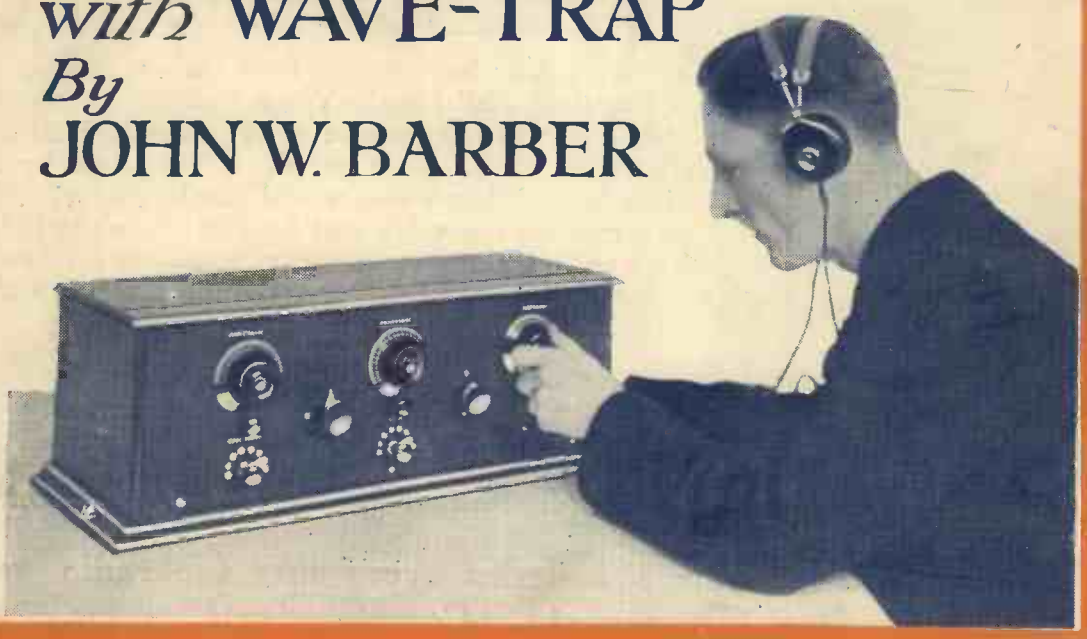
Wireless Weekly, 6d. Net. Wednesday February 3rd, 1926

Wireless Weekly

Vol. 7. No. 20.

A THREE VALVE REINARTZ RECEIVER with WAVE-TRAP

By JOHN W. BARBER



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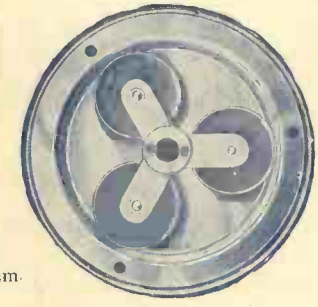
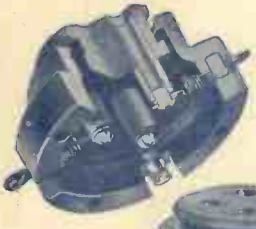


Back view showing mechanism.



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Double view showing construction.

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Radio Settles Down

PARADOXICAL as it may seem, the many arguments, discussions, inquiries, and the like which are now agitating the wireless public are a good proof that broadcasting is settling down to be a permanent factor in national life. As long as "radio" was considered as a scientific novelty, a fad, or a passing craze, serious consideration could not be given to it.

Now we find that a carefully-constituted committee, sitting at the House of Lords, takes evidence from Educational Bodies, Musical Interests, Radio Societies, the Press, and many other interests, examining witnesses with judicial care—all with a view to establishing broadcasting on the firmest and most equitable basis for the future. As a nation we are famous for being slow in taking to great new inventions. Others may carry them far before we ourselves take notice, yet once we have taken them to our hearts, developments along sound lines follow rapidly.

Nothing is more fatal to the progress of a new movement than apathy and indifference. For this reason we rather welcome the critical attitude taken by the general public on the matter and quality of the broadcast programmes. Such dissatisfaction as exists (and, of course, it will never be possible to remove all dissatisfaction) is a clear indication of the desire of the public to have better and broader programmes and to see that it gets them.

CONTENTS

The report of the House of Lords inquiry will not be available until April at the earliest, and although its report will fail to please some of the interests concerned, there is no question that, as a whole, it will be of great value in furthering the art. It is an open secret that the present predominance of trade interests in the B.B.C. is unpopular in many quarters, and it is a foregone conclusion that among the recommendations will be one that the trade element be, to a considerable extent, replaced by those who have the broadest interest of the public at heart.

So far as the programmes themselves are concerned, there are welcome signs that recent criticisms are having effect, although those who would instruct the public during those hours when most listeners desire amusement and relaxation still seem to play too prominent a part in the selection of the items. On the other hand, we have lately had a commendable freedom from "stunt" items which have little entertaining interest.

Listeners who may have possibly felt unsettled by reports of the House of Lords inquiry and other movements can rest assured that, far from weakening the prospects of broadcasting in this country, they can only strengthen it.

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

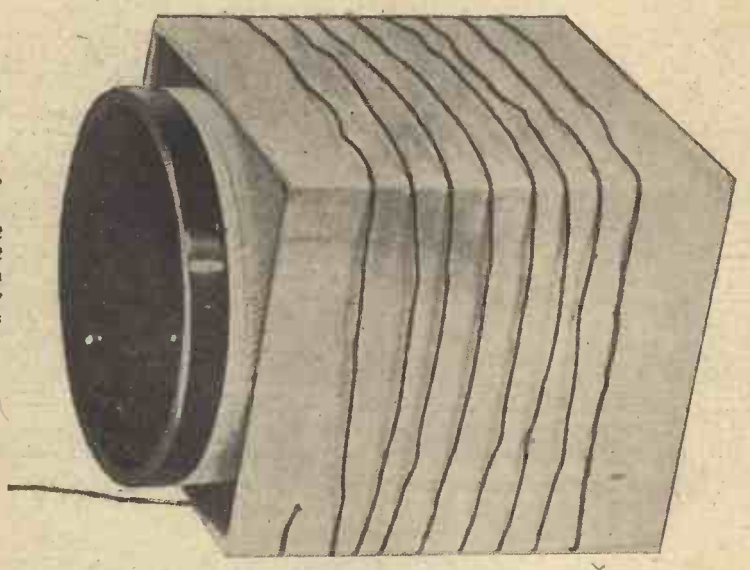
Edited by
JOHN SCOTT-TAGGART,
F. Inst. P., A.M.I.E.E.

February 3, Vol. 7, No. 20.

SCREENING AND TUNING COIL EFFICIENCY

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

Screening is capable of being used to great practical advantage in multi-valve receivers, but care must be taken to avoid the introduction of undue losses. Mr. Reyner gives some very interesting results of his researches in this article.



An improvised screen can be made by winding a few turns of wire round a cardboard box.

A SHORT time ago I discussed in these columns (*Wireless Weekly*, Vol. 7, No. 18) the general principles of screening and its application to wireless receivers. It was pointed out that screening was of two kinds—electrostatic and electromagnetic.

The former type operates by producing a capacity effect to earth from each of the bodies to be screened, so that the capacity currents normally flowing between the two bodies are diverted.

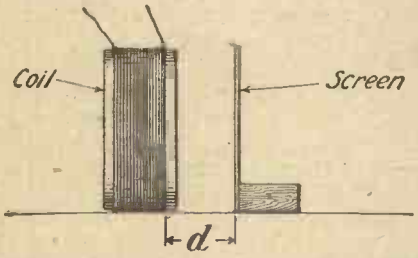


Fig. 1.—In the first series of experiments the effect of placing a screen end-on was observed.

Eddy Currents

The second type of screening operates primarily by the production in the screen of eddy currents which set up a counter magnetic field in opposition to the main coil field.

It will be obvious that even in the case of a static screen the presence of the metal near the coil will cause eddy currents to be set up in the screen, and this will absorb energy from the coil.

Screening and Losses

In the case of a static screen we do not require these eddy currents, so that any losses which occur are wasteful without being useful. With a magnetic screen, on the other hand, the currents are useful, and the screening effect produced has therefore to be paid for by additional losses. The effect of the screen may be minimised by keeping it well away from the coil, but this necessitates a somewhat bulky arrangement.

Experimental Investigation

With the object of finding out how serious the effect of a screen was under ordinary conditions, a series of experiments was carried out on a variety of different arrangements. The first experiment consisted in measuring the resistance and inductance of a given coil, first by itself, and then with a metal plate at a given distance from one end. The diagram given in Fig. 1 illustrates the arrangement.

Tin Plate

The actual coil employed for the purpose was 3 in. diameter and ¾ in. long, being wound with 30 turns of 30 d.s.c. wire slightly spaced. For the first test a piece of tin plate was employed (actually the lid of a tobacco tin). Tin plate, of course, is thin sheet iron coated with tin, so that the screen in this case was magnetic.

The Results

The results of the test are shown in Fig. 2. The percentage increase in resistance is plotted against the distance of the screen from the end of the coil (see Fig. 1).

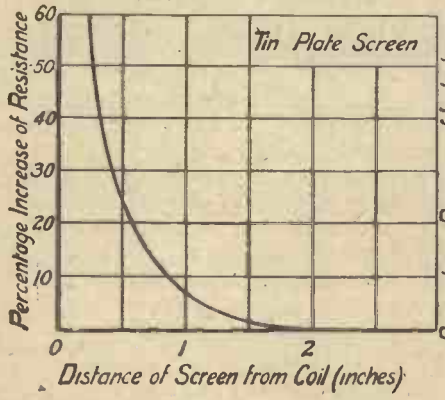


Fig. 2.—Using a tin-plate screen the effective resistance of the coil increases rapidly as the screen is brought near to the coil.

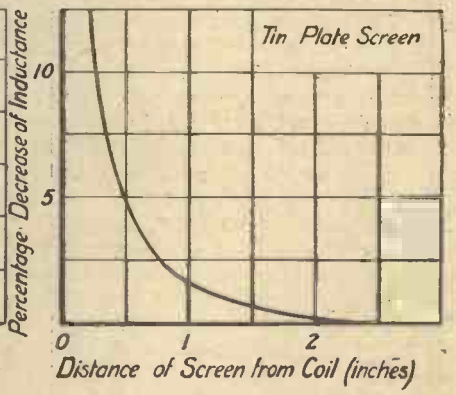
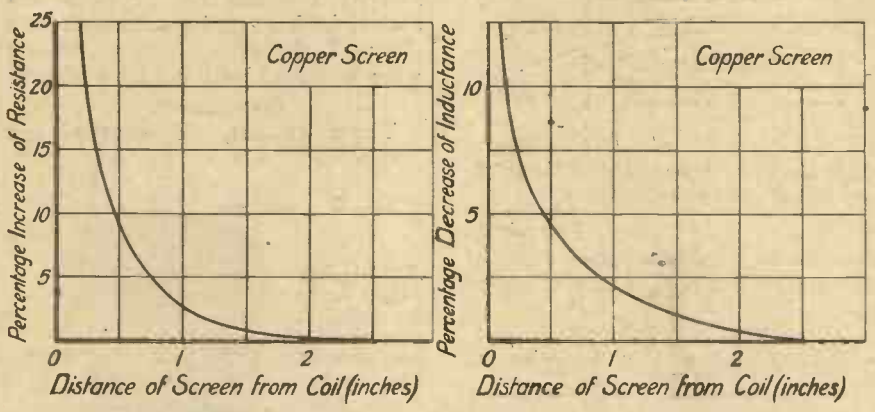


Fig. 3—Due to the presence of the screen the effective inductance of the coil is also altered, the variation being as shown above.

It will be observed that the resistance is only slightly affected as long as the screen is more than 1½ in.

away, but that within this distance the losses increase rapidly until, when the screen is only ¼ in. away from the coil, the resistance is increased by 60 per cent.



Figs. 4 and 5.—When a copper screen is employed the increase in resistance is considerably reduced, but the change in inductance is only slightly affected.

That is to say, a coil having a resistance of 10 ohms would have its resistance increased to 16 ohms by the presence of the screen.

Variation of Inductance

It was pointed out in the previous article that the presence of eddy currents in the screen reduced the effective magnetic field, and so caused a reduction in the inductance of the coil. This decrease is quite marked in practice, and the curve given in Fig. 3 shows the percentage decrease in inductance as affected by the position of the screen.

An Example

It will be seen that in this case also the variation is small until the screen is brought fairly close, when the inductance changes somewhat rapidly. At a distance of ¼ in. the decrease is about 10 per cent. Thus with a coil of 100 μH inductance the altered value due to the presence of the screen would be 90 μH.

The presence of the screen is thus doubly deleterious, because what is required in a coil is a low ratio of resistance to inductance. The presence of the screen increases R and reduces L, so that the ratio R/L is doubly increased. In the case just given the ratio is increased by nearly 80 per cent.

Other Metals

The fact that the iron in the screen is magnetic, however, will probably give rise to additional losses due to hysteresis and kindred effects. The next experiment, therefore, employed a copper sheet for the screen, and the results are given in Figs. 4 and 5.

A Reduction

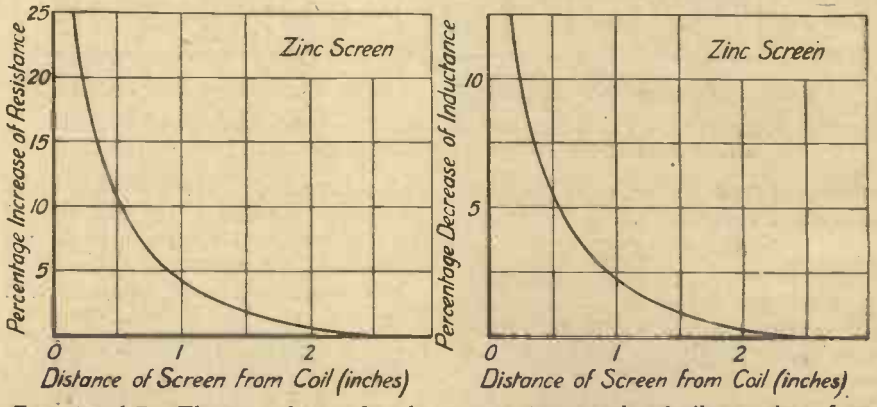
It will be seen that the losses are considerably reduced, the percentage increase in resistance when the screen is ¼ in. away being only 20 per cent. instead of 60 per cent.

The maximum decrease in the inductance is also slightly less, but the curve does not fall away so rapidly. The difference throughout is not very marked. This indicates that the extent of the eddy currents, and hence the effectiveness of the screening, is approximately the same in the two cases, so that the increase in the loss is probably due largely to the greater resistance of the iron and only partially to hysteresis effects.

Perforated Sheet

The metal employed for the screen in the last experiment was not a continuous sheet, but was perforated with small holes, as may be seen from the photograph.

This construction is more convenient when making up receivers, because leads can be taken through the holes, and experiment shows that the difference in efficiency is quite small.

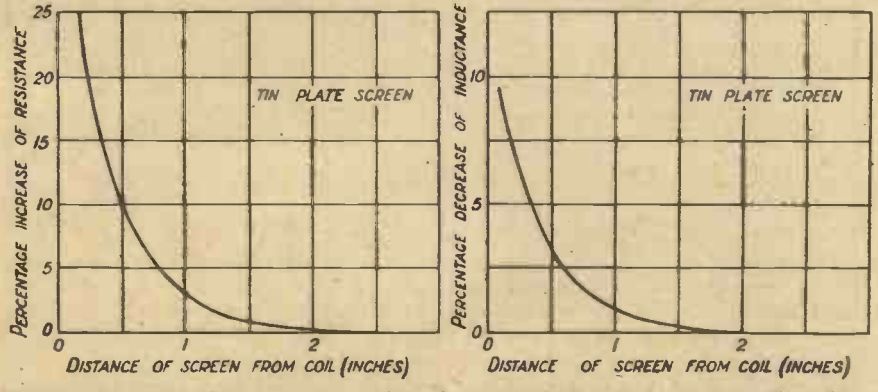


Figs. 6 and 7.—The use of zinc for the screen gives results similar to those for copper. If the screen is not nearer than two inches the effect is practically negligible.

Use of Zinc

The next experiment was to try a zinc screen. For this purpose perforated sheet was again employed. This may be purchased at any ironmongers, as it is used extensively for larder windows, etc.

The results of these experiments are shown in Figs. 6 and 7, and it will be seen that they are very similar to those for the copper screen. The losses are slightly



Figs. 8 and 9.—The screening effect depends on the shape of the coil, and is smaller with a long coil than with a short one. Compare these curves with those in Figs. 2 and 3.

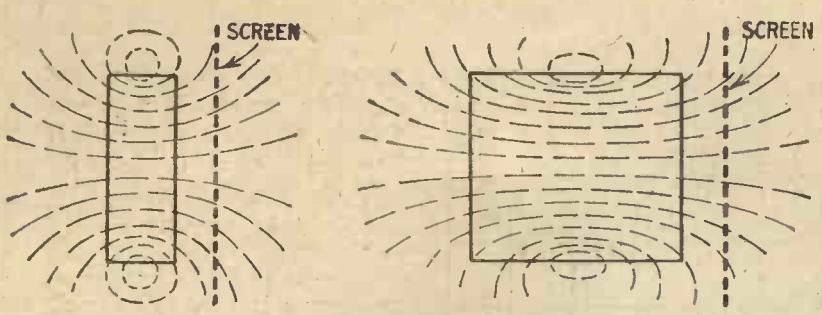
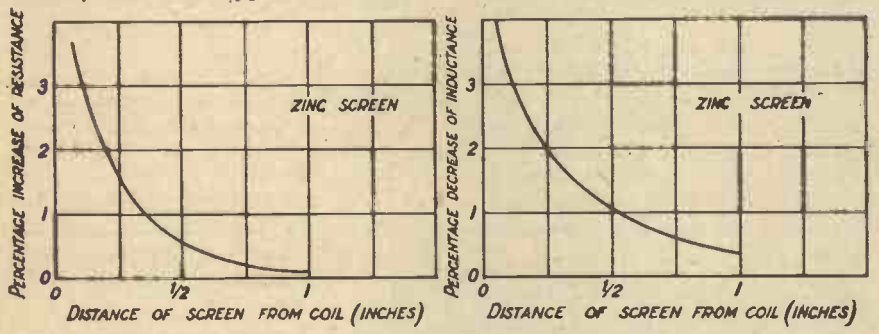


Fig. 10.—With a long coil the external field is a smaller proportion of the total field, so that the effect of the screen is not so marked.

higher, the decrease in inductance being approximately the same. The differences, which are probably due to the slightly higher resistance of the zinc sheet, are not very serious, and this type of screen would appear to be a reasonable substitute for copper.



Figs. 12 and 13.—The variation of resistance and inductance is much smaller when the screen is placed at the side of the coil.

Shape of Coil

The next effect investigated was that of the shape of the coil. A coil 1½ in. long and 3 in. diameter was substituted for the previous coil and the experiments repeated. The iron screen was used for this test, and the effect of the coil can be seen by comparison with Figs. 2 and 3.

It will be observed that the effect of the screen is by no means so marked. The nature of the effects is the same as before, but the actual increase of resistance and decrease of inductance is considerably less.

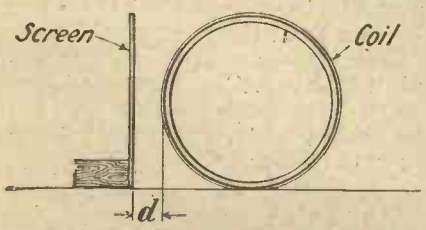


Fig. 11.—In the final experiments the effect of placing the screen at the side of the coi was investigated.

This is probably due to the fact that the field of the longer coil is somewhat more self contained, as shown in Fig. 10. It will be noted that the stray field from the ends of the coil is a smaller proportion of the whole in the case of the longer coil.

Other Positions

These preliminary experiments were concluded by placing the screen at the side of the coil instead of at the end, as shown in Fig. 11.

As one might expect, the effect here is considerably smaller, and the screen may be brought much closer to the coil without causing any serious increase in the losses.

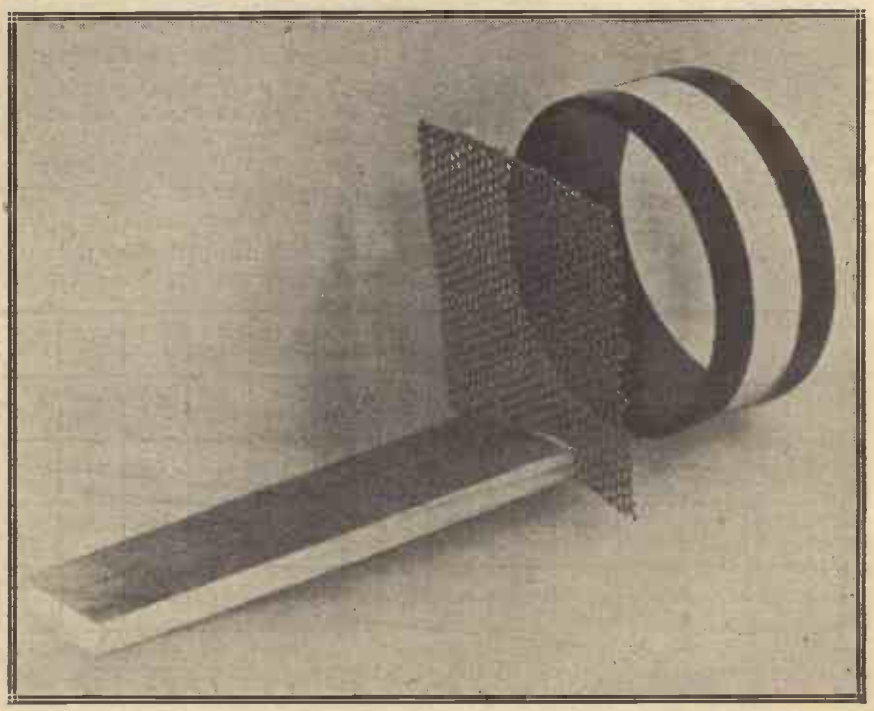
The curves shown in Figs. 12 and 13, taken for a perforated zinc screen, indicate that the screen should be kept at least half an inch clear of the coil. Similar results were obtained with an iron screen.

Conclusions

These results, of course are merely preliminary, and refer principally to static screens. They are interesting in that they show how near a metal object may be brought to a coil without having any serious effect on the efficiency of the circuit.

The problem of magnetic screening is more complicated, because it is necessary here to take into account the effectiveness of the various types of screen, and experiments in this direction are proceeding at the present time.

A tin-plate shield (note its origin!) was found to give perceptibly higher losses than one of copper or zinc.

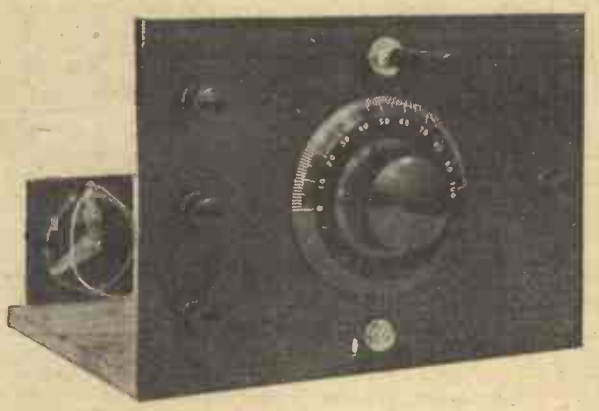


The screen used by Mr. Reyner in some of his experiments was cut from the ordinary perforated zinc obtainable at ironmongers.

Some Experiments with Superheterodyne Circuits

By A. JOHNSON-RANDALL.

The use of H.F. amplification preceding the first detector in a superheterodyne receiver often does not prove amenable to the ordinary rules governing the use of H.F. valves. A certain amount of experimental work is usually necessary, and the author of these notes presents some very helpful information upon this point.



A special H.F. unit made up for the purpose of the experiments described in this article.

OPINIONS differ as to whether supersonic receivers are improved to any appreciable degree by the use of one or more stages of high-frequency amplification preceding the first detector. In the United States, the birthplace of the supersonic heterodyne receiver, very few sets of this type make use of any H.F. amplification at the incoming frequency, the majority relying solely upon two or three beat-tone stages for their sensitivity.

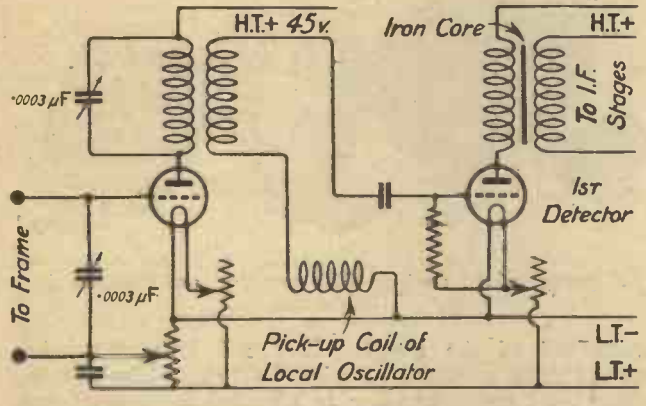


Fig. 1.—The first circuit tried by the author. When used on a frame aerial this proved exceedingly unstable.

A Little-Used Method

In this country, to the best of the writer's knowledge, no commercial receiver employs other than the usual first detector valve, followed by its long wave amplifying portion.

The reason for this is probably owing, firstly, to the difficulty in operating a receiver with more than two controls, particularly when, as in the case of the superheterodyne, it is necessary also to rotate the frame; secondly, to the fact that to add one or more H.F. stages would mean an increase in the number of valves.

Personal Experience

In the writer's opinion the use of an efficient H.F. stage in front of the first detector is a great advantage, since, provided attention is given to the design, both the sensitivity and selectivity of the receiver are greatly increased and the difficulty in operation with three controls appears to be over-rated.

It may therefore be of interest to the superheterodyne enthusiast to have the benefit of the results of work carried out by one who has suffered many disappointments in his efforts to produce a receiver second to none.

A Good Arrangement

The writer's favourite arrangement, after many experiments, consists of a circuit employing two efficient beat-tone stages, tuned to 55 kc. (5,400 metres) and one or two low-frequency amplifying stages, although very careful choice is necessary in the case of two L.F. transformers.

Separate Oscillator

In experimental work the use of a separate oscillator "feeding" into the grid circuit of the first detector valve forms a very reliable and simple method, and the writer prefers it, although it necessitates the use of an extra valve. In all these experiments a variable "pick-up" coil was found to be a distinct advantage.

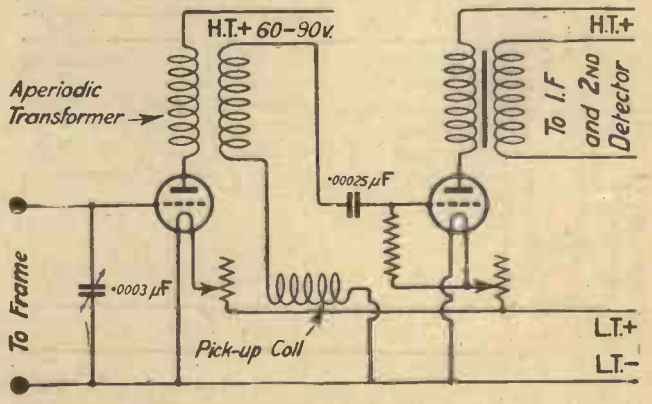


Fig. 2.—An aperiodic transformer was tried, and found to give considerable amplification, without the addition of another tuning control.

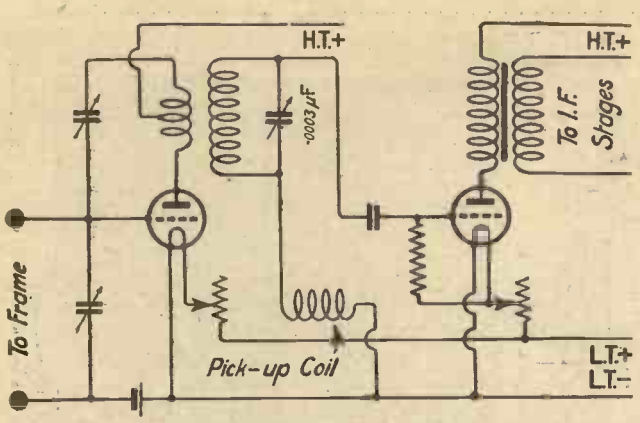


Fig. 3.—The first neutrodyne circuit tried proved somewhat unsuitable for the set under test.

Oscillator Coils

A simple oscillator to work with a beat frequency of about 5,000 metres (60 kc.) may consist of a grid coil of 35 turns of No. 22 S.W.G. d.s.c. wire wound upon a former 2¾ inches in diameter and tuned with a variable condenser of .0005 μF.

A coil of 30 turns of the same wire, separated from the grid coil by about ½ inch, can form the anode coil, while inside the grid coil can be inserted a small rotary "pick-up" coil of 14-16 turns upon a two-inch former.

This arrangement will give satisfactory results with practically any type of valve and will cover the broadcast band with a condenser of .0005 μF.

The First Attempt

The first H.F. circuit tried was that shown in Fig. 1, which shows the ordinary method of employing a plug-in H.F. transformer with potentiometer control of oscillation. The circuit, as shown, oscillated violently with general purpose valves of the .06 type and a 300-600-metre H.F. transformer. This, of course, was to be expected, and since the use of grid current damping is undesirable, the effect of two plug-in coils for primary and secondary was tried.

It was found, however, that when two coils of the same size were used, oscillation was practically uncontrollable without recourse to excessive positive bias.

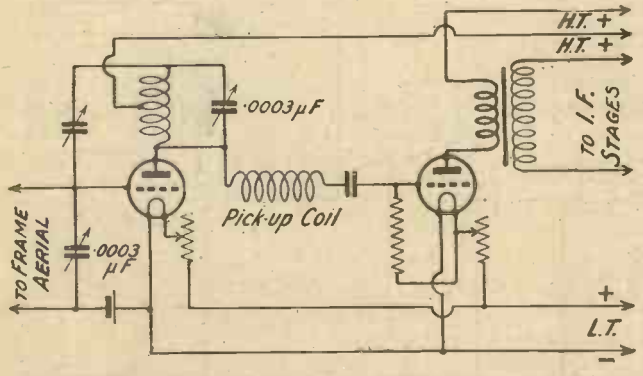


Fig. 4.—A circuit which gave very good signals, but hand capacity effects were troublesome.

If the secondary was tuned instead of the primary, and the primary coil was made small enough to stop oscillation, there was little or no amplification. (It must be remembered that the circuit was being used with a frame aerial.) This method was abandoned, and the next circuit tried is shown in Fig. 2.

An Aperiodic Stage

In this case the arrangement is simply that of an aperiodic transformer coupled in the usual way with the "pick-up" coil, either in the grid or filament lead. Two different types of transformer were employed, one of them a commercial pattern and the other one of the usual slot variety wound with resistance wire in place of copper wire.

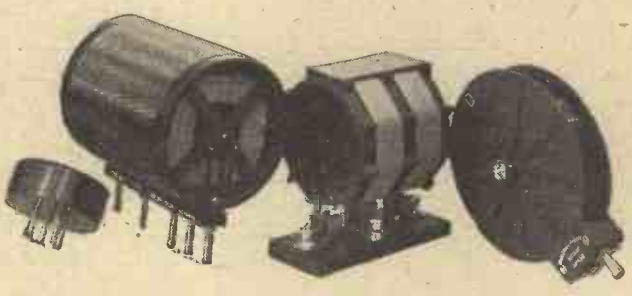
A More Stable Arrangement

The first type was perfectly stable and gave fair amplification with a high-impedance valve and about 60-80 volts H.T.

The other transformer required a potentiometer to control oscillation, but gave more amplification on the whole. A circuit of this type has the advantage of being untuned, and therefore the number of controls remains the same as in the more usual first-detector arrangement.

Neutrodyne Tests

Attention was next given to some method of neutralisation whereby maximum amplification could be obtained with good stability. The Fig. 3 circuit employs a "low-loss" H.F. transformer, of the type described by Mr. Percy W. Harris in the January issue of *Modern Wireless*, in connection with the "Special Five" receiver.



A group of the various H.F. coupling units tested by the author.

Instead of the small "X" coil (primary) being wound with 40 turns of wire, 60 turns were put on, since the smaller winding is intended for two stages.

Poor Selectivity

Using a D.E.5 type of valve, perfect stability was obtained with very fair signal strength, but, curiously enough, the selectivity of this type of coil used with the supersonic receiver was not up to the standard of a similar coil in a straight conventional circuit.

It is quite possible that some method of metal screening would have improved it, but this was not tried owing to the fact that a screen giving the necessary clearance would have been too cumbersome.

A Split-Coil Method

In view of this the writer decided to try a tuned anode arrangement of the type shown in Fig. 4. This consists of some form of centre tapped coil, such as a Gambrell C, a McMichael "Dimic," or a home-made single layer coil comprising 40-45 turns of No. 30 S.W.G. d.s.c. on a 3-in. former, the whole coil being tuned and the centre tap being taken to H.T. +.

The arrangement works quite well with every type of

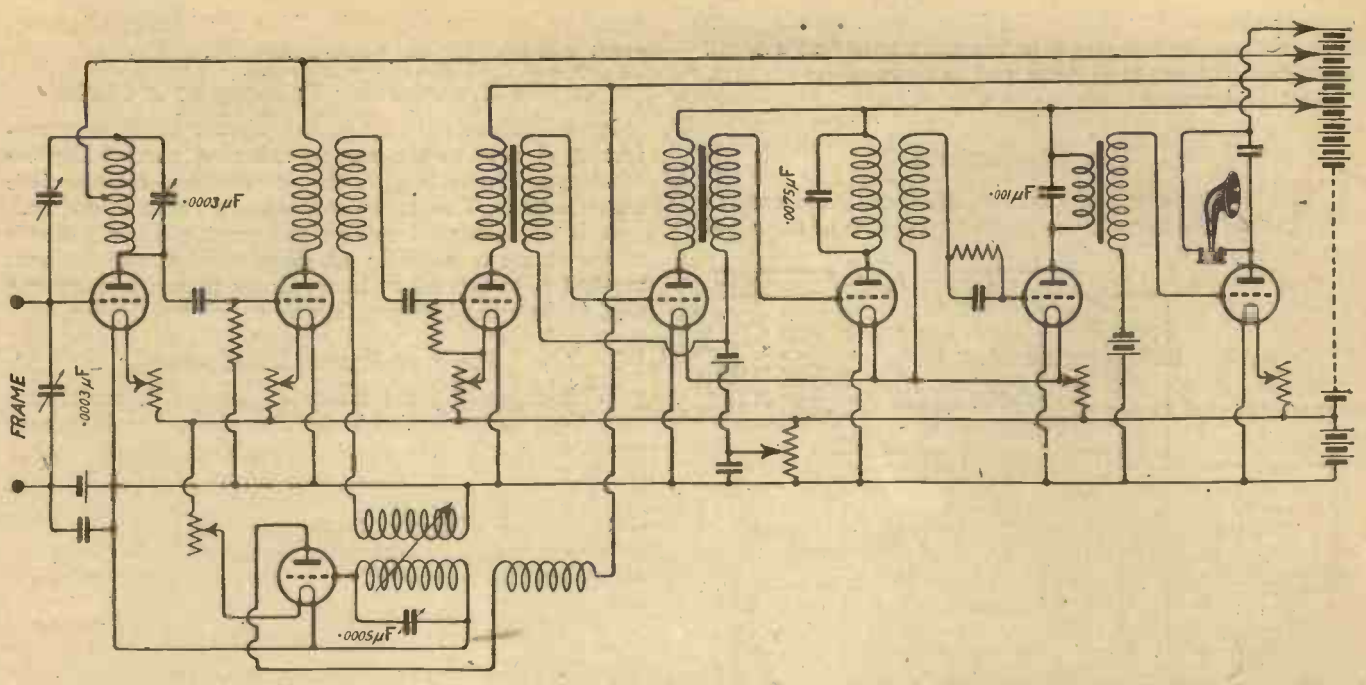


Fig. 5.—The most successful arrangement tried. Two stages of H.F. precede the first detector.

valve the writer has tried, and gives an increase in selectivity with very excellent amplification. Hand-capacity effects seem to be rather noticeable in some cases, however.

Test of a "Dimic" Coil

Of the various coils tried the "Dimic" coil and a home-made single layer type seem to be the best from the point of view of selectivity, but it is difficult to say whether it was due to the type of coil or to some other factor.

Two Stages

So promising were the results obtained that it was decided to try two stages, and the circuit shown in Fig. 5 was finally adopted. It will be seen that the first stage is neutrodyned, a tuned anode arrangement being employed, and that the second stage makes use of an aperiodic transformer, the transformer being so constructed that a band of frequencies from about 1,200 to 550 kc. (250-550 metres) is covered with a fair degree of amplification and there is no tendency to oscillate.

Ease of Operation

With this particular circuit there was no difficulty in neutrodyning the tuned stage, and the number of controls is only three, a comparatively simple number to handle since the tuned anode can be matched up with the frame, the readings on the two condenser dials being practically the same over the whole band. This, of course, means that the coil must be home-constructed in most cases to match the frame, the number of turns required being determined experimentally.

In addition, the tuning of the tuned anode is not very critical and most of the preliminary adjustments can be made on the frame and oscillator condensers.

A Possible Drawback

The arrangement was found to be very sensitive, the only disadvantge being in the number of valves required.

The experiments carried out have convinced the writer that the use of at least one H.F. stage, preferably tuned, before the first detector has such distinct advantages that he has decided to make its use a regular feature in all his own supersonic receivers.

Reduction of "Second Channel Troubles"

Apart from the increase in sensitivity, there is the reduction in "second channel" interference so common

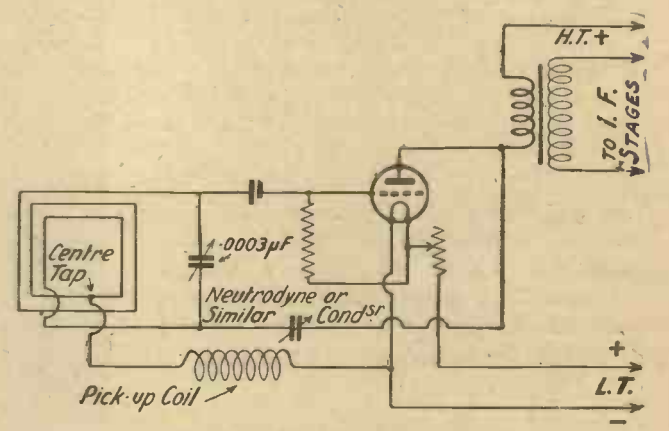


Fig. 6.—The use of reaction from the first detector may be arranged in this way, and may prove very effective.

in this type of receiver, and, further, the employment of H.F. stages helps to eliminate trouble from long-wave C.W.

One of the difficulties in stabilising seems to be produced by the nearness of the frame to the receiver, since by moving it slightly stability is often improved. One gathers from this that some form of screening is desirable, and the writer intends to conduct some experiments with various types of metal screens in order to see whether any material advantage is gained.

Plain Reaction Effects

So far, only H.F. circuits have been dealt with, but a considerable improvement in selectivity and sensitivity

can be obtained without the addition of H.F. stages to the receiver by the use of a tapped frame and a small condenser of the type employed in neutrodyne circuits. The arrangement is shown in Fig. 6.

The Connections

The two ends of the frame winding are connected to the grid of the first detector and to one side of the small

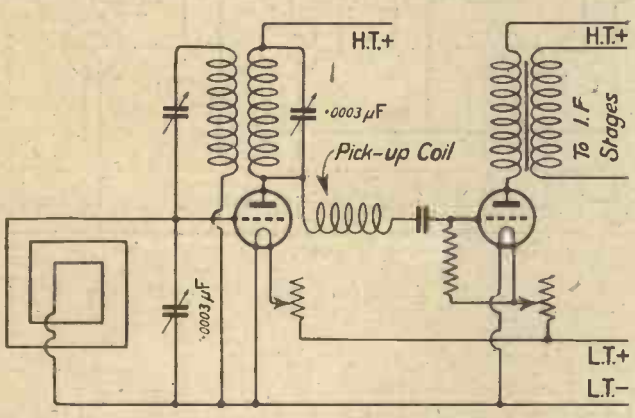


Fig. 7.—The "Cowper" neutrodyne method was tried and found very stable, but the degree of selectivity was not high.

neutrodyne condenser. The frame tuning condenser is joined across the whole winding as usual. The centre point of the frame is taken to L.T. – via the "pick-up" coil, while the other side of the neutrodyne condenser is joined to the anode of the first detector.

By increasing the value of this small condenser a reaction effect may be obtained, with a consequent increase in signal strength. Too much reaction, however, will produce very bad distortion.

Use of Transformer Primary as a Choke

It will be noticed that in this circuit the filter transformer is next to the second detector, there being no condenser across the primary of the first intermediate transformer. This is important in this type of circuit.

It is not essential to find the exact electrical centre of the frame in order to get good results, and the best method is to tap off at intervals by means of a spring clip, finding the best position by experiment.

Effect of Frame Resistance

With a really good frame of low H.F. resistance very little reaction should be necessary, but in actual practice its effect is most astonishing, signals being received which, without reaction, are inaudible. Any small condenser of the "neutrodyne" type is satisfactory, and with the frame tap arranged so as to include a smaller number of turns, a three-plate condenser of the "vernier" type may be found to work well.

Choke Sometimes Needed

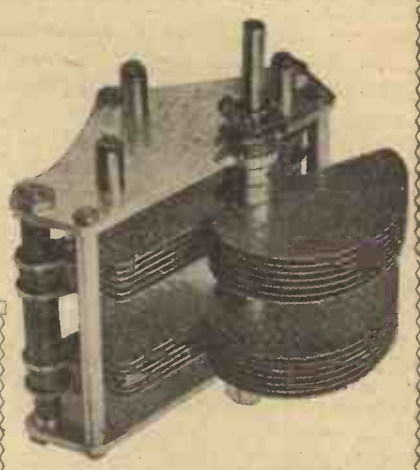
This form of regeneration will not function properly if a condenser is connected across the primary winding of the first intermediate frequency transformer, unless a radio choke of low self-capacity is inserted in the anode lead of the first detector. This choke might consist of a winding of about 250 turns for the broadcast band, but this value may require experimental adjustment. The most efficient type of valve for use as the first detector seems to be one of the high μ, high impedance type, such as the D.E.5b, D.F.A.1, D.E.3b, etc.

An eight-valve portable super-heterodyne receiver designed by Mr. Kendall and described in the July, 1925, issue of "Modern Wireless." A stage of H.F. amplification was included in front of the first detector, employing an untuned coupling unit.

WHERE ARE THOSE CONDENSER LOSSES?

By H. J. BARTON-CHAPPLE, Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

In choosing a condenser attention should be paid to those points of design and construction which experience indicates affect its performance. Mr. Barton-Chapple indicates clearly which are these important points, and explains which deserve the greatest consideration.



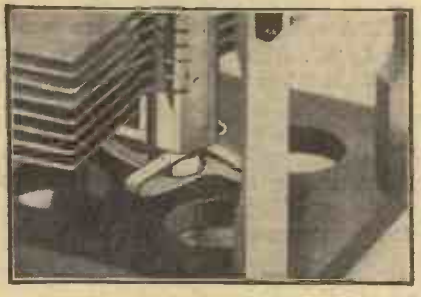
One of the more recent types of "low-loss" condenser (Igranic dual) in which the fixed plates are supported by side pillars of insulating material.

IT is quite apparent from the articles that have recently appeared in the columns of Radio Press publications, and also from the type of advertisement used by the manufacturer when endeavouring to popularise his wares, that we have reached a stage in wireless developments where the questions of "low-loss" are of real importance. This phase of progress has, no doubt, been reached rapidly as the natural outcome of the fillip given to wireless by the advent of broadcasting.

Unfortunately, this stressing of "low-loss," while being worthy of commendation, since it is indicative of the improvements made in wireless receivers both by the home constructor and the professional wireless engineer, is apt to provide a complete misapprehension of facts, which, when viewed in their true light, show how energy has been diverted into channels which will only produce a very small and barely perceptible increase in efficiency.

Correct Relationship

One hears the term "low-loss" applied to coils, transformers, con-

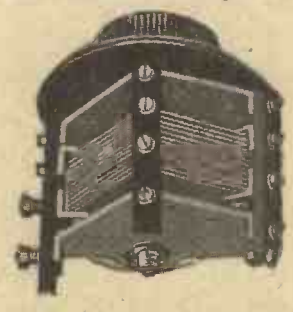


Special precautions are taken in the Bowyer-Lowe "Four-square" condenser to make good contact on the moving spindle.

densers, etc., and it becomes imperative to place each one of these components in its correct relationship to the others before making rash statements as to requirements and merits. With these points in our mind, it would appear opportune to devote a certain amount of attention to losses in condensers, which should be taken into consideration with the details of coils which have recently appeared in the columns of this journal.

The Problem

Condensers without losses are the ideal to be aimed at, and remarkable progress has been made in the construction of these essential components which, in the case of reputable makes, has placed them



Another example of up-to-date practice in the mounting of the fixed plates.

in the front rank of reliable wireless accessories, at least as far as reliability can be judged with our present systems of measurement. That certain losses do occur in condensers is an established fact, and consequently when one employs condensers in a circuit carrying high-frequency currents, detrimental effects are produced which should be eliminated as far as possible. The real problem is effectively to separate the losses, and then to effect improvements which will minimise them as far as is practicable when questions of cost have to be borne in mind.

Where the Losses Exist

The losses are due to a variety of causes, among the most important of which may be mentioned:—

(1) The actual leakage between plates through and across the dielectric of the material employed in the construction.

(2) Dielectric hysteresis losses.

(3) Actual heating losses in the metals comprising the plates themselves and also any metallic supports.

(4) Contact resistance between the two sets of plates and their terminals.

(5) Corona losses round the edges of the plates.

The problems introduced by the losses included under heading (5) only concern condensers when employed at high voltages, and will not be dealt with here, as few experimenters are likely to be confronted with such questions. The remaining four sets of losses, however, do exist in receiving circuits, and will be discussed in this article.

Dielectric Leakage

Good quality insulating material possesses a very high specific resistance, that is to say, for a given length and cross section of the material its resistance to a flow of current is particularly large, and consequently the resultant current for a given applied voltage is very minute. Now the actual voltage across the condenser in ordinary receiving circuits is generally quite a small quantity, and consequently the amount of current leaking through the dielectric itself is practically negligible.

In conjunction with this we must consider the actual leakage across the surface of the insulation employed in constructing the condenser. For good quality commercial material this also is a small quantity, but the surface is prone to moisture effects which may seriously influence the ultimate result. Best quality ebonite has only a very small leakage, even

when moisture is present, but in all cases it is necessary to ensure that the condenser is situated in a dry atmosphere, and the surface of the insulating material should be made quite smooth in order to reduce the tendency for small globules of moisture to adhere, which tendency would be enhanced if the surface was at all rough.

Hysteresis Losses

When a condenser is in a circuit carrying high-frequency current, it will be apparent that a certain alternating potential or voltage exists across the plates which produces a definite alternating electric field. The molecules comprising the solid material are thus subjected to a pulsating strain, which will tend to alter their orientation a number of times per second, depending upon the frequency of the circuit. The resistance to any change of orientation of these molecules produces what is known as a hysteresis or lag effect, and consequently a loss is introduced from this feature. Of course, as far as the air portion of the dielectric is concerned, these remarks have no direct application, but the amount of insulating material in the main portion of the electric field should be reduced as far as possible so as to minimise these losses.

Heat Loss in Condenser Plates

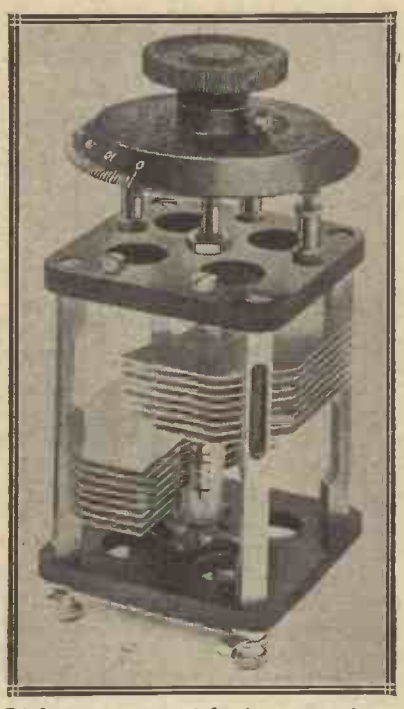
Any metal which is present in the condenser will be subjected to the alternating electric field, and this will cause eddy currents to be induced. Although small, they will represent a certain percentage of the loss. As far as the actual currents flowing through the metal plates and leads are concerned, it will be obvious that the smaller their resistance the smaller will be the resultant heat loss which is proportional to the product of the square of the current and the resistance, *i.e.*, I^2R.

Contact Resistance

Quite appreciable losses may be the outcome of the contact resistance between the plates and their terminals and any necessary connections. Sometimes a rubbing contact is employed between the spindle of the moving plate and the lead to the respective terminal. Again the contact is made in some cases to a connection through the bearing of the moving plates, but this method should be discouraged. Constant movement in the bearing is sure ultimately to produce a varying contact, with the consequent introduction of a variable resistance into the circuit which may be quite appreciable.

Surprising Results

Using a special low-resistance measuring instrument somewhat similar in operation to a megger, it is possible to read direct from a pointer moving over a graduated scale the resistance in ohms of such a contact, and it would surprise many experimenters to see how the needle of such an instrument fluctuates as the spindle is rotated. This resistance variation, although comparatively minute, is enhanced when the condenser is used for high-frequency work. It is therefore imperative to ensure reliable and clean contacts between the individual



Dielectric material is sometimes "economised" in the electrical sense by drilling large holes in the end plates.

plates, and in the case of the moving plates connection to the terminal can be made through the medium of a thin helical spring. The use of certain common types of "pig-tail" in this case is liable to produce scratchy noises, and consequently should not be resorted to.

Enclosing the Condenser

Where possible the condenser should be enclosed in a dust-proof cover, as for accurate measurements the presence of dust between the plates is liable to introduce an error. Quite recently the National Physical Laboratory found that it was not possible to produce a check on certain results, and traced this fault to dust particles on the condenser plates. The application of a blow-pipe flame across the plates reduced the resistance by about $\frac{1}{15}$ of an ohm, as a result of burning off the dust. The alternating voltage across the plates caused rapid movements of the dust particles, and this was registered as an apparent resistance, hence producing a discrepancy when checking the results of the measurements then being undertaken.

Metal for the Plates

The metal employed in manufacturing the plates should not be prone to the objection of rapid oxidation, as this causes a film to form over the surfaces of the plates, which not only introduces losses, but produces capacity alterations, and thus militates against constancy of calibration. Aluminium plates, for this reason, are not very reliable, since they readily oxidise, and for the best work good quality brass is to be preferred. In addition, the plates should be quite flat and no burred edges present.

Fixed Condensers

Turning for a moment to a consideration of fixed condensers, it should be noted that dielectric losses exist, and in the case of paper and some grades of glass these may be somewhat high. Again, it must be remembered that when using solid dielectric condensers they very rapidly lose their insulating properties as the temperature increases.

The results of some tests made by L. W. Austin at a high pressure of 14,500 volts and a frequency of 300 kilocycles are given in the table opposite.

In this table the last column, representing the "equivalent series resistance," is obtained from the following considerations.

Equivalent Resistance of a Condenser

For purposes of calculation all the losses in a condenser can be grouped together and represented by a certain hypothetical resistance. The condenser with losses can be represented as a perfect condenser of the same capacity with a non-inductive resistance in series as in Fig. 1, the latter being of such a value that it will dissipate the same amount of power as the "faulty" condenser. For example, suppos-

Type of Condenser.	Power Factor.	Capacity in μF.	Equivalent Series Resistance in Ohms.
Compressed air	0.001	0.0058	0.14
Leyden jar in oil (glass)	0.003	0.0060	0.28
Composition Murdoch	0.004	0.0054	0.41
Glass plates in oil	0.005	0.0042	0.58
Moscicki condenser	0.006	0.0055	0.57
Leyden jar in air	0.016	0.0061	1.40
Moulded micanite	0.023	0.0041	2.90
Paper	0.024	0.0058	2.20

ing the power lost in a given condenser was .003 watt when a current of 100 milliamperes was flowing, the equivalent series resistance would be given by the expression

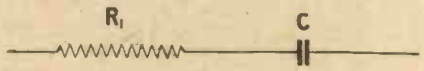


Fig. 1.—The losses in a condenser may be regarded as equivalent in effect to a resistance in series with it.

$$R_1 = \frac{.003}{.1^2} = .3 \text{ ohm.}$$

Shunt Resistance

Or, again, the faulty condenser might be replaced by a perfect condenser shunted by a suitable leak or resistance, as in Fig. 2. It can be shown quite readily that, under these circumstances, if the voltage across the condenser is, say, 300 volts, and the loss quoted above is present, then

$$R_2 = \frac{300^2}{.003} = 30 \text{ megohms.}$$

The equivalent series resistance should always be a small quantity,

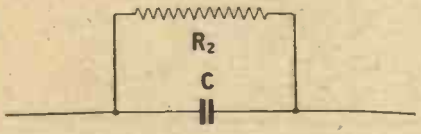


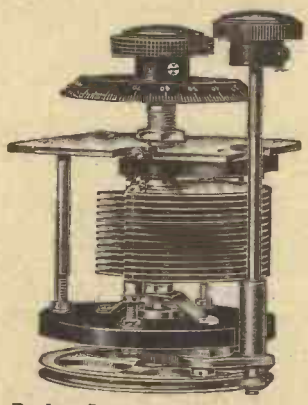
Fig. 2.—The leakage losses in a condenser may be regarded as a parallel resistance.

while the shunt resistance should be large for good condensers.

For most condenser dielectrics it is found that the equivalent series resistance varies inversely with the frequency, thus indicating a constant energy loss per cycle.

In actually measuring the losses of condensers at high frequencies, many difficulties are encountered which prevent accurate results unless elaborate and expensive apparatus is employed. However, when all the possible sources of losses mentioned in this article are taken into consideration, it will be found that the total equivalent series resistance is usually less than .5 ohm for high-grade variable condensers.

When this is viewed in the light of the resistances of the coils with which the condenser is incorporated in wireless apparatus, it will become apparent that the low-loss question is unduly stressed, for the coils themselves frequently have high-frequency resistance values of several ohms.



The Radio Instruments geared condenser, showing the special method of making contact with the moving spindle.

Another method of supporting the fixed plates with a minimum amount of dielectric material is illustrated here.

The remarks in the opening paragraph are thus justified, and so long as the condenser is constructed in a sound mechanical manner, with an absence of large metal end plates and a minimum of metal supports, together with reliable insulating material, "low-loss" will be the natural outcome in the finished component.

FORTHCOMING EVENTS

WEDNESDAY, 3RD FEBRUARY, AT 6 P.M.
Wireless Section, Institute of Electrical Engineers.
Paper by Mr. J. Hollingworth, A.M.I.E.E., on "The Propagation of Electric Waves."

THURSDAY, 4TH FEBRUARY, AT 6 P.M.
Institute of Electrical Engineers.
"Power Factor and Tariff," by Mr. E. V. Clark, B.Sc.
"Power Factor Improvement," by Mr. E. W. Dorey.

WEDNESDAY, 10TH FEBRUARY, AT 6 P.M.
Informal Meeting, R.S.G.B.
"The Manufacture and Properties of Electrical Conductors," by Mr. E. L. Wildy.

WEDNESDAY, 24TH FEBRUARY, AT 6 P.M.
Ordinary Meeting, R.S.G.B.
"Some Loud Speaker Experiments," by Professor E. Mallett, M.Sc.

FRIDAY, 19TH MARCH, AT 6 P.M.
T. and R. Section, R.S.G.B.
Open discussion on "Short-Wave Transmitters."

HAVING completed the Telepeeper, of which I gave you a full description recently, it might have been thought that Professor Goop and I would be content to rest for a spell upon our laurels. Such a thing as idleness is, however, abhorrent to my active nature, except that I have a curious prejudice, superstition—call it what you will—against working upon any day that has not a Z in it.

As soon, therefore, as the Telepeeper had assumed concrete form the Professor and I returned to the experiments which we had begun with a view to helping wireless enthusiasts to economise in time, materials, money and labour. I am now publishing for the first time certain very important results in the form of hints and tips of the most valuable kind. It is, unfortunately, too late for either the Professor's name or my own to be in the New Year's Honours List, but I am assured upon the highest

. . Commanders of the Yugo-Toblazian Order of Intellect . . .

authority that recognition of our untiring efforts to popularise wireless will not be left very much longer unrewarded.

Foreign Recognition

In other countries our merits have been more fully recognised than at home; this is, of course, always the way. Possibly you did not know that both of us are Commanders of the Yugo-Toblazian Order of Intellect (Fourth Class), whilst we received recently at the hands of the President of the French Republic the much-sought-after title of Chevalier d'Industrie.

Modesty prevents me from mentioning the other dignities that have been conferred upon us by appreciative foreign nations. I will only say that when we are in full dress and wearing all our orders each of us rattles and clinks like a three-wheeled Ford van loaded with empty milk-cans proceeding at top speed over a frozen ploughed field.

Wire

The first of the hints that I wish to give you concerns wire. Most of you, when you are wiring up a set, snip off lots of little bits and pieces which you simply fling away recklessly. It has been calculated by a great authority that if all the copper wire so wasted could be collected and melted down into farthings there would be sufficient to make every 'bus conductor in London exceedingly annoyed.

How it is Done

No piece of wire, however small, should be consigned to the dustbin. Portions three inches or so in length should be placed in a special box, and when a sufficient supply has been collected excellent mouse-traps may be made from them. Shorter pieces should be soldered together end on end, or they may be pointed and given heads by placing them in the vice and smacking one end with a round-ended hammer. If this is done they make excellent nails for repairing boots, and there are many other useful purposes for which they can be employed.

A Non-Skid Device

If, for example, you are bald-headed, and find that the bands of your headphones are apt to slip, you will find it an excellent tip to drill twenty or thirty holes in the bands, inserting into them, point downwards, as many of the copper nails as there are holes. This simple tip completely eliminates that distressing phone-skid which makes wireless reception such a hardship for those with shiny pates.

Bent or kinked wire may be straightened very easily. Place a number of lengths which require treatment in your pockets, and go to call upon a selection of your friends. On reaching the first front door, pull out a kinked length and fasten one end to the knob. Hold the other between the teeth, knocking and ringing loudly as soon as you are ready. The ensuing violent opening of the door is guaranteed to do the trick.

A Sad Warning

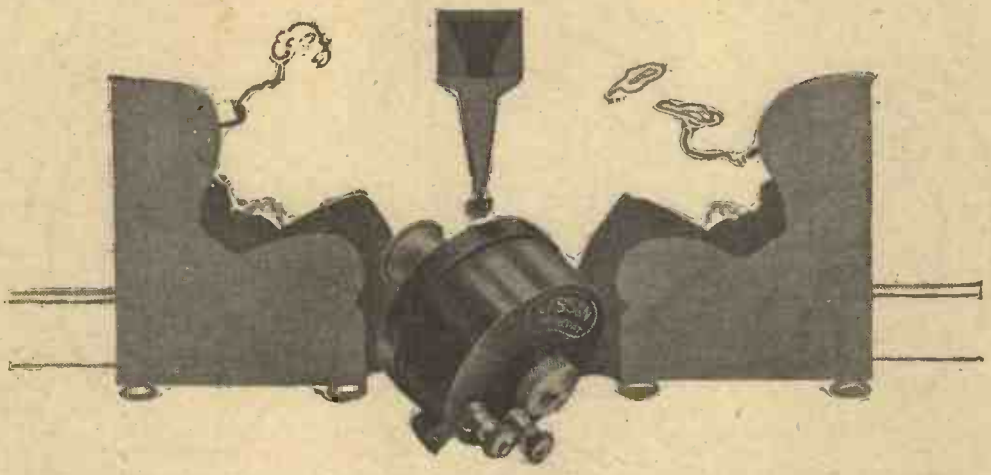
Always make sure before knocking and ringing that the door opens inwards. Gubbsworthy, whom we are using for experimental purposes, had a sad little experience the other day when he was testing the new wire-straightening system. Going to the house of a perfect stranger, he jangled the bell and rapped in such a peremptory fashion, that the door was instantly flung open. Unluckily it opened

. . . the door was instantly opened . . .

outwards, with the result that the wire was worse kinked than ever, and the Professor and I had later to pull his nose out of his face with gas pliers.

High-Tension Batteries

Only too frequently high-tension batteries whose voltage has declined to small proportions are cast disdainfully aside by thoughtless wireless folk who can see no further use for them. Actually few components that have served their time can be made to give more useful service than ex-batteries of the high-tension type. Without any



Build your own Loud Speaker and discard your headphones

Gone are the days of troublesome 'phones. The Lissenola brings loud speaker convenience to every home at a record in low price. For 13s. 6d.—less than the cost of headphones—you can buy the Lissenola, which only needs the addition of a horn to make it a powerful, full-sized instrument yielding results equal to an expensive loud speaker.*

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You can build a horn yourself—with each Lissenola we give you full-size exact patterns and clear instructions how for a few pence you can build a big horn of proved efficiency. The illustration above shows the effective horn you will build. It can be covered with fancy paper or painted so as to resemble a factory-made article. In addition, the Lissenola will fit the tone-arm of any gramophone, instantly converting it into a radio loud speaker.

By using the Lissen Reed (sold separately for 1s.) the Lissenola will carry a cone or any other diaphragm working on the reed principle. You can quickly make a paper diaphragm yourself.

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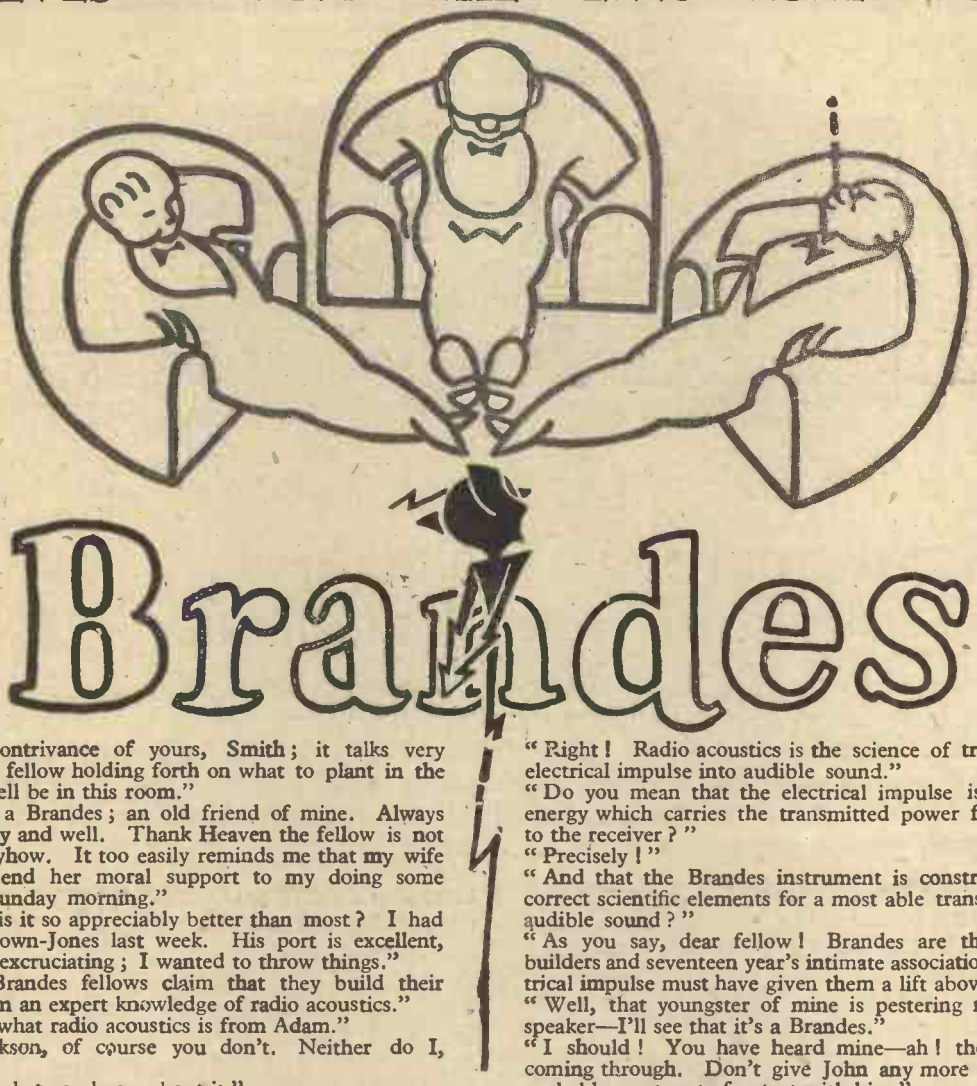
L.11

OURSELVES — AND THE ELECTRICAL IMPULSE



Brandes

"That radio contrivance of yours, Smith; it talks very naturally. The fellow holding forth on what to plant in the garden might well be in this room."

"Ah yes! It's a Brandes; an old friend of mine. Always did sound clearly and well. Thank Heaven the fellow is not in the room, anyhow. It too easily reminds me that my wife will probably lend her moral support to my doing some gardening on Sunday morning."

"Yes, but why is it so appreciably better than most? I had dinner with Brown-Jones last week. His port is excellent, but his radio is excruciating; I wanted to throw things."

"Well, these Brandes fellows claim that they build their instruments from an expert knowledge of radio acoustics."

"I don't know what radio acoustics is from Adam."

"My dear Jackson, of course you don't. Neither do I, technically."

"Well, tell me what you know about it."

"You perhaps know that acoustics is the science of sound?"

"Well, ye-es!"

"Right! Radio acoustics is the science of transforming the electrical impulse into audible sound."

"Do you mean that the electrical impulse is the electrical energy which carries the transmitted power from the studio to the receiver?"

"Precisely!"

"And that the Brandes instrument is constructed with the correct scientific elements for a most able transformation into audible sound?"

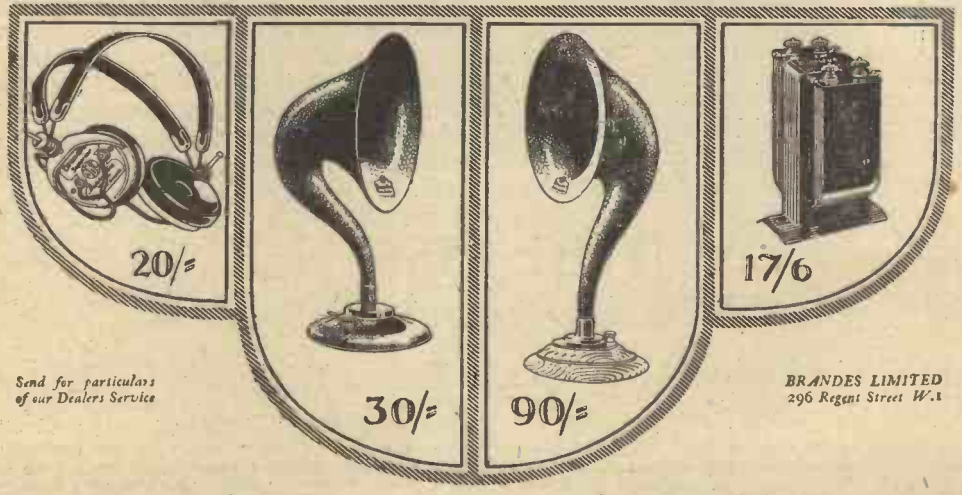
"As you say, dear fellow! Brandes are thoughtful radio builders and seventeen year's intimate association with the electrical impulse must have given them a lift above the others."

"Well, that youngster of mine is pestering me for a loud-speaker—I'll see that it's a Brandes."

"I should! You have heard mine—ah! the Savoy Bands coming through. Don't give John any more whisky. He'll probably want us to fox-trot with him."

"No sir! On the contrary, I am thinking of investing in a Brandes."

MATCHED TONE HEADPHONES — THE TABLE-TALKER — THE BRANDOLA — AUDIO TRANSFORMER



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EXPERTS IN RADIO ACOUSTICS SINCE 1908

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preparation at all they form most excellent missiles for use in neighbourhoods where feline broadcasting follows the closing down of the B.B.C. stations. They also make handy little paperweights, whilst ardent balloonists will find that there is no more convenient form of ballast.

Further Bright Ideas

When they have given service in the ways mentioned, old high-tension batteries are by no means at the end of their usefulness. The wax should be carefully melted down and cast into candles. If the covering is of pitch it may be boiled up with a little sugar, and made into inexpensive but satisfying caramels for the younger members of the family.

Each little zinc pot should be gently removed from its bed, emptied of its contents, and brightly polished. So treated, the cell cases may be turned into liqueur glasses, hat ornaments for one's wife or ferrules for walking-sticks. They also make tasteful little receptacles for sprouting acorns, and nothing could be more attractive than a row of them, each with its baby oak, upon the mantelpiece of the wireless den.

Condensers

What are we to do with old condensers, both fixed and variable? Throw them away? Give them to the vicar's wife for the village jumble sale? Present them to our foes? Such courses are all very well for the financially reckless, but they will not fall in with the views of students of economy in wireless.

The uses for time-expired fixed condensers are many. If they are in ebonite cases with a filling of wax they form first-rate firelighters, a dozen or so being used at a time for this purpose. Much the most economical way of disposing of them, however, is to take each carefully to pieces, placing in one box the sheets of alleged ruby mica and in another the pieces of copper foil. With the mica all kinds of handy things may be made, such as goggles for motoring or fireproof face covers for the use of cooks. The little sheets may be carefully cemented together until a piece large enough to roll up into a lamp chimney is obtained, whilst from a still larger sheet a splendid fire screen may be turned out by nimble fingers.

For the Children

The empty cases may be filled with marzipan and clamped together in pairs. So treated, they are tremendously popular at children's parties, each of the little ones being provided with a pair of nut crackers. The copper-foil plates should be cut into strips $\frac{3}{8}$in. in width and soldered together end on end. In this way you can soon

. . . *make your boots entirely non-slipping* . . .

acquire sufficient copper tape to make a highly efficient aerial.

What to Do with Old Variable Condensers

The uses for decrepit variable condensers are legion. It is not generally realised that if four small holes are drilled through the middle of a knob it becomes a perfectly good overcoat button—everyone knows how prone the lowest button on an overcoat is to come off and how difficult it is in the ordinary way to replace. If you are a footballer or a hockey player you will find that you can make your boots entirely non-slipping by fixing with the help of screws half-a-dozen knobs to the soles of each.

Ideas Innumerable

Dials and endpieces should be placed in the scrap-box for melting down as previously described and recast into panels. From the aluminium vanes very pretty numbers for your front door can be cut

. . . *stripped screws and nuts for the ostrich* . . .

out, or stencils for marking collars, and other articles can be manufactured with the help of a fretsaw and a little skill. There are so many other ideas for using up old variable condensers that I will not insult you by mentioning them, especially as none of them happens to occur to me at the moment.

Transformers

I suppose that there must be upon the shelves in the dens of wireless enthusiasts about the country millions upon millions of low-frequency transformers too bad even to give to one's boys when they first begin to flirt with valve sets. Even the vilest types will be found to contain on their primary and secondary windings a yard or two of wire, which should be carefully removed and stored in case a use turns up for it—though, between you and me, I do not see how it possibly can—upon a disused cotton-reel.

A Gymnasium for Birds

When there is a considerable amount of wire the garden may be turned into a temporary rope-walk, excellent flex being readily made at home by plaiting together thirty or forty hundred-yard lengths. Odd pieces of transformer wire may be used in the spring-time for constructing those little entanglements over sprouting seeds which afford our feathered friends so much healthy exercise and amusement.

The cores of even the worst transformers are made up of thin plates, usually carefully insulated from each other by interleavings of paper, and then connected up again electrically by having bolts pushed through them all over the place. These thin plates, having been cut to a suitable shape, may be tempered by heating them in the drawing-room fire and dropping them into the slop-basin. This having been done, they may be ground and sharpened into very effective safety razor blades.

Miscellaneous

Let me close with a selection of minor hints and tips. Disused terminals of the telephone type may be turned into tasty tie-pins by cutting off the shank and inserting a needle into a hole drilled for its reception. A diamond or ruby, obtainable at any sixpence-halfpenny bazaar, should be mounted in the hole intended originally for the reception of a lead. Screw-down terminals with their shanks cut off short make evening studs so simple to insert that no loss of time or temper need be feared. Broken telephone leads may still be used as leads, not for 'phones, but for little Fido; whilst stripped B.A. screws and nuts, if collected and placed in a paper bag, will form an acceptable and satisfying meal for the ostrich during your next visit to the Zoo. **WIRELESS WAYFARER.**

Some Notes on Low-Frequency Amplifiers

By PERCY W. HARRIS, M.I.R.E.

Many of the arrangements which we habitually provide in L.F. amplifiers are purely conventional, and the author shows in these notes the matter is not perhaps so simple as some assume.

THERE are one or two points about low-frequency amplifiers which do not receive the attention they deserve, and which merit our consideration from an efficiency point of view. For example, consider the diagram in

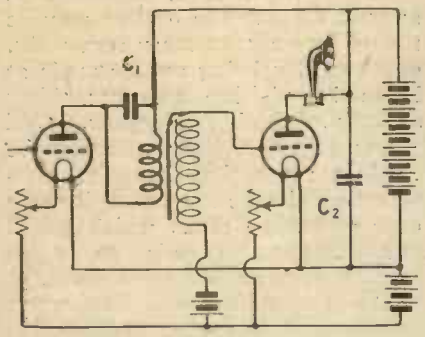


Fig. 1.—The by-pass and reservoir condensers C1 and C2 are here shown in their conventional positions.

Fig. 1, which shows the L.F. circuits of a receiver using transformer coupling. Whether or not we have a reaction coil in the anode circuit of the detector valve, it is usual to shunt the primary winding of the transformer with a fixed condenser of a value which may vary within limits, but is generally about .001 μF. The object of this condenser is to by-pass the high frequency component of the anode current.

Position of By-Pass Condensers

In almost every amplifier the condenser is connected across the IP and OP terminals, and, indeed, one or two makers of transformers provide clips so that this may be done on the instrument itself. We are liable to forget that the requisite path of the high-frequency component is back to the filament. Why, then, should we cause the oscillations to go through the condenser and then round the often long leads of the high-tension battery before the filament is reached?

A far more scientific method, and one which I now adopt in all my own receivers, is to connect the condenser between anode and negative of the filament circuit, thus giving a short path between the two points which have to be connected. I can see no virtue whatever in including the high-tension battery in the high-frequency circuit when there is no need to do so.

A Logical Improvement

Notice also the conventional position for the shunting condenser across the high-tension battery. Here we see the conventional practice of connecting the shunting condenser between the positive and negative terminals of the battery. Why should we connect it here only? In all those cases where the negative high-tension is joined to the positive low-tension, the voltage of the low-tension battery is added to that of the high-tension battery in the anode circuit. Logically,

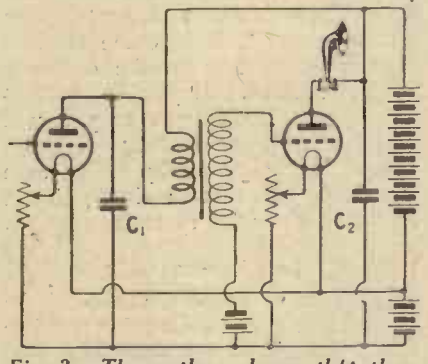


Fig. 2.—The author shows that these are the logical connections for the condensers discussed.

then, the condenser should be connected across the positive H.T. and negative L.T., as shown in Fig. 2. I am adopting this scheme also in my own receivers.

What are Your Own Views?

These are small points, you may say, but at least they are logical reasons for making the connections suggested. Indeed, in super-heterodyne receivers it has already been found that the condenser connected between anode and filament is definitely superior in its results to the old arrangement of connecting the condenser across the transformer alone. Possibly other advantages may be found when we consider the subject more deeply, but in any case, if any of my readers can see any objection to the modification, I should like to hear of it.

Self-Capacity of Transformers

It is sometimes found that in a circuit comprising a reaction coil and the primary winding of the transformer in the anode circuit of the detector valve, no shunting condenser is needed across the transformer winding. This is due to the fact that the self-capacity of the winding is sufficient to by-pass the H.F. component. Other transformers having little self-capacity in the winding act as radio frequency chokes, and with them proper reaction effects are difficult, if not impossible, without a shunting condenser. Probably more than half of the transformers on the market have sufficient self-capacity in their windings to by-pass high-frequency energy, but there is no reason to pass the current through the relatively poor dielectric so provided.

Bad Effects of Large Condensers

Again, large shunting capacity across the transformer will by-pass some of the energy which should go through the winding, and the quality also may suffer if the value is too great. We thus see that it is advisable to use a minimum of

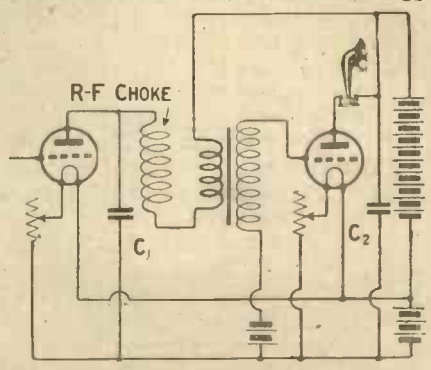


Fig. 3.—Mr. Harris recommends the use of the radio frequency choke illustrated in some circumstances.

shunting capacity here, provided we can by-pass the high-frequency component satisfactorily. I think it just as well that this by-passing should be done entirely through a condenser having low dielectric losses.

(*Continued on page 700*)

OPERATING YOUR SET

The effect of reaction on calibration charts—The importance of the detector valve—Soft valves—H.T. adjustment on the detector—Special valves for detection—Backlash.

IN discussing the calibration of receivers, as distinct from wavemeters, in last week's issue of *Wireless Weekly*, it was pointed out that interaction between various circuits might tend to upset the calibration of one circuit. This is especially noticeable when one comes to investigate the effects of variations of the reaction coupling. There are two methods by which this difficulty may be overcome. One is to take all readings with the reaction coupling at a minimum.

Then to tune in a station the tuning condenser is set by chart, and the reaction coupling is increased to the desired degree, with the necessary readjustments of the tuning condenser. It is true that the final reading on the tuning condenser does not depend directly on the calibration chart, but this method possesses the advantage that there is little risk of causing undesirable oscillation when tuning in a station. This method, of course, can only be used for strong signals. It may be noted here that normally in a single-valve "straight" or "Reinartz" receiver an increase in the reaction coupling will necessitate a reduction in the tuning condenser.

Another Method

The second method, which is less satisfactory, but may be preferred as giving the final readings on the calibration chart, is to set the reaction coupling so that the receiver is just off oscillation when taking readings. This method is open to the objections that it will be hard to judge an exactly similar point for each reading, and that it will be only too easy to go too far and set the receiver oscillating. Also any variations of the reaction requirements of the receiver at different settings of the tuning condenser will

One of the special valves recommended for rectification purposes: a D.E.8. H.F.

be reflected in the calibration chart, causing it to deviate from the straight line, and making it necessary to plot a large number of points if accuracy over the whole scale is to be obtained.

These difficulties, of course, mainly affect sets *without* H.F. stages. Where a good deal of real H.F. amplification is being obtained the first method can be used with entire success.

Detector Valves

It is probably too seldom realised what a great improvement in the performance of a valve receiver may be effected by the choice of a suitable detector valve. It is perhaps the most common practice simply to employ any general-purpose valve for rectification. Now, if a general-purpose valve is to be used, it is usually worth while to try several in turn, even if the available valves are all of the same make and type. A very slight difference from others in the exact disposition of the electrodes or the exact degree of evacuation in one valve may make it more effective as a detector.

Soft Valves

Wireless amateurs in America make extensive use of special soft valves as detectors. Such valves *are* obtainable, though none too easily, in this country, but they are not by any means so widely used as in the U.S.A. They possess the advantages of being highly sensitive detectors and of requiring only a comparatively low anode voltage for efficient operation. On the other hand, those samples of which the author has had experience were inclined to be far from silent in operation, a continuous rushing noise being often audible. This noise tends to become unduly prominent when one or two stages of L.F. amplification follow the detector. Soft valves have a further advantage in economy of apparatus that they will rectify in an ordinary circuit without a grid condenser and leak and without very critical ad-

justment of anode voltage and filament current.

H.T. for Soft Detectors

The main point to be careful about is the value of anode voltage. Normally this should not be above about 45 volts, the maximum permissible varying with different valves. If the valve shows any signs of a blue glow of ionisation round the anode, the voltage should immediately be reduced or the valve may be ruined. So long as both filament current and anode voltage are kept down to moderate values, parasitic noises are less noticeable, and the soft valve is often well worth a trial.

Special Valves for Detectors

There are available nowadays a number of special valves with a high impedance and a large amplification factor. Such, to take a few examples, are the D.E.8 H.F., the D.E.3B., D.E.5B., D.F.A.4, etc. This type of valve is excellent as a detector, especially in Reinartz and similar reaction circuits, since they usually give a particularly smooth control of reaction, and the signal strength which they give is usually very good.

"Backlash"

Intimately connected with the choice of a detector valve, and, more than this, with its correct operation, is the phenomenon known as "backlash." This trouble, it may be noted, may also make the calibration of a receiver a difficult matter if it is not cured.

Incorrect values of components or of applied voltages may be responsible for backlash. Too large a reaction coil, too low or too high a value of grid leak, too high an anode voltage relative to the filament current—all these, either separately or together, may be the cause.

Choice of Reaction Coil

The cure for too large a reaction coil is obvious. To obtain the greatest benefit from reaction, and a steady increase in signal strength right up to the point of actual oscillation, the reaction coil should preferably be of the smallest size consistent with its operation over the desired range. This does not apply, of course, to special circuits, such as those of the super-regenerative type, in which a reaction coil above the normal size is generally desirable.

Grid Leak Difficulties

The trouble with grid leaks is most commonly noticeable in receivers operating at the higher frequencies. Here it is normally required, the reception of continuous waves being the main objective, that the receiver shall go into and out of oscillation with a scarcely perceptible "transition" band. On a well-designed receiver of this type it is often possible to receive continuous wave signals clearly and with a minimum of interference, with the set oscillating so gently that, in the absence of signals, it is hardly possible to tell whether it is oscillating or not. It is generally advisable in such cases to use a variable grid leak, since some valves operate best with a much higher value than others.

Power Valves on Short Waves

The small power valves, for instance, such as the B4, D.E.5, and the D.F.A. valves, which make excellent detectors for the higher frequencies, function best with a higher value of grid leak than that suitable for ordinary general-purpose valves. At the broadcast frequencies this type of valve does not prove relatively so effective for detecting, self-oscillation occurring very readily.

H.T. in Moderation

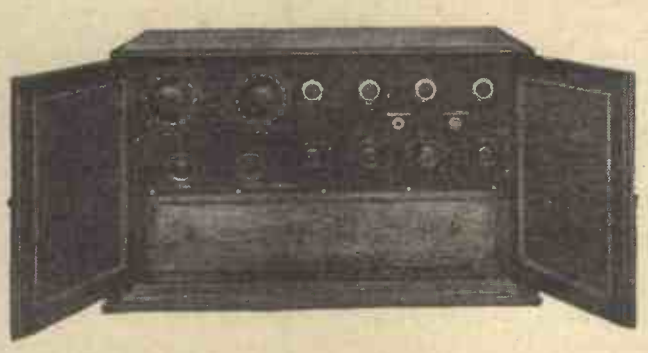
It is a mistake to suppose that better results in every way can be obtained by increasing beyond the normal the voltage applied to the anode of a detector valve. It is true that when a receiver is used in the neighbourhood of a broadcasting station signal strength may be increased in this way, provided that the filament current is also increased with the anode voltage. An increase in anode voltage without a corresponding increase in filament current will produce as serious backlash as any other fault, rendering quite impossible any attempt at fine tuning of the kind necessary to get the utmost from the receiver.

A Warning as to "Over-running"

If it is not possible, by turning up the filament to its full *normal* brilliance, to eliminate all trace of backlash, the anode voltage should be reduced. The temptation to overrun the filament slightly in order to secure the rather doubtful benefit of a higher anode voltage should be resisted for the sake of economy, if for no other reasons. The advantage gained will be so slight as to be not worth while.

Cut Down the H.T.

To get the best results, and especially the best quality of reproduction from a distant station, whether the receiver consists of a detector valve only or whether it is a multi-valve set, the detector valve should preferably be operated with a rather low filament current and anode voltage. It is quite surprising to find what low values can be satisfactorily used.



Even in multi-valve sets it is important to provide proper working conditions for the detector valve.

On Short Waves

To take an example, at the higher frequencies the writer has not infrequently found that for the reception of weak telephony, when it was desirable to cut down "mush" and general noise, as far as possible, in order to obtain clear speech, about 12 to 16 volts on the anode of a .06 ampere type of valve with the filament only just glowing gave the clearest results. Signals were not, of course, at their loudest, but there was hardly any sign of parasitic noises or mush interference.

Again, at the broadcast frequencies, a bare 3 volts on the filament of a 4-volt soft valve with 20 volts on the anode gave none of the rushing or "frying" noises associated with higher values, while quality was distinctly superior.

THE TRANS-ATLANTIC TESTS

Conditions have so far proved far from favourable in the international broadcasting tests, and certain of the schedules were interrupted by S O S traffic.

A group of prominent radio men at a farewell dinner in New York to Messrs. Eric Palmer and Thornton Fisher (third and fourth from the right respectively), who paid a visit to Europe in connection with the arrangements for the Transatlantic Tests.

AT the time of writing the Transatlantic Broadcasting Tests are in progress, but reports of reception so far received indicate that conditions are not favourable this year for good reception of the American stations.

An S O S Interruption

On the morning of the first tests, January 25, a certain number of American stations were heard, but not identified, before 3 a.m., the time scheduled for the opening of the tests proper. By a stroke of ill-luck, a vessel off the Atlantic coast was compelled to send out distress calls at about 3 a.m. G.M.T., with the result that the American broadcasting stations had to close down.

Distress-Call Watchers

This is the regular rule in America, a watcher being detailed for continuous duty during transmitting hours at every broadcasting station. His task is to listen on the frequency band employed by ships and to report if distress calls are heard. Complete freedom from broadcast interference is thus afforded for the handling of the S O S traffic.

Bad Conditions

This circumstance does not, however, fully account for the failure of American stations to get their programmes across, though the period of enforced silence lasted for more than half the scheduled hour. There is no doubt that conditions, dependent on the weather or other factors unknown to us, were far from good for reception.

This impression is confirmed by the reports so far received from various parts of the country. "Carrier waves unresolved," "Speech heard, but unintelligible," "No trace of stations," are extracts from reports from districts as far apart as Norfolk and Devonshire.

The Second S O S

On January 26 distress calls from a ship at sea again caused a curtailment of the test period available for the American stations. Reports from the London district indicate that reception conditions were no better than on the previous morning.

Another Bad Period

A member of the Radio Press staff, listening on a "Special Five" receiver in South-West London, reported that during the evening of January 25 the Continental stations came in at excellent strength. It was then misty and close, and conditions generally appeared favourable. By 3 a.m., however, the sky had cleared, and careful search with the aid of an accurate wavemeter failed to find a trace of any of the principal American stations. The general impression gained was that the ether was absolutely "dead" for long-distance reception.

Little Improvement

On January 27 and 28 little, if any, improvement in reception conditions was observed. Members of the Radio Press staff reported faint signals from two separate stations which could not be identified with certainty. Attempts to pick up the transmissions from KDKA and WGY at the higher frequencies, normally a simple matter, produced only the faintest of signals. A listener in Yorkshire was able to distinguish an announcement of KDKA's identity, but fading and atmospherics subsequently obliterated the programme.

Reception in America

Reports from America show that the B.B.C. stations were heard over there fairly well. 2LO was heard in Mexico City on the first morning of the tests, and on January 27, when a slight improvement in conditions was noticeable, reception of Cardiff and Aberdeen was reported from Baltimore, Omaha, and Missouri.

From reports received, a number of listeners appear to have taken advantage of the opportunity provided to listen to the Continental stations. Good reception of most of these was experienced.

SHORT-WAVE *Notes & News*

AT last there seem to be a representative number of "G" stations "on the air," judging by the week-end list of "Calls Heard" compiled by the writer. This includes 86 British stations, as compared with only 22 French, whereas a few weeks ago the reverse was almost the case.

That A.C.!

It is also very noticeable that, whereas practically all the British stations are using pure D.C. notes, an even moderately good note from a French station is quite the exception. They still delight in their ear-splitting "raw A.C."

The Americans are improving in this respect, and one hears far more steady and pure notes from across the Atlantic than were ever heard formerly. Their 60-cycle mains, when any hum is audible in their C.W., have the useful effect of producing a very distinctive note by which they are readily identified.

Some New "Qs"

Below are given a few recent additions to be made to the list of "Q" signals published in *Wireless Weekly* for December 23, 1925. Most of them are due to the American Radio Relay League, and have been adopted by the I.A.R.U.

QRAR?—Is your address as given in list correct?

QRDD?—In what direction are your messages going?

QRFF?—From what station did you receive message No. .....?

QSRM?—Will you forward message No. ..... by mail?

QSUF.—Please call me at once by land telephone.

Now in Use

Although abbreviations dealing with message-handling are not of much value to us from the transmitting point of view, anyone hearing or working an American station is liable to be asked any of the questions given above, so that it is just as well to know them.

The North

Several new stations in the North have put in an appearance recently, and also several of the "old hands" have come back. 2QM has moved from Glasgow to Daventry, where he spends his time fairly evenly between low-power transmission on 6,667 kc. and decidedly high-power work (from 5XX) on 187.5 kc. (1,600 metres)!

The Popular Hertz

6YU, of Coventry, continues to work world-wide DX, being one of the stations to work French Indo-China recently. Practically all the northerners are using Hertz aerials, two of them having burnt their bulbs out, and one other having attracted a crowd to watch him sending light-waves to Australia!

New Stations

A new Irish station, GI-6YW, has started up recently, and has been heard several times in London, this making a total of about eight active "GIs."

A new French station with the call OCNG has recently been heard. He is a long-wave commercial station with an auxiliary low-power set for short-waves, and his location is Nogent-le-Rotrou, France. Other similar stations are OCTU (Tunis), and OCDJ (Djibouti, West Africa). OCMV has also been heard, and we should be glad to know his location. Another mysterious station is G-1RW, who states that he is using his receiver as a transmitter, but apparently does all kinds of "DX work."

The Evening Fade

It is extremely interesting, in fact almost awe-inspiring, to listen on a Sunday evening, when a large number of stations are transmitting, just when they begin to fade out. On Sunday, January 24, this occurred at 6.57 p.m. in South London, and practically all the European stations disappeared simultaneously. Within about three minutes all the stations that were R7 or R8 before had been reduced to a mere R2 or R3.

Observations Wanted

It gives one an impression of helplessness to sit at a transmitter or a receiver and know that your signals *will definitely* fade out, as far as European work is concerned. It should be interesting to note the exact time at which this occurs day by day.

The Work of NRRL

Further useful information has been compiled by Mr. F. H. Schnell, Traffic Manager of the American Radio Relay League, as a result of his voyage on the U.S.S. *Seattle*, using the famous call-sign NRRL in connection with three separate transmitters. His receiving log was also very helpful in comparing the values of different frequencies for daylight and night work.

A Referendum on Kilocycles

Incidentally, we are glad to see that the A.R.R.L. are urging all experimenters to adopt kilocycles as a standard. To quote their own words, "All those who object to kilocycles please write to Headquarters. Those in favour of metres keep quiet!" This, of course, is meant to imply that, unless we adopt something else in place of them, we shall have to adopt kilocycles, "metres" having been shown quite unsatisfactory.

We hope to publish next week the results of further observations on the best times to listen for various countries, as, with the approach of longer days, these times have changed somewhat since our last list was drawn up.

Wireless News in Brief.

Broadcast Boxing. On February 22 some incidents of the contest for the Lonsdale Belt at the National Sporting Club may be broadcast from 2LO.

* * *

The success of Mr. Heath Robinson's broadcast drawing lesson from London recently, which drew 15,000 entries, has encouraged the B.B.C. to arrange for features of a similar kind with other artists. The dates for these will be announced in due course.

* * *

Listeners who have enjoyed hearing the "Radio Radiance" entertainments will no doubt be pleased to learn that a new revue called "Listening Time" is being prepared, to take the place of "Radio Radiance."

* * *

Other interesting items to be broadcast from the B.B.C. stations in the near future include:—

London.—February 9: Act 2 of "The Magic Flute," performed by the B.N.O.C. at Liverpool.

Manchester.—February 8: Grand Guignol, No. 1, "In the Library" (W. W. Jacobs).

Bournemouth. — February 11: Programme of the works of Sullivan, Elgar and German.

Newcastle.—February 10: Scenes from the opera "Faust."

Birmingham.—February 11: A light operetta in two acts.

* * *

Rugby Radio Service. The Rugby wireless station has now taken over the service previously provided by Oxford for transmitting messages over long distances. The useful range of the Oxford station was about 3,000 miles, but the increased power available at Rugby will enable a world-wide service to be maintained. Radio-telegrams for transmission to ships in any part of the world will be accepted at any postal telegraph station and sent out from Rugby. The existing service provided by the coast stations and by Devizes for ships within ranges of 250 miles and 1,500 miles respectively will continue, Rugby handling the traffic for greater distances.

* * *

Television Experiments The Postmaster-General has agreed to authorise, according to Mr. J. L. Baird, the broadcasting of pictures by Mr. Baird's system. We understand that the French authorities have also been approached with a view to securing permission to attempt the transmission of pictures between London and Paris.

* * *

Wireless Strike. The strike of ships' wireless operators, which began on November 26, 1925, had not been settled at the time of going to press. A letter from the Ministry of Labour, published recently, stated that a series of meetings had been taking place, but that they were not yet completed. In the meantime, ships have been permitted to sail without fully qualified operators, with the consent of the Board of Trade.

* * *

Oscillating Receivers. A considerable increase in "howling" has been noticeable in the last few weeks. The B.B.C. has received complaints from East London, West Croydon, Catford, Windsor, Ipswich, Blackburn and Leicester that the oscillation nuisance is particularly bad in these areas.

Though careless handling of sets may be responsible for much of the trouble, it seems likely that a good deal of interference is being caused by listeners who have taken to wireless only since Christmas, and who do not realise the annoyance they are causing to others.

"Wired" Wireless. We mentioned last week that The Hague telephone administration has arranged to supply telephone subscribers with wireless programmes over the ordinary telephone lines. It appears that the scheme suggested provides for the installation of a receiver at the telephone exchange. Subscribers who have head-telephones fitted in their homes are then enabled to hear items from selected broadcast programmes. A disadvantage of the system would appear to be that the choice of items by individuals is naturally somewhat limited.

* * *

Daventry Forecasts for Ships. It is announced that the B.B.C. have begun to broadcast special shipping forecasts from Daventry as a regular feature of the day's programme. These forecasts are given at 10.25 p.m. on weekdays and 9.10 p.m. on Sundays, and include information about the wind, the weather, and the accessibility of harbours in various localities.

* * *

Wireless on Trains. An experiment in the reception of broadcasting on a moving train was carried out recently by the Great Western Railway - Bristol Radio Society. Specially equipped coaches were attached to a train running from Bristol to Cardiff while the Cardiff broadcasting station was transmitting.

A seven-valve superheterodyne receiver was used, and twenty loudspeakers were installed. It appears that the experiment was very successful. Interesting observations were made of the effect of bridges and other "obstructions." Signals faded out almost entirely during the passage through the Severn Tunnel, returning to full strength as the train approached the Cardiff end of the tunnel.

A THREE-VALVE REINARTZ RECEIVER WITH WAVE-TRAP

By JOHN W. BARBER.

WITH so many stations broadcasting daily, the problem of selectivity is one of vital interest to all who take any interest in even the musical side of radio, and the hunt for selectivity is ever pursued, with varying degrees of success.

Selectivity is a property which must be tempered with other essentials, or the resulting arrangement may lie outside the scope of average utility. For example, a receiver which can separate two very approximate frequencies would scarcely find favour if five or six separate adjustments were necessary for each change of tuning.

Wave-Trap Advantages

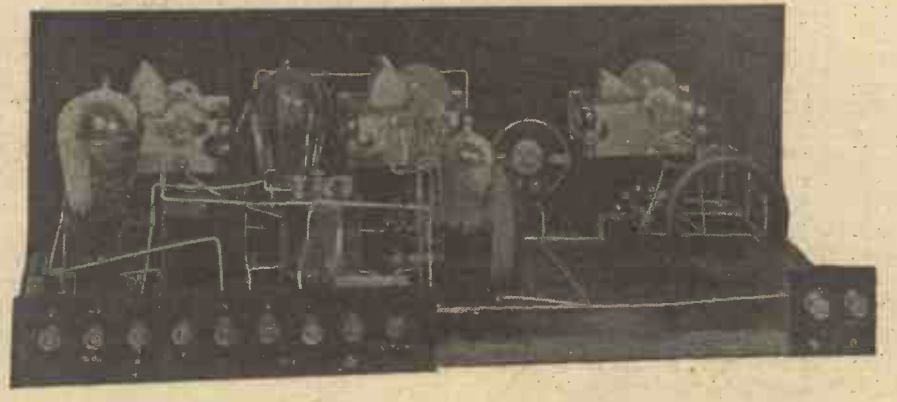
In order to keep the tuning controls as few in number as possible, it is essential that the receiver shall not consist of a considerable number of separately tuned circuits, and in such a case it becomes apparent that some form of wave-trap shall of necessity be employed, which will act as an efficient barrier to the interfering signals.

The type "D," which the writer has found most efficient, is of the auto-coupled series type, which, when constructed in accordance with the principles of low resistance design enunciated by Mr. J. H. Reyner in recent issues, will entirely eliminate all signs of London's transmission at 4½ miles, and, in fact, has been known to do so at two miles from 2LO.

Reaction Control

The demands of simplicity necessitate the use of a simple form of reaction control, and here it is that the Reinartz circuit, so well known on short waves, comes into prominence. Tuning is effected upon one variable condenser, the reaction condenser being rotated slightly towards the maximum in order to increase signal strength.

The wave-trap, once adjusted for the elimination of the powerful nearby signal, needs no further adjustment over the whole tuning range of the set. It may here be pointed out that the present receiver is only designed for the reception of stations upon the 1,500-600 kc. band, no provision being made for reception of Daventry and like stations.



The special disposition of the coils should be particularly noted and copied. This is an important point when the wave-trap must be placed in fairly close proximity to the receiving circuits.

The design gives a pleasingly symmet clearly seen in this view, namely, the coupling wi

The Circuit

A diagram of the circuit adopted is reproduced, and a little explanation may not be out of place. The aerial lead is taken to the arm of switch S1, the studs of which connect to tappings on the wave-trap coil L1. This coil consists of forty turns of No. 36 double silk-covered copper wire, wound on a piece of ebonite tube 3 in. in diameter and 1 in. long.

Trap Connections

Tappings are taken at 5, 10, 12, 15 and 20 turns, the sixth stud (right-hand side) being connected directly to the arm of S2 in order that the trap may be cut out of circuit if so desired. The condenser C1 is of the geared variety, as tuning on the trap is very sharp, and is of .0003 μF maximum capacity. In cases where longer wave stations, such as Birmingham or Aberdeen, have to be eliminated, the use of a .0005 μF condenser is recommended.

The Grid Coil

The grid circuit inductance L2 and the aerial-reaction coil L3 are wound on the same piece of

rical panel. A special feature is tapping switches for the various ndings.

ebonite tube, which may conveniently have the same dimensions as that upon which the wave-trap coil is wound. Forty turns of No. 36 d.s.c. constitute the grid coil L2, and a tapping is made at five turns from the earth end as shown. L3 consists of 20 turns of the same wire, the coils being wound consecutively.

Coil Connections

From the earth tapping, taps are taken at 3, 5, 8, 12 and 20, and one taken to the studs of S2. Two stages of note magnification are added after the detector valve, the first consisting of a transformer coupled stage, whilst the final amplification is obtained by the use of a choke-capacity coupled amplifier.

The Choke

The high-frequency choke L4 is easily constructed, and consists of about 200 turns of No. 36 d.s.c. wound solenoid fashion on a piece of ebonite tube one inch in diameter and about 2½ in. long. The remainder of the circuit is perfectly straightforward and calls for little comment.

Experienced constructors know that, given a really effective method of reaction control, a simple valve detector with or without note magnifiers is capable of remarkable long-distance results. The Reinartz circuit gives the necessary scheme of reaction control and a fair degree of general selectivity. In the very effective receiver described on these pages the necessary "special selectivity" for work in proximity to a powerful station is obtained by means of a built-in wave-trap.

Components

The following is a list of parts used in the construction of this receiver. Although there is no necessity for the parts mentioned to be used, it is recommended that some form of geared or other type of slow-motion condenser be employed for the trap and grid circuits, on account of the critical tuning present.

Panel, 21 in. × 7 in. × ¼ in.

Cabinet and baseboard for above. (Both these items were supplied by The Artcraft Co.).

One .0003 μF and one .0005 μF square-law geared condensers. (As explained, two .0005 μF's may be necessary.) (Jackson Bros.)

One .0005 μF square-law variable condenser for reaction control (Jackson Bros.).

One .0003 μF condenser and 2 megohm leak (Dubilier).

Three Cosmos anti-microphonic valve holders (Metro-Vick Supplies, Ltd.).

Two switch arms, twelve studs, and four stops (Bowyer-Lowe Co., Ltd.).

Three 30-ohm filament resistances (British L.M. Ericsson, Ltd.).

One Eureka Baby Grand first stage L.F. transformer (Portable Utilities).

One "Success" Super L.F. choke (Beard & Fitch, Ltd.).

One clip-in condenser, .01 μF, and base (L. McMichael, Ltd.).

One clip-in grid-leak, 1 M Ω, and base (L. McMichael, Ltd.).

One terminal strip with nine terminals.

One terminal strip with two terminals.

Two terminals for telephones.

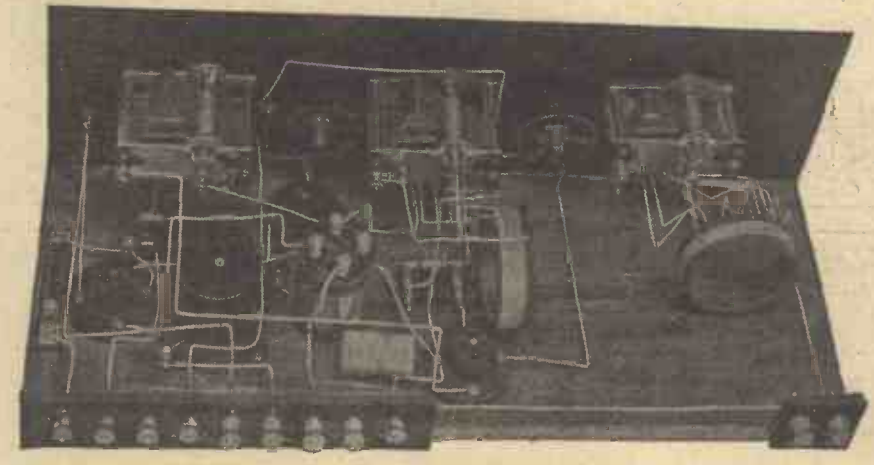
Radio Press panel transfers.

"Glazite" for wiring up.

Ebonite tubing as previously mentioned for coil formers, and about ¼ lb. No. 36 d.s.c. wire.

Constructional Details

The construction is quite simple, and no difficulty is to be anticipated in this respect, the only points calling for comment being the coils. The beginning and end of each coil is secured by passing the wire through small holes drilled in the



A view with the valves removed to show the general run of the wiring and lay-out of the parts.

ebonite, and the tappings may be made in any simple way, that of twisting loops in the wire being quite convenient. Care should be taken when baring the loops for soldering purposes, as any undue strain imposed upon the wire may cause it to loosen, and ultimately to break.

Coil Mounting

The coils are secured to the baseboard by means of wood screws, which pass through the ebonite, the latter being held off the baseboard by means of washers placed between the two. The provision of ebonite tubing one inch long allows sufficient room for the necessary holes to be drilled.

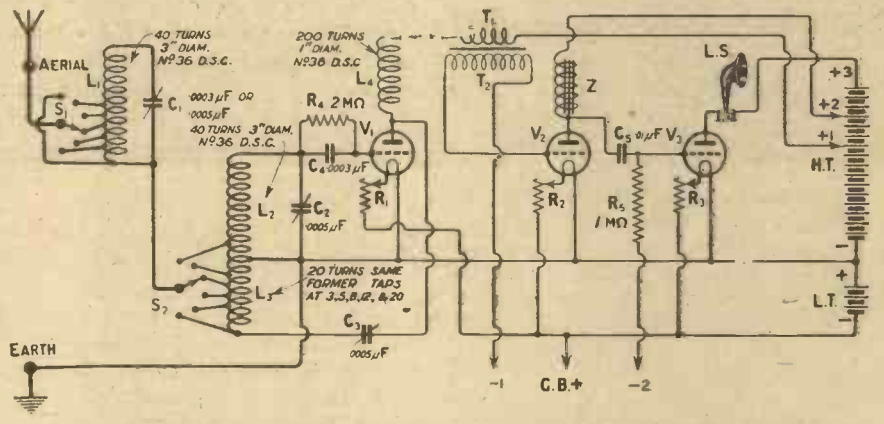
Remember to join a wire to each of the contact arms of the rotary switches before securing the panel to the baseboard, otherwise this operation will be rendered very difficult.

The Terminal Arrangement

The arrangement of terminals on the large terminal board is somewhat unusual, and may lead to some confusion unless explained. In order to simplify the wiring as much as possible, it was found desirable to have the L.T.+ terminal on the left of the strip, looking from the front of the receiver. Next is H.T. –, which is, of course, joined to the previous terminal, and then follow the three positive high-tension terminals. It may be noticed in the photographs that I have used a larger size terminal for the H.T. than for the other battery connections. The next terminal in the row is L.T.–, then G.B.+, after which follow first and second negative grid-bias terminals.

Operation of the Set

The set is perfectly simple to operate, tuning being effected simply by means of the middle condenser, the right-hand one controlling the reaction effect.



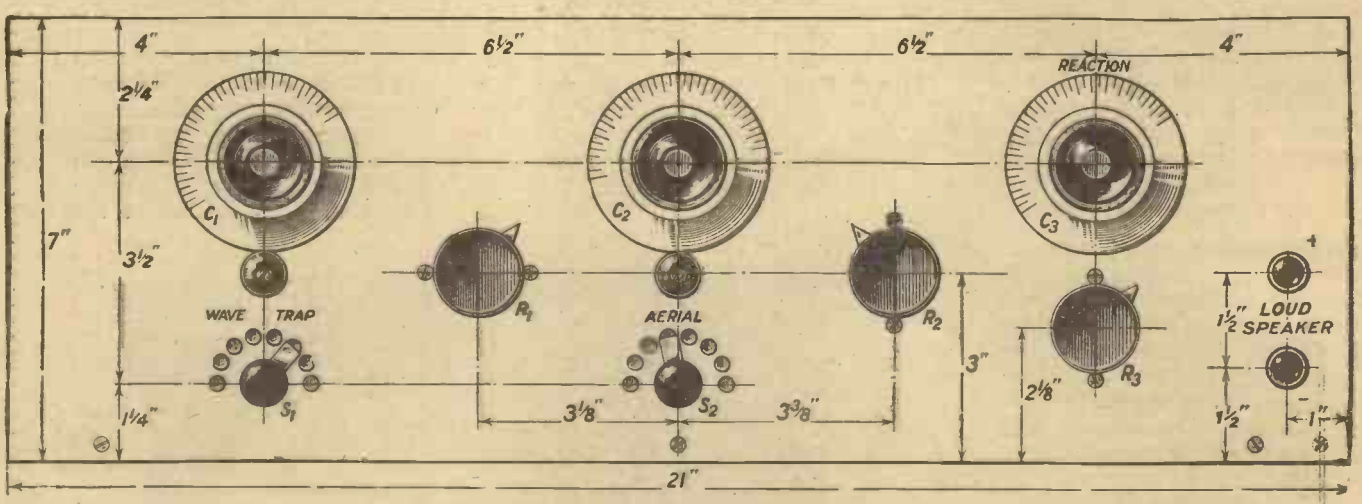
A simplified version of the circuit employed, showing how the switching of the coupling turns of the wave-trap and tuning coils is effected. Note the position in the circuit of the reaction condenser.

To set the wave-trap, first tune in to the station you desire to eliminate. Then put the wave-trap selector switch on to, say, the first stud, and slowly rotate the wave-trap condenser, using the main knob until signals begin to fade, when the gearing mechanism should be brought into operation and the final adjustment effected. You will find that one particular stud enables elimination to be carried out more completely than the others.

The Aerial Tap

The first (left-hand) stud on the aerial selector switch is joined to a tapping on the grid side of the earth tap, and this may be tried in certain cases. It will in general, however, be found more satisfactory to use one of the tappings on the reaction coil, and the switch will then be on one of the studs 2 to 6. Here again you will probably find one stud suits your aerial for a given station better than the others, and this tapping should be used.

Once these tappings have been found, the only adjustment necessary for tuning is that of the grid tuning condenser, and following round with the reaction control so that the set is always just off the oscillation point.



In making an exact copy of the original set this drilling diagram should be used. The only terminals on the front of the set are for the loud-speaker, those for aerial and earth and batteries being placed on strips attached to the rear edge of the base-board.

Hints on Winding the Coils

Although the construction of the coils is fairly straightforward, a little ordinary care is called for, in order to make a satisfactory job. Primarily, it is necessary to wind the coils fairly tightly, in order to prevent slipping, and to this end a

certain amount of tension must be put upon the wire when winding.

Care Needed

Do not overdo this tension, however, as the wire is fairly thin and will break if pulled too strongly. Another important point is to prevent the wire from kinking as it passes from the spool to the coil, as if this is allowed to take place, the wire will be considerably weakened at the point where the kink occurs, and any attempt to straighten out the kink may quite easily result in a break occurring.

Making Tappings

When making the tapping loops, hold the last turn in position with the thumb, and twist the wire into a loop, making several twists to ensure that the loop will not come undone after further turns have been wound on. Any attempt to tighten up the loops after the coil is completed may quite well result in a break taking place. All these remarks may sound somewhat alarming, but in practice no real difficulty will be encountered provided care and patience are exercised.

Operating Notes

The operation of the set is thus seen to be quite simple, and once the wave-trap is set to the correct position for the elimination of the local station, the operation becomes as simple as that of any ordinary receiver.

At the writer's station, roughly 4½ miles from London, on the south-east side, that station was easily eliminated, it being possible to receive many other stations during the progress of London's transmission. A similar receiver, working at not more than a mile and a half west of 2LO, is able to receive Cardiff and Manchester while London is working, with a definite silent spot between each station.

Adjusting the Tappings

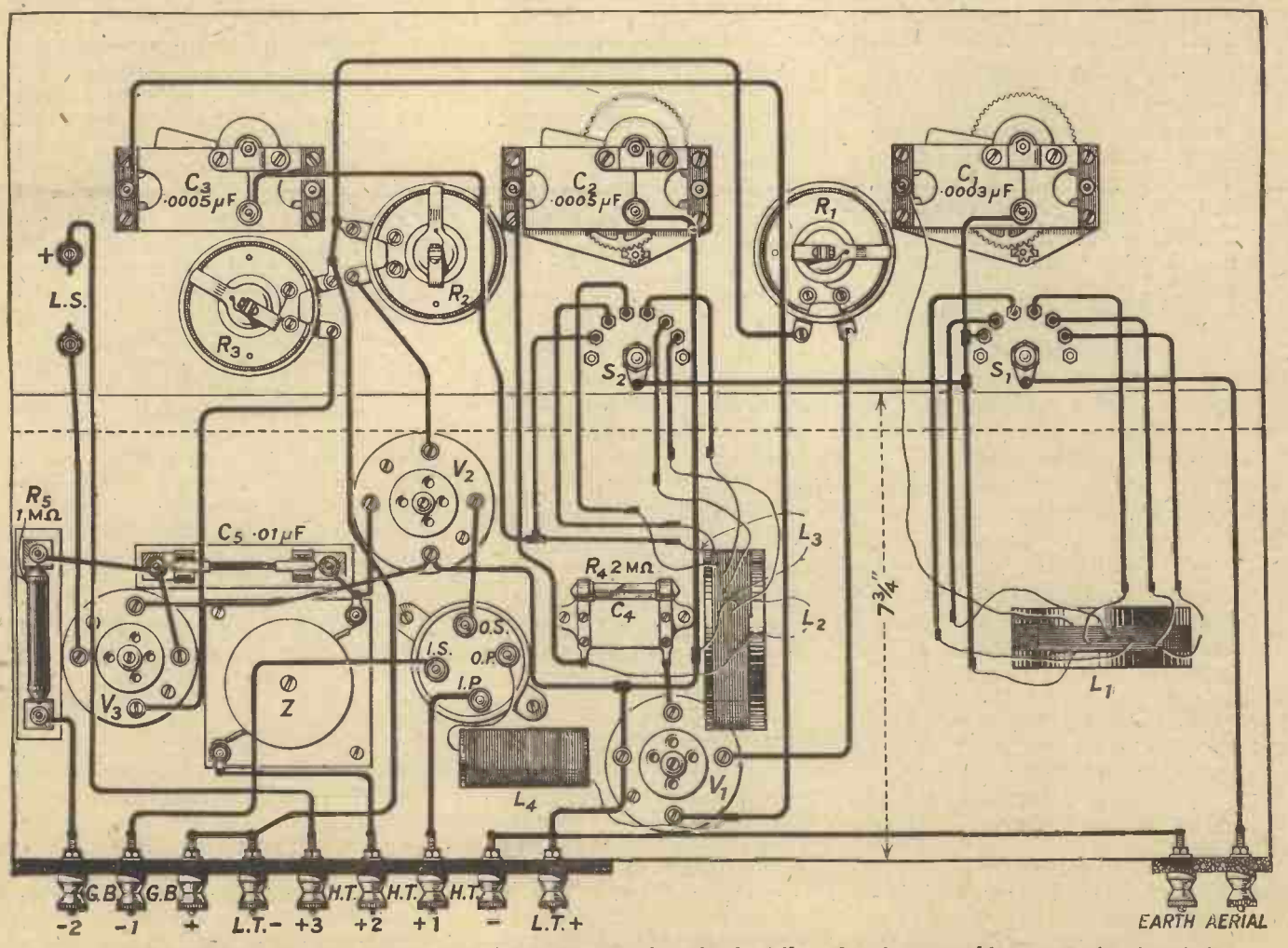
In order to adjust the wave-trap tapping to the best point, first of all set the left-hand switch to the sixth stud, that is, cutting the wave-trap completely out of circuit, and tune in the local station to the loudest point by means of the middle variable condenser.

Wave-trap and Reaction Adjustment

Bring up the reaction until the set is just off the oscillation point, when the wave-trap selector switch should be moved back one stud. Now slowly rotate the wave-trap condenser until a point is found at which the signals are weakened. Using the fine adjustment gearing, continue the rotation until the signals are at their weakest, and increase in strength when the condenser is rotated in either direction. If it is not possible entirely to eliminate signals from the local station with the selector switch on the fifth stud, try each of the other studs in turn, and one of them, at least, will be found to give complete elimination.

The Aerial Tap

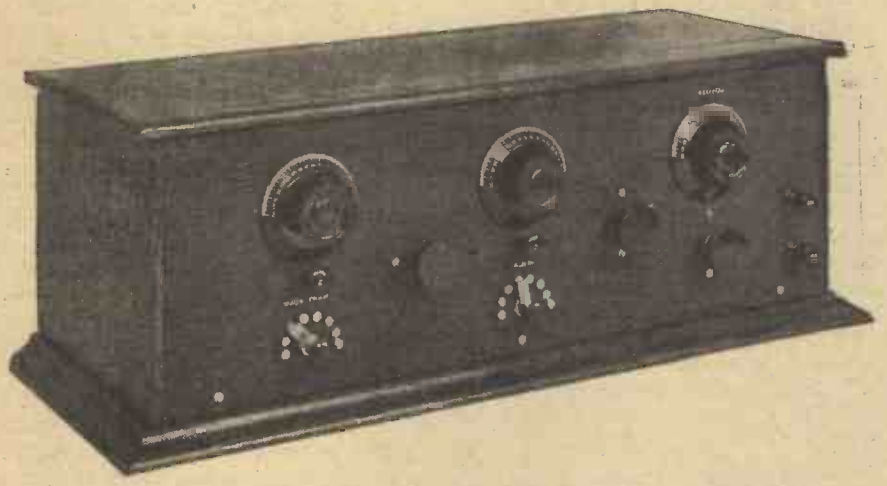
The adjustment of the aerial tap will vary somewhat with the frequency, a stud which is most suit-



A complete wiring diagram is provided, and it is advised that this be followed with reasonable exactitude, since it is important to avoid inter-action effects between the wave-trap circuits and those of the receiver proper.

able for stations round about 1,000 kc. possibly giving poorer results on a 600-kc. transmission.

These tappings will differ with different aerials, and the only way to find which is the best is to try each in turn, making the tuning adjustments very carefully each time, and noting the difference. When experimenting in this manner do not make the adjustments too hurriedly, as if the station listened to is fading at all, misleading results will be obtained.



The wave-trap and main tuning condensers are of the geared variety, the author finding a plain pattern adequate for reaction control.

Transfers

A final point to be noted concerns the application of the panel transfers: this is that by placing them judiciously one label can be made to refer to two of the controls for a given circuit.

This is a result of the fact that the tuning condensers and tapping switches for the wave-trap and receiving circuits are placed one above the other. Thus, if a suitable label is chosen, it can be placed between the switch and the condenser, and will serve for both.

The space above the condenser dial is then left free for the attachment of a scale indicator.

Notes for the Transmitter

QRA's Found

G-6YS.—C. Prosser, Pleasant Harbour, East Aberthaw, nr. Cardiff.

N-2PZ.—Dordrecht, Holland (QSL's via R. Tappenbeck, Hoogduin, Noordwijk, Holland).

KPL.—Herr Fagien, Königsberg 12, East Prussia.

F-8PEP.—Paris (via Journal des 8).

Y-A2Q.—R. J. Drudge - Coates, Rawalpindi, India.

Mr. W. M. Bakewell (6UZ) has kindly forwarded the following:—

YS-7XX: M. Gruz, Torbacino, Yugo-Slavia.

K-Y8: Mr. Horkheimer, Rottenburg à N., Germany.

I-1BD: Ennio Pirovano, 11, Viale Varesse, Como, Italy.

N-2PZ: Amsterdam (QSLs via Journal des 8, à Rugles, Eure, France).

All cards for F-8PY, 8NN, 8LDR or B-A44 may be sent via 6UZ, at Yeovil House, Regent Street, Stoke-on-Trent.

A-5BG is the station of Mr. H. A. Kauper, 20, Gurney Road, Dulwich, South Australia.

QRA's Wanted

We shall be glad to receive information concerning any of the following stations: CHNM, NAJD, NUQG, NA-1G, NA-1Q, H-9XE, G-6EZ, Y-2HP, E-GEH, URLI and NAL.

OCML, OCMV, G-6KY, B-Z22, M-4HS and CRP.

* * *

We have received from Mr. R. J. Drudge-Coates (Y-A20), of Rawalpindi, India, the following list of calls heard:—

G.—2LZ, 5AN, 5DH, 2OD, 2KF, 2FM, 2NM, 2GK, 2QF, 2XY, 5MO, 2OM, 2VY, 2AC, 2CC, 6DF, 5PM, 2SZ, 6AH, 5LF, 5GM, 2KW, 2GO, 2SH, 6YU.

F.—8DE, 8BO, 8DD, 8DK, 8JN, 8JD.

K.—KPL, KY5, KY4.

S —SMTN, SMXT.

B.—T2, 8SSC.

I.—1AS, 1AY, 1AU.

PI.—1HR, 1CW, 1AU, 1AR.

A.—6AG, 6BO.

N.—PCLL, PCMM, PB3, PB7, PCJJ.

O.—A3E.

Miscellaneous. — OCML, ANE, ANF, NPO, NPU, WIZ, ABC, LPZ, FW, WIR, GCS, GB1.

Mr. Drudge-Coates will be very glad to receive reports on his transmissions (between 6,000 and 10,000 kc.—30-50 metres). The above reception was all carried out on this frequency band with a "o-v-1" Reinartz receiver.

SOME NOTES ON L.F. AMPLIFIERS

(Concluded from p. 690)

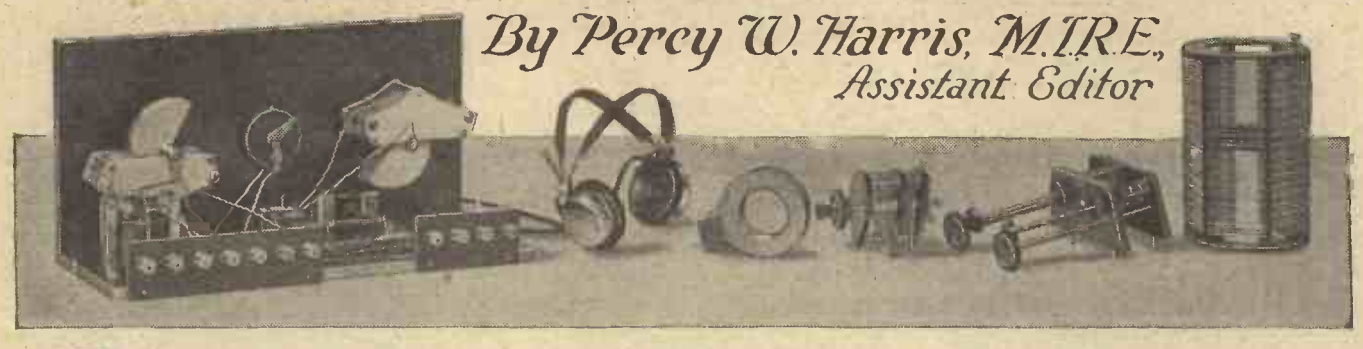
In a low-frequency amplifier, which I have just built for experimental work, I have used the circuit shown in Fig. 3, where the anode circuit of the detector valve contains not only the primary of the transformer, but preceding this a radio-frequency choke. Between the anode and the filament negative a clip-in condenser may be connected; when this is in place, virtually the whole of the high-frequency component passes through the condenser and none of it through the self-capacity of the transformer primary winding. In this way it is possible to fit a condenser of a definite value and to ascertain the necessary value to by-pass the high-frequency component.

Transformer Interaction

It is possible that some of the annoying interaction effects found in L.F. amplifiers may be traced to errant currents. Certainly in choke-coupled low-frequency amplifiers the introduction of a radio-frequency choke, where shown, definitely increases the efficiency, since grid leak howls and other troubles may arise through the choke passing on high-frequency as well as low-frequency impulses. It is certainly better to track trouble to its source and stop it there, rather than to reduce it with shunting resistances.

Random Technicalities

By Percy W. Harris, M.I.R.E., Assistant Editor



AM writing these notes on the evening of Monday, January 25, and as soon as I have finished them I am going to bed for an hour's snooze prior to listening for America in the Transatlantic Broadcasting Tests. At the moment conditions look very favourable, as the night is muggy and misty, with a halo round the moon, and, so far as I have listened-in this evening, quite promising. It is rather strange that good Transatlantic reception on the broadcast band is rarely achieved on clear bright nights.

Preparing the Set

When you are really out to achieve a definite object in long-distance reception there are many things you can do to effect slight improvements. For example, there is the question of the choice of valves. If you are fortunate enough to possess several of the same type you will probably find that some are slightly better than others, as, say, high-frequency amplifiers, while in any particular receiver running through your valves you may find one which acts as a particularly good detector. The valve which shows the best results with telephones may not necessarily be the best with a low-frequency transformer, unless the impedance of the transformer winding has been matched with the valve in question.

Comfort in Listening

You may, too, find that among your telephones there is one pair which seem particularly suitable for listening-in for long periods at a time. It is difficult, if not impossible, to do good and accurate searching for weak signals if the discomfort of the telephones is continually asserting itself. The rubber ear-caps which can now be bought in a variety of patterns are a very great help.

Have you noticed that adjustment of the pressure of your headbands and ear-caps of telephones often affects the quality of the signals you hear? This is due to the fact that the imprisoned air between the cap and your ear-drum exerts a different pressure with different adjustments.

KDKA's Improvement

The peculiar distortion of the KDKA signals, so apparent last year, particularly when the B.B.C. re-broadcast this station, has now largely disappeared, and the other night I listened for two hours without a break to a very enjoyable programme from this station. Apparently a large part of the distortion was due to slight frequency changes, and as the KDKA short-wave transmitter is now "crystal-controlled" these have ceased. There is still a certain amount of fading which may give rise to annoyance, but the peculiar distortion, which made speech almost unintelligible, seems to have gone entirely.

Ball-bearing Variable Condensers

I see that a number of variable condensers now sold are fitted with ball bearings. It seems rather a peculiar use of this kind of bearing, as we do not want a condenser spindle to be too free. The usual purpose of a ball bearing is to give the maximum freedom. Mechanically-minded readers may ask why some manufacturers, after providing as near as possible frictionless bearings, deliberately introduce friction in another part of the movement in order to prevent the moving plate spinning round with a slight touch from the dial. The advantage, if any, of this ball bearing, however, is probably to give maximum movement with freedom from that unpleasant stickiness of action which so often causes irritation when trying to effect fine tuning on some makes of condenser.

Life of H.T. Batteries

High-tension batteries do not seem to have improved, but rather deteriorated, and one rarely hears of the fine performance which some of the earlier high-tension batteries used to give. It must not be overlooked that the modern listener makes very full use of his high-tension battery, whereas the experimenter of pre-broadcast days, although he worked pretty actively, rarely put in more than ten or fifteen hours a week of direct listening. Thousands of listeners nowadays use their sets for four or five hours a day for every day of the week, with power valves, too. These latter, of course, exhaust the high-tension battery rapidly.

H.T. from the Mains

America seems well provided with devices for supplying the high-tension current from the mains with the aid of a rectifier and smoothing circuits. Owing to the fact that practically all American electric light installations give 110 volts 60 cycles, there is sufficient market for instruments of this voltage and periodicity to make the manufacture of them well worth while. In this country we have such a variety of voltages, both D.C. and A.C., that a manufacturer would find it necessary to make fifteen to twenty models in order to supply the demand. With the foreshadowed standardisation of electrical power supply we may in a few years reach that happy state of having but one frequency and voltage, but before we reach that point much apparatus will have to be scrapped.

STOP PRESS.—In spite of promising conditions nothing came through from America, so you see how useless it is to prophesy!

THE BROADCASTING INQUIRY

During the recent continuation of the work of the Broadcasting Committee evidence was heard from a number of interests, including the Radio Association and the National Association of Radio Manufacturers and Traders.

THE Broadcasting Committee heard further evidence on January 21 when Mr. Filson Young gave his memorandum.

He was followed by Commander the Hon. J. M. Kenworthy, M.P., Chairman of the Council of the Radio Association, who was supported by Mr. Samuel Landman, Hon. Sec. and solicitor of the Radio Association.

Mr. Filson Young appeared on his own behalf, and mentioned that he was a critic and composer. The memorandum was principally of a technical character, and the committee noted the points raised. No recommendation as to any future constitution was made.

Commander Kenworthy, who read the evidence on behalf of the Radio Association, gave a brief history of the Association, and then dealt with the organisation.

Organisation of Broadcasting

When the Select Committee on Broadcasting was appointed the Association took a referendum of its members on the following question :—

" Do you consider the present system satisfactory from the point of view of the listeners in regard to

" (*a*) Efficiency.
" (*b*) Cheapness.
" (*c*) Quality of programme.
" (*d*) Variety of programme."

The result of this referendum showed that 95 per cent. of the members approved of the present system which is carried on by the British Broadcasting Co.

A Recommendation

As the country is not big enough to accommodate two broadcasting companies or authorities, the Association is in favour of continuing the policy of granting a licence to broadcast to one licensee only, which might be called the Board of Broadcasting Control. The period for which the licence should be granted should be three years. If at the end of that time the licensee has not given general satisfaction, the Postmaster-General should have the power to withdraw it and grant it to a rival body or company.

Briefly, the Radio Association recommend that the present arrangements continue for a further three years until the future of broadcasting is more clearly discernible, but in the meantime various minor modifications should be made in co-operation with the various interests which are concerned.

Commander Kenworthy, who gave evidence on behalf of the Radio Association.

The News Items

In regard to news the Radio Association considers that the progress of broadcasting is being retarded by vested interests. No effort should be spared to build up a real news service. The Broadcasting Company should be allowed to have its own announcers or narrators present at big events of the day who will report either from the spot or shortly afterwards from the studio on such events. The Association do not consider that the newspapers can reasonably object to this extension of broadcasting.

Mr. Landham's evidence contained the following points :—

Alternative Programmes

Many members of the Association have requested us to press for alternative programmes on different wavelengths.

Advertising

It may not be generally known that the Broadcasting Co. has already a large advertisement revenue, said to be about £100,000 per annum, from the *Radio Times*. This is in some measure due to the special advantage which the *Radio Times* possesses by virtue of its connection with the Broadcasting Co. It obtains exclusive or prior information in regard to programmes and official announcements and views in regard to broadcasting arrangements. *Other wireless technical periodicals are at a disadvantage in this respect, to the detriment of the advanced amateurs, home constructors and experimenters. The Radio Association are of opinion that this fact militates against the success of their efforts to improve the technical knowledge of the user.*

It was suggested by the Association that licences should be granted free to blind persons.

This concluded the evidence. Earl Crawford commenced the examination of the witnesses with the request for a few statistical facts. What was the membership of the Society? Commander Kenworthy stated that the number was about 3,000. Asked regarding any qualification for membership, Commander Kenworthy said that an examination was held for Fellows and Associates.

This examination was regarded by many as too stringent, and only about 40 per cent. of the applicants succeeded in obtaining passes.

The Chairman remarked that this was very creditable and greatly increased the value of the suggestions.

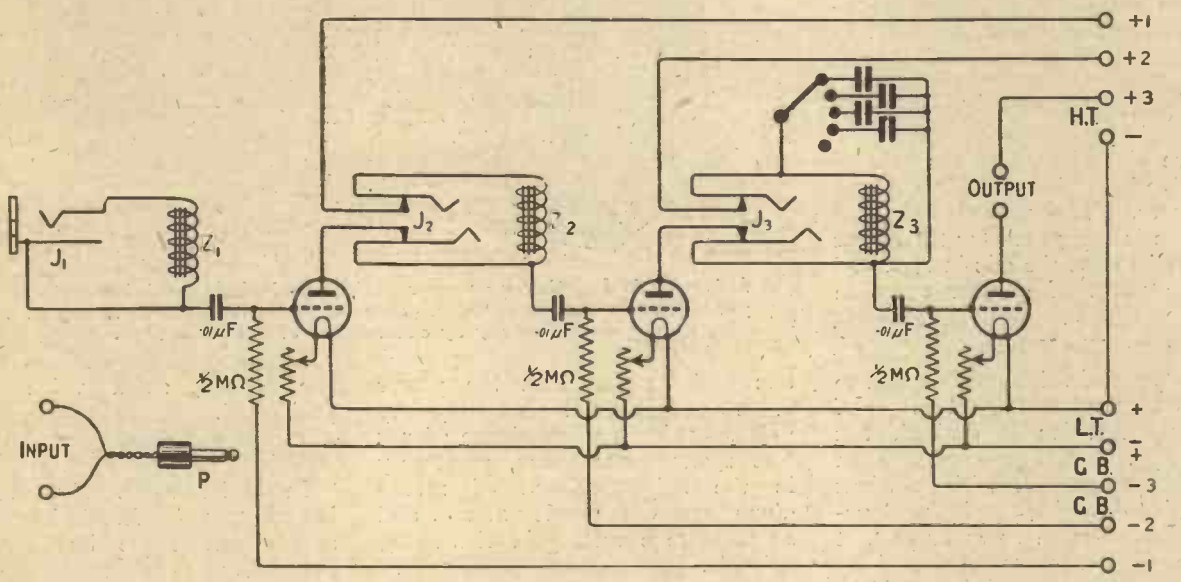
Capt. I. Frazer : Is the membership figure given a direct or indirect membership?—Witness : Direct.

Capt. I. Frazer asked witness whether he was aware that the idea of free licences for the blind had received the consideration of the B.B.C. and this company had indicated their willingness to forgo their proportion of such revenue.

(*Continued on page 710*)

Circuits for the Experimenter

No. 3.—A CHOKE-COUPLED POWER AMPLIFIER



IT is usual to associate the idea of a low-frequency amplifier capable of handling considerable power with transformer inter-valve coupling, but there is no reason why the attractions of the choke-capacity method should not be utilised in such apparatus. Success in the usual choke-coupled amplifier when handling strong signals is largely a matter of the choice of suitable chokes, and the correct type of valve for each stage of amplification, with the usual attention to the value of grid leaks, grid bias, and high tension voltage.

Three Stages

Three stages of amplification will usually be necessary to obtain the desired output volume, if it is assumed that the power amplifier is one intended for operating large loud-speakers for dancing and similar purposes. This week's circuit illustrates a convenient arrangement on these lines, and it will be observed that a plug and jack system of switching is provided which enables one, two or three stages of amplification to be used at will.

Normally, all three stages would, of course, be used, and the switching system is provided chiefly to enable the stages of amplification to be brought into action one at a time, and the necessary adjustments made to each to ensure the most effective functioning. This arrangement will be found a decidedly convenient one, since in the event of any trouble developing in the amplifier, by cutting out the valve circuits one at a time the source of the trouble can be located rapidly.

CIRCUIT No. 3
SPECIAL FEATURES

1. **Good Quality Reproduction of Powerful Signals.**
2. **Separate H.T. and Grid Bias Adjustment for Each Stage.**
3. **Special System of Switching Brings Circuits into Use One by One for Testing Purposes.**

Switching System

The system of switching illustrated is a somewhat unusual one, since it will be observed that the input terminals are connected to a plug, which can be inserted in Nos. 1, 2 and 3 of the jacks, in such a way that when it is placed in jack No. 3, only the last stage of amplification is used. It will be observed that in this way the loud-speaker is always connected in the anode circuit of the last valve, which, of course, is therefore always of the correct type for the purpose. When the plug is inserted in jack No. 2 the last stage and the middle stage of amplification are in use, while when it is placed in No. 1 the whole amplifier is in use.

Advantages of the Method

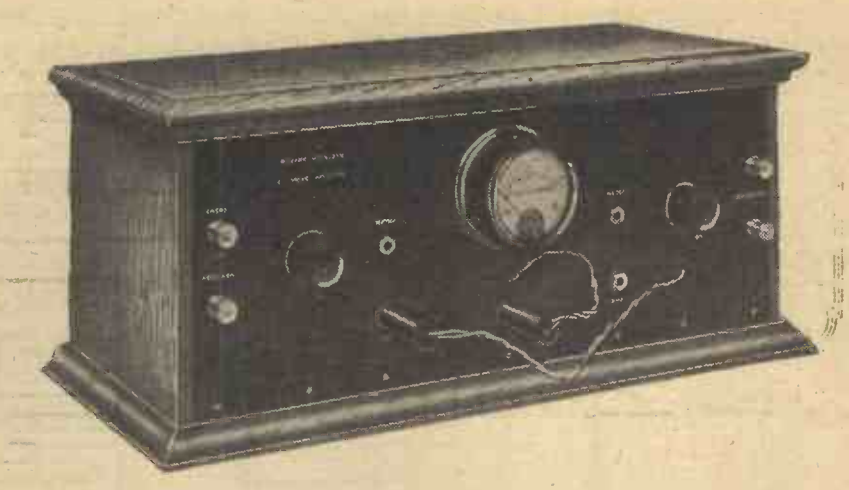
The reason for the adoption of this arrangement is to be found in the fact that different types of valve will be used at each stage, and those in the last will be of the correct type for working a loud-speaker. Furthermore, if it is desired to use the amplifier with, say, only two stages in use, for the reason that the input signals are sufficiently strong to get the desired output with only two stages of amplification, the correct type of valve will be automatically selected at each stage.

Coupling Units

The success of the amplifier from the point of view of clarity of reproduction will depend very largely upon the choice of a good choke coil, and due attention should be paid to this point. Further, chokes of robust manufacture are called for, since if the amplifier is used for handling signals of considerable power, valves passing a fair amount

of anode current will be required to obtain the necessary large permissible grid swing.

It is imperative that the grid condensers shall be of the best possible quality, especially as regards insulation, since a very small leak here will result in the application of positive bias to the grid with consequent distortion. The provision of low-value grid leaks is, of course, largely intended to minimise such risks, since the lower the value of the grid leak the smaller will be the positive bias applied to the grid of the valve by a given leak in the grid condenser. The value of half a megohm is suggested for these, but it is well to use the clip-in type and try the effect of quarter megohm leaks.



It is wise in building a power amplifier to include a milliammeter on the panel in order that the correct adjustment of grid bias, etc., may be made most easily by observation of anode current.

The Valves

The types of valves will depend to some extent on the actual power of the output which is desired, but assuming that it is required to work a large loud-speaker with sufficient strength to provide music for dancing in a fair-sized room or hall, it will be suitable to use a valve of the high impedance and high amplification ratio type in the first stage. Such valves are the D.E.5B and D.F.A.4, to name only two examples. This valve will require an anode voltage of about 100 and a negative bias of about 1½ volts.

The Second Stage

In the next stage it will be desirable to use a valve of somewhat lower impedance and greater permissible grid swing. A suitable one will be found in the power valves or special low-frequency valves having an impedance of not less than 10,000 ohms, preferably in the neighbourhood of 12,000 ohms, 120 volts anode voltage, and 4½ volts to 6 volts grid bias being suitable.

The use of such a valve in the second stage of amplification will enable really strong signals to be handled without undue distortion, but, of course, it will not give so much amplification for the stage as would be obtained with a high ratio type. An alternative which will be found to give a somewhat greater volume lies in the use of two of the high impedance valves connected in parallel for this stage, and this course is recommended where the use of an extra valve is not prohibited.

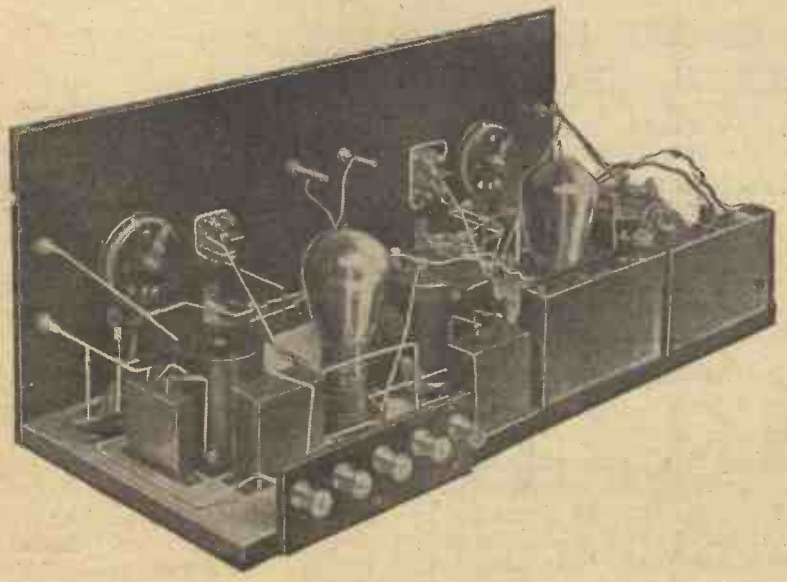
The Loud-Speaker Stage

In the last stage only a very low impedance valve should be used, the actual permissible impedance depending upon that of the loud-speaker. In general, however, it will be desirable to use one of the D.E.5A type, with an impedance in the neighbourhood of 4,000 ohms. With not less than 120 volts on the anode and about 10 volts grid bias, it will be possible to handle a really powerful signal without distortion.

Tone Control

It will be noted that an arrangement of stud switch and fixed condensers is provided across the third choke coil (Z_3). This is to enable the adjustment usually known as "tone control" to be performed, by shunting a selected capacity across the choke.

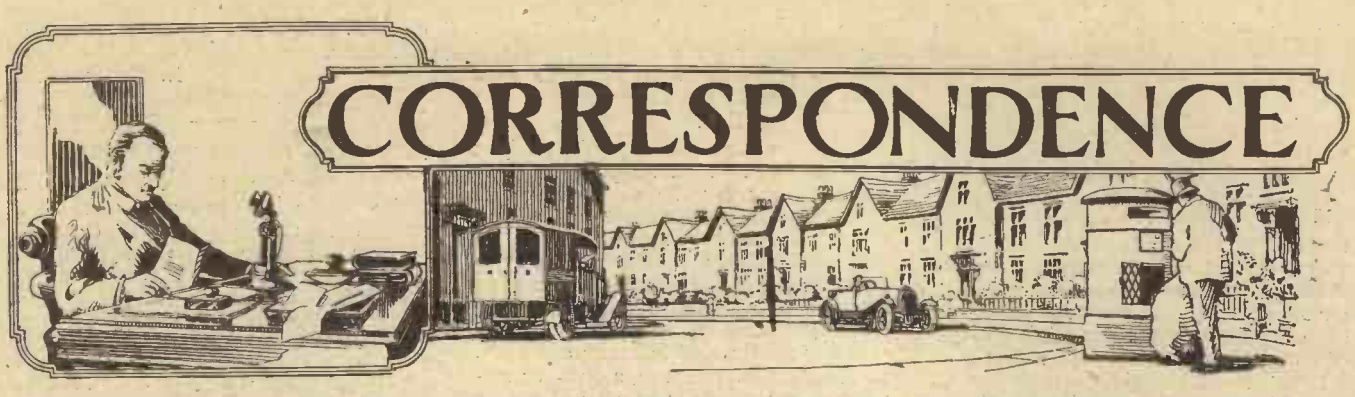
In this way a certain lowering of tone can be produced, which may lead to an apparent improvement in reproduction with certain types of loud-speaker.



It is preferable to use separate grid-bias batteries for each stage, while the spacing out of the wiring and components requires considerable attention when a good deal of power is to be handled.

REPORTS WANTED

We should be glad to receive still more reports on short-wave experiments, whether in transmission or reception, carried out by our readers, so that these may be summarised and inserted in "Short-wave Notes and News." These reports should be sent to "The Editor," *Wireless Weekly*, Radio Press, Ltd., Bush House, W.C.2.



"B.B.C. AND WAVELENGTH EXTENSION"

SIR,—With reference to your Editorial, "B.B.C. and Wavelength Extension," appearing in the January 13 issue of *Wireless Weekly*, we feel that this may seem in some respects very misleading to those members of the public who have purchased manufactured sets, for the following reasons:—

(1) The B.B.C. has already issued an official statement to the effect that no extensions of wavelength beyond the present band have as yet been decided upon.

(2) Even were such extensions ultimately introduced, there are very few manufactured sets now upon the market which could not be easily modified at very small cost to the owner.

(3) In the case of the sets manufactured by my company, all these sets may be modified to operate down to 200 metres by the purchase of two small coils which are interchangeable with the coils supplied with the installation, and the cost of which is 2s. 6d. each coil. The total modification, therefore, can be carried out for 5s., and by anyone without any knowledge of wireless technique. Furthermore, all such sets can be made to operate between any wavelength from 100 to 4,000 metres by the use of a complete set of coils marketed for this purpose and selling at 2s. 6d. each.

We think it only fair, in view of the statements made in your Editorial to the effect that you have sympathy with those members of the public who have "now bought a ready-made receiver which will be obsolete in a year," that you should publish the names of all those firms whose receivers are readily adaptable, at trifling cost, to any wavelengths which may be required for broadcasting purposes.
—Yours faithfully,

B. BINYON,
O.B.E., M.A., M.I.E.E.,
Managing Director, Radio Communication Co., Ltd.
34-35, Norfolk Street,
London, W.C.2.

AN APPRECIATION OF "CIRCUITS FOR THE EXPERIMENTER"

SIR,—I am writing chiefly to inform you of my appreciation of your new weekly feature, *i.e.*, "Circuits for the Experimenter." This is the very thing I have been looking for, but I have not been able to give a name to it. I hope you will continue it each week. I also wish to express my appreciation of all four of your periodicals, none of which I have missed since I started reading them eighteen months ago.

I am at present experimenting with "The Special Five," but on a most indifferent aerial, but later I am going to the country, and I shall be pleased to send you in a report of it.

I have had excellent results with every Radio Press set I have so far constructed.

I am not attempting to receive the Transatlantic tests, as my aerial is too poor, but next year I hope to have an ideal aerial.

Last year, in the country, at our house at Hassocks, Sussex, I successfully received WBZ and WGY eleven times in succession on the loud-speaker on "The Home Three-Valve Receiver," by Mr. Redpath (December, 1924, *Modern Wireless*). On one occasion the transmission from WGY was at full loud-speaker strength for about three minutes. This is marvellous in a receiver with no H.F. valve.

I am expecting great results on the "Special Five." By the way, I have found that primaries of 30 turns, using 140 turns on a 4½-inch diam. secondary with 38 g. enamelled wire, get Daventry quite well. I use 4½-in. formers for the B.B.C. broadcast band as well, with 30 turns of 32 g. d.c.c. wire for secondaries, and 20 turn primaries with satisfactory results, that is to say, Bournemouth, Cardiff and Birmingham full-loud speaker strength. But I will give you a fuller report later on.

Wishing your papers every success.
—Yours faithfully,

J. HUGHES.

London, W.2.

P.S.—As you may deduce from the dimensions of my transformers, I read Mr. Reyner's articles, though I fear I rush the formulæ!

FROTHING

SIR,—I am relating the following experiences with accumulators in the hope that some of your readers who possess a greater chemical knowledge than mine may be able to explain them.

At one time I had a great deal of trouble with accumulators frothing when on charge (I use a vibratory rectifier for charging, running from 220 volt A.C. mains), and was greatly delighted at the result when I tried the tip suggested in *Wireless Weekly* some

The new main studio at Birmingham is exceedingly spacious, and much better acoustical effects are obtainable than were before possible at this station.

time ago of adding a pinch of Hudson's soap to each of the cells. The result was certainly satisfactory in that the frothing stopped at once, but I found that it started again a few months later, requiring further treatment.

I have always understood that the frothing was the result of some chemical action between the electrolyte and the celluloid containers, and therefore when buying a new accumulator recently, I took care to obtain one of the glass-box type. This accumulator has certainly never given the slightest sign of frothing, and behaves perfectly, and I thought that the glass container was a positive cure. Six weeks ago, however, I bought a high-tension accumulator also of the glass-box type, and now this has started to froth almost as badly as my old celluloid battery! Can any of your readers explain?—Yours faithfully,

K. G. HENDRICKSON.

London, S.W.19.

SELECTIVITY

SIR,—One hears a great deal of talk and grumbling at the present time about heterodyning between different broadcasting stations, but it seems to me that people should look nearer home for the cause of the trouble. Surely, it is entirely the fault of their own sets, which are not sufficiently selective? To produce the familiar heterodyne whistle, it is well known that both carrier waves must be being received in the set, and does not this point to a lack of selectivity? If the set is sufficiently selective, it will receive only one of the carrier waves, and thus no whistle can be heard. It seems to me it is up to us to make our sets more selective and not grumble so much about "Why doesn't Geneva stop it?"—Yours faithfully,

"CRYSTAL USER."

Hull.

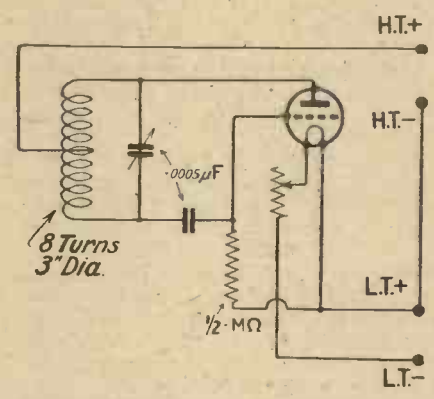
[EDITORIAL NOTE.—"Crystal User" makes a perhaps natural mistake in assuming that there is no reason why the selectivity of a set should not be increased to any desired degree. As a matter of fact, if the set is made so selective that it will eliminate a station separated by less than ten kilocycles from the desired one, there will theoretically be a loss of quality, since the "side bands" of the desired carrier wave will be cut off. "Crystal User" must remember that a carrier wave does not comprise a single frequency, but is made up of quite a band, which must all be received with a certain degree of uniformity if perfect reproduction is to result. There is, therefore, a limit to the degree of selectivity permissible.]

OSCILLATOR COUPLERS FOR SHORT WAVES

SIR,—I was very much interested by the article in this week's *Wireless Weekly*, by Mr. Johnson-Randall, upon the use of super-heterodynes for the higher frequencies, and I can fully corroborate everything he says with regard to the fascinating nature of such reception.

I believe that the super-heterodyne receiver, even in its simplest form, is the ideal set for the short waves, if only because it is so extremely easy to operate. If only some of our short-wave enthusiasts would realise this point they would give up their beloved reaction circuits, with their yard-long extension handles, exasperating body capacity effects, and in many cases distorted signals, and use a five- or six-valve super, which is capable of giving much better results without any critical manipulation.

I first commenced using a super-heterodyne for short-wave work rather more than 12 months ago, and with only a very little preliminary experimenting, succeeded in receiving KDKA (who was at that time working on about 3,000 kilocycles) at full loud-speaker strength with only six valves, with a three-turn loop about 2 feet



The oscillator circuit recommended by Mr. Brand for KDKA.

square. Since then I have tried a great number of circuits, and my present set works quite effectively up to a frequency of about 9,000 kilocycles, and I have obtained consistent reception of WGY on 7,500 kilocycles (40 metres) on a number of occasions.

I have tried the separate reaction coil and tuned grid coil oscillator circuit used by Mr. Randall, but prefer, on the grounds of simplicity and ease of arrangement, the Hartley type, which I also find preferable on the further ground that it oscillates more readily, and therefore one is not so limited in the choice of a valve. The main difficulty with the Hartley oscillator I find to be that it is rather prone to squeal upon the lower dial readings of the condenser, but this is overcome by using a good size condenser with a slow-motion drive, and using interchangeable units for the oscillator coils (i.e., by not working at the low readings).

I enclose a diagram of connections giving the details of a unit which I use for KDKA, for the benefit of those readers who may care to try this type of oscillator for the purpose.—Yours faithfully,

L. R. BRAND.

Norwich.

THE "ALL-CONCERT" RECEIVER IN NEW ZEALAND

SIR,—I was recently fortunate enough to pick up an old copy of *Modern Wireless*, dated September, 1923, and a perusal of its pages led to my being interested in the "All-Concert Receiver," described by Mr. Percy W. Harris. I had previously been using a simple 3-coil single valve regenerative set (home-made) and was getting excellent results from all New Zealand stations on 'phones up to 680 miles. The reading of the above-mentioned article fired me with ambition to get further afield, which to us in these islands is a very far cry, the nearest foreign station being approximately 1,260 miles. I decided to adapt my old receiver, and although I could not follow Mr. Harris's instructions as to lay-out rigidly, I must say that the ultimate results exceeded all expectations. The only variation I used in the general idea was to use separate H.T. for each valve and potentiometer control on the H.F. valve. With this set I now get all New Zealand stations on the loud-speaker with sufficient strength to fill the house. The distances of our New Zealand stations from here are: Auckland, 1YA and 1YB, 300 miles; Wellington, 2YK and 2YB, 340 miles; Christchurch, 3AC, about 500 miles; Dunedin, 4YA, 700 miles, I have to detune slightly. These are our main stations, but there are numerous small stations of very low power which I hear on 'phones. Outside our own land I regularly each night, between 9.30 p.m. and 11.30 p.m., hear Australian stations, and I have no difficulty in receiving at comfortable loud-speaker strength either 2BL, Sydney, or 2FC, Sydney, a distance of 1,260 miles from here. I have at various times, when conditions were very favourable, picked up KGO, California, and KHJ, in the same American State, these stations being approximately 6,800 miles, and on one occasion, only for a brief period of about 35 minutes, I heard KDKA experimenting, reception being faint, but clear. These latter stations received on 'phones, needless to state. The possibilities of this type of receiver are indeed great, and I have no hesitation in recommending it to those in need of a simply operated yet effective means of hearing broadcast music. I forgot to mention that, except for loud-speaker work, I use a 2 ft. frame aerial, made up with 72 ft. of No. 18 s.w.g. copper, for New Zealand stations. My outside aerial is stranded copper, 35 ft. high and 95 ft. long, earth and lead-in included, the earth being 3 ft. of heavy copper strip about 1 in. by ⅛ in., soldered to a water-pipe.—Yours faithfully,

SAM. J. PEARSON.

Gisborne, New Zealand.

LICENCE EXTENSION

SIR,—I have just received an extension of my 2,000-1,500 kc. (150-200 m.) transmitting period, and have been further allotted the frequencies of 3,333, 6,667 and 13,044 kc. (90, 45 and 23 m.).

I shall continue to work on the lower frequencies, but shall shortly be making tests on the above newly-allotted waves.

My call sign is G-5JD, and reports will be extremely welcome.

Wishing your journals every success.
—Yours faithfully,

JOHN L. WOOD.

Stanhurst,
Burntisland, Fife.

CHARGED RAIN

SIR,—Noticing the other day that a curious "ticking" noise was audible in my receiver, although it was switched off at the time, I found on investigation that the noise was caused by small sparks jumping across between the plates of the aerial series condenser. The aerial was, of course, connected to the set at the time. This was on January 23 last, and a sharp shower of rain was falling.

This is not the first time that I have observed this phenomenon. Last spring, during the blustering weather commonly associated with April showers, I sometimes found that reception was made quite impossible by the noise produced in the telephones, and sparks were sometimes seen to bridge the condenser plates in the same way. It appeared to me that each drop of rain falling on the aerial wire caused a click in the telephones, while occasionally a big enough charge to cause a spark would be accumulated on the aerial.

Inquiries among friends in other parts of the country seem to indicate that the phenomena described are, to a certain extent, local. The experiences of your readers in this connection would, I am sure, be most interesting.
—Yours faithfully,

KENNETH L. JEFFREYS.

Raynes Park.

MISUSE OF CALL-SIGN?

SIR,—Reports are continually reaching me from listeners in the Birmingham district of the activities of a transmitter making use of the call-sign 6QU. If you will permit me, I should like to draw your readers' attention to the fact that I am not responsible for these transmissions, but would appreciate further reports in so far as they would assist in the location of this station. I should be happy to forward the reports I have received to the owner of the station in question, who might also be interested to know that the matter has been brought to the notice of the Postmaster-General.

Surely it ought to be unnecessary to remark upon the confusion which must arise from the unauthorised use of a call-sign which has already been allotted to another transmitter.—Yours faithfully,

A. EATON (6QU).

21, Dashwood Road,
Prestwich, Manchester.

SUPER-HETERODYNES ON THE SHORT WAVES

SIR,—With reference to Mr. Johnson-Randall's article in the last issue of *Wireless Weekly* concerning an oscillator-coupler for KDKA, I should like to inquire of your readers what their experience has been with various types of tuning circuits for super-heterodynes on short waves. Upon first using a super-heterodyne on the higher frequencies, I used my ordinary broadcast frame aerial, tapped off at four turns, and obtained some exceedingly conflicting and puzzling results.

I put these down largely to dead-end effects in the frame, and therefore constructed another one with only three turns of copper tape, spaced one inch apart, the diameter of the frame over all being about 2 feet 6 inches square. The results with this frame were certainly better, but I am still troubled by the fact that there seems to be an entire absence of directional effect. Even when receiving distant signals, such as those of WGY, on his short wave, one can turn the frame through a whole revolution, with practically no difference in the intensity of the signal.

This is disconcerting, but does not lead to any particular difficulty in reception, but certain other effects which I have noticed very decidedly do. For one thing, my next-door neighbour uses one of the ordinary single-valve reaction circuits for reception upon similar frequencies, and whenever he tunes in WGY that station is absolutely lost off the map so far as I am concerned, only the very faintest sign of the carrier wave still coming through.

This happens whenever he uses the set, and does not necessarily imply that he is actually oscillating, since I have gone from one set to the other, and it seems that whenever his set is receiving WGY, with the reaction adjusted to the correct point for maximum signals, that is to say, just below the oscillation point, it sucks up all the energy which would otherwise have been working my super.

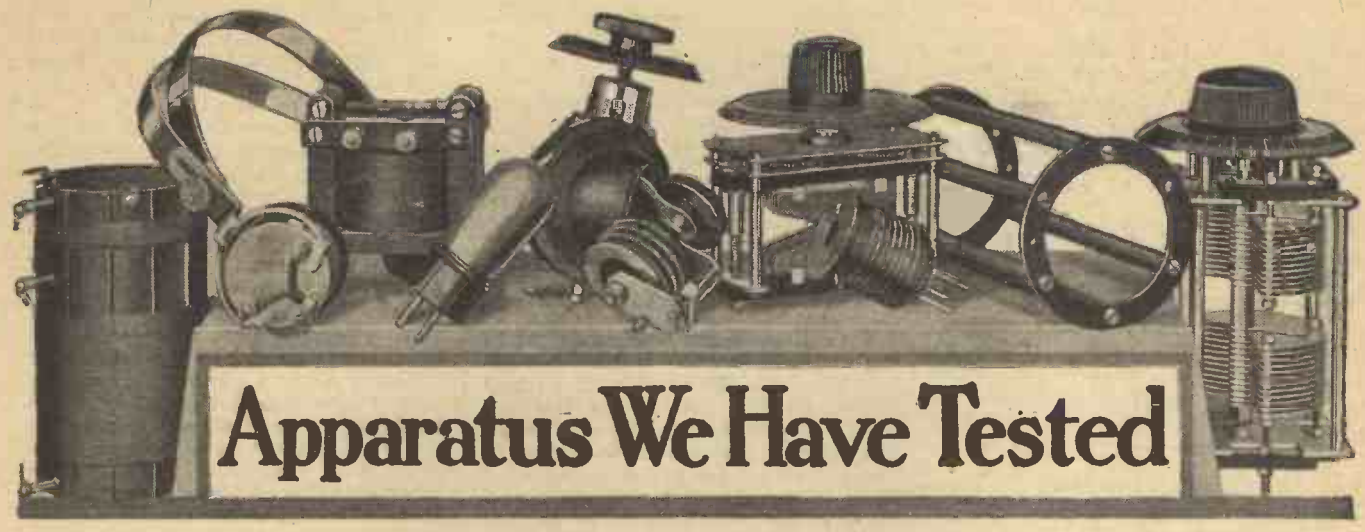
I have always thought that a remedy for this might be found in the use of an outside aerial, but have hesitated to employ one for fear of causing annoyance to my neighbours and also because I have thought that the familiar phenomena of "dead-spots" when the receiver was tuned to one of the harmonics of the aerial, would be present in the same way as in a single valve set; and since one cannot easily compensate for them by means of reaction in the case of a super-heterodyne, they would give trouble in the form of flat tuning.

Perhaps Mr. Johnson-Randall or some of your readers who have had experience on this point would state whether they find this to be actually the case? The risk of interference could probably be minimised to some extent by the use of a sufficiently weak degree of coupling, a point upon which I could invoke my neighbour's aid in determining the extent of the nuisance.
—Yours faithfully,

L. C. CROWTHER.

Glasgow.

A scene in the modulation room at the Birmingham station during the opening of the new studio. Mr. Cooper (centre), the chief engineer, is seen making adjustments.



Apparatus We Have Tested

Conducted by Radio Press Laboratories, Elstree.

Self-Soldering Wire

Messrs. the Rexo Engineering Co. have submitted to us for test a sample of their "Junit" self-soldering wire.

Manufacturers' Claims.

It is claimed that this self-soldering wire renders the use of a separate stick of solder unnecessary, and that it also makes soldering both easier and neater than when the usual methods are employed.

Description of Component.

The basis of this soldering wire is H-sectioned copper, the grooves on either side being filled with solder. It is made in two gauges, a light one about equivalent to No. 18 S.W.G. suitable for small sets, and heavier No. 17 S.W.G. suitable for large sets and for long leads. The light wire is supplied in three-yard coils on a card, while the heavier is provided in the form of 2 ft. straight lengths.

Laboratory Tests.

It was found on test that this self-soldering wire fulfilled the makers' claims in that it renders soldering easier, and that quite good joints can be made with its aid. It was found possible to obtain sufficient solder for a joint by running the iron along the wire and touching the solder thus obtained on to the joint. The light wire appears to be of somewhat too fine a gauge for general wiring, and many amateurs may prefer to use heavier wire even for small sets.

General Remarks.

This self-soldering wire embodies quite a good idea, and many amateurs who find difficulty in using the ordinary method of soldering should benefit by its use. A special advantage is that it is difficult when using this wire to drop blobs of solder on to parts of the set.

Variable Condensers

Messrs. Wilkins & Wright have submitted to us for test samples of their "Utility" square law variable condensers, i.e., two .0003 μF and one .0005 μF condensers.

Description of Condensers.

These variable condensers, which are of the square law pattern, possess several novel and interesting features. All the plates are of aluminium, and the fixed plates are enclosed on the sides remote from the shaft on which the moving vanes are mounted. The moving vanes are mounted on a screwed shaft, which screws into the inside of a screwed bearing in the end plate nearest to the dial. Thus as the moving vanes revolve through the 180 degrees allowed, the shaft screws and unscrews, but the amount is, of course, too small to allow the two sets of plates to approach each other appreciably.

The latest "Utility" condenser is enclosed in a dust-cover.

The upper end plate is separated from the fixed plates by three pieces of ebonite so arranged that the dielectric loss is negligible.

Substantial soldering tags are provided, but no terminals. The knob and dial are made in one piece of black moulded material, and half the circumference is divided into 100 divisions. The dial is secured to a ¼-in. shaft by a set screw.

Laboratory Tests.

The movement of this condenser was found to be very easy and uniform. The results of further tests are shown in the table.

The resistance between moving vanes and soldering tags was less than .01 ohm.

General Remarks.

This condenser is quite good, and can be thoroughly recommended to the constructor.

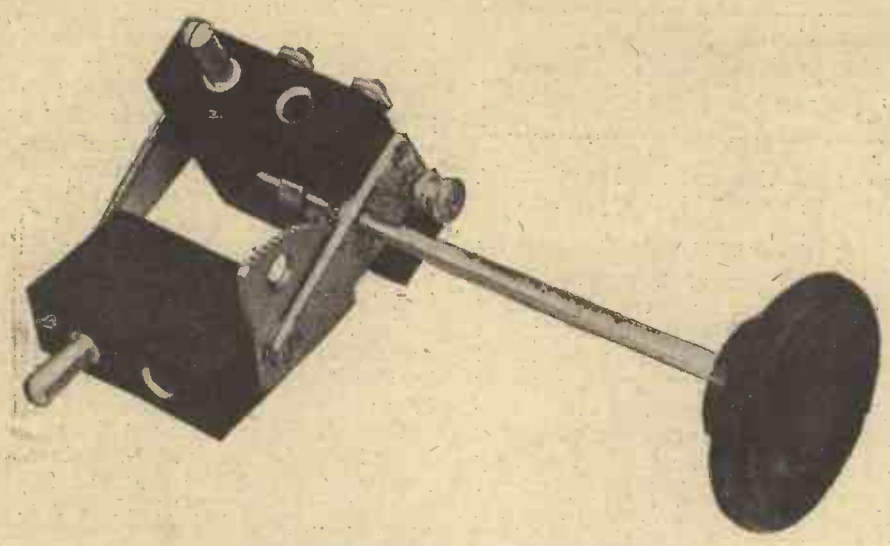
Two-Way Coil Holder

Messrs. the Norman Radio Co., Ltd., have submitted to us for test a sample of their geared two-way coil holder.

Description of Component.

This coil holder is provided with single-hole fixing by means of a large brass screw which screws directly into the ebonite of the fixed coil holder. This enables front of panel, back of panel or baseboard mounting to be employed. The moving coil holder is fixed to a geared quadrant which engages with a small pinion wheel connected to a 3-in. brass spindle, to the end of which is fixed a fairly large milled knob.

Rated Capacity in μF.	Actual Capacity in μF.	Minimum Capacity in μF.	H.F. Res. at 833.3 Kilocycles.	Insulation Resistance.
.0003	.00027	.000010	Negligible	Infinity
.0003	.00027	.000010		
.0005	.000485	.000012		



The Norman Radio geared coil holder.

As the knob is rotated the reduction gearing enables a fine motion to be imparted to the moving coil holder, so that as the controlling knob is rotated through a whole revolution the moving coil holder only moves from its position parallel to the fixed coil holder to a position at right-angles. All the metal parts of the coil holder are of brass, brass terminals being provided for fixing connections. A particularly useful feature is that all the terminals are fixed in the ebonite of the main coil holder, so that flexible leads are not necessary.

Laboratory Tests.

The motion of this coil holder was found to be particularly smooth, back lash being inappreciable. The setting for several coils was found to be quite good, and the insulation resistance was infinite.

General Remarks.

There are several excellent points in the design of this component. The workmanship and finish are also both excellent, so that the coil holder can be thoroughly recommended.

Rheostat

Messrs. C. A. Vandervell & Co. have submitted to us for test a sample of their rheostat designed for dull or bright emitter valves.

Description of Component.

The interchangeable resistance element of this rheostat consists of resistance wire wound on a cylindrical former about 1½ in. long. This former is supported at its extremities by a bent copper strip, so that it is free to rotate. A length of thin copper rod bent into the form of half a turn of a spiral presses against the resistance element, so that when it revolves the resistance element revolves also. One terminal of the rheostat is connected to one end of the resistance element, and the other to the bent copper rod already mentioned.

The bent copper rod can be rotated through half a revolution by means of a milled knob of moulded material. As it revolves it slides along the resistance element, revolving the latter at the same time. The effect of this is that as the knob is rotated through half a revolution the resistance varies continuously between the maximum and zero.

Terminals and soldering tags are provided for this rheostat, and the component can be secured to the panel by means of single hole fixing.

Laboratory Tests.

On test, it was found that the maximum resistance of this rheostat was 39 ohms. On testing it in a set it was found that the motion was particularly easy, and the rheostat was almost silent in action. The rheostat was found to be capable of taking .2 of an ampere without overheating.

General Remarks.

This rheostat is a well-made and well-finished article, and can be thoroughly recommended.

Combined Earth Switch and Lead-in Tube

A combined earth switch and lead-in tube has been sent by Messrs. E. Shipton & Co., Ltd., for test at our Laboratories.

Description of Component.

This component consists of a ½-in. insulating tube 6 in. in length, with a plated metal clip and terminal fixed at each end. An ⅛-in. square section metal rod passes through the centre of the tube, one end terminating in a V-shaped metal clip and wing nut terminal, while the opposite end has a similar clip and milled knob. The wing nut terminal is connected to the aerial down lead, and the clip and terminal close to the knob is connected to the receiving set. The remaining terminal on the tube is provided for the earth lead.

Laboratory Tests.

The tube was inserted in place of an ordinary lead-in tube. On pushing the knob the aerial was connected to the set, and on pulling the rod until the back clip registered with the earth terminal the aerial was earthed.

The component was in use during a week of very bad weather. No trace of loss in signal strength was noticed due to leakage, and the insulation resistance before and after test was infinite. No corrosion was perceptible on the clips or terminals, and the component, which was strong mechanically, adequately fulfilled its function.

Aerial Insulator

A sample aerial insulator has been sent to us for test by Mr. W. J. Scott.

Description of Component.

This insulator consists of two flat egg-shaped pieces of ebonite, 5-16 in. thick, which are held together by four brass screws and nuts. A groove is cut on the inner face of each half so that when the ebonite halves are clamped together a 7/22 aerial wire is tightly gripped. The shape of this groove enables the aerial and lead-in wire to be continuous without the necessity for twisting round the insulator. A ¼-in. hole is provided through the complete insulator for attaching the stay wire, and the edge of the insulator is grooved, thus providing additional leakage path.

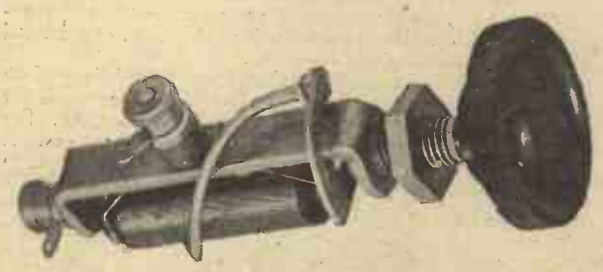
Laboratory Tests.

The insulation resistance of the component was initially found to be infinity. The insulator was then placed in position on an outside aerial and left for a period of one month, during which time extreme atmospheric conditions were experienced. No trace of signal strength reduction was noticed, and after dismantling and retesting for insulation resistance, it was found to be unimpaired.

General Remarks.

The ebonite appeared to be of very good quality, but the four screws should not have been screwed into the ebonite, as the fit is too tight.

The component can be confidently recommended.



The C.A.V. rheostat is provided with interchangeable resistance elements.

The Broadcasting Inquiry

(Concluded from page 702)

Period of Trial

Earl Crawford desired witness' opinion as to whether three years was a sufficient length of time to enable a new licensee to give satisfaction.

Commander Kenworthy thought it was.

Lord Blanesburgh suggested that possibly the B.B.C. would not wish to continue after the expiration of the current licence. Should they be induced to continue?

Witness said "decidedly."

Views of the N.A.R.M.A.T.

On January 22 Mr. W. W. Burnham appeared for the National Association of Radio Manufacturers and Traders, of which he is Chairman. After dealing with the importance of the wireless trade to the British community, he put forward the suggestion that the existing stations be replaced by six or seven of high power. This would offer the greatly desired alternative programmes to listeners, particularly on two-valve sets. He thought crystal sets would disappear.

Composition of Broadcast Authority

"A 98 per cent. expression of opinion of our members is in favour of broadcasting remaining in the hands of one independent authority and not passing under Government control. They consider that the capital needed by the authority could be easily found by the issue of guaranteed 7½ per cent. debentures or bonds, and the income for running the service obtained from licences as at present. We consider that the said authority should have a representative Board of Control constituted broadly as follows:—

"British Radio Manufacturers.
"Musical Interests.
"Theatrical Interests.
"News Interests.
"Religious Interests.
"Educational Interests.
"Wireless League and Associations.
"Government representatives.

"We consider the manufacturers' interest in the management should be in the greater proportion, as their highly trained technical and research people have been connected with the development of wireless transmission from its infancy, and they also control all the patent rights. They therefore should be in a position to control and advance the technical and engineering side of broadcasting."

Capt. I. Frazer asked: Has membership of the N.A.R.M.A.T. increased or decreased?—Mr. Burnham: Increased.

Capt. I. Frazer: Is not the suggested plan for six or seven regional stations the same as that put forward by the B.B.C.?—Witness: Very similar.

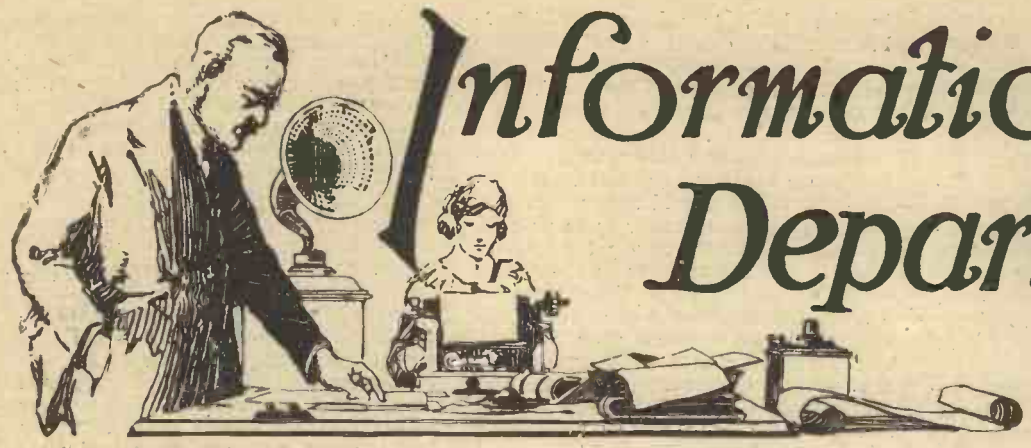
Dame Meriel Talbot asked whether they had any opinion on the programmes.

Witness thought there was a great body of criticism.

Lord Blanesburgh asked a few questions regarding the patent situation.

Other questions related to manufacturers' interests and what representation was desired on the controlling body.

The committee then adjourned until January 27.



Information Department.

W. E. F. (PARIS) complains that he cannot obtain a sound from his 4-valve Family receiver, which he states is wired correctly according to the blue print, and to prove this statement encloses an excellent photograph of the wiring.

Careful examination of our correspondent's photograph at once shows why he hears no signals with the set in question, the trouble being due to wrong connections in joining up the grid condenser and grid leak, which is of different type to that used in the original set. The side of the grid condenser which should be joined to the switch arm of the H.F. "in and out" switch only is also connected to the grid of the detector valve, whilst the common point between the grid condenser and leak is joined to low tension positive. The grid condenser is thus placed across grid and filament of the detector valve, which fault is sufficient to account for the set not functioning.

H. H. M. (SUTTON) wishes to alter his 6-volt 40 actual accumulator to give 4 volts and an increased capacity in ampere hours. He submits a diagram and asks whether the method is correct.

With a 6-volt accumulator it is not possible to reduce the voltage to 4 and at the same time increase the capacity in ampere hours. Satisfactorily to do this a further 2-volt cell of the same rating as those at present employed is necessary. With such a cell available the cells should be connected so that two sets of two cells each in series are obtained, and these two sets should then be joined in parallel. The resulting arrangement gives four volts and the ampere hour capacity is doubled.

P. H. (NORTHAMPTON) has constructed the H.T. accumulator unit described by Mr. H. J. Barton-Chapple in the January 1926 issue of "THE WIRELESS CONSTRUCTOR," and has had this charged at the local garage. When returned the plates showed the usual healthy colour and

the voltage was 65. After one evening's use the voltage had dropped to 30 volts and sediment from the "formed" plates had collected at the bottom of the "sample tubes."

It is obvious from the particulars given by our correspondent that his H.T. unit has been charged at an excessive rate, whilst it is likely that the plates have not been sufficiently serrated. This latter is not only necessary to increase the surface of the plates which is presented to the electrolyte, but also serves to hold the resultant substances, obtained by "forming," in place.

We would therefore advise our correspondent to score his plates more deeply, for example, by scratching with a sharp knife, if a vice with well-marked jaws is not available, whilst the current employed in charging should not be permitted to exceed 50 milliamperes.

D. R. (DULWICH) is experiencing trouble with his "Family" 4-valve receiver, which has hitherto given excellent loud-speaker results. Excessive crackling noises accompanied by great loss of signal strength are observed when using both note magnifiers, but the instrument functions normally when only one L.F. stage is in circuit. He asks where to look for the fault.

From the symptoms given it would appear likely that the fault is located in the L.F. transformer which is brought into circuit when both note magnifiers are used, that is, the component in the centre of the panel. The most common cause of failure in a transformer is a breakdown in the windings, although other more obscure faults are sometimes present. A reliable test which should throw considerable light on the matter is to proceed as follows: First remove the normal leads to the transformer in the centre of the panel, and then join one tag of a pair of telephones to a terminal of a small battery, such as your low-tension accumulator, the free terminal of the battery to IP, whilst OP should be touched with the free telephone tag. A loud plonk should be heard in the telephones, both when making and breaking this circuit, and complete silence should prevail between these two operations. If the primary winding is continuous the loud clicks mentioned above will be obtained, but if broken or partially broken the clicks will be feebler and a crackling noise will be heard between making and breaking the circuit.

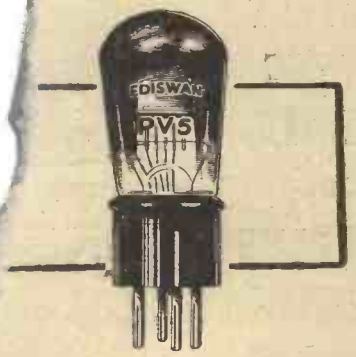
When testing the secondary winding plonks will also be heard if this is continuous, but the sound will not be quite so loud as that given when testing across a sound primary winding. In practice, however, trouble due to breakdowns is most usually confined to the primary winding, which carries the steady anode current.

F. S. (BATH) has constructed an "Anglo-American Six" receiver, and states that although the H.F. tuning condensers tune sharply, it appears to make little difference what size aerial coil is employed, and tuning is extremely flat in this part of the receiver.

The coils employed are home-made, and appear to be of suitable size from the particulars given in our reader's letter. We would therefore suggest that they be removed from their mounts, which should be tested for insulation between the metal of the plug and socket fittings. Much of the flat tuning for which coils are often blamed is not due to the coil itself but to poor insulation of the coil mount. This latter, when removed and tested with telephones and a dry cell, will often be found to be responsible for the trouble, in which case appreciable clicks will be heard when testing for insulation between the metal of the plug and socket.

If attention to this point does not improve matters we would suggest that alternative earth connections be tried since a poor earth will account for very flat tuning. By employing a temporary counterpoise arrangement, which may consist of a length of wire taken throughout the house on the floor, it will often be found that tuning is very much sharpened and signal strength improved, which indicates that the earth is poor.

FAMILY



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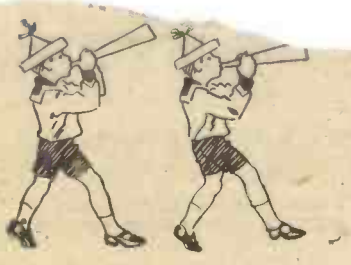

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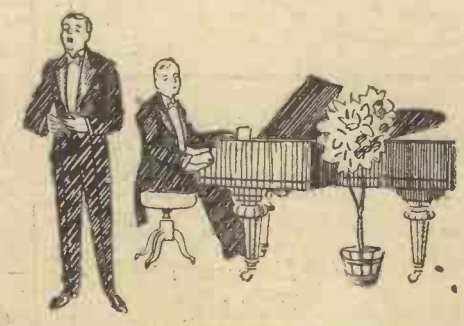

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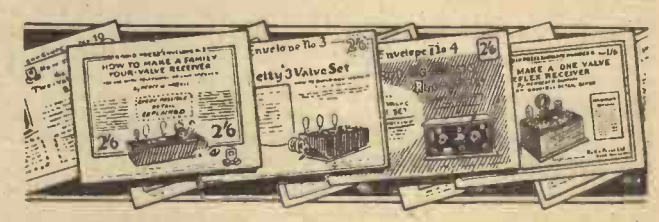

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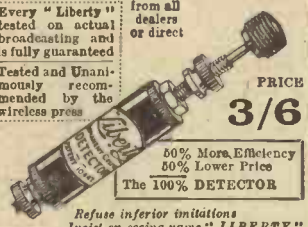

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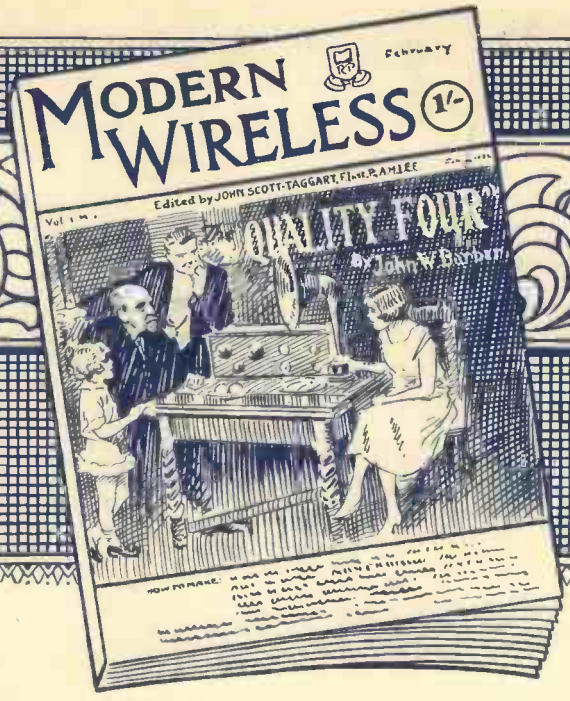

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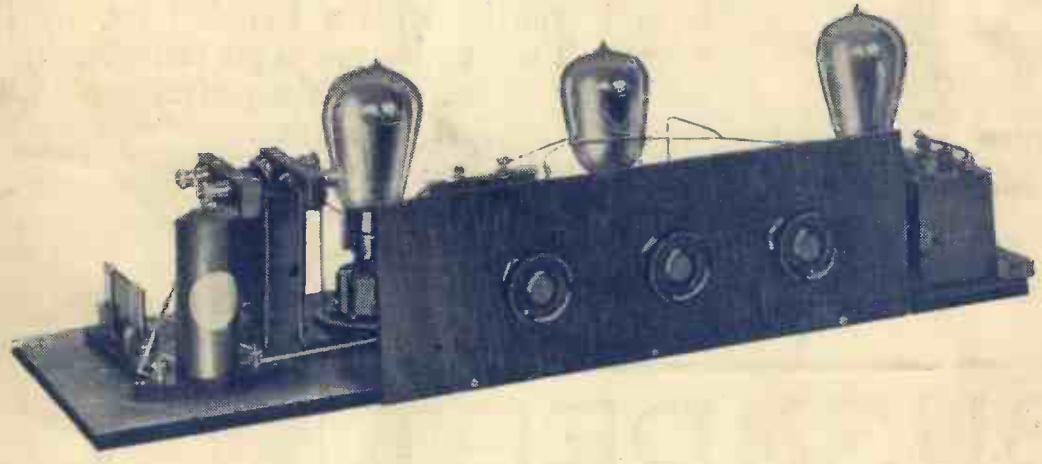

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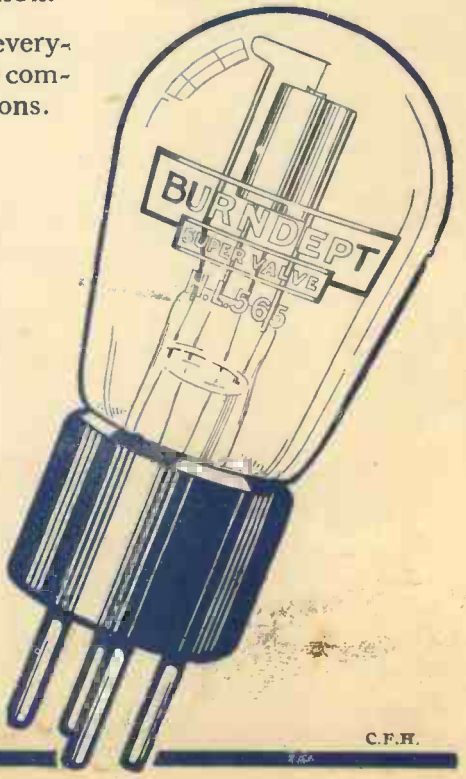

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The New "Wireless Weekly"

WE have pleasure in announcing that on and from February 17 (our next issue) the price of *Wireless Weekly* will be reduced from 6d. to 3d. In its new form *Wireless Weekly* will be outwardly unaltered in appearance; inwardly, its contents will be such as to have a still wider appeal.

We are sure our readers will be particularly interested to hear that Mr. J. H. Reyner, B.Sc., A.C.G.I., D.I.C., A.M.I.E.E., has been appointed Technical Editor. His recent brilliant articles and experimental work described in this journal have placed him in the first rank, and his appointment will be a great asset to the paper in its new form.

An important series of articles by the Editor and by Mr. J. H. Reyner, Captain H. J. Round, Percy W. Harris, Captain A. G. D. West, Captain Crowther, Mr. G. P. Kendall, and other authorities, is already definitely arranged for. Many new features will be introduced, while Captain H. J. Round, Chief of the Research Department of the Marconi Company, and Captain A. G. D. West, Chief Research Engineer of the British Broadcasting Company, have signed two very important contracts to contribute articles. As these contracts cover a whole year, our readers will have the benefit of frequent and regular articles from the pens of these experts.

The important work now being carried on in the Radio Press technical laboratories will very shortly be reflected in the descriptions of highly-interesting technical developments to be published in this journal. The important and widely appreciated features which have contributed much to the success of *Wireless Weekly* will, of course, be retained.

In making our plans for the new *Wireless Weekly* we have been greatly helped by the kindness of our readers in forwarding to us, duly filled in, the question forms which were published recently in our pages. We fully appreciate that the filling in of the particulars asked for has involved much thought, and we take this opportunity of once more thanking our numerous correspondents for their kindness. In addition to this we greatly appreciate and welcome the many letters which we receive expressing views on numerous matters connected with the publication.

It is this intimate contact with the wireless public that has enabled us to supply its demands in the past, and to go forward into the future with that confidence which comes from knowing that we are providing articles, experiments, and descriptions of the kind that are most required.

CONTENTS

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

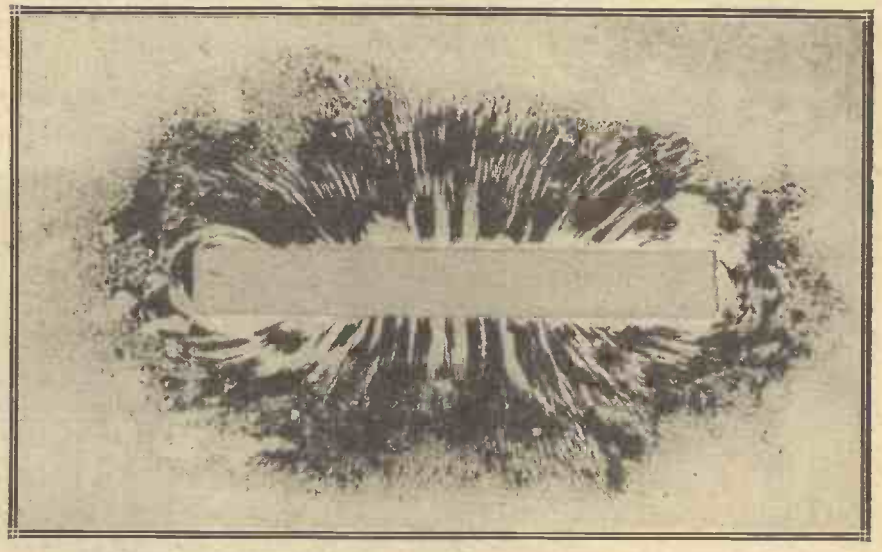
Edited by
JOHN SCOTT-TAGGART,
F. Inst. P., A.M.I.E.E.

February 10, Vol. 7, No. 21.

PLOTTING COIL FIELDS

By H. J. BARTON-CHAPPLE, Wh.Sch., B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E.

An increasing amount of attention is being paid to the effects of coil fields in the design of receiving sets, and in this article Mr. Barton-Chapple describes some simple methods of investigating the problems involved which any experimenter can use.



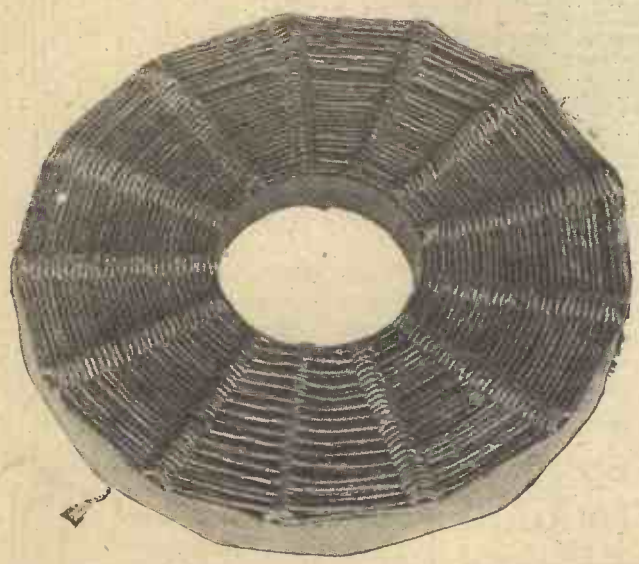
A photograph of a coil field as indicated by the iron filings method. This was "coil A."

IN view of the wide interest created by Mr. Percy W. Harris's article on "Coil Fields and their Influence on Set Design" in *Wireless Weekly* (Vol. 7, No. 17), the writer thought that a certain amount of useful information would be secured if the shape and extent of coil fields could be obtained by some simple means. It will be unnecessary to duplicate Mr. Harris's remarks concerning the immense importance of coil fields and their resultant influence on the design of a receiver or transmitter for wireless purposes, and the reader is referred to the previously-mentioned article to discover where the important points should be emphasised.

Lines of Force

The reader is probably aware of the fact that if a current of electricity is passed through a wire a magnetic field will be formed round the conductor. If the conductor is straight the resultant magnetic lines of force will form themselves into concentric circles which lie in planes perpendicular to the current, the common centre being the point where the plane cuts the axis or centre of the conductor.

Faraday investigated magnetic fields in the case of permanent magnets by using iron filings, and this method can, with advantage, be employed under certain conditions to find the resultant magnetic field when an electric current is flowing through a conductor or a coil. If a vertical current is passed through a hole in the centre of a card and iron filings are sprinkled on the card, they will form themselves in the manner shown in Fig. 1 when the card is very gently tapped.



Coil "A" was a large inductance of the "lattice" type.

A Useful Rule

A useful mnemonical rule can with advantage be stated here, which will enable the relation between lines of force and the direction of current flow to be quite easily committed to memory. This rule, for reasons which will be self-obvious, is familiarly known as the "corkscrew rule," and may be stated in the following way:—

"If the direction of travel of a right-handed corkscrew represents the direction of the current in a straight conductor, the direction of rotation of the corkscrew will represent the direction of the resultant magnetic lines of force."

This will be made clear by reference to the sketch shown in Fig. 2.

Difficulties

Difficulties are encountered when employing the iron filing method in the case of the majority of coils used for wireless purposes, owing to the relatively weak fields consequent upon the absence of iron, and great care is necessary to ensure good results unless the current employed is very large. When the iron filings method fails, however, recourse can be made to a small permanent magnet pivoted at its centre, usually called a compass needle, and by its aid the resultant magnetic fields can be plotted.

Plotting Fields with a Compass

This is done by cutting a piece of paper or cardboard so that it will fit over the particular coil to be investigated, and this should be supported so that it coincides with the centre plane of the coil. Pass the required current through the coil and then place the magnet on the cardboard close to the coil and mark

the position of the N and S poles. Now place the magnet so that the north pole registers with the position of the previous south pole, and

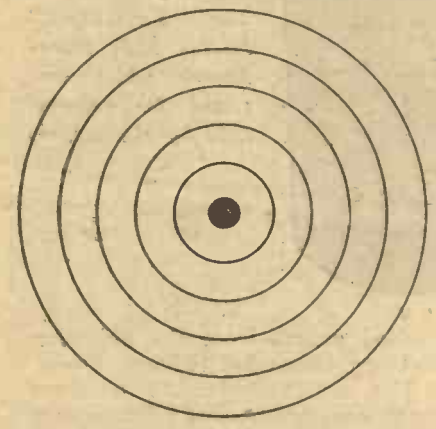


Fig. 1.—The field around a straight wire takes the form of a series of concentric circles, along which iron filings would set themselves.

again mark the position. This process should be continued until a complete circuit is made, the magnet always taking up a position along the resultant line of force.

Join the individual points with a fair curve, as shown in Fig. 3, and this will give the resultant shape of a line of force. This must be repeated for several starting positions of the small compass, and the resultant fair lines give the shape of the resultant field under the particular conditions of the experiment. If the magnetic curves of an ordinary solenoid are taken with filings the result will be similar to that shown in Fig. 4, and it will be seen that the superposition of a number of circular loops has produced a field similar to that of an ordinary bar magnet.

Large Multi-Layer Coil

A very large coil was first taken (coil A), and having completed the necessary preliminaries of cutting the paper to fit the coil section a current of .5 amp. was passed through the coil. The resultant

Fig. 3.—Showing how a compass needle can be used to determine the direction of the lines of force at a series of points.

field is shown by reference to the photograph, which indicates quite clearly, by the orientation of the iron filings, how the magnetic lines of force are disposed. The filings were fixed in position by spraying over the surface of the paper a special liquid fixative with the aid of a scent spray having a fine nozzle. By moving a small compass needle in proximity to the coil the influence of the magnetic field was found to extend to a distance of 8 in. from the centre of the coil.

Small Multi-Layer Coil

The experiment was repeated with a small multi-layer coil (coil B) such as would be employed as a high-frequency choke in certain wireless receivers. The resultant field was again found by the iron filings method, a current of 2 amps. being passed through the coil in this instance. The field's influence was found to extend up to a distance of 4 in. from the centre of the coil in this case.

Special Plug-in Coil

With a special plug-in coil (coil C) which was wound in four segments to reduce the magnitude of the external field, the iron filings method did not produce very satisfactory results, so recourse was made to the compass. The result of plotting this field is shown in Fig. 5, and it should be noticed that this type of winding produces the effect of a double solenoidal arrangement, and on investigating the extent of the external magnetic field when a current of 2 amps. was flowing through the coil, the field influence was found to just fail at a distance of 3 in. from the coil centre. Thus it would appear that an advantage has been gained by constructing this coil with a special type of winding.

The Bodine "Twin-Eight" H.F. Transformer

A new type of coil, namely, the Bodine "Twin-eight" Radio-Frequency Transformer (coil E) was next experimented with. It is claimed by the makers of this coil that it combines the features of a very limited magnetic field with that of high amplification when used as an intervalve transformer. As our immediate concern is with the former claim the resultant fields plotted with the compass needle and shown in Fig. 6 will be of interest.

Coil "B" was a small honeycomb wound on an ebonite ring.

It is somewhat similar to that of the "D" astatic coil, and with the high current of 5 amps., the field's influence was only found to extend to a distance of 4 in. from the coil centre.

Actual Practice

Of course, in actual practice, the magnitude of the current carried by any coil in a receiving set is much less than that employed in the experiments. In consequence, it may be assumed that the extent of the field influence is reduced, but, and this is an important point which must not be overlooked, other considerations enter into the question, due to the fact that the coil carries

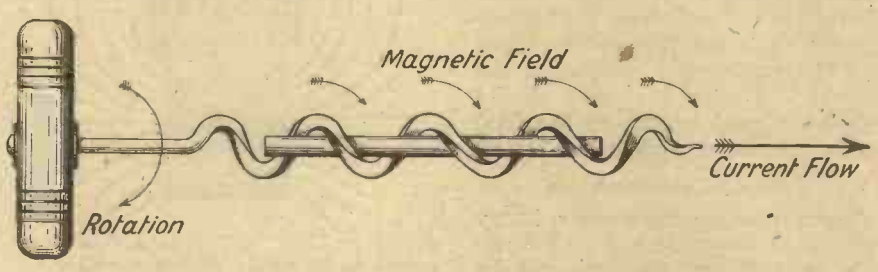


Fig. 2.—A useful rule for the direction of a magnetic field can be memorised with the aid of this diagram.

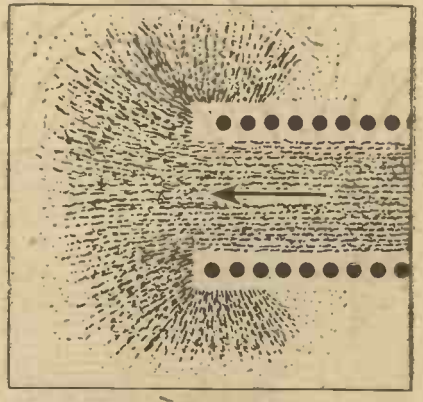


Fig. 4.—Iron filings arrange themselves in this way in the field of a solenoid coil.

high-frequency currents of varying amplitudes.

A Difficult Problem

This complicates matters, because of the very rapid collapse and re-establishment of these fields as the current flows first in one direction and then another. To trace these factors is a work of no mean skill, but the problems involved are no doubt capable of elucidation if the required delicate apparatus is at hand.

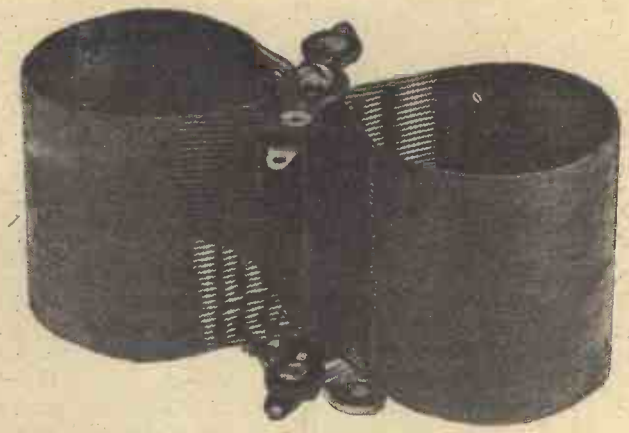
Practical Experimental Details

For the benefit of any interested experimenters who may wish to duplicate these experiments with a view to pursuing the matter for further conclusions, one or two practical details deserve comment. In the first place, be sparing with the iron filings, which should be of the soft-iron variety and very fine.

In order to secure a reasonably uniform distribution over the surface of the paper the filings should be placed in a muslin bag and then carefully sprinkled round the coil by shaking them through the muslin mesh. Do not switch on the battery current until the filings have been spread on the paper, and when the current is flowing the paper should only be tapped gently, or the final results will be disappointing.

Further Considerations

When passing reasonably heavy currents through the coil do not unduly heat it, or the coil will be damaged. During the process of spraying the liquid fixative, let the spray fall gently on the paper, and do not point the nozzle directly at the filings, or their positions will be altered.



The "Twin-Eight" Bodine H.F. transformer which was tested for external field by the author.

Employing the compass needle

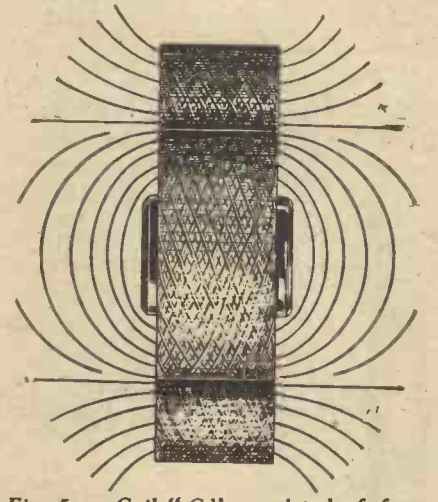


Fig 5.— Coil "C" consisted of four small honeycombs placed together in such a way as to minimise the external field.

gives quite satisfactory results, but it will be appreciated that this method suffers from the objection of being somewhat tedious.

The writer hopes to continue these investigations at a future date with a view to arriving at some definite conclusions.

A Plug-In Coil Comparison

Since it was suggested in the previously-mentioned article that the fields of, say, a Lissenagon coil and such a coil as the Gambrell may differ considerably in extent and configuration, it was deemed advisable to try these two suggested coils. A No. 40 Lissen (coil F) and a B1 Gambrell (coil G) were chosen for the purposes of comparison, and the filings method indicated quite clearly the configuration of the respective fields.

The fields are somewhat similar in shape, but that of the Lissen coil is more concentrated, due no doubt to its smaller dimensions. When the extent of the coil field's influence was tested they were found to extend to a distance of 5 in. in the case of the Lissen and 6 in. with the Gambrell. The current employed in both cases was 4 amps.

Further Results

The completion of these interesting experiments will be found in a later issue when considerations of one or two other coils, together with their resultant magnetic fields, will be given. The final results are to be presented in a convenient tabular form for reference purposes.

In addition to this another simple and practical method for securing an accurate map of the coil field, while still employing iron filings, will be described.

The reader will then be in a position to make his choice from three possible methods when conducting experiments of a similar nature, and the author will welcome any reports of such experiments for reference purposes.

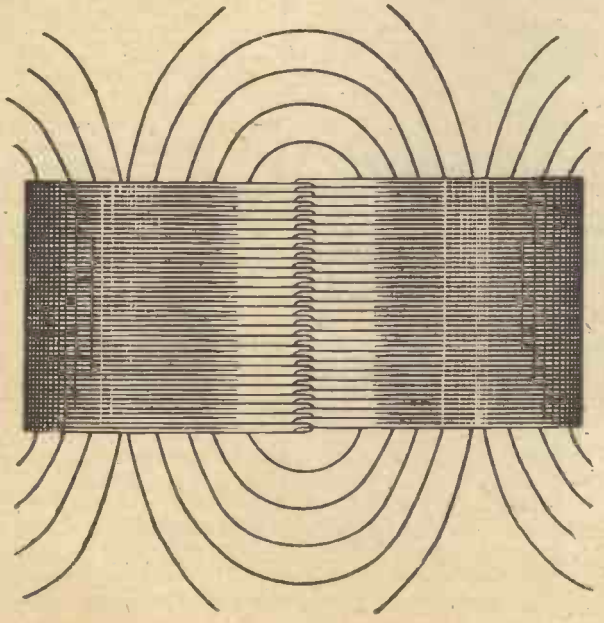
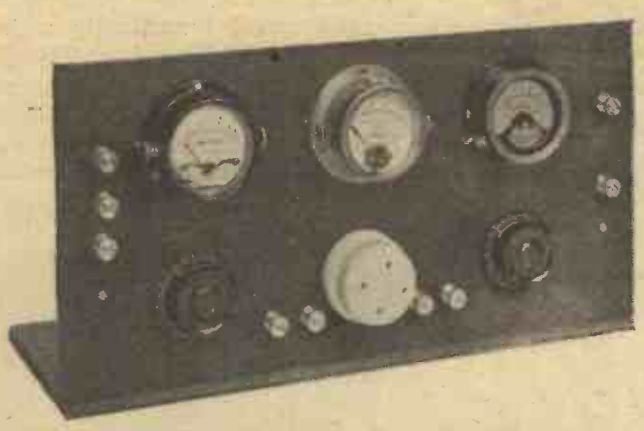


Fig. 6.—The field of the "Bodine" twin-coil transformer was plotted by the compass needle method.



A Useful Power-Control Unit

By L. H. Thomas (6QB).

This power unit will prove a valuable asset to the transmitting amateur whose set has the common fault of having the various meters and controls too far apart to permit accurate regulation.

IN my article on "An Inexpensive Short-Wave Transmitter" in *Wireless Weekly* for January 20, I mentioned that the various chokes, keying resistances, and milliammeter, etc., were not incorporated in the actual transmitter, as they were mounted on a separate "power unit." This idea has since been elaborated somewhat, and the unit shown in the photographs is the result.

Measuring Instruments

Three meters have been mounted on the panel; these are (from left to right) the input ammeter (in series with the input to the M.-L. converter), the output milliammeter, and a filament voltmeter.

The rheostat on the left controls the input to the converter, that on the right being in the filament circuit of the transmitting valve. In the centre is a fuse-case, containing a short length of lead wire, which will "blow" at about 4 amperes. This has been inserted more as a protection for the accumulators than for the generator.

Terminals

The three terminals on the left are for the input from the accumulators. Since 6 volts are needed to supply the filament of the valve used (an L.S.5), and 12 volts is the specified voltage for the "Type D" converter used, the bottom terminal is taken to the negative end of the "bank" of accumulators, the top one to the positive end, and the centre one is tapped on at 6 volts.

The two terminals on the right supply the filament, a rheostat being in series with the lead from the "6-volt" terminal on the left.

The Fuse

Since the negative terminal has a common connection to the generator and the filament, the fuse has been placed in this lead, thus acting also as a safeguard against a short-circuit occurring across the filament circuit in the transmitter itself.

Key Connections

The two left-hand terminals at the bottom of the panel are connected to the key, which may be placed at any reasonable distance and connected by twin flex. The two terminals on the right of these are the high-tension output terminals.

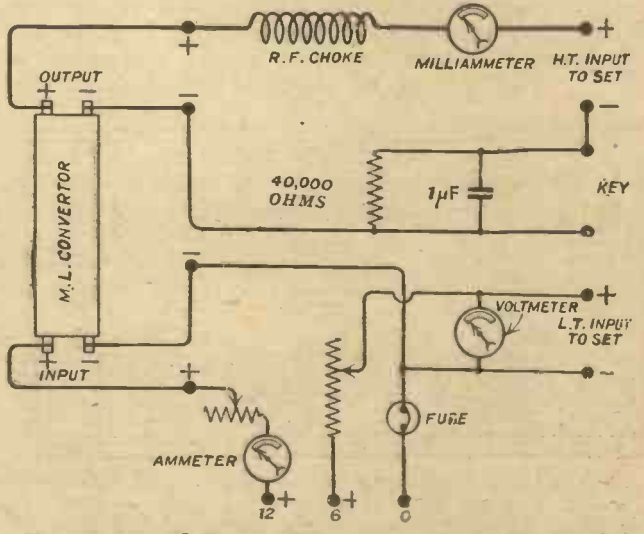
Position of the Converter

It was the writer's original intention to provide a baseboard of such size that the M.-L. converter could be stood lengthwise at the back of it, connections to the input and output terminals (which are at its ends) being taken directly from the appropriate points on the unit.

It was found, however, that the very slight mechanical vibration of the converter was evident in the emitted wave, causing what should have been pure D.C. to sound like rectified A.C. The converter was therefore removed to a considerable distance (still behind the unit) and connected by flexible leads.

Converter Terminals

To facilitate this the necessary connections were taken to two pairs of large terminals at the back of the baseboard, which were kept at roughly the same distance apart as those on the converter, allowing the shortest possible connections to the latter.



The negative L.T. and H.T. terminals on the output side are not connected together, and this must therefore be done in the transmitter itself.

This arrangement proved quite successful, as the converter could be placed on the floor, while the transmitter was on a fairly high bench.

Connections of the Unit

The first diagram shows, in theoretical form, the function performed by the power unit, and the

positions of the various rheostats and meters will be readily apparent upon reference to this diagram.

It will be found to differ slightly from the diagrams in the previous article, and these differences will now be explained. Firstly, no "back-load" resistance has been provided, and only a two-contact key is used. This is because it has been found that, with the 40,000 ohm resistance in parallel with the key, the slowing-up effect of the generator was not noticeable enough to cause trouble of any kind, either in an unsteady note or in surges when the key was lifted.

Key Shunts

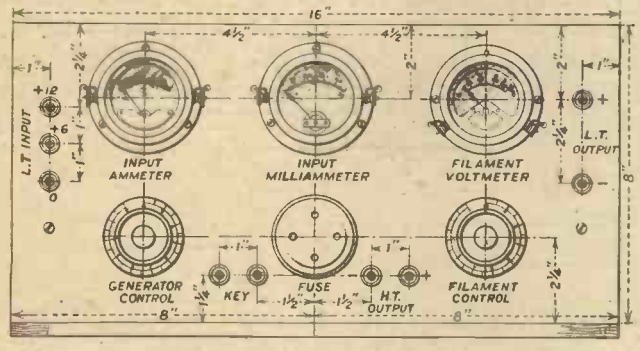
Secondly, by means of listening to weak harmonics of the transmitter in a near-by receiver, it was found that, even with the shunt resistance, the note was liable to cause undue interference on account of rather heavy "clicks." These were entirely eliminated without any trouble by shunting the key with a 1 μF condenser as well as the resistance. Since the full voltage of the generator is never across it, a paper condenser of good make is perfectly satisfactory in this position.

Only One Choke

Lastly, no radio-frequency choke has been inserted in the negative high-tension lead. Though this was used previously with success, its presence was found, for some reason, to reduce the input to the valve very slightly. On removal the note did not appear, either from local observations or distant reports, to have suffered at all.

Generator Input Control

It should be mentioned that the generator is provided with a rheostat on the input side, but it is found more convenient to cut this out and control it from the panel than to crawl on the floor to start it up! A standard 5- or 6-ohm rheostat is quite suitable for the purpose as long as it is capable of carrying about 1.5 amperes, which has been found to be the maximum "no-load" current of the generator in use. With a load of about 20 milliamperes this



Symmetry is a pleasing feature of the panel lay-out.

increases to approximately 2.2 amperes, but this, of course, only flows during keying.

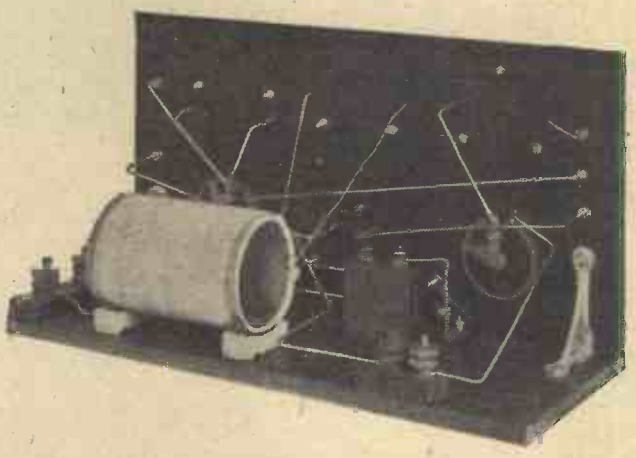
Meter Reading

The meters actually employed are:—An ammeter, reading 0-5 amperes; a milliammeter, 0-50 milliamps; and a voltmeter, 0-10 volts. The milliammeter should preferably be as nearly "dead beat" as possible, to enable comparative readings of the input to be taken as quickly as possible.

The R.F. choke actually used consists of 250 turns of No. 26 d.c.c. wire on a 3-in. former. These dimensions may probably be varied considerably without detrimental effects.

Necessary Materials

The following is a list of the components needed for the construction of a unit of this type, with an



The H.F. choke is mounted on two porcelain cleats.

indication of the actual makes of those used by the writer:—

- 1 Panel, 16 in. by 8 in. by ¼ in. (Paragon).
- 1 Baseboard, 16 in. by 7 in. by ⅝ in.
- 2 6-ohm rheostats (McMichael).
- 1 1 μF condenser (T.C.C.).
- 1 40,000-ohm resistance (McMichael).
- 1 0-50 milliammeter.
- 1 0-5 ammeter.
- 1 0-10 voltmeter.
- 1 circular fuse-case, with a length of 3- or 4-amp. fuse wire.
- 2 panel brackets.
- Various terminals, quantity of 26 d.c.c. wire, a length of 3-in. cardboard tube, and some square wire.

Doubtless various elaborations of this scheme will suggest themselves to readers, who will, it is hoped, obtain a certain amount of help from the design of this unit.

Low Tension Leads

This particular lay-out employed was chosen with a view to keeping all leads, especially those on the low-tension side, which have to carry a current of 2 or 3 amperes, as short as possible, bearing in mind the arrangement of the author's other apparatus. It will possibly be found that if this lay-out is rigidly adhered to, certain leads will be unduly long, but the general idea of another possible arrangement of the terminals may be gained from the circuit diagram. It is essentially a unit which may be fixed in position, the utility of which will remain practically unaltered, whatever transmitting circuit is in use at the time. It is certainly infinitely preferable to having a tangle of H.T. and L.T. leads sprawling over the bench, with the attendant uneasiness upon connecting up for a fresh "stunt."

Loud-Speaker Distortion and its Causes

In this article, which forms a continuation of that which appeared in a recent issue, will be found a very illuminating explanation of the factors of uneven sound distribution, phase differences in hornless types, environment and so on.

The hornless type of loud-speaker presents problems of reproduction of an individual kind. (The instrument illustrated is a "Kone.")

We may now pass to the effects due to the directional properties of the trumpet, if any.

It is well known that the sound emitted by a trumpet is not as a rule distributed uniformly around it, but that there is in general a greater intensity in front than behind or at the sides. A more or less typical form of distribution for a single frequency is shown by the curve in Fig. 10, in which the lengths of such lines as AB, AC, AD, AE drawn from the point A, which represents the position of the source of sound and trumpet, to the curve, are proportional to the intensities of the sound received at points lying in the directions of those lines.

Sound Distribution

Now the shape of such a curve will depend on the ratio between the

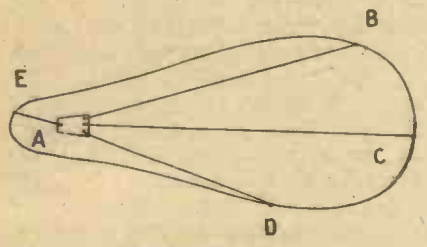


Fig. 10. — Illustrating the distribution of a single frequency from a horned loud-speaker situated at A.

wavelength of the sound concerned and the principal dimensions of the trumpet; if the wavelength be very large compared with these dimensions, then the curve will approximate to a circle with the trumpet at the centre, while conversely as the wavelength is reduced for a given trumpet, the curve will get more and more "pointed," so to speak, and the unevenness of distribution more and more marked.

Different Wavelengths

Thus for three different wavelengths—one relatively long, one of moderate length, and one short—the distributions might be as shown in Fig. 11 as X, Y and Z respectively. It is clear that if these three sounds be constituents of some complex sound emitted by a loud-speaker at A, a listener situated on the line AP will receive too large a proportion of the constituent Z and too small a proportion of the constituent X as compared with the constituent Y. Similarly in the direction AR, X will be unduly prominent and Z unduly reduced, whereas in the direction AQ the sounds X and Y will be correctly proportioned, while Z will be markedly defective. It follows that in a case of this kind there is no position which a listener can adopt with respect to the loud-speaker in which he will receive all frequencies in their proper proportions, unless he place his head right up against the horn!

In short, if a loud-speaker be directional at all, it must be so selectively, and this selectivity must produce distortion in a greater or less degree at every point within range.

Hornless Loud-speakers

In the case of hornless loud-speakers using a relatively large diaphragm (*e.g.*, the pleated paper type and its derivatives), complications of another kind are likely to arise.

Consider the case of a plain diaphragm (D D, Fig. 12) oscillated by any electro-magnetic drive M.

If we neglect the trivial influence excited by the actual bulk of the component M, it is clear that either side of the diaphragm D is just as good a generator of sound as the other. Thus every element of each side of the diaphragm will act as a source of sound of the frequency at which the diaphragm is being oscillated, but the disturbances on the one side will be precisely out of phase with those on the other, since a motion producing a compression in front of the diaphragm must simultaneously produce a rarefaction behind it and *vice versa*.

Effect on Listener

Consider now the effect produced at some listening point P, which in the first instance we will suppose to be on the axis of the diaphragm. If the distance of P from the diaphragm be large compared with the radius of the latter, we may consider that it is equidistant from all points on the nearer face, so that the sounds from all parts of that face will arrive in phase. This is not true, however, of the sounds from the further face, for these, in order to reach P, must travel an additional distance, depending on their

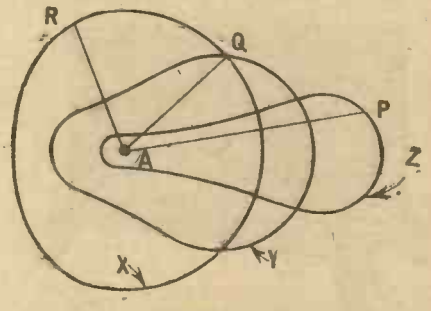


Fig. 11.—The outlines X, Y and Z represent the relative distributions of three different frequencies from the loud-speaker at A.

place of origin, which in the extreme case of disturbances from the centre C_1 will be equal to the radius of the diaphragm.

Phase Difference of Two Sides

Now the disturbances from the two sides are completely out of phase when they start, and if their path distances to P were equal, they would be equally so on arrival, and would cancel each other out altogether. This will actually be true of the sounds proceeding from the extreme edges of the diaphragm, but will become increasingly less so as we consider sounds from points nearer the centre, so that the total result at P will not be complete interference. The magnitude of the residual sound will clearly depend on the ratio of the wavelength to the radius of the diaphragm, for if this be very large the relative displacement from the out-of-phase condition of the two sets of waves will be negligible, and the interference substantially complete. If the radius of the diaphragm be equal to half a wavelength, the sound from C1 will actually reinforce that from C2.

Suppression of Lower Frequencies

These phenomena are more easily treated mathematically in a manner which would be out of place here, but the foregoing should suffice to show that an "unbacked" diaphragm will cause interference of which the degree at any point depends *inter alia* on frequency—thus producing distortion — and, further, that the general tendency will be to suppress the lower rather than the higher frequencies.

Similar considerations apply, of course, to positions of P not on the axis, and it may be noted that if P be in the plane of the diaphragm, complete interference will result at all frequencies.

It should be understood, of course, that such complete interference would be realisable only under ideal conditions for the experiment. In actual practice sounds can be heard from a loud-speaker of the type under discussion when the listener is in line with the plane of the diaphragm, owing to reflection from walls and so on.

The C.A.V. semi-hornless loud-speaker

Conical Diaphragms

Phenomena of the same type occur with conical diaphragms such as are indicated in Fig. 13 (*a*) or (*b*), but not with the arrangement (*c*), provided that the motions of the two cones be always equal and opposite.

Environment of Loud-speakers

The next source of distortion to be dealt with has, strictly speaking, nothing to do with loud-speakers themselves at all, but mainly with the conditions under which they are used—that is to say, with the effects of the room or hall in which they operate.

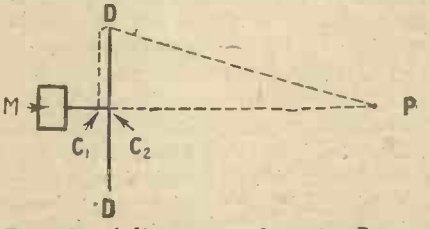


Fig. 12.—A listener at the point P may hear sounds from both sides of the diaphragm D, as indicated by the two dotted sound-paths C1-P and C2-P.

This is, in a sense, a matter of minor importance, partly because it can scarcely influence the design of commercial instruments and partly because we are so accustomed to hearing people speak, sing or play in closed spaces that we subconsciously adapt ourselves, I suspect, to minor variations in such conditions.

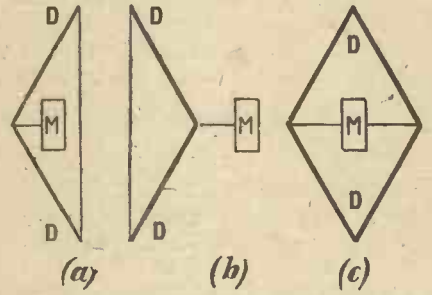
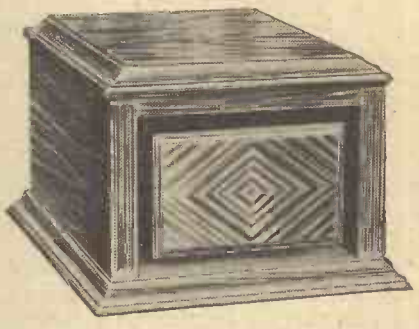


Fig. 13.—Certain types of conical diaphragms are prone to give distortion as a result of phase differences in the sounds arriving at a distant point from opposite sides of the diaphragm.

On the other hand, it seems likely that many a good loud-speaker has been blamed for apparent defects not really its own, and many enthusiasts have been puzzled by inexplicable discrepancies between the behaviour of the same instrument on different occasions or in different places. It may be worth while, therefore, to include a few brief notes on this subject, even though the purist may consider them something of a digression from the strict course of my thesis.

Bad Positions

The influence on distortion and allied phenomena of the room in which a loud-speaker is used arises from three main factors. Of these the first, which we will call reverberation, does not of itself produce distortion in the strict sense at all, but the effects as experienced are so similar that the phenomenon may legitimately be included here.



One of the recently-produced Brown loud-speakers is of the cabinet type.

Causes of "Local" Distortion

The story is substantially as follows:—If one makes a noise inside a closed space of which all the sides are *perfect* reflectors of sound, that noise will go on echoing to and fro for ever—or, rather, it would do so if air were a perfect fluid and there were no degradation losses of the kind mentioned earlier in this paper. Actually, of course, no wall, ceiling or floor is a perfect reflector, but some are much better than others, so that in a bare and empty hall a speaker's voice will often reverberate to such an extent as to make him unintelligible. The first part of a word or even of a sentence is still audible by echo, while the second part is being heard direct.

Not True Distortion

This does not produce true distortion, unless the walls reflect selectively with respect to frequency, but it does make it impossible properly to appreciate the speech or music to which one wishes to listen.

Reducing Echo

I do not propose to enter here into the very difficult question of how best to design auditoria with a view to reducing such effects to a practicable extent, but it is obvious that in general terms the solution is to introduce a suitable proportion of absorbent surfaces, such as carpets, curtains, cushions or open

windows. But if this process be carried too far, everything will sound "dead," since we are accustomed to a certain small amount of reverberation which is generally held to add "life" or "richness" to the sounds concerned.

Shape of Room

The next point is very simple, and is merely to the effect that there may be in a room certain spaces, such as alcoves, fireplaces, cupboards or other cavities—even, perhaps, large vases—which may act as resonators, and thus unduly intensify certain notes. (For example, a large Chinese jar in the room where I am writing this has a very good resonant frequency of its own, which I judge to be about 64 v/sec, or two octaves below middle C.)

A Possible Trouble

I do not suppose that this kind of thing often happens to a serious degree, but it might be worth while

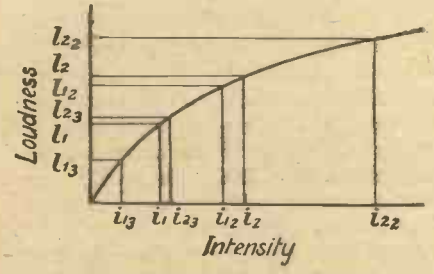


Fig. 14.—Illustrating the relation between an imaginary scale of "loudness" and actual sound intensity.

to bear it in mind, if ever some particular note seems to come out with undue prominence. I hope I need not remind my readers that the offending resonator cannot produce energy on its own account; it merely draws it from the surrounding acoustical field and acts as a secondary source of sound of the appropriate frequency.

Reflection from Walls

The third factor here is probably the most important, and is concerned with the formation of stationary waves and regions of maximal and minimal intensity by reflection from the walls of the room.

Without entering upon a detailed description of what occurs, it is easy to realise that the sound waves proceeding from the loud-speaker are reflected from the walls in various directions, and that the reflected waves combine with the incident waves and with each other so as to form regions of maximum intensity where they are in phase, and of minimum intensity where they are out of phase.

Practical Demonstration

The effect is easily demonstrated by using an electrically maintained tuning fork, say, as a source of sound and exploring the room with a sensitive microphone (*e.g.*, a resonated hot-wire instrument) connected through an amplifier to telephones, or to a rectifier, thermo-junction, and millivoltmeter. For any given frequency and position of the source the "pattern" of maxima and minima will be substantially steady, but movement of the source will cause a rearrangement while the different wavelengths will naturally give rise to different patterns.

Empty Rooms

Thus a listener may be in a position where the intensity is maximal for one frequency, minimal for another, and intermediate for others, and this again will cause distortion. As in the case of reverberation, the effect will be reduced by hangings, carpets, etc., which tend to absorb sound. The presence of furniture in the room tends to break up the waves and scatter the sound. The trouble is consequently unlikely to be serious except in bare and empty rooms, but if by any chance it arises, it can usually be dealt with by moving the loud-speaker to a different position or, if it be of the trumpet variety, even by rotating it slightly so as to alter in some degree the angles of incidence of the various sounds upon the walls.

Too Great Amplification

Another possible cause of distortion which is not commonly recognised is to be found in the actual degree of magnification employed. That is to say, some measure of distortion will arise if the sound as heard is much louder or much fainter than it would be if heard direct in the presence of the artist. The reason for this may be explained as follows: When considering the magnitude of a sound, we may think either of "intensity"—a purely physical quantity measurable in the usual physical units—or of "loudness," by which term I refer to the psychological sensation actually experienced by the listener, which obviously cannot be measured in physical units at all.

Measurement of Loudness

I am not going to enter here into the very difficult question of whether it is legitimate to devise and use units of loudness of any kind, but it is quite clear that some sounds are louder than others. It is a matter of experimental fact (known as Weber's law) that in order to produce a just perceptible difference in loudness, intensity must be increased by an amount proportional to the previous intensity—that is to say, by a constant percentage and not by a constant number of units. In other words, the curve between intensity and loudness, if it be legitimate to draw one at all, must be *something* like Fig. 14.

An Explanation

Consider now two sounds of intensities, i_1 and i_2 and "loudness" l_1 and l_2, and suppose their intensi-

The B.T.H. hornless loud-speaker.

ties are both doubled, becoming $i_{1\cdot2}$ and $i_{2\cdot2}$ respectively; then the "loudnesses" will become $l_{1\cdot2}$ and $l_{2\cdot2}$ respectively. It is evident by inspection that the increase in loudness has been relatively much greater for the sound whose original intensity was i_1 than for the other.

Conversely

If the intensities were halved so as to become $i_{1\cdot3}$ and $i_{2\cdot3}$, the relative decrease of loudness would be greater for i_1 than for i_2. It follows that magnification of a group of sounds of unequal intensities will tend to make the less intense members of the group disproportionately loud, while diminution will tend to make them disproportionately faint. If the members of the group be of different frequencies, as must be assumed for our present purpose, distortion will result.

Too great or too small a measure of amplification is therefore likely to lead to imperfect reproduction, even if all the causes of distortion already discussed have been completely overcome.

Loud-speakers in the Open Air

The last item to be mentioned applies only to loud-speaker work over considerable distances in the open air, but it is worthy of comment, because it seems to be commonly, though erroneously, supposed that, given a loud-speaker of sufficient size and power, speech or music could be satisfactorily broadcast over miles of country. This would be true if the atmosphere were even reasonably homogeneous, but unfortunately it is not.

Limits of Range

Actually, as everyone knows who has tried to do any long-distance work with sound, the air is full of eddies and currents and turbulences of layers and streaks and patches, warm and cool, dry and moist, all of which conspire to bend the path of the sound this way and that, and, in particular, to absorb the shorter wavelengths.

Absorption of Higher Frequencies

This latter effect is often most striking. The noise of a klaxon horn, for example, which at close range is about as harsh and strident as anyone could find, becomes a gentle hum when heard at a range of a few thousand feet, simply because the higher harmonics which are responsible for the harshness are filtered out, so to speak, by the intervening air. So, although long-range broadcasting in this given range be practicable up to the point of transmitting *recognisable* signals, it seems safe to say that it can never become a source of any great aesthetic pleasure.

Summary

We may now summarise the various causes of distortion as follows :—

(i) Resonance of the diaphragm as a whole.

(ii) Resonance of the material of the diaphragm.

(iii) Resonance of the air in the trumpet.

(iv) Resonance of the material of the trumpet.

(v) Failure of the air to follow the diaphragm.

(vi) Acoustical degradation.

(vii) Directional properties of trumpets or diaphragms.

(viii) Interference from the two sides of " unbacked " diaphragms.

(ix) Reverberation in the auditorium.

The "Radiolux" Amplion is a departure from the conventional horned type.

(x) Resonant bodies in the auditorium.

(xi) Stationary waves in the auditorium.

(xii) Incorrect degree of amplification.

(xiii) Atmospheric absorption.

It is interesting to note that of these the first, third, fifth and eighth tend, on the whole, to favour the higher at the expense of the lower frequencies; the thirteenth alone can be said with certainty to favour the lower rather than the higher; as regards the remainder, the effects of all except the sixth, which is still somewhat obscure, will depend on local circumstances.

Horned and Hornless Loud-speakers

If we compare the two main types of loud-speaker, namely, the " horned " and " hornless " varieties, we find that the third and fourth causes apply only to the horned type, the eighth only to the hornless; the fifth, sixth and seventh are chiefly important to the horned, the second to the hornless.

Questionable Superiority

At first sight this suggests that the hornless loud-speaker is definitely superior to its trumpet-using rival. It must be admitted that remarkable developments in the former type have recently taken place. I am by no means certain, however, that the superiority is so definite as might appear at first sight, but this is a matter which I must leave for the present.

Conclusions

In the meantime, and by way of conclusion, it seems legitimate to express a wondering admiration for the success which in the last year or two has attended loud-speaker design, in spite of so many and so intricate difficulties. The cynic may suggest that where many diverse factors are concerned a lucky shot on the trial and error principle may cause most of them to cancel out, apart from any reasoned intention on the part of the designer. This is as may be, but, at any rate, we all have good reason to be thankful for our deliverance—however fortuitous—from the strident monstrosities of some few years ago.

We have not by any means reached perfection yet, but progress has been great, and the remaining obstacles do not seem insuperable.

W. WHATELEY-SMITH.

R.S.G.B. MEETING

Mr. Alford on the Superheterodyne

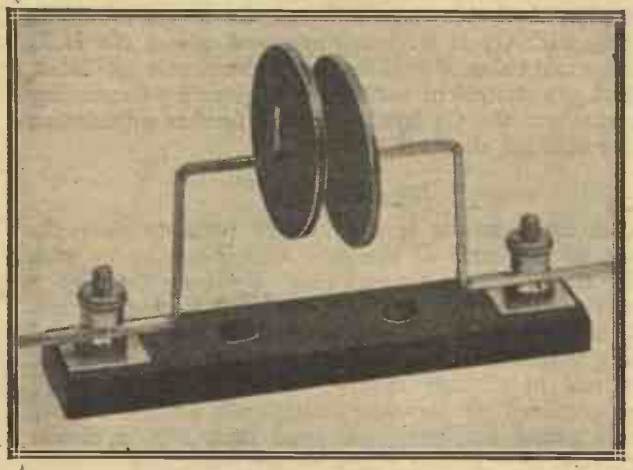
AT a meeting of the T. and R. Section of the Radio Society of Great Britain, held at the Institution of Electrical Engineers, on Friday, January 29, Mr. W. K. Alford (2DX) gave a most interesting talk on " The Supersonic Heterodyne Receiver."

He commenced by pointing out that the superheterodyne was well worth the seven or eight valves necessary, and, though its construction might appear very complicated, this was neutralised by the extreme simplicity of operation. Above all other points, the great feature of the superhet was probably the certainty with which it " got there."

He then dealt with the two faults most common to the " Super," namely, instability on the high-frequency side and interference from long-wave stations near the intermediate frequency chosen. The former trouble was generally cured by potentiometer control, which he did not recommend. He looked on the potentiometer as a kind of " radio emetic," which stabilised the set by making it inefficient. He preferred neutralising methods at all times. He also strongly recommended the use of the reactance-capacity system of intervalve coupling.

The long-wave interference could, he stated, be reduced to a minimum by choosing the intermediate frequency of about 93.75 kc. (3,200 metres), but careful screening of the set was a help.

In the discussion which followed several members commented on the excellent quality obtainable with a superheterodyne when used on distant stations, in spite of its remarkable selectivity. The discussion was adjourned until a future occasion.



The author uses two foreign bronze coins as an aerial series condenser.

Some Short-Wave Experiments

By STANLEY G. RATTEE, M.I.R.E.

The field of frequencies above 15,000 kilocycles is as yet largely unexplored, and much interest attaches to the simple experiments involved in the construction of a receiver for frequencies yet higher.

DURING the summer months of last year much interesting work was done upon frequencies in the region of 15,000 kc. (20 metres), and though at that time there was little to be heard by listeners upon this frequency, times have changed and numbers of stations may now be received at good strength. In fact, this frequency has become among experimenters one of the ordinary working regions, and is now generally used for daylight transmission.

Below 20 Metres

So far as reception is concerned, various circuits have been used, the majority of which have given satisfactory results up to frequencies of about the figure given above without very much difficulty, and it is not until one attempts to design a receiver for reception on higher frequencies still that one finds oneself really "up against it."

It must not be inferred, however, that "20-metre" reception is as easy as that upon, say, a frequency of 3,000 kc. (100 metres), but so long as due care is taken

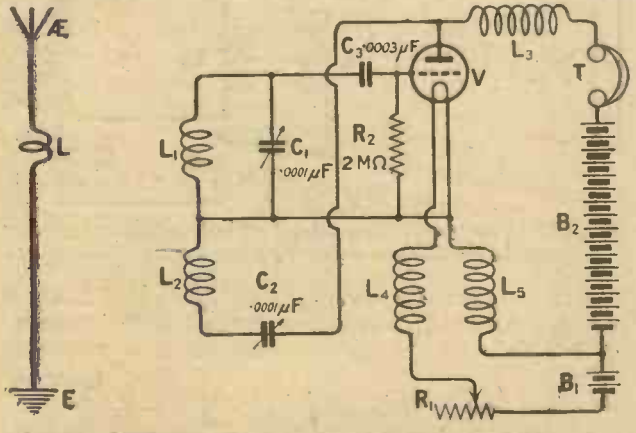


Fig. 1.—With this circuit it was found advisable to place the coil L at least a foot from the secondary, L1.

in choosing the circuit, the right components and "lay-out" of the receiver, success is fairly easily attained.

Requirements in Circuits

In choosing a circuit for short-wave reception, which we will assume to be a single valve arrangement, since a note magnifier may always be added if desired, the two main considerations are these: Which form of reaction control will give the best results and, secondly, what form of circuit will allow of easy self-oscillation?

The first consideration is relatively easy of solution when compared with the second, and for the benefit of

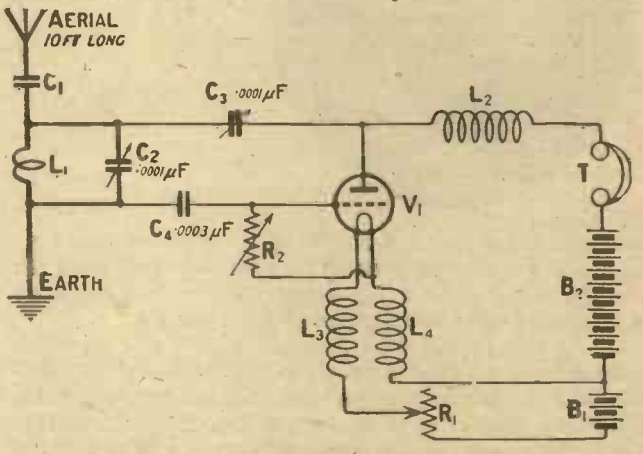


Fig. 2.—This circuit oscillated over the whole scale of C2 with either a one-turn or a half-turn coil as L1.

would-be experimenters I propose giving details of circuits and values with which I have recently been attempting reception upon the very high frequencies above 15,000 kc. (20 metres).

The First Circuit

The circuit given in Fig. 1 is one which covers a frequency band of from 25,000 kc. (12 metres) to 10,000 kc. (30 metres), the receiver having been calibrated by a member of the Radio Press staff. The two coils L1, L2 each consist of three turns of No. 14 bare copper wire, air-spaced, 4 in. in diameter and self-supporting. The values of the condensers are as given in the drawing, while the two chokes L4 and L5 consist of 30 turns of No. 22 d.c.c. each, wound upon a lead pencil, the latter being removed when the last turn is made. The third choke L3 may be either a good make of plug-in coil or may be a home-made choke of 100 turns of small gauge d.c.c. wire wound upon a 2-in. cardboard former.

Coupling Arrangements

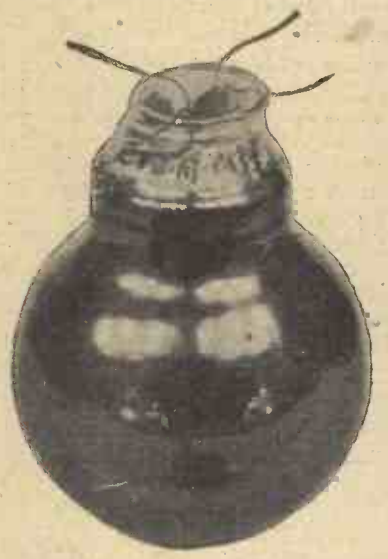
The aerial coil, represented by L, is made up of one turn of No. 16 d.c.c. wire, 4 in. in diameter, with the aerial connected at one end and the earth at the other. The exact amount of coupling required between L and L1 is relatively unimportant, save that the coils should

not be less than about a foot apart, otherwise difficulty may be experienced in making the set oscillate.

So far as signal strength is concerned, the position of L in relation to L1 is, as stated, relatively unimportant in that signals remain the same strength whether the coils are 12 in. apart or 18, the only requirement being a readjustment of the reaction condenser C2.

Valves

As regards the valve, though the ordinary four-pin type has been used for 20-metre reception, it is recommended that a valve of the V 24 or other tubular type be used, for though results may be obtained with the present circuit when using ordinary valves, our objective is reception upon frequencies *above* 15,000 kc.



For some of his experiments the author used a valve with the cap removed.

Using this circuit with the coils given, a V 24 valve and 60 volts H.T., the receiver will be found to oscillate over the whole range of the grid tuning condenser, and when this latter is at its zero reading the receiver will be tuned *approximately* to a frequency of 25,000 kc. (12 metres).

One-turn Grid Coil

It will be understood that if, using the same circuit with the same values, we use coils of smaller size for L1 and L2 then we may reasonably expect to tune the receiver to a frequency above 25,000 kc.

Actually, coils of the same diameter, but consisting of one turn for L1 and two turns for L2, have been used, and it was still possible to adjust the receiver so that an oscillating condition was maintained over practically the whole of the grid tuning condenser dial; as a matter of interest, the first 20 or so degrees, that is, from 0-20, were "dead."

In the locality where these experiments were carried out a peculiar "purring" noise is picked up on about the 25,000-kc. frequency, in much the same way as motor "noises" are picked up on 15,000 kc., and it was the absence of these noises as the size of L1 was reduced which gave indication that the receiver was tuned higher in the frequency scale.

Another Arrangement

Since the circuit just discussed would not oscillate over the full reading of the grid tuning condenser with the one-turn coil, the arrangement of Fig. 2 was tried, the chokes L3, L4 and L2 being as before.

The condenser C1 consists of two foreign bronze coins spaced about ¼ in. apart, while the coil L1 may be either one complete turn of 4 in. diameter (No. 14 bare copper) or else only half a turn. The method of operation is to set the condenser C2 at its minimum setting with C3 at its maximum and adjust the H.T. voltage and value of grid leak until the circuit oscillates, whereupon control of oscillation is given by decreasing the value of the C3 condenser and further adjustment of the filament rheostat R1.

The Results

This arrangement was found to oscillate over the whole of the scale of the grid tuning condenser with either the one or half turn coils. By using the Fig. 1 circuit with a single turn grid coil and setting the circuit into the oscillating condition in one room and tuning with the Fig. 2 arrangement, also using a single turn coil in another room, "loud-speaker signals" were obtained as far down the scale as the Fig. 1 circuit would oscillate. Beyond this, Fig. 2 circuit was made to oscillate down to the minimum reading of the condenser C2.

When using the half-turn coil it was found necessary to increase the value of the grid leak and of the anode voltage before the circuit would oscillate at the zero reading of C2.

Still Higher

The next attempt to raise the frequency range still higher was to use the half-turn coil in conjunction with a 3-plate condenser for tuning purposes. It was found here that with the aerial arrangements of Fig. 2 the circuit would not oscillate except at the maximum setting of C1, therefore after trying various schemes the arrangement shown in Fig. 3 was used.

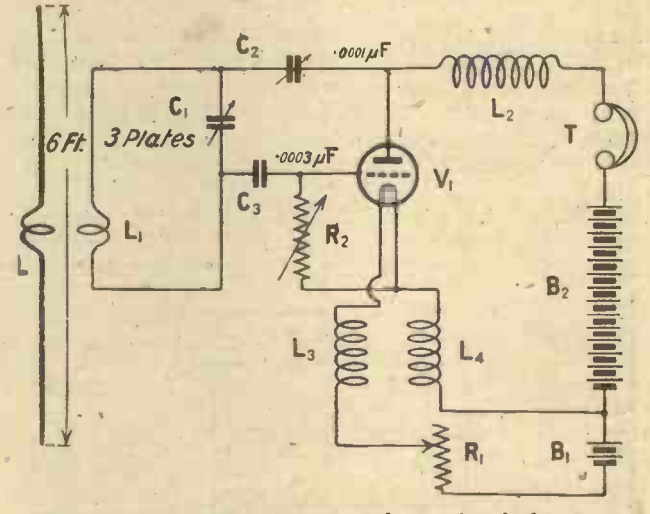


Fig. 3.—The use of an aerial circuit of this type permitted oscillation on still higher frequencies.

The aerial circuit here consists of six feet of No. 12 bare copper wire with a half-turn in the middle, situated at about four feet from the receiver in a vertical position.

(Bringing the "aerial circuit" any nearer to the receiver resulted in much difficulty as regards oscillation at the lower reading of C1.)

"Noises" Heard

Using this arrangement various "noises" were picked up during the passing of motor cycles, but other than these nothing was received.

(Continued on page 740)

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Some Notes on the Tropadyne Oscillator

By G. P. KENDALL, B.Sc.

The Tropadyne arrangement offers the attraction of a saving of one valve in a super-heterodyne receiver, but unless certain practical points are attended to with care it is apt to prove very tricky in operation.

TO anyone who has once got the Tropadyne system of oscillator working effectively in a super-heterodyne, it is a source of wonderment that rather greater use is not made of this attractive scheme. All the various methods of combining the oscillator and first detector valves in a super-heterodyne are admittedly somewhat tricky to get into operation, but there can be no doubt that they offer some very substantial attractions. Firstly, the present-day tendency is to reduce the number of valves needed to produce the desired results, and here the combined oscillator-detector offers at once an economy of one valve.

High Selectivity

Further, many experimenters have found that it is unexpectedly easier to obtain a high degree of selectivity when using a Tropadyne oscillator than when using many types of the separate variety. Finally, from a constructional point of view, it is somewhat easier to arrange an oscillator coupler for a Tropadyne than for a separate local generator, since only two windings are needed, and it is not essential to provide a variable coupling between them.

As has been said, the Tropadyne circuit is no exception to the general rule of trickiness of the combined oscillator - detector arrangement, but it is probably the most easily operated of those at present available. A little experimenting is usually needed to get it working properly, but such experimenting is rendered very much easier by the fact that it gives certain fairly clearly-defined indications as to the adjustments required to obtain satisfactory working.

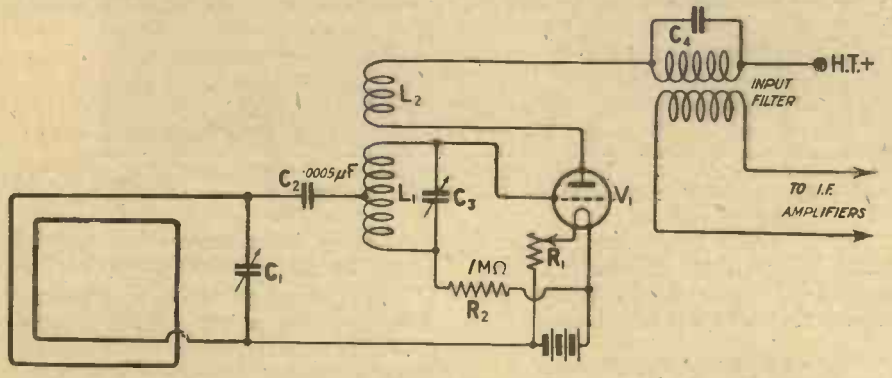


Fig. 1.—The conventional form of the Tropadyne oscillator circuit, which presents several practical difficulties.

The Simple Form

The simple conventional form of the Tropadyne oscillator circuit is illustrated in Fig. 1, and it will be observed that the tuned frame aerial circuit is connected across the grid and filament of the detector valve as usual, but that also in this grid circuit there is included a second tuned circuit to which a reaction coil is coupled to maintain self-oscillation. The local oscillations generated in this circuit are prevented from passing back into the frame circuit by the expedient of making connection from the latter through a fixed condenser C2, which acts as the grid condenser, to the centre or nodal point of the oscillator grid-winding L1. The lower end of the oscillating circuit is connected to the filament only through the grid-leak R2.

Howling Troubles

One of the great difficulties with this original arrangement was that it was particularly prone to the fault of oscillating quite weakly at the upper end of the range of the condenser C3, and far too strongly upon the lower range, so strongly, indeed, that it was quite likely that a grid-leak howl would be set up.

It has been found that this drawback can be overcome to a very large extent by the use of a very much lower resistance grid-leak than was originally recommended. A value of 100,000 ohms has been found very helpful in reducing the squealing trouble, and it does not appear to reduce signal strength to any appreciable degree. This, of course, depends to some extent upon the choice of a suitable oscillator valve, one of the type specially produced for resistance-capacity low-frequency amplification having proved very successful. Such valves are the D.E.5B, the D.F.A.4, etc.

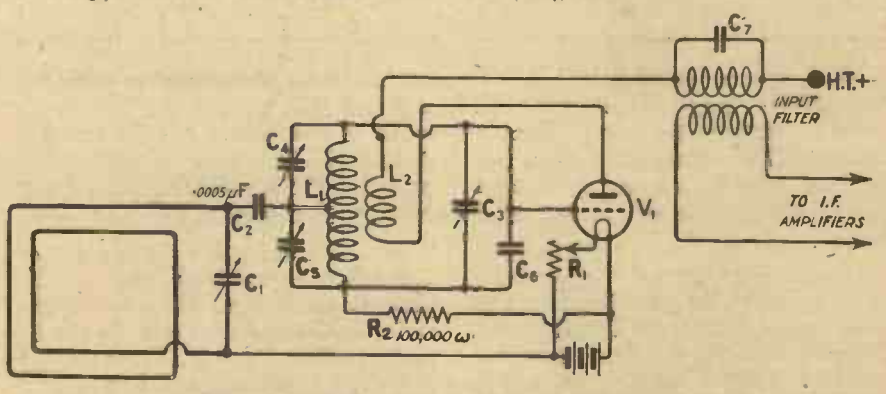


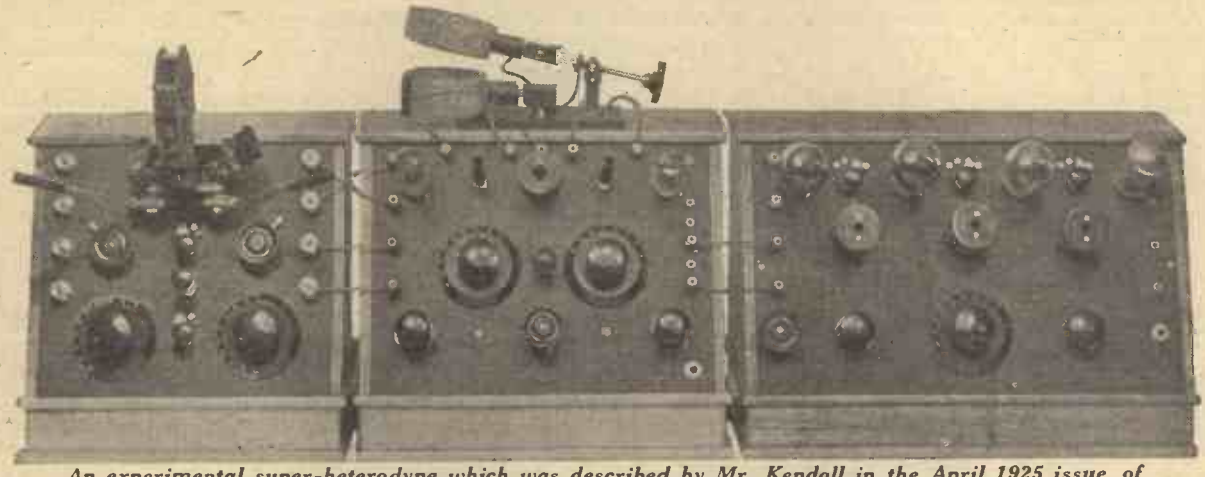
Fig. 2.—The difficulty of finding the exact centre of L1 may be overcome by the use of the two small condensers C4 and C5.

As a further precaution, it is advisable to use a fair-sized variable condenser, say, one of .0005 μF as C3, and to connect in parallel with it a small fixed condenser (C6 in Fig. 2) of a capacity in the neighbourhood of .00005 or .0001 μF.

Finding the Centre Point

Another difficulty sometimes met with in the use of the Tropadyne circuit is concerned with the finding of the exact nodal point upon the winding L1. If this is not done with some accuracy, it will be observed that there is a certain amount of back-transference of energy from the circuit L1, C3, to that composed of the frame aerial and the condenser C1. The evidence of this will be found in the fact that the valve will stop oscillating when these two circuits come into tune with each other, and clicks will be heard, therefore, as the condenser C3 is revolved.

My own experience has been that this effect is not so commonly noticed as some writers have led us to believe. As a matter of fact, if a few tappings are made near the centre of the coil L1 it will usually be found possible to discover a point at which the valve functions normally with a reasonably close degree of reaction coupling between the coils L1 and L2.



An experimental super-heterodyne which was described by Mr. Kendall in the April 1925 issue of "Modern Wireless." The Tropadyne circuit could be used in this instrument.

An Alternative System

Should it prove difficult to locate the nodal point with a sufficient degree of accuracy for practical purposes, an expedient which has been used in certain American receivers may be adopted, and this is illustrated in Fig. 2. Across the two halves of the coil are connected two small variable condensers, C4 and C5, which may conveniently be of the neutrodyne pattern. With a little adjustment of the relative capacities of these two a balance can easily be obtained which will serve for all practical purposes.

When these points have received due attention a very little experimenting with the degree of reaction coupling and the high-tension voltage will almost always result in satisfactory functioning on the part of the combined oscillator and detector valve, the usual experience being that about 100 volts is required for the best results with the valves which I have mentioned.

QRA SECTION

Readers are reminded that we are always prepared to forward cards to stations that are unknown to them, but must, of course, remember that we cannot *guarantee* to find the location of every station wanted.

If sufficient response is received to this innovation, we hope to expand our "Amateur Transmitting Notes" section; but this can, of course, be done only to meet the requirements of our readers. This will, obviously, also be of value to the receiving enthusiast, who wishes to keep in touch with the stations he hears, although it is primarily run with the object of helping the *transmitter* by furnishing him with reports.

Similarly, all amateur transmitters who are desirous of receiving reports should communicate with us, and we will publish an announcement to that effect in this section. A list will be found on the second page of "Short-Wave Notes and News" in this issue.

We hold cards for the owners of the following stations, and will be pleased to forward them on application. Communications should be addressed to "QRA Department," *Wireless Weekly*, c/o Radio Press, Ltd., Bush House, W.C.2 :—

P-1AB, E-1BH, E-GEH, GB1, YS-7XX, H-9AD, Y-HBK, SGC, SDK, CRP, SI, R-CB8, U-99X, G-5FQ, 5PO, 6ER, 2AEY; BZ-1AF, 2AB, 2AF, 6QA; GHA, PE-6YX, PE-6ZK; F-8CA, 8GI, 8JD, 8JR, 8DK, 8JC, 8IL, 8IX, 8DUCH, 8PM, 8RZ, 8Z3; K-I2, K7, L4, W4, Y5.

MEETING OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

At a meeting of the Institution of Electrical Engineers (Wireless Section), on Wednesday, February 3, Mr. J. Hollingworth, of the N.P.L., read a paper on "The Propagation of Radio Waves." He described how the problem had been tackled by the erection of four receiving stations in different parts of Great Britain, at which the signal-strength of various transmitters was measured daily, and how, from the results obtained, it had been deduced that, in general, two distinct sets of waves were received from any station to which the receiver was tuned.

The deductions had been confirmed by means of a motor tour with a portable signal-strength measuring set; "bands" of maximum and minimum signal-strength were found for almost every station, corresponding to interference zones between the horizontal and the reflected sets of waves.

THE FUTURE OF BROADCASTING

Further evidence before the Commission of Inquiry, which is reported below, includes that of Sir Walford Davies, Sir Hugh Allen and Messrs. Secret Wireless, Ltd.

THE Committee resumed the hearing of evidence tendered by interested parties on January 27. A memorandum submitted by Sir Walford Davies was read. This evidence was principally devoted to the development of technique in connection with the broadcasting of music. Sir Walford remarked that it would be quite apparent that some absolutely new technique was required for the satisfactory transmission of musical items, and this necessitated much research. The educational value of music was realised, and the necessity of training and educating the younger element in this sphere received consideration.

Musical Education

It was decided that an afternoon transmission to schools would be a useful means of disseminating knowledge of this subject. The transmission of a half-hour's instruction on music was now a regular feature of many of the stations' programmes. He visualised the time when it would be an accomplished fact that the whole of the nation was interested in and able to appreciate music of the highest standard. He mentioned that the present transmission of half an hour was devoted not only to verbal instruction, but that many of these lectures were illustrated by means of a piano.

Duration of Instructional Periods

He was questioned by Sir Henry Hadow, in view of a statement by a previous witness to the effect that a quarter of an hour was found the maximum time during which a listener's attention could be held. Sir Walford replied that they had carried out many experiments with a view to determining exactly how long they could hope to hold the juvenile attention on such a subject. They had even experimented in having children placed in the studio. It was found that these illustrations on instruments and such interjections as "Now write this down" had a considerable effect in retaining the listeners' attention. Earl Crawford asked what effect was produced on the children's minds by modern music. Sir Walford thought that much of the modern music could be classed as bad and that many of the children realised this after a certain period of instruction in appreciation of the better music.

The Practice of Music

Earl Crawford mentioned that one witness had declared his opinion that execution would diminish as the interest in listening increased. Was witness of this opinion? The witness stated that his experience

A recent portrait of Sir Hugh Allen.

was to the contrary. Many who would otherwise not be interested in such execution were now stimulated and evinced a considerable desire to emulate the performances given by many exponents of musical execution. He thought that the number who would relinquish the desire for execution would be far outnumbered by those who were stimulated to such a desire. Lord Blanesburgh asked Sir Walford Davies whether he considered that broadcasting was the best means of providing an opportunity of acquiring intellectual culture. Sir Walford replied that in his opinion it was the only means. After some further discussion as to the influence of music on the minds of children the examination closed.

Evidence of the Performing Right Society

Mr. J. Woodhouse, solicitor, then read his memorandum tendered on behalf of the Performing Right Society, Ltd. This memorandum discussed the existing copyright and performing right situation. He pleaded on behalf of the Performing Right Society that the payment for the right to perform certain items now figuring in the B.B.C. programmes should be increased, and gave figures in support of this request. Lord Blanesburgh asked whether, previous to the Act of 1911, there was any question of performing rights. The witness replied that he did not know, whereat Lord Blanesburgh remarked that surely the witness, being the solicitor to this company and fully conversant with the law, should be aware of this. Lord Blanesburgh also asked, "Is not the value to the owner of a copyright increased by people hearing what they would otherwise not hear?" Mr. Woodhouse did not think so.

After further discussion on the technicalities involved the meeting adjourned until the following day.

Sir Hugh Allen

On January 28 Sir Hugh Allen presented a memorandum drawn up by himself. The substance of this memorandum was very similar to the evidence tendered by Sir Walford Davies. A point arose in connection with a submission by Sir Walford Davies that there was a surfeit of music. In Sir Hugh Allen's opinion there was not any such surfeit. He concurred with Sir Walford Davies in the value of the training of the young. He submitted that music could be divided into three categories, viz., classical, light and dance music. There was good music in each class, and he thought that the closest approximation to the ideal programme could

be obtained by a suitable admixture of all these three. Sir Henry Hadow queried whether the witness had any information as to whether an increased or decreased interest in wireless was noticeable, and the witness thought that an increase was noticeable and that a great stimulus had been given to an appreciation of good music by the efforts of the B.B.C.

"Good" and "Bad" Music

Again, in answer to Sir Henry Hadow Sir Hugh Allen agreed with a suggestion by a previous witness that the rescoring of certain music might be beneficial. Captain Ian Fraser asked how the witness would define bad music? Would he, for instance, define it as music possessed of merely a transient interest? The witness agreed that this was a possible definition, whereat Captain Fraser suggested that surely music which gave only a passing interest, but at the same time gave pleasure, could not be bad. This concluded Sir Hugh Allen's evidence.

Secret Wireless, Ltd.

Evidence was also given by Mr. J. D. Chisholm, Managing Director of Secret Wireless, Ltd. Under the heading of "General" the following statement was made :—

The question of broadcasting by means of wireless telephony is of such importance not only to the general public from the educational and entertainment point of view, but also to industry and commerce, that it must be considered with due regard to all these interests. Dealing then with the question of private or selective transmission and reception, provided that it can be demonstrated that no interference will be caused by private broadcasting to the general broadcasting at present in practice, it is suggested that licences for transmission, as well as reception, should be granted to business and other firms and even to individuals, just as private telegraph and telephone wires are at present installed.

Claims for the System

The company claim to have perfected a system of secret wireless which will satisfy all conditions in this direction. It is hardly necessary to point out that the application of a secret method of wireless to this type of transmission and reception would be of the greatest advantage to all concerned, enabling wireless signals to be broadcast, but to be received only by those for whom they are intended. It is possible, by the methods claimed and accomplished by this company, for any particular enterprise or individual to communicate privately, even though any number of persons may be using the same system at the same time, and without interference to general broadcasting. It is claimed for the method suggested by Secret Wireless, Ltd., that a great range of programmes, operated by different companies at different stations, could be made available at will for the users of the system. A group of theatre managers, for instance, could combine and broadcast their programmes at such times as might be arranged.

Wavelengths

Dealing with the allocation of wavelengths, the memorandum goes on :—It may be objected that the granting of licences for commercial purposes, for theatrical broadcasting and so on, would necessitate such a multiplicity of wavelengths or wave bands as might render the system impracticable. While at first sight this may appear a real difficulty, it could be easily overcome.

After dealing further with the question of general broadcasting companies and also with the elimination of "pirates," the evidence was closed. The cross-examination of Mr. Chisholm then followed, when the following particulars regarding this new company were elicited.

Organisation of the Company

The company was incorporated in September, 1925, with a capital of £10,000. It was intended to commence by erecting two 1-kw. stations, one to be situated in England and the other in Scotland. The P.M.G. had offered permission for the erection of two stations.

Practical Proposals

The patents involved in this new system were situated both in the transmitter and the receiver. A main difficulty in the past had been the necessity of devising some synchronising device for the transmission and reception of secret transmissions. They contended they had now overcome this difficulty. A combination of three wavelengths was used and the combination would be changed each week. A penny programme would be sold weekly by any particular station, and this programme would give the necessary information printed as an instruction. Asked by Lord Crawford whether one person could buy a programme and tell his friends the combination, the witness agreed; he said that while many might be reluctant to pay 10s. for a licence, nobody would worry about a penny. Earl Crawford thought that the witness was "unduly optimistic."

Sir Walford Davies is well known to listeners in connection with his series of talks on music.

SHORT-WAVE *Notes & News*

THE past week has seen no developments of specially great interest, but activity amongst the amateurs on short waves is still increasing rapidly. In fact, the time does not seem far distant when our 6,000-10,000-kc. band of frequencies will be quite full! Once more the writer logged over 70 British stations during the week-end, together with innumerable foreigners.

Summary Needed

However, "the more the merrier!" Certainly it is easier to summarise the results of short-wave experiments when there are plenty of others about to help, and at the present time it seems as if a summary is what is needed most. Each separate experiment seems to produce more or less the result expected, but it is often very difficult to reconcile one with another.

Some Interesting Observations

Mr. A. E. Livesey, of Horncastle, Lincs., has been taking notice of the time of day that is apparently most satisfactory for logging signals from various distances and directions. A table of these times, with various additions, is given below :—

Time. Country.

00.00-02.00.—U.S.A., districts 1, 2, 3, 4, 5, 8, 9.
02.00-06.00.—Very little.
06.00-08.00.—U.S.A., all districts, Argentine, Canada, New Zealand, Australia.
08.00-10.00.—U.S.A. fades out except 6th and 7th districts, New Zealand remains audible until about 10.30, Hawaii until about 10.00.
09.00-19.00.—All Europe, nearer countries fading out at about 17.30.
14.30.—China, Philippines, Western Australia.
18.00.—S. Africa, India and Scandinavia.
18.30.—Australia.
19.00-22.30.—Almost blank except for nearer U.S.A. districts, when good conditions prevail.

Curious Fading

He has also noticed, in common with the writer, that WIR, WIZ and WQO have a double fading effect, and has noticed this on KDKA. At times the latter station is described as "sounding like 20-words-per-minute Morse," with an additional slow fade with a period of about 50 seconds. He has also observed that in the short fading periods the music remains pure, whereas during the longer ones it "breaks" and "blasts" badly.

Co-operation Wanted

He would be very glad to be of any assistance to transmitters working on the 10,000-6,000-kc. band, and would particularly like to get into touch with another reception enthusiast for the purpose of comparing notes on signals heard, etc.

Norwegian Stations Identified

Mr. D. H. Johnson (6DW) informs us that the stations NA-1G and NA-1Q, mentioned in these columns a few weeks ago, are both of Norwegian origin, certain Norwegian stations apparently using the intermediate "NA" instead of "LA." He has worked NA-1G and most other active European countries with 9 watts input.

A Record?

2GO has been heard in Rawalpindi, India, by Mr. R. J. Drudge-Coates, when his input was 12 watts only. The distance is nearly 6,000 miles, and this is believed to be a low-power record for work between India and Great Britain. This low-power work is certainly on the increase now, and it makes one wonder how some of our 250-watt stations would get along if they suddenly found themselves restricted to 10 watts or so!

The Greater Credit

After all, there is, in a sense, more credit due to the 10-watt man who works New Zealand once than to the "250-watter" who does it every morning, as he must *always* be sure that everything is "up to scratch," whereas the owner of the high-power station can be fairly sure of doing plenty of "DX" work even if his efficiency sinks as low as 20 per cent. at times.

East Anglian Activity

The Eastern Counties seem to have livened up considerably during the past week or so. The most active transmitters at present are our old friend 2LZ (Wickford), 5QV (Clacton), 2TO (Ipswich), 6JV (Norwich), 2OF and 2MA (Lowestoft) and 6BT (Bury St. Edmunds). 2OF has, with powers between 12 and 16 watts, worked E-GEH at Cairo, who reported his signals R8; with PE-6YX of Palestine, signals R5; NRL in Russia, R5; and Rome, R8.

Lower-Power DX

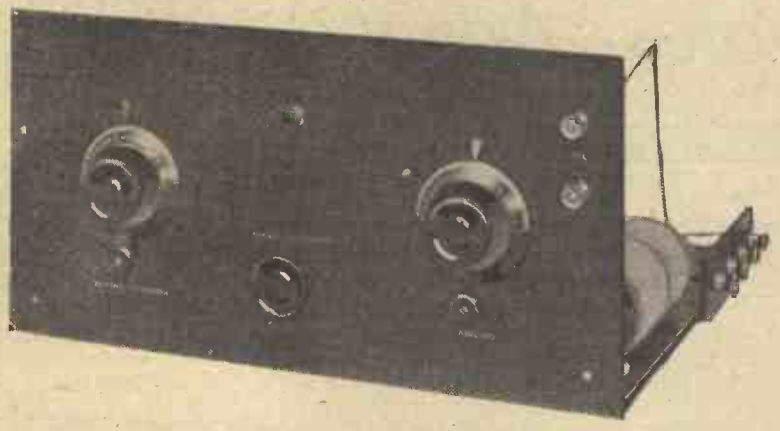
6JV has "got across" for the first time, having worked U-1BZ and another first district station on Saturday, January 23, and U-1VC on the 24th, input being less than 30 watts.

2MA has been working East Prussia, Finland, Denmark and Ireland, and as yet his signals have never been reported less than R6. He is carrying out fading tests with GW-11B.

The Efforts of 5QV

The work of 2LZ is too well known to need further comment, but it might be mentioned that

5QV has not yet succeeded in achieving his "heart's desire," which was to establish two-way working with the Canadian fourth district. He is, however, working all manner of people, and has not yet given up hope.



One of the attractions of the popular one or two-valve short-wave receiver is the simplicity of the panel and the small number of controls necessary.

The North

In the North, 5PO and 5SO are two new stations working on the 6,667-kc. band of frequencies. They both use fairly low power, and are doing good work.

A Neglected Frequency

Very few stations are still to be heard on the 3,333-kc. (90-metre) band. This certainly seems remarkable when one thinks that it is the frequency that saw the first two-way Transatlantic work and the first "Trans-World" work, in addition to possessing excellent carrying properties for European working.

Why Not Use 3,333 kc.?

The tendency seems to be for stations using the 1,500-kc. (200-metre) band, when they want to start work on a higher frequency, to try this band for about a day, and then disappear for ever, settling down on the 6,667-kc. band.

Only two or three stations are to be heard on the lower frequency. If only some of the stations that are none too successful on 6,667 kc. would go back to the good old 3,333-kc. band of frequencies there would be less interference on the higher frequency and more satisfaction on the lower!

Still Used in America

G-6KO, of Forfarshire, Scotland, has been heard several times at excellent strength by the writer on about 3,158 kc. (95 metres). There are still large numbers of Americans working in the region of 3,750 kc. (80 metres), where they seem to be considerably stronger than on the higher frequency band.

A Discovery!

"QST" has received a newspaper cutting reading as follows: "Sir Oliver Lodge, paying tribute to Marconi, complimented him on his *new* discovery that a long wave preferred the darkness, while a short wave preferred light"! We are just beginning to wonder whether this really is true after all, as the period when it is probably darkest over the Atlantic corresponds with the time that American signals are often at their best!

Intermediates

In response to requests from several readers, we are giving this week an up-to-date list of "Intermediates," with an indication, where they are used by more than one country, in which case they are officially recognised.

Notes for the Transmitter

The following stations are now transmitting, and would be glad to receive reports on reception of their signals:—

2NT: A. C. C. Willway, Knowle Hill, Mayfield, Sussex.

2TK: K. H. Thow, 2, Victoria Road, Eltham, S.E.9.

5BD: C. E. Bradford and A. C. Simons, Empire Buildings, Mablethorpe, Lincs.

5IN: A. H. Cooper, 58, Greyswood Street, Streatham, S.W.16.

5YG: J. Wyllie, 105, Mossgiel Road, Newlands, Glasgow.

6MI: R. Maynard, Tynwald Street, Douglas, Isle of Man.

6NX: J. T. McDade, 8, Monteith Row, Glasgow, S.E.

6YZ: F. G. Bettles, Brownsea Island, Poole, Dorset.

QRA's Wanted

We have been asked for the locations of the following stations:—

OCML, OCMV, L20, M-4HS, PH, NSA, TPAX, SQ1, BZ-6QA.

QRA's Found

We are able to supply the following, for which we have been asked:—

SGC: Swedish Motor-Liner *San Francisco*. QSL's via Swedish SMZS.

B-G6: via Réseau Belge, 11, Rue du Congrès, Brussels.

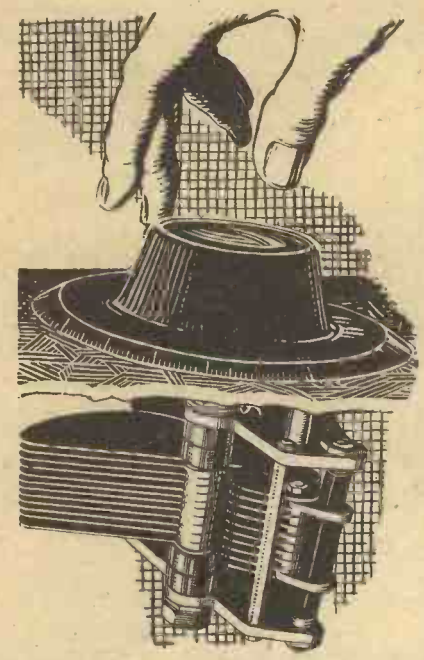
PR-4UR: I. A. Baldrich, P.O. Box 148, Cayey, Porto Rico.

U-8ES: G. G. Collins, 601, Copley Road, Akron, Ohio.

CALL-SIGN "INTERMEDIATES."

A	:	Australia.	J	:	Japan.
B	:	Belgium.	K	:	Germany.
BE	:	Bermuda.	L	:	Luxemburg.
BO	:	Bolivia.	LA	:	Norway.
BZ	:	Brazil.	M	:	Mexico (Mosul).*
C	:	Canada.	N	:	Holland.
CH	:	Chile.	NA	:	Norway.
CO	:	Colombia.	O	:	South Africa.
CR	:	Costa-Rica.	P	:	Portugal.
CS	:	Czecho-Slovakia.	PI	:	Phillippine Islands.
D	:	Denmark.	PR	:	Porto Rico.
E	:	Spain (Egypt).*	Q	:	Cuba.
F	:	France.	R	:	Argentina (Russia).*
FI	:	French Indo-China.	S	:	Sweden, Finland.
G	:	Great Britain.	U	:	United States.
GI	:	Northern Ireland.	V	:	(Venezuela).*
GW	:	Irish Free State.	XA	:	Tasmania.
H	:	Switzerland.	Y	:	India (Uruguay).*
HU	:	Hawaiian Islands.	YS	:	Yugo-Slavia.
I	:	Italy.	Z	:	New Zealand.

* Brackets indicate that the use of the intermediate is unofficial.



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„ .0005 „ „ ... ... 29/6 „

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RC45/69.	12in. x 9in.	1 6 6
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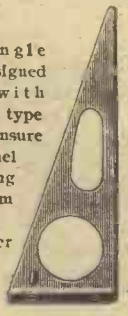
"Duco" Angle Brackets, designed for use with American type cabinet to ensure rigidity of panel when removing baseboard from cabinet, No. RC46/2, per pair, 1/-



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Let's investigate further. The old bright emitter possessed a tungsten filament which required a very high temperature—as much as 2000°—in order to create the necessary stream of electrons. Such a temperature—coupled with the constant expansion and contraction of the filament—rapidly caused brittleness and disintegration. In other words, the intense heat—while necessary for the prolific production of electrons—robs the filament of many hours of usefulness. But if the temperature is reduced—then the electron stream is impoverished, too.

So other means had to be sought. Instead of tungsten, the Wuncell uses a filament which is built up layer upon layer under a secret process known only to Cossor. This external covering emits a copious supply of electrons at an extraordinarily low temperature. In fact, at 800° the Wuncell produces more electrons than a bright emitter valve does at 2000°. The Wuncell goes a long way towards banishing heat from the valve altogether—at all events 800° is no more than a dull red glow practically invisible in daylight. When you choose the Wuncell for your set, therefore, you get a valve which has the longest life of any because it is the only valve which so effectively reduces the ruinous influence of heat.

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Wireless News in Brief.

Forthcoming B.B.C. Items. February 16.—London: "Carmen," performed by the B.N.O.C. Glasgow: Folk song recital.

February 17. — Birmingham: Wagner programme. Daventry (11.0-12.0): The Savoy Orpheans, Havana and Tango Bands. Manchester: Musical comedy.

February 18.– Aberdeen: Special feature, "What is it?" Glasgow: Bach Society Concert.

February 20. — London (10.30 p.m.): The Savoy Bands. Newcastle: Recitals by Winifred Small (violin), Maurice Cole (pianoforte), and The Station Orchestra.

* * *

We understand that the Musicians' Union stipulated for a payment of 5s. to each member of the orchestra at the Grand Theatre, Birmingham, when it was proposed to broadcast the music accompanying 'Charlie Chaplin's film, "The Gold Rush."

* * *

Wild Atlantic Weather. It will be recalled that S O S calls interfered with the transmissions from America on the first two mornings of the Transatlantic Tests. The Cunard liner *Andania* reported on her arrival in Plymouth from New York last week that furious gales were experienced on the voyage. Numerous S O S messages were picked up during the passage across the Atlantic.

* * *

Cancelled Theatre Broadcast. We understand that the last-minute cancellation of the broadcasting of "Betty in Mayfair" a few days ago was due to the refusal of the orchestra to perform if excerpts from the play were broadcast. A London secretary of the Musicians' Union has stated that their case is that the B.B.C. have no right to use their services without payment. It was also said that most musicians feel it a greater strain to perform for an enormous invisible audience.

* * *

An Interesting Event. On the evening of Sunday, January 31, Cologne was officially "liberated" from British occupation. The celebrations which marked the occasion in Cologne were broadcast, and listeners in this country that evening heard the speeches made, and the singing of "Deutschland Uber Alles" by the crowd.

* * *

Duplex Wireless Telephony. Considerable claims are made by Mr. D. B. Shannon for the portable transmitter and receiver which he has designed. We gather that tests have been carried out between the island of Guernsey and a steamer owned by the Great Western Railway. The apparatus is intended for use without aerial or earth, and low power is employed. A further feature of the instruments is that the ordinary land-line telephone can readily be connected to them. Much interest has been aroused by Mr. Shannon's claims, and one question is raised by a "technical expert": "Can he employ full reaction without seriously reducing the strength of signals?" A solution of the oscillation problem, perhaps, but unfortunately the question remains unanswered.

* * *

It is hoped that the Prince of Wales will have sufficiently recovered from his recent hunting accident to fulfil his engagement to propose the toast of the British Industries Fair at the Mansion House banquet on February 15. In this event his speech will be broadcast from all stations of the B.B.C. at about 9.30 p.m.

Cardiff Birthday Programme. The third birthday of the Cardiff Station will be celebrated on February 13, when a special concert will be broadcast. Mr. Rex Palmer and other well-known Uncles and Aunts will take part, and the new Cardiff studio will be used for the first time.

* * *

Soviet Wireless. We hear that the Communist International in Moscow is planning to use wireless for extensive propaganda. Thus, it is stated, in the event of war with other Powers and the isolation of the Communistic centres, such propaganda would be a good weapon against "capitalism," while communication with foreign Communist organisations would be established.

* * *

B.B.C. Dance Band. The B.B.C. are forming a small Dance Band to be called "The London Wireless Dance Band," who will perform sometimes in the studio and sometimes in dance halls under the conductorship of Mr. Sidney Firman.

The B.B.C. have been considering the formation of such a band for some time, and they do not intend that they shall replace other dance bands who are willing to broadcast.

* * *

Wireless Operators' Strike. The position in the strike of marine wireless telegraph operators was, on February 4, that the employers were insisting on a reduction in wages and the resumption of work before further claims for allowances and leave could be considered. The union refused to accept such terms, since they indicated no concession by the employers.

The amplifier is built on experimental lines, with facilities for easy testing of different values of components etc.

A T.A.T. L.F. FOR WEA

By PERCY W. H

Many experimenters know three stages of low-frequency difficult matter. Mr. Harris analogous to the T.A.T. syst fication may be used with a gives full practical details o built on t

BEING desirous of carrying out a number of experiments with the low-frequency amplification of very weak signals, I recently had occasion to construct a three-valve low-frequency amplifier for the purpose. It is by no means easy to obtain stability in low-frequency amplifiers, particularly when the transformer method of coupling is used, and as I desired to obtain greater amplification than is normally possible with two stages of transformer-coupled amplification, it occurred to me to try the T.A.T. system originated by Mr. John Scott-Taggart, in which an aperiodic stage is placed between two tuned circuits.

The Use of the T.A.T. Method

I am, of course, rather stretching the use of the word " tuned " in the case of the transformer-coupled low-frequency amplifier, but as every experimenter knows, the tendency to low-frequency oscillation with such transformers is often very pronounced, and, as great stability is obtainable with the T.A.T. system for high-frequency amplification, there was every prospect of its being satisfactory for low frequencies.

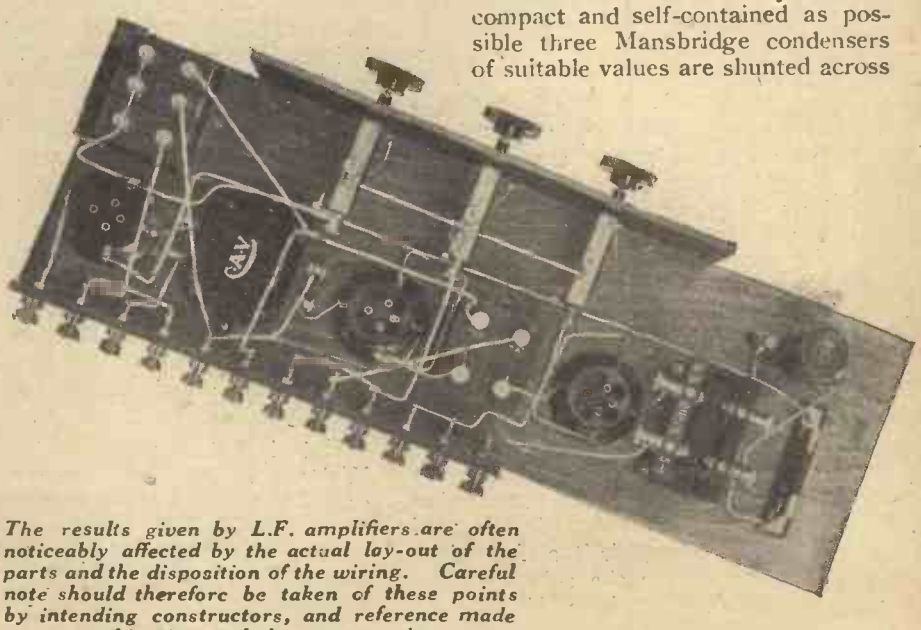
The circuit then adopted was that shown in Fig. 1. It will be noticed that the input connection to the first transformer goes, first of all, through a radio-frequency choke, a condenser being connected between one input terminal and LT – to by-pass any radio-frequency component in the signals. This condenser, which is of the clip-in variety, can be tried in different values.

The Connections

The reason for the use of this condenser and the radio-frequency choke was explained in last week's *Wireless Weekly*, where I discussed the question in some detail. The secondary of the first L.F. transformer is connected as usual to the grid of the first valve, the IS terminal being taken to a grid-bias terminal in the conventional manner. The anode circuit of the first valve is connected by the resistance-capacity method to the second valve, the coupling for this purpose being that contained in the special resistance capacity coupling unit made by Messrs. Fullers. For this, readers can, if desired, substitute the usual anode resistance, coupling condenser and leak.

The Last Coupling Unit

The second valve is connected to the third by a " second stage " low-frequency transformer of the type manufactured by Messrs. C. A. Vandervell, Ltd. Each valve has its own high-tension positive terminal, and, of course, grid-bias terminals are provided for each valve. In order that the unit shall be as compact and self-contained as possible three Mansbridge condensers of suitable values are shunted across

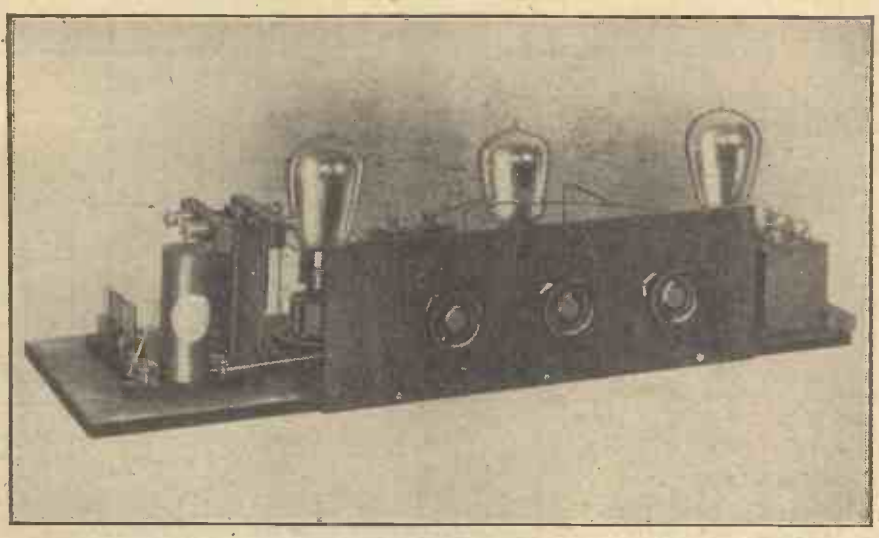


The results given by L.F. amplifiers are often noticeably affected by the actual lay-out of the parts and the disposition of the wiring. Careful note should therefore be taken of these points by intending constructors, and reference made to this view and the one opposite.

AMPLIFIER
K SIGNALS

ARRIS, M.I.R.E.

from experience that to use amplification is a somewhat shows that an arrangement tem of high-frequency ampli- dvantage in such a case, and an instrument which he has hese lines.



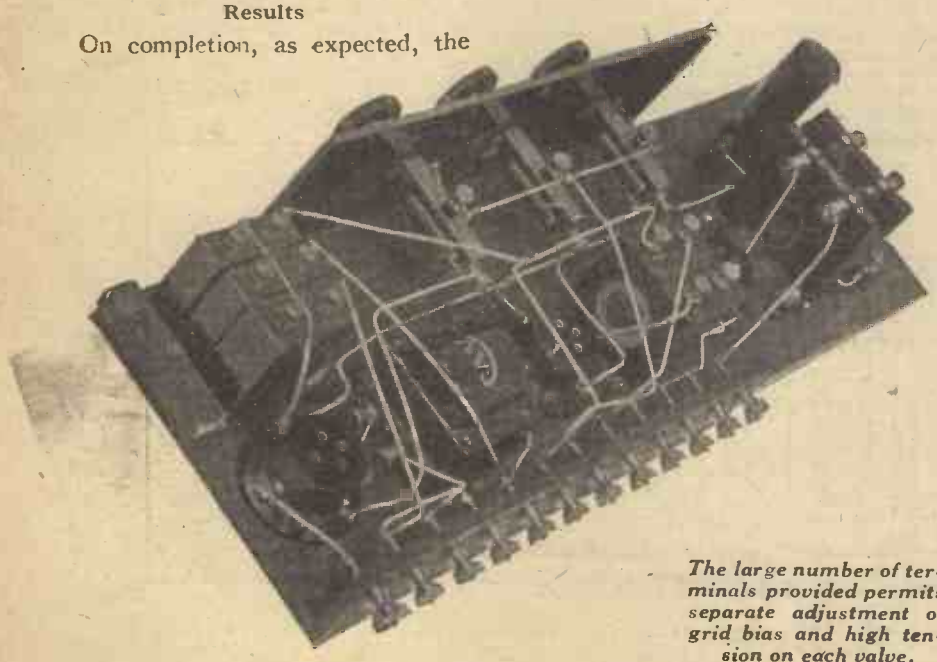
It is possible to make the amplifier in the form of a cabinet instrument if desired by making the front panel larger.

the high-tension battery. As experience has taught me that a straggling lay-out on the bench may give quite different results from those obtained by the apparatus built up in a compact manner, I thought it worth while making up the amplifier in a fashion so that, if necessary, it could be fitted into a cabinet. There was no need in my own case to use a large ebonite panel for the front, as the only front support required is that for the three filament resistances, which I have attached to a piece of ebonite of a convenient size that happened to be handy.

Results

On completion, as expected, the amplifier proved to be very stable, free from undesirable noises and of high efficiency. Its sensitivity is such that when connected by long leads to a "Kone" loud-speaker in the dining-room on the floor below my experimental room (the lead from the Kone being taken to the input side of the amplifier), and with a horn-type loud-speaker connected to the output in my own room, the ticking of a clock 15 ft. away from the Kone could be distinctly heard from the loud-speaker anywhere in my room.

In addition to this, and for a reason I could not fully fathom, when a receiving set (consisting of a crystal detector and three resistance coupled-note magnifiers) was supplying the Kone in the room below, the "pick-up" of the amplifier (with nothing whatever connected to its input side!) was sufficient to give loud-speaker strength on London's signals when my hand was held within an inch or two of the first transformer winding. Seeing that the set in question ("My Own" receiver, described in a recent issue of the *Wireless Constructor*) has no transformers in it, and, therefore, no straying magnetic fields, and as the loud-speaker being operated was in a room below, the reason for the pickup is not particularly obvious.



The large number of terminals provided permits separate adjustment of grid bias and high tension on each valve.

Components Used

As some readers of *Wireless Weekly* may care to construct a similar amplifier for experimental work constructional details are given herewith.

If it is desired to build it into a cabinet, the only change necessary will be to fit the filament resistances to a larger ebonite panel. The size of cabinet suitable is that sold for the "Harmony Four" receiver by any of the cabinet makers advertising in this journal.

Baseboard 21 in. × 7 in. × ⅜ in.

1 Fixed condenser in clips for board mounting (L. McMichael, Ltd.).

1 R.F. choke (Lissen, Ltd.).

1 L.F. transformer (U.S. super 5—1).

1 L.F. transformer (C.A.V. 2nd stage).
1 Resistance-capacity coupling unit (Fuller's United Electrical Works).
3 Valve sockets (Aermonic).
3 Filament resistances (C.A.V.).
1 Ebonite strip, 12 in. × 4in. × ⅜ in. or ¼ in.
12 Terminals.
3 Mansbridge condensers, 1 μF each.

Valves

Any suitable low-frequency valves can be used, but better results will be given with one of the types of valves specifically designed for resistance-capacity coupling if this is used in the appropriate stage.

The Wiring

The instrument is wired with No. 16 gauge Glazite, which successfully safeguards against the possibility of shorting between wires. Radio Press panel transfers can, of course, be used as terminal indicators.

Wiring up can be readily conducted by the aid of the diagram given. On completion care should be taken to ascertain the correct grid-bias for the valve used. Personally I am in favour of separate grid-bias batteries for each valve, all positives being connected to the common positive. If one grid bias battery is used, its resistance is common to all three circuits, and may sometimes give undesirable coupling effects in a sensitive L.F. amplifier.

Stabilising Precautions

It must not be forgotten that any low-frequency amplifier of high efficiency needs careful handling, and you must not expect to maintain stability if the loud-speaker is brought very near to the amplifier. It will usually be found advantageous to earth the L.T. battery. Howling may, and probably will, occur in your first experiment, due, not to any instability in the amplifier, but to the impinging of the sound waves from the loud-speaker on the valves setting up a microphonic effect.

It can generally be checked by turning the loud-speaker round or by stuffing a handkerchief in the horn. A good test of sensitivity of the set is to connect an ordinary pair of telephones to the input terminals (one condenser terminal and the O.P. of the transformer) and to join a loud-speaker to the output end. Speak into one or other of the ear-pieces of the telephones and you should get very powerful reproduction in the loud-speaker.

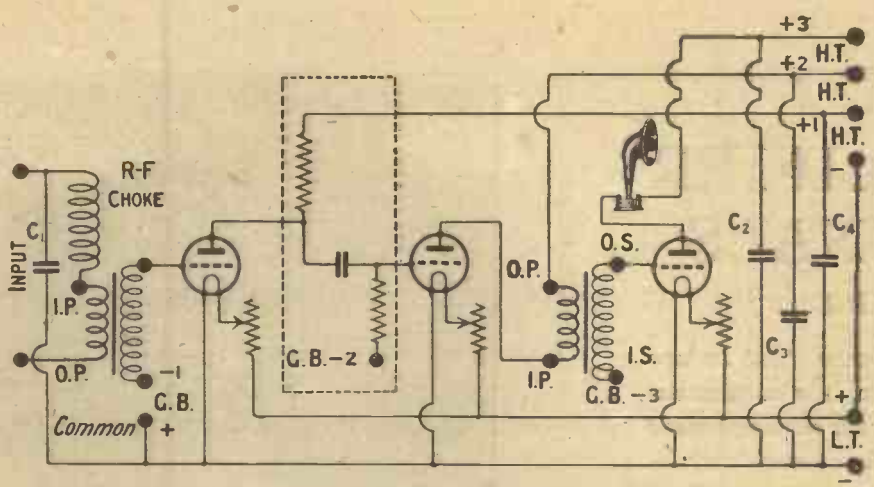


Fig. 1.—The circuit incorporates two stages of transformer coupling and one of resistance-capacity.

The Function of the Amplifier

The purpose of this amplifier is not to obtain a very great volume so as to work "oversize" loud-speakers, but to give high amplification at audio frequencies on very weak signals such as those obtained with a crystal detector at a considerable distance from a broadcasting station.

Some quite surprising results can be obtained by connecting this amplifier to a well-designed crystal set and listening in telephones connected to the last stage. Provided atmospherics and other noises are not too bad, it is often possible to hear several broadcasting stations in this way.

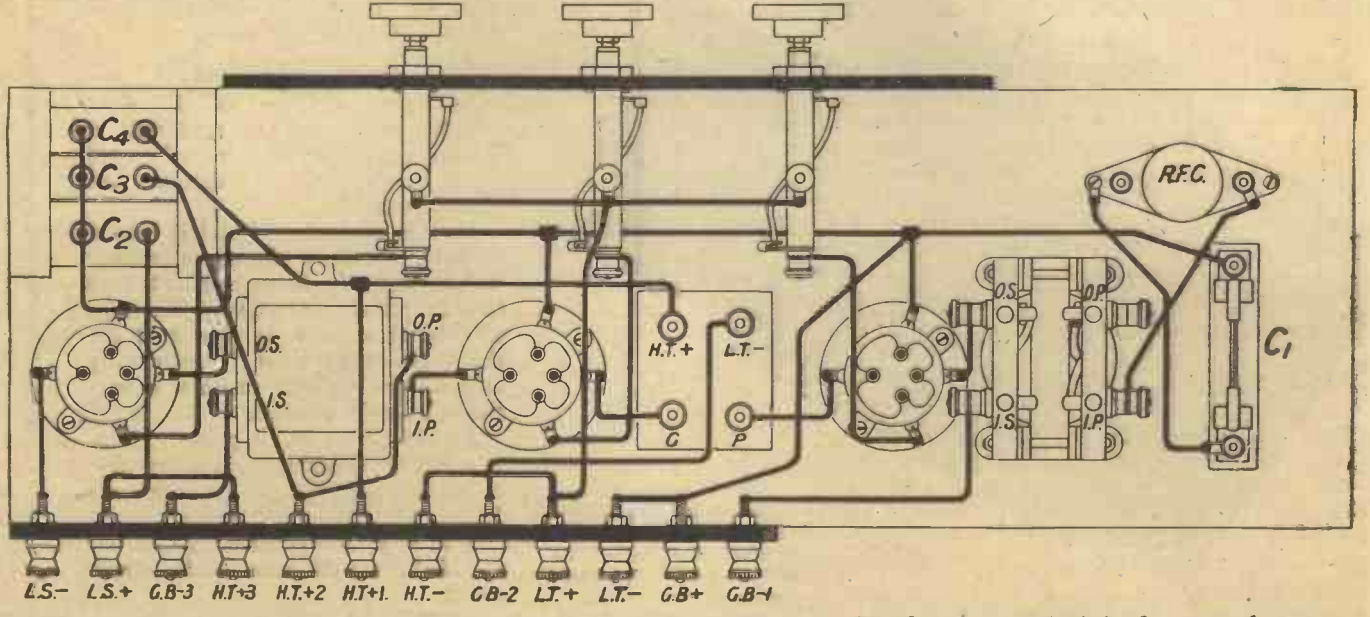


Fig. 2.—The lay-out of the set is given in detail in this wiring diagram. The O.P. terminal of the first transformer and one of the terminals of the condenser C_1 serve as input terminals.

RESULTS OF THE TRANSATLANTIC TESTS

Although conditions have been far from favourable during almost the whole period of the tests, some valuable information has been obtained. Results of reception on the American side are not yet available.

FROM the report on the Transatlantic tests published in the last issue of *Wireless Weekly*, readers will have gathered that the first few days of the week were attended with little success, so far as the reception of American stations in this country was concerned.

Continuing Bad Conditions

The latter part of the week showed little improvement in the conditions for reception. We have received reports from listeners in widely separated localities, and local conditions do not seem to have affected results to any appreciable extent. The same "deadness" of the ether is reported in almost every case.

The poor results are attributed in some cases to atmospherics or morse interference, but there appears to be little doubt that the real causes of failure must be some factor or factors about which we have little knowledge at present.

The Causes

With the scanty data available on such points as the influence of barometric variations or other natural phenomena on the passage of wireless waves over long distances, it is impossible to generalise and assert positively that this or that phenomenon was directly responsible.

Valuable Results

It should not be supposed, therefore, that because the tests have been disappointing from the standpoint of actual reception they have been necessarily a failure, and that time has been wasted in carrying out the tests. Previous experience led the organisers of the Tests Week to believe that the time chosen would be the most favourable.

An Unusual Winter

This winter has been notable, however, as no doubt most listeners will agree, for a remarkable "slump," if one may use the term in such a sense, in the reception of American stations. The unfavourable conditions have not been confined to the week of the tests only. Stations which in previous years could be listened to in comfort on the loud-speaker have been almost inaudible this winter.

We may find therefore that the chief value of the reports sent in by listeners is to be found in their notes on the state of the sky and weather, though the collection of a large number of such observations spread over a considerable period of time would be necessary before any definite theories could reasonably be advanced.

Actual Results

Turning to actual reports of signals received, on January 29, a member of the Radio Press staff, listening at the Elstree Laboratories, reported reception of WJAZ, Chicago, WLW, Cincinnati, and WGY, Schenectady. Speech was unintelligible, and accurate frequency measurement was the main guide to the identity of the stations. We await confirmation of this reception, and hope to publish further particulars in due course.

For January 30 two listeners, in Middlesex and Essex, reported signals, which were too indefinite to be assigned to any particular station without verification from America. At Elstree on this morning a number of carrier waves were picked up on a 6-valve superheterodyne receiver and a frame aerial, but they could not be resolved.

Reception of Continental Stations

In the absence of signals from America, the Continental transmissions provided listeners with an opportunity of testing their receivers. We have received numerous reports of good reception of most of the Continental stations.

It appears that the Prague station was working normally at a frequency slightly below that of Madrid, a fact which may have been puzzling to some listeners. According to the official announcement regarding frequencies, Prague had been assigned a frequency higher than that of Madrid. Some of the Spanish stations, too, carried out "unofficial" tests to America during the Continental transmission periods.

The "local" tests in America on the last two days of the week appear to have been fairly successful. Several South American broadcasting stations, including Lima in Peru, were picked up by listeners in the North American continent.

The Advantages of Calibration

It may be of interest to readers to note that indications of the frequency (or wavelength) of stations heard during tests of this kind can be of great assistance in the identification of those stations. Owing to differences in receivers and aerials, mere indications of coil sizes and condenser settings are a poor guide to frequency.

It is hoped to carry out further tests under the Radio Press Calibration Scheme in the near future, so that readers may calibrate their apparatus accurately.

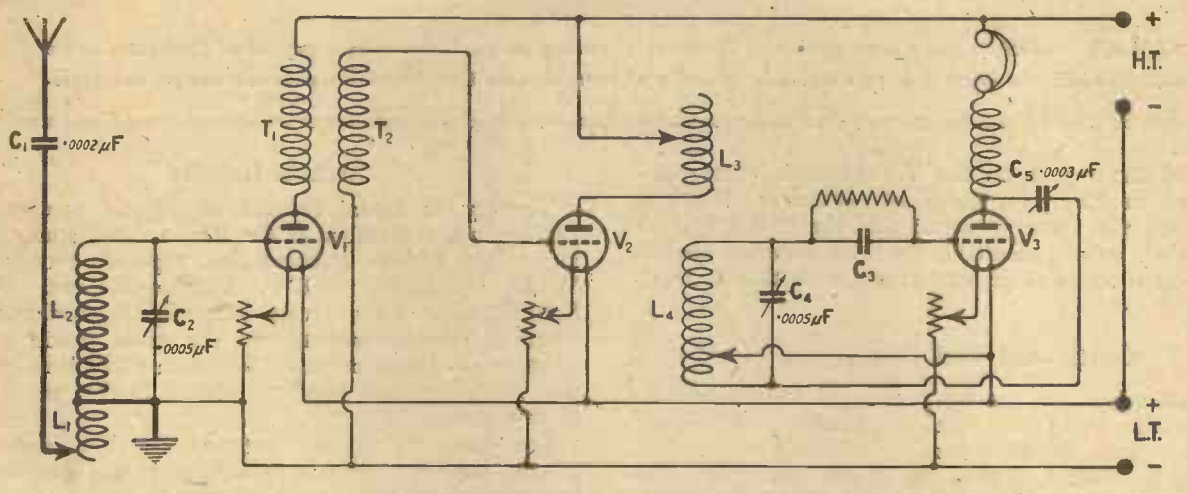
Thank You!

We take this opportunity of expressing our thanks to those listeners who have sent in reports.

Replies to definite individual queries on the subject of items of programmes heard will be sent as soon as the required information comes to hand.

Circuits for the Experimenter

No. 4.—A THREE-VALVE T.A.T. CIRCUIT.



ONE of the difficulties associated with the design and construction of receivers possessing a high degree of selectivity, is that a circuit with the necessary low degree of damping usually has a strong tendency to self-oscillation, and a variety of methods are adopted to control them. Some of the most successful, of course, employ one of those reaction neutralisation methods usually described as a neutrodyne circuit, but it should not be forgotten that stability can be achieved in other fashions which have advantages of their own.

Stability without Neutrodyning

A type of circuit which achieves the desired degree of stability without any scheme of neutralisation is that known as the T.A.T. system, wherein alternate tuned and untuned stages are arranged in cascade, coupled by means of valves, and it is possible to arrange quite a large number of high-frequency valves in this way which will be perfectly stable in operation. By making use of this method it is possible to arrange a very effective receiver, in which certain circuits are incorporated to give a high degree of selectivity, without any real difficulty from instability.

This week's circuit illustrates such an arrangement, which has been found to give a very satisfactory degree of selectivity and sensitivity. When tested at a distance of eight miles from 2LO it was found possible to receive Bournemouth without interference from the former station, and also a French station falling between the two, with a frequency in the neighbourhood of 793 kilocycles (378 metres).

Selectivity

An examination of the circuit will show that there are two tuned circuits with special arrangements for giving selectivity, those being the grid circuit of the first high-frequency valve, and the grid circuit of the detector valve respectively, between them being placed a stage of untuned high-frequency amplification, the coupling unit being a semi-aperiodic transformer. The transformer may well be one of the improvised type described in *Wireless Weekly* for January 27 (Vol. 7, No. 19) or one of those obtainable commercially.

CIRCUIT No. 4
SPECIAL FEATURES

1. **Only Two Tuning Controls.**
2. **Stability Without Neutrodyning.**
3. **Good Selectivity.**
4. **Condenser - Control of Reaction.**

Aerial Coupling Arrangements

The grid circuit of the first valve is composed of the usual secondary coil and tuning condenser, the coil L2 comprising 40 turns of No. 36 double silk-covered wire upon a 3-in. diameter, 1 in. long, section of ebonite tube. The primary winding should be arranged inside this in the form of a small basket coil of 40 turns, with tappings at 15, 20, 25, 30 and 35 turns, while also included in the aerial circuit will be seen a fixed condenser of .0002 μF. This condenser has been found to give distinctly improved selectivity, and also appears to assist in covering a broader band of frequencies for a given number of turns upon the primary winding.

Stabilisation

It will be observed that the lower end of the grid circuit of the first valve is connected directly to L.T. negative, and in this circuit it will usually be found quite permissible to do this. Whether this will be so or not, of course, depends in large measure upon the design of the semi-aperiodic transformer T1 T2 and upon the type of valve employed in the first stage. If any difficulty from self-oscillation is experienced, the usual potentiometer should be provided, to the slider of which the connection from the lower end of the grid circuit of the first valve is taken. It will be found that only a very small positive bias will be needed to stabilise the first valve, and little selectivity is lost.

Intervalve Coupling Unit

The construction and adjustment

of the coupling unit between the second high-frequency valve V2 and the detector valve V3 has an important bearing on the selectivity of the final arrangement, and due attention should be paid to this portion of the lay-out. The construction and arrangement of this unit should be the same as that of the primary and secondary winding, L1 and L2, the secondary winding being of the same size. The primary, however, should be differently tapped, the connecting points being at the 10th, 15th, 20th and 25th turns, the whole winding comprising 30 turns. A few tappings should also be provided near one end of the secondary winding, these being at 10, 12 and 15 turns for the special type of valve which will be recommended for use as V3. If a general purpose valve is to be used as the detector, two other taps should be taken at 18 and 20 turns.

Position of Primary

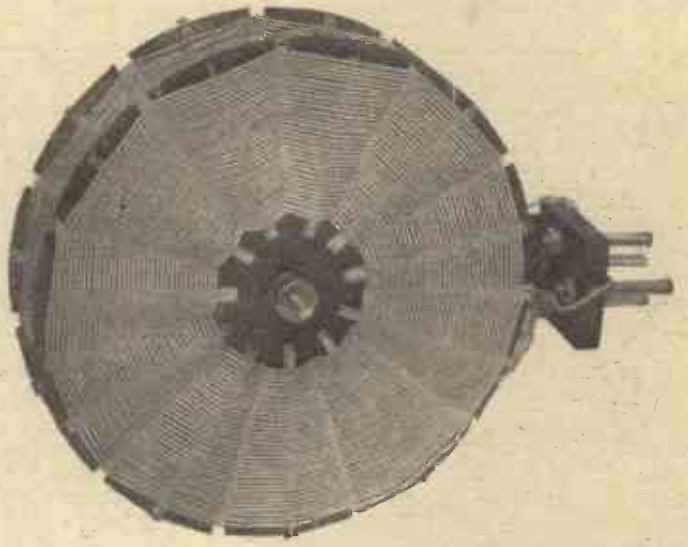
The primary winding L3 which, of course, is of basket form, may be placed inside either the grid or filament end of the secondary winding L4, somewhat different results being produced in each case. In the grid end it may be found that signal strength is improved, but that selectivity is not quite so good as in the alternative position. It may be of interest to make this primary coil capable of sliding right through the secondary, and to observe the effect produced by the different positions. Whenever its position is changed, of course, the effect of varying the tapping point should also be tried.

The secondary circuit of the unit coupling the second and third valves is tuned by a .0005 μF variable condenser and one of the geared type or one fitted with a slow-motion dial is advised. Tuning in the first circuit L2 C2 will be found moderately sharp, but that in the tuned circuit L4 C4 will be exceedingly critical, since reaction is provided here.

Reaction Control

The method of reaction illustrated is akin to that employed in the Reinartz circuit, and it will be seen that reaction is obtained by taking a tapping point from the tuned grid circuit to the filament, and connecting the extreme lower end of the grid circuit to a reaction condenser C5, of which the other set of plates is connected to the anode of the valve. The usual radio frequency choke is provided, and it will be found that the condenser C5 (of .0003 μF capacity) gives an extremely smooth and effective control of reaction.

The scheme of reaction control as illustrated has, of course, the effect of connecting the detector valve across only part of its tuned grid circuit, and this, as has been previously noted in this section, has the beneficial result of reducing the amount of grid current damping in this circuit. The position of the filament tapping should be adjusted with some care, since it will be found that for the best results this should be in one particular position for any special valve, if the best and easiest control of reaction is to be obtained.



A very effective H.F. transformer can be made with two basket coils wound with fine resistance wire.

Operation

The general operation of the circuit is exceedingly simple, since there are only two tuning condensers and a reaction control to manipulate. The adjustment of the size of the aerial primary winding will, of course, depend to some extent upon the frequency of the signals being received, and upon the desired relative degrees of selectivity and signal strength. In general, the smaller the number of turns upon the coil L1, the greater the degree of selectivity which will be obtained, but if the number of turns is made too small, signal strength will suffer to an undue extent. It is good practice, therefore, to keep down the number of turns as much as possible, bearing in mind that if they are made so large that the aerial circuit is actually tuned to any very strong station, that station will be received over practically the whole dial of the condenser C2, and for that one station we shall be working upon the "dead area" of the characteristic of the coil L1, as has been explained in recent issues of *Wireless Weekly* by Mr. Kendall.

Transformer Primary

A somewhat similar rule applies to the size of the coil L3 constituting the primary winding of the unit coupling the valve V2 to the detector V3. The size of this winding should be such that there is no tendency to oscillate on the part of the preceding circuits, but signal strength must, however, not be caused to suffer by making the coil too small. Its size will also have some effect on selectivity, as would be expected, and the number of turns should therefore be kept down to the minimum required for good signal strength.

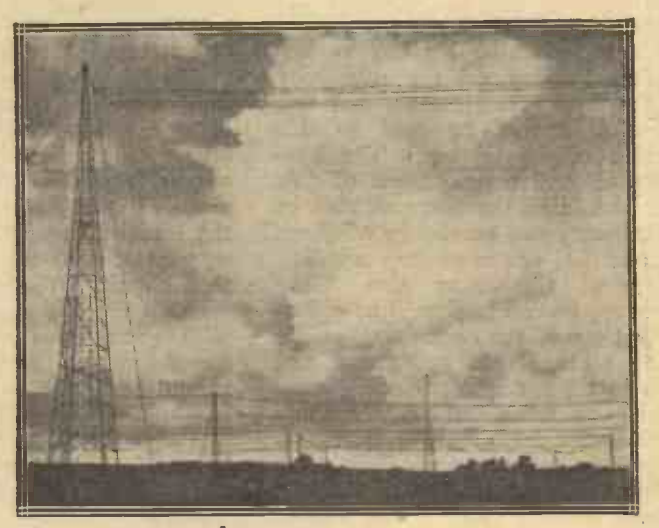
Valves

The valves to be used in this circuit will be found to exert a very considerable influence upon the controllability and also upon the degree of selectivity which it gives, and for the first two stages general purpose valves of fairly high impedance will be found satisfactory. A valve which oscillates very readily should not be chosen for either of these two positions, or the special feature of the circuit may be lost. For the detector valve, on the other hand, one of the valves of the special high amplification ratio type, such as the D.E.5B. and the D.F.A.4 variety, will probably prove most suitable. This detector valve should be chosen with some care, being selected from the standpoint of smooth reaction control, since in a circuit of this type the correct use of reaction has naturally a considerable influence upon the results which will be obtained.

THE COUNTERPOISE EARTH IN THEORY AND PRACTICE

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

The counterpoise earth is an appliance which can be put to very good use if the experimenter possesses the necessary elementary knowledge of its functions



MANY amateur transmitters employ a counterpoise in place of the usual buried earth connection, and some doubt may have arisen in the minds of some experimenters as to the efficacy or otherwise of such an arrangement. It is proposed in this article to discuss the fundamental principles of the counterpoise (or more correctly the "earth screen") and to indicate wherein its advantages lie.

Hertzian Oscillators

The first types of wireless transmitter were made up in the form of a Hertzian oscillator, and were provided with two large plates a certain distance apart, connected by a suitable inductance and a spark gap, for in those days all the transmissions were carried out by means of an induction coil. Later one of these two plates was replaced by a connection buried in the ground. The necessary condenser in the oscillating circuit then simply became the elevated conductor or aerial and the surface of the earth immediately underneath.

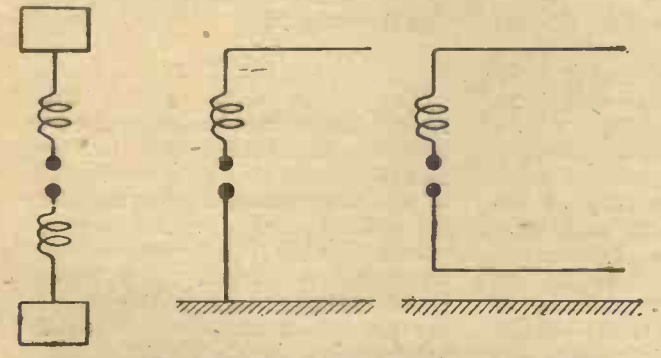


Fig. 1.— The early transmitters made use of arrangements closely similar to that of the modern aerial and earth screen. (Right and left above.)

Increased Resistance

It was soon realised, however, that the advantages obtained from the use of the buried earth were to a large extent discounted by the actual increase in the resistance of the aerial system due to the comparatively high resistance of the ordinary earth connection. Attempts were made, therefore, to return to the older system by providing, in place of the usual earth, a "counterpoise" consisting of a network of wires arranged at a small distance above the level of the ground. By connecting this counterpoise earth in exactly the same manner as the original buried earth connection, a similar distribution of the voltages and currents may be obtained so that the system is quite as effective as the ordinary buried earth system. There is a slight decrease in the effective height of the aerial, due to the fact that the lower plate of the condenser is now several feet nearer to the upper plate than it was previously.

Improved Results

Obviously a counterpoise such as this can be arranged to have a reasonably low resistance, considerably less than with the usual buried earth, and a material improvement might be expected. It was found, however, that the improvement obtained was sometimes considerably greater than one would expect if the only effect was a reduction in the earth resistance. Further investigations showed that the use of a counterpoise was very beneficial in reducing some of the external losses which occur in an aerial circuit.

Losses in the Aerial Circuit

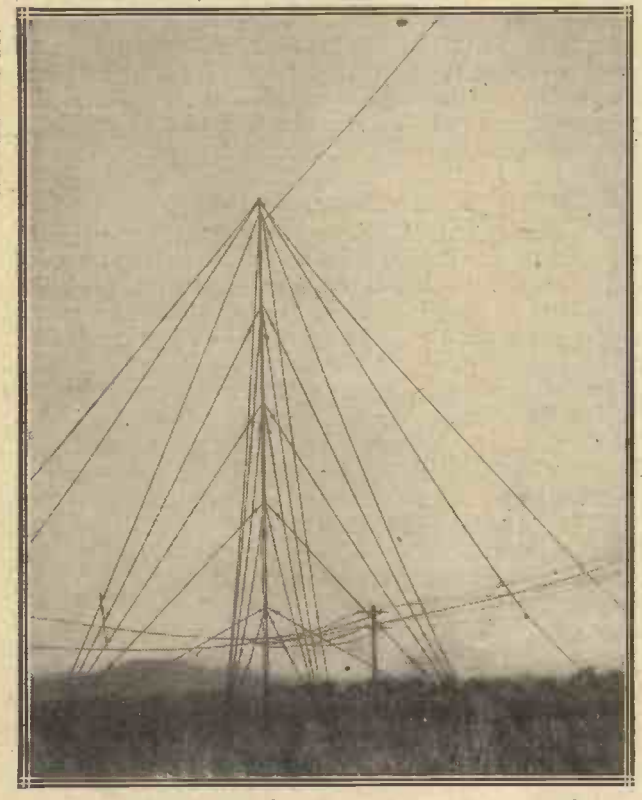
The energy in an aerial circuit is dissipated in a variety of ways. First of all there is the simple resistance of the conductor itself and, as has just been observed, this factor may be reduced by the use of a counterpoise instead of a buried earth. Secondly there is the useful radiation from the aerial, which naturally absorbs energy, and this factor should be kept as high as possible. Thirdly there is a variety of extraneous losses due to the proximity of foreign bodies, and these losses are a considerable proportion of the whole.

It was found that the presence of a counterpoise assisted in minimising some of the external losses by the operation of a form of shielding or screening, with the result that it improved the efficiency of transmission. This screening effect is really more marked than the simple reduction of resistance, and for this

reason the arrangement has come to be known as an "earth screen" rather than a counterpoise, since this gives a better conception of its actual function.

Eddy Current Losses

Let us consider just how the screen assists in minimising the losses. Now, the first source of external loss is the eddy current loss: a transmitting aerial is



A very elaborate aerial and earth system is employed at Burnham, the receiving station for Devizes (GKU).

periodically charged and discharged at a comparatively high voltage, and there is thus an electro-static field set up in the vicinity. Any masts or metallic objects, such as parts of buildings, in the neighbourhood of the aerial will thus have eddy currents set up in them, and these will absorb energy from the aerial.

A particular aspect of this problem is that due to the flat top of the aerial, since the field produced by this flat top is horizontal and produces eddy current losses in the earth immediately underneath the aerial itself. If, however, we place a screen of wire a short distance above the earth and arrange this to be the lower plate of the oscillating system, the majority of the electric field will be confined within the space between the aerial and screen.

A Screening Effect

There may be a certain portion of the electric field which penetrates the earth screen, but the effect of this will largely be nullified by the stray fields due to the screen itself, with the result that very little electric field actually penetrates to the earth. The loss which was due to this cause, therefore, is considerably minimised by the use of a screen of wires such as has been described, and the use of the term "earth screen" in preference to "counterpoise" will readily be understood.

Dielectric Loss

There is a still further source of loss in an aerial system, and that is the loss due to dielectric absorption. It must be remembered that the whole of the space between the aerial and the earth, including such insulators as may be incorporated in the arrangement, constitutes the dielectric of the oscillating circuit condenser. It is well known that a poor dielectric will absorb energy from the circuit in which it is placed, and this, of course, is one of the reasons for the use of low-loss condensers. Unfortunately, the aerial is by no means an efficient condenser, and the dielectric is a highly absorbing one in most cases.

In particular, trees and shrubs, and even the grass underneath the ordinary aerial, are fruitful sources of dielectric loss. Here again an earth screen is effective, because it confines the majority of the electric field to the space between the aerial and the screen so that very little of the field reaches the earth itself. In such manner the loss due to grass and low shrubs may be overcome.

Number of Wires

These remarks will serve to indicate that a suitably erected earth screen may give a considerable improvement in the efficiency of the aerial system. It might be thought at first sight that the erection of a screen of wires sufficient to produce appreciable improvement would be a very complicated matter to construct. It so happens, however, that this is by no means the case. It is found that a comparatively small number of wires suitably arranged can produce all the effects which are required. Experiments show that for a large horizontal multiple wire aerial of the commercial type, 150 ft. across, 6 wires 40 ft. apart would produce an efficient screen.

The average amateur, of course, is usually concerned with a twin-wire aerial or possibly even a single wire. In such cases a suitable earth screen would be that indicated diagrammatically in Fig. 1. The screen should extend a distance on each side of the aerial equal to half the width thereof, and should also extend a distance equal to half the length of the aerial beyond

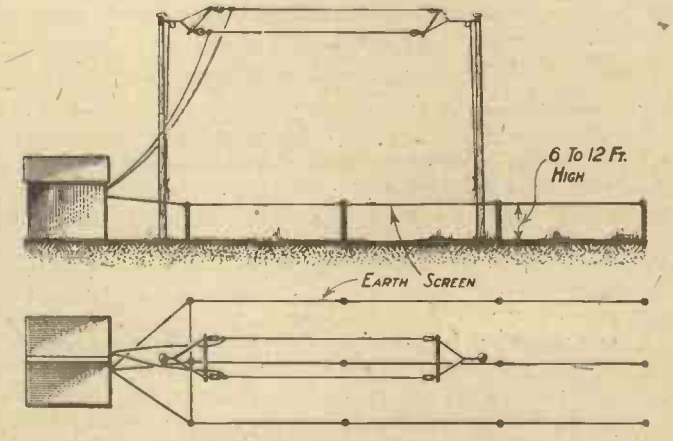


Fig. 2.—A comparatively simple arrangement of aerial and earth screen which can be made to serve experimental purposes very successfully.

the end. It is conceivable that these conditions cannot always be fulfilled in practice, but an attempt should be made to approach the ideal as far as possible.

Too many wires should not be placed in the screen, because if this is done the electric field produced by

the screen wires themselves may produce appreciable losses in the earth, which of course is re-introducing the trouble which we are seeking to eliminate. For this reason the use of a greater number of wires than that shown in the figure is not to be recommended.

Screen Oscillations

An earth screen possesses several disadvantages, one of the most serious being the tendency to oscillate at its own natural frequency. The arrangement of wires possesses inductance and capacity, and thus has a natural frequency at which it may tend to oscillate if suitable precautions are not taken. The natural frequency of the screen oscillation is usually above that at which the aerial system is to be worked (*i.e.*, the wavelength is shorter), and it is therefore usually possible to check the oscillation in the screen by any of the usual means, such as the insertion of suitable chokes at any convenient part of the screen.

It is not possible to give actual details in a brief review of this character, simply because the troubles experienced are usually peculiar to the particular aerial system. The fact that such screen oscillations are possible, however, may help to throw light upon unexplained effects which may have been noted by experimenters.

High Frequency Work

A question which will be of particular interest at the moment is whether earth screens are necessary at high frequencies. One is in the habit of associating high frequency with excessive losses, but in many cases the losses at ultra-high frequencies (short waves) are not as serious as one would suppose. We have seen that the principal losses in an aerial circuit are the actual ohmic resistance of the aerial, the eddy current loss in the surrounding objects, and the dielectric loss.

Now the conductor resistance and the eddy current losses both vary directly as the square root of the frequency. Thus as the frequency is increased so the loss due to these factors increases at a slightly slower rate. The dielectric loss, on the other hand, decreases as the frequency is increased. At a very high frequency the dielectric loss of a condenser may become very small indeed.

A Matter of Circumstances

The variation of the total loss therefore depends entirely upon circumstances. If the eddy current and conductor losses are less than the dielectric losses at frequencies of the order of 1,000 kilocycles, then it is conceivable that up to a point the total loss in the aerial will decrease as the frequency is increased. Sooner or later, of course, the eddy current and conductor losses will begin to take control and the total resistance will increase once more. It is probable that at the ultra-high frequencies now being employed the presence of an earth screen would be particularly beneficial. It would save a good deal of the conductor resistance and the eddy current resistance in the aerial system, and at very high frequency these factors are the principal contributors to aerial resistance.

These remarks, therefore, show just how an earth screen operates and where it is useful. On the whole, provided the precautions mentioned in this article are followed, there should be no difficulty in obtaining considerably improved results by substituting an earth screen for the usual buried earth connection.

SOME SHORT-WAVE EXPERIMENTS

(Concluded from page 724)

Ignition Systems

On 15,000 kc., for instance, noises from the ignition systems of some motor-cars are most pronounced, while above the frequency certain makes of motor-cycles transmit strong crackling noises. Beyond these the best way to find out whether one is progressing upwards in the frequency scale is, in my opinion, to use two receivers, the maximum tuning range of one overlapping the minimum of the other. Since the apparatus involved is not expensive or bulky this is not a very serious condition for most experimenters to comply with.

Range Determination

The receiver with the lower frequency range should be set in an oscillating condition with its tuning condenser at the minimum reading in one part of the house, and " signals " from the set should be tuned in near the maximum reading of the tuning condenser on the second receiver; the size of coil and value of condenser serving to indicate that one is progressing upwards in frequency.

Construction

As to the form in which the components should be mounted and assembled for these experiments, the actual connections between components should be direct as possible. Many schemes were tried with the components laid out upon a baseboard, but since these were all more or less indifferent as to results, the circuit was laid out in " hook-up " fashion upon a table.

Valve Mounting

One of the main difficulties was found to be a satisfactory method of mounting the valve, and the use of a socket or clip mounting was subsequently abandoned in favour of soldering the leads direct on to the connecting wires of the valve after removing the metal contacts.

These latter were found to be quite easily removed by applying a little heat to the metal caps in much the same way as is done when removing the cap from a four-pin valve. As the connecting wires of the V24 type of valve are soldered to the inside of the metal contact caps, it will be found that there is but a very short length of wire remaining after the caps have been removed; great care is required, therefore, otherwise insufficient length will be available for connecting the valve in circuit.

Supporting the Coils

The coils were connected direct on to the variable condenser, as was also the grid condenser. The filament resistance was placed some distance away from the " receiver " and used as a fine control of the circuit as regards oscillation.

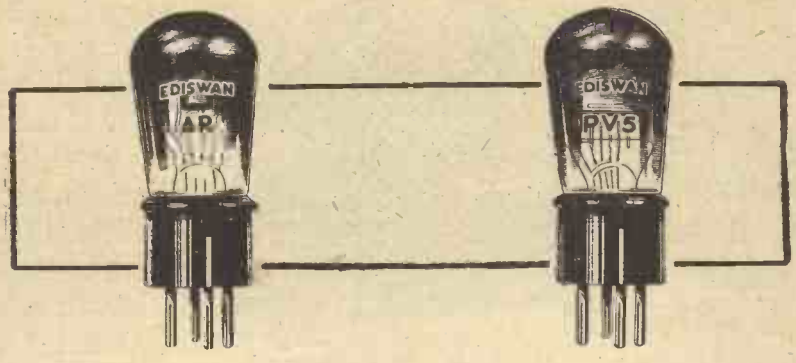
The two small chokes in the filament leads were connected as near to the valve as possible, while the leads to the batteries were also kept short.

Conclusion

It is essential that no spare coils or other receivers be in the vicinity of the apparatus being operated, otherwise it will be found in many cases that the valve will not oscillate. Long extension handles should be used for adjusting the condensers, and the operator should stand as far away from the apparatus as possible.

THE HAPPY FAMILY

"Affinities"



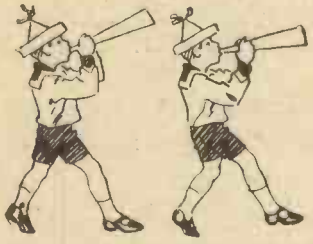
There is a decided affinity, a quite definite link between each Ediswan Receiving valve and Ediswan Power valve. The Receiving valves are supplied either H.F. or L.F. and the best Power valve to use is shown in the table opposite.

They always get on well together. It's like that in every large family. Always two that will work—or play—better with one another than with anybody else. Every Ediswan valve has its family affinity. It gives good service in any conditions—the *best* service when it is employed with its "twin."

The Valves to use.

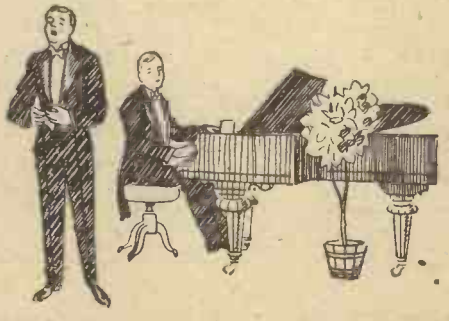
Receiving	*Accumulator or Battery Volts.*	*Power*
AR	6	*PV5*
ARDE	2	*PV6*
AR.06	3	*PV8*

With these groups and Ediswan H.T. and L.T. Accumulators the ideal is attained.



THE EDISON SWAN ELECTRIC CO., LTD.
123-5, Queen Victoria Street - London, E.C.4.

EDISWAN VALVES
Will Improve ANY Set



Ediswan Valves are entirely British made.

162-06

"A SUPERHETERODYNE QUERY"

SIR,—With reference to Mr. Wilson's Superheterodyne inquiry in the January 27 issue of *Wireless Weekly*, I think his troubles are due more to the type of circuit he is using rather than to the valves.

I have done quite a lot of experimental work with Superheterodynes during the last few months, and though I can by no means pose as an expert on this subject, I can at least give a few practical experiences with this circuit which may help Mr. Wilson and perhaps many of your readers.

First of all, the type of valve used does play an important part in the results obtained; in fact, I will go as far as to say that the results obtained will be, in most cases, mediocre unless the experimenter has the facilities for picking his valves from quite an extensive stock, as my experience is that even valves of the same classification by the same maker very often vary enormously.

We experimenters, with great ambitions, but very small purses, when we set out to build a Superheterodyne are out to get the very most we can out of the smallest number of valves, and though, in a sense, this is a step in the right direction, we very soon find that this is not everything. To digress a little, the writer, after a few years of seeking (in common with most experimenters), the ideal receiving circuit, has come to the conclusion that there is not yet a circuit for all-round use which can hold a candle to our old friend, the straight circuit. There is, with nearly all the super circuits, a "catch" somewhere, and though the results *sometimes* obtained are truly remarkable, they are usually most uncertain of achievement, and we soon get tired of their inconsistency, many of us only continuing building and rebuilding because of the one "snag" in the "straight," its comparative non-selectivity when working near a powerful local station.

Now to justify my digression. The above remarks apply to the Superheterodyne receiver, since by doing away with the separate oscillator valve and using the autodyne method, say, on the Tropadyne principle, we find that, with five valves, oscillator, detector, 1 inter, second detector, 1 L.F., we get some really remarkable results, both as regards distant reception and volume (sometimes), yet when one sits down with such a receiver the results obtained are always superlatlvely good or bad, and there is always a great element of uncertainty. The same applies to the second harmonic principle and most other valve-saving circuits, and we soon get tired of the extremes and look for something less wonderful and more certain in action. A further trouble I find is the instability of these types, and my experience is that if you make them stable they are more or less useless for the purpose for which they were built.

There is, however, one circuit using the one valve for the oscillator and detector valves which is worth working, and though the superlative degree cannot be used when judging the results, it is, in my opinion, the only *simple* Superheterodyne really worth while, and results, under similar conditions, can always be relied upon to be consistent. If Mr. Wilson will try this out for himself I feel sure he will be pleased with the results obtained. The circuit and components are the simplest possible, this no doubt accounting for its reliability, and the outlay is as small as one could wish when the usefulness and reliability of the resulting receiver are considered.

It will be noticed that the intermediate stages have tuned anodes instead of the conventional transformers. This I have found to give greater amplification per stage, and providing these inductances are kept reasonably spaced, compact and at right-angles to one another, very little trouble will be experienced through interaction.

The following are the principal practical data:—

Valves.—V1, D.E.3.B.; V2, B.6; V3, D.E.3.B.; V4, D.E.3.

Coils.—L1, "Unitune" coupler; L2, No. 50; L3, No. 50 or 60; L4, No. 30 or 35.

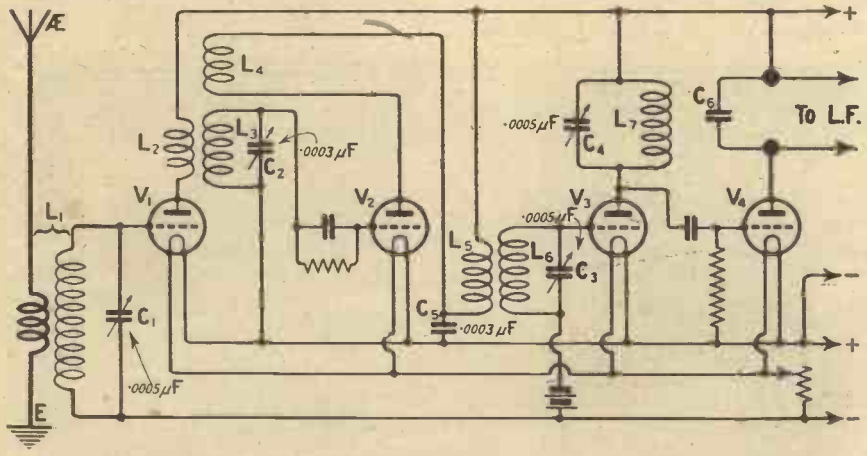
Wound in slotted formers.—L5, 400 turns No. 30 d.c.c.; L6, 500 turns No. 30 d.c.c.; L7, 500 turns No. 30 d.c.c.

Trusting these remarks will be of some use to Mr. Wilson, whose letter prompted them, and also to other readers of your very excellent and useful publication.

If Mr. Wilson or any others of your readers would like any further details, they may have them by communicating with me through your paper.—Yours faithfully,

GEO. COLLETT.

Croydon.



The autodyne circuit referred to in the letter from Mr. Collett.

EDITORIAL NOTE: One of the characteristics of superheterodyne receivers is that they are greatly influenced by small and apparently insignificant changes of lay-out, circuit constants, etc., and hence the same circuit, when made up by different experimenters, may yield widely differing results.

The circuit which Mr. Collett finds so successful, for example, is one incorporating a type of combined oscillator-detector which has been largely abandoned because it is usually found to possess a number of undesirable features, among them being that of

unreliability. Its main drawbacks are these: No provision is made to render the oscillator circuits and receiving circuits independent of one another, and in practice it will often be found that the adjustments of the condensers C1 and C2 are "interlocked" in a fashion which makes accurate tuning well-nigh impossible. Further, the circuit L_3 C_2 constitutes the tuned secondary of a transformer, yet to obtain the desired beat between the received signals and the local oscillations flowing in this circuit it must be detuned to an extent which produces a serious loss of signal strength in many cases.

Such an arrangement is a decidedly dangerous one to use upon an outside aerial, since under normal conditions it may be expected that there will be a sufficient amount of back-transference of energy from the oscillator to the grid circuit of the first valve to cause a certain amount of interference, especially when searching is proceeding.

The fact that no definite provision, other than the use of fairly high resistance coils, is made for preventing self-oscillation on the part of the intermediate frequency amplifying valve V_3 may also cause trouble in attempting to duplicate Mr. Collett's good results. It is possible that the grid bias shown on this valve, if excessive in amount, might prevent self-oscillation, but such a method, of course, is not to be recommended.

EXPERIENCES IN INDIA

SIR,—In your issue of November 25, No. 10, Vol. 7, I notice you mention that a gentleman living in Jodhpur managed to pick up an English concert with a 6-valve long-range set. I don't think this is very remarkable, for I can tune in Daventry, 2LO and several European stations any morning I like to try.

My set is a home-made tuned anode, four-valve 1-D-2, and with the exception of the detector, which is a Cossor P1, all my valves are Mullard R.'s. My coils are all home made (with the aid of "Tuning Coils and How to Wind Them," by G. P. Kendall, B.Sc.), and the plugs are the pins from old valves.

My H.R. 'phones are by one of the leading makers, but I also use a pair of old Fullerphone earphones, connected to an old L.F. ex-W.D. transformer, with the windings reversed, and I find that by this arrangement they give 50 per cent. better reception than the H.R. 'phones.

My aerial is about 40 ft. high and about 60 ft. long, whilst my earth is an ex-W.D. earth mat, 20 ft. by 2 ft., buried 3 ft. deep, directly at the foot of the set, and immediately underneath the aerial. By re-arranging the drains, all the water from the bathroom flows in on to the mat, and so gives me a highly efficient earth.

Oscillators are a great nuisance here, although, as far as I can find out, the only other set in the district is a two-valver. Nevertheless, on every station these people appear to be permanent.

Although I never fail to get the B.B.C. stations, reception varies greatly, and sometimes is only just audible, while at others it is very clear, right up to the "Good night everybody."

Around the 350-400 metre band Morse spoils a great deal of reception, the particular offenders in this respect being Kabul, Taschkent and other Russian stations. Moscow, on 1,500 metres, comes in remarkably well, very early in the evening.

Practically all I know has been learned from your excellent publications, and I trust your staff will accept my greatest thanks.

I made up Mr. Harris' "Low-Loss Tuner for Short Waves" (*Wireless Weekly*, Vol. 5, No. 5), and although I only used R valves, I got an Australian amateur within ten minutes of finishing it. I have since altered it to a fixed coupled set, using a low-loss coil former.

With heartiest wishes for your staff and publications.—Yours faithfully,

ARTHUR H. MOORE.

Ferozepore, India.

A HANDSOME SET

SIR,—No doubt you will be interested to have one of your readers' experience with one of your circuits made up in American form, the "Family Four" being employed.

I have received three B.B.C. stations and as far as "Radio Iberica" on the frame aerial enclosed in the cabinet.

With my outside aerial I can receive most B.B.C. and all the Continental stations on the loud-speaker, in some cases using only three valves. At present I am using one Mullard H.F., one Marconi, one Cossor and a P.M.4. —Yours faithfully.

F. J. AMOS.

Clapham.

FEWER STATIONS AND HIGHER POWER?

SIR,—You ask in the Editorial of *Wireless Weekly* for your readers' opinions on the subject of higher power stations.

My own personal opinion is that a less number of high-power stations would be infinitely preferable to the present arrangement. The B.B.C. make a great deal of the strength of local sentiment, which they say is strongly in favour of a local station giving a local programme and local news. I doubt very much whether more than a very small percentage care in the least where their programme is coming from or who pay much attention to the local news.

I almost invariably listen to Daventry, which comes in better than Swansea (about five miles distant), and only turn on to Swansea if Daventry is broken down or if Swansea happens to be relaying a programme I prefer to Daventry, as sometimes happens when Swansea is taking London and Daventry has its own.

Judging by the strength of Daventry here, it ought to be possible to cover the country with eight or ten stations of high power suitably placed, which would give even crystal users in most

The modified "Family Four" receiver, built by Mr. Amos, incorporates measuring instruments in the battery circuits.

places at least one alternative programme.

This would mean a reduction in the B.B.C. staff, unless, as is desirable in the interest of hospitals, etc., they extended their hours of transmission.—Yours faithfully,

Swansea. LINDSAY B. FRY.

SIR,—I was very interested in the leading article in the January 27 *Wireless Weekly*, and I quite agree that the future of British broadcasting lies in the erection of a few high-power stations, and I venture to make a few suggestions.

Your idea is that the power of the main stations should be increased to, say, 15 kilowatts.

If this was carried out there would be numerous complaints from people who persist in using "direct coupled" sets in the neighbourhood of a broadcasting station.

In my opinion it would be more satisfactory, for several reasons, to erect the stations out in suitable spots in the country as in the case of the present Daventry station.

In this way a better aerial system could be erected, and there would be fewer people in the immediate vicinity.

For instance, a 20-kw. station erected on the North Downs about 12 miles south of London would serve all crystal users in the Metropolis as well as at present, with less interference to valve users, and would have a far better range.

Similarly, about seven other stations erected at strategic points would give excellent service.

I also suggest that the B.B.C. erect a powerful short-wave relay station working on about 70 metres for the benefit of the Colonies.—Yours faithfully,

H. C. GRANT WATSON.

Magdalene College, Cambridge.

THE BEST SHORT-WAVE RECEIVER

SIR,—In the correspondence columns of last week's *Wireless Weekly* Mr. L. R. Brand, of Norwich, says, "I believe that the superheterodyne, even in its simplest form, is the ideal set for short waves," and goes on to talk rather disparagingly of "yard-long extension handles, exasperating body-capacity effects," and so on.

In my opinion, if the only other short-wave receiver Mr. Brand has used has required yard-long extension handles, etc., he prefers the "super-het." simply because he has never had another receiver that really worked with which to compare it!

No short-wave receiver of the "D. and Mag." type nowadays requires an extension handle at all. Two respectable geared condensers and a fixed reaction control have always given me very satisfactory results, and, while admitting that ease of operation is a great feature of the superheterodyne, I cannot help "following the crowd" and asking "if I hear New Zealand with one valve and no trouble, why should I use seven valves and goodness knows how much trouble?"

Mr. Brand does not mention the hectic times that he has probably spent trying to cure an unaccountable fit of instability on the part of his "super," neither does he describe the appalling "mush" received by interference on the long-wave side if one happens to live near Northolt, or some other similar interference factory.

The selectivity of an ordinary "low-loss" single-valver would probably surprise Mr. Brand, and, as far as ease of operation goes, there are two condensers to control, and most human beings, being provided with two hands, experience no difficulty in doing this.

KDKA may be received at fair loud-speaker strength on almost any receiver of the o-v-1 type which will tune to 4,918 kc. (61 metres), and apparently Mr. Brand does not realise this. I should certainly recommend that he builds a *good* receiver of this type and then publishes a comparative report on its performance and that of a "super-het."—Yours faithfully,

Harrow. J. R. STINGLEBERRY.

MISUSE OF CALL-SIGN?

SIR,—I was interested to read the letter under the above heading in this week's *Wireless Weekly* from Mr. A. Eaton (6QU), and in this connection I should like to mention a few points about the frequent reports we hear nowadays of the misuse of call-signs.

I think that a great deal of the trouble is caused by listeners who are not thoroughly acquainted with the Morse code, and yet send reports to stations that they imagine they have heard, without troubling to make absolutely certain that they logged the call-sign correctly. In the case in point I think it is fairly obvious that the reports may have been intended for 6YU, the station of Mr. J. Hanson, of Radford, Coventry, who has of late been very active on 6,667 kc. (45 metres).

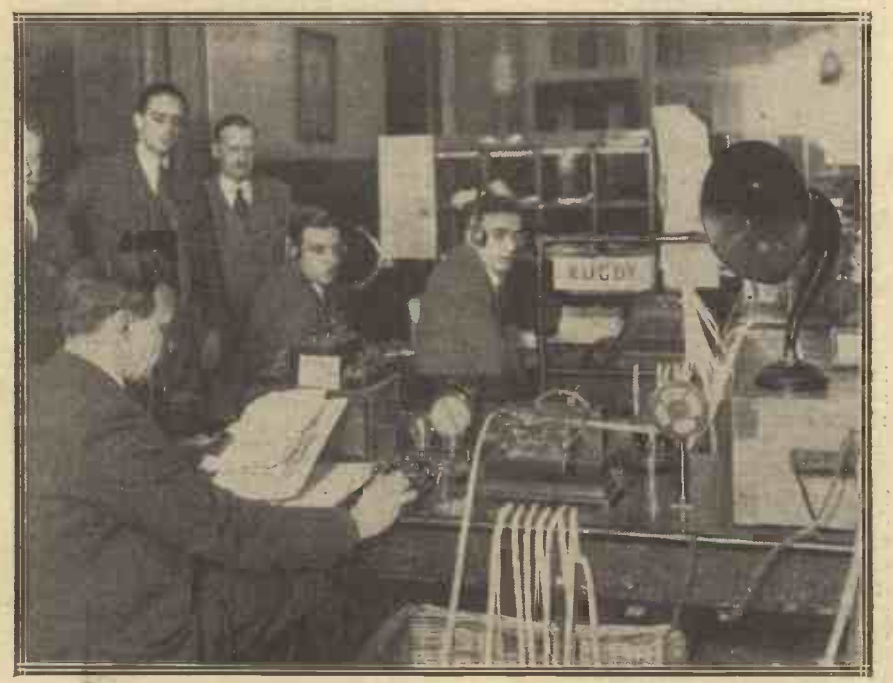
I am *not* insinuating in any way that 6YU's operating is at all blameworthy, as I know that it is not; my point is that the man with just an elementary idea of Morse hears 6YU sending his call-sign slowly, and with a great effort logs it, letter by letter, and probably makes "6QU" of it, thereupon sending a letter to 6QU which leads him to believe that someone has been "burgling" his call-sign.

The practice of reporting, or even of logging stations, unless one is *absolutely dead sure* of their call-signs is most strongly to be discouraged. It is extremely annoying to a transmitter to receive a report that is obviously not intended for him, as he feels either that (i) someone else is misusing his call-sign, or (ii) that some other transmitter has been deprived of a report that was intended for him.

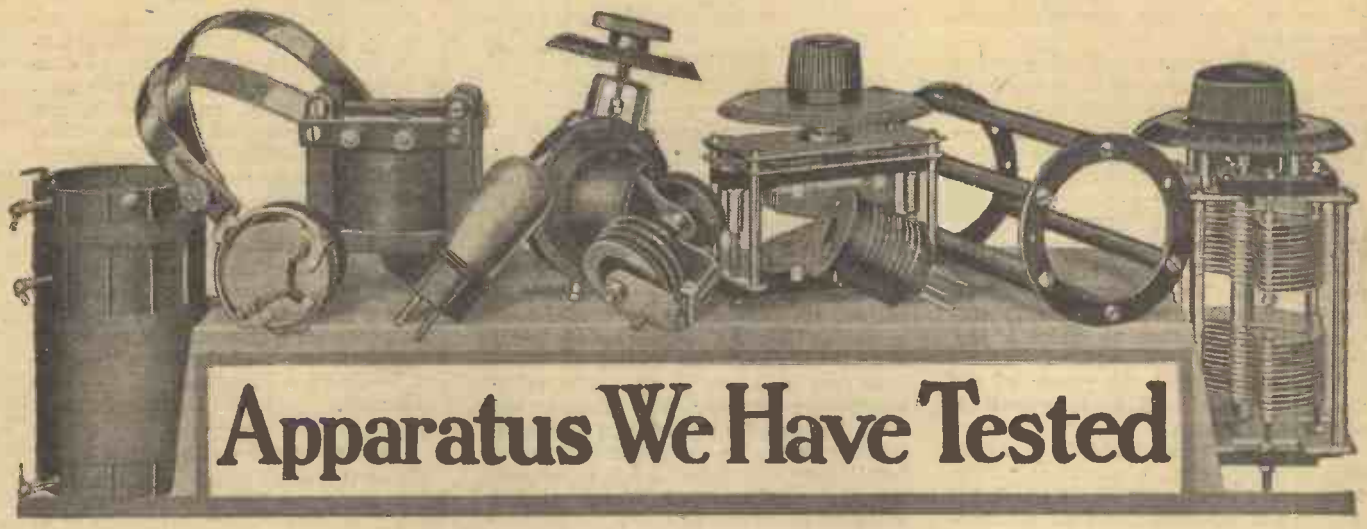
In my experience it is only on very rare occasions that the transmitting operator is at fault. Most transmitters have realised the necessity of "slowing down" when sending their call-sign, and of spacing the "intermediate" and their call-letters with the utmost care. It is therefore up to the receiving enthusiasts to co-operate with them and to see that they do not make slips. If they are not sure that they are capable of reading call-signs correctly, they should certainly not send a report to the "nearest approximation."—Yours faithfully,

L. H. THOMAS (6QB).

33, Harpenden Road,
West Norwood, S.E. 27.



The despatch of the message which "opened" (officially) the Rugby station is here seen in progress.



Apparatus We Have Tested

Conducted by Radio Press Laboratories, Elstree.

Coil Holder

Messrs. the Holrose Manufacturing Co., Ltd., have submitted to us for test at our Elstree Laboratories samples of their coil holders, *i.e.*, a two-way coil holder with extension handle and a single coil holder.

Description of Components.

The two-way coil holder is mounted on a circular insulating base about 2½ in. in diameter. Four plated terminals are fixed into this base, and serve to secure two pairs of brackets,

A two-way coil-holder manufactured by Messrs. The Holrose Manufacturing Co., Ltd.

which in turn support the coil holders themselves. The coil holders proper are cylindrical in shape, being about 1 in. long and ¾ in. in diameter. They are composed of the same insulating material as the base, and are fixed to the brackets by means of screws. For the moving coil holder the two screws serve also as pillars, and enable the coil holder to be moved through an angle of 90 degrees between a position parallel to the other coil holder, and one at right angles. A bent rod projects from this coil holder and screws into an insulated rod about 4 in. long, which serves as an extension handle.

The Holrose single-coil holder.

The single coil holder is very similar in design to the two-way coil holder, and is mounted on a circular base 1½ in. diameter.

Laboratory Tests.

It was found on test that the insulation resistances of both the coil holders were infinite, and that the resistance between a plug or socket and a corresponding terminal was negligible. It was also found that the fit for several makes of coils was good, and that all connections were in good order.

General Remarks.

Both these coil holders have an excellent finish, and appear to be electrically and mechanically sound. A good feature is that no flex leads are needed for the terminals of the moving coil holder as the latter are fixed.

Crystal Detector

Messrs. S. A. Lamplugh, Ltd., have submitted to us for examination at our Elstree Laboratories their Lamplugh micro-detector.

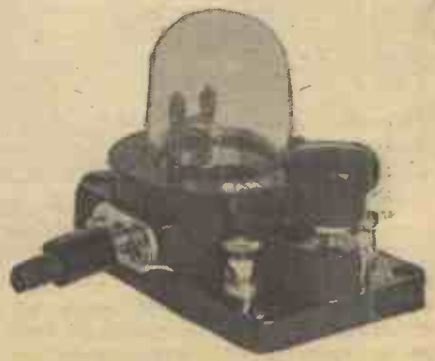
Makers' Claim.

It is claimed that the universal movement enables search to be carried out over the whole surface of the crystal, while the micrometer adjustment enables 1/100,000 of an inch movement of the contact to be obtained with a little care. The glass dome can readily be removed, thus providing easy accessibility, while both large and small crystals can be easily picked up from the base.

Description of Component.

This detector is of rather an elaborate type. It is mounted on an insulated base of solid construction 3 in. long by 2 in. wide, and holes are provided at the four corners for fixing the component to a baseboard or panel. At one end the insulating material is partly cut away, and two telephone terminals are mounted thereon. At the other end, the base is moulded with a projection, and drilled with two holes through which a stiff vertical U-shaped piece of wire passes. The bottom of the U projects into a longitudinal channel cut in the underside of the base, and a cross-piece slide fits over the two vertical legs.

Two milled nuts screw on the ends of the legs, and hold the cross-piece



The Lamplugh micro-detector is fitted with a glass cover.

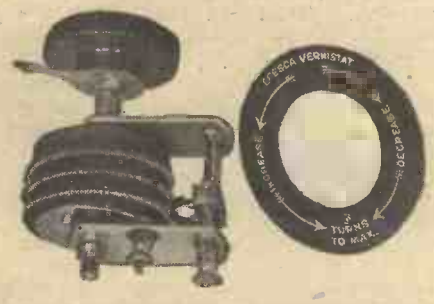
in position against two springs, slipped one over each leg. A horizontal split screw, about ½ in. long, screws into the middle of the cross-piece, and tightly grips a piece of spear-pointed

wire bent vertically downwards to act as a catwhisker. One end of a plated metal strip passes between the bend in the U-shaped wire and the underside of the base, while a screw rotated by a knob of insulating material passes through a nut and presses on the other end of the metal strip. This combination acts as a lever with about a six to one ratio, so that an exceedingly fine control of the vertical motion of the catwhisker is ensured.

The crystal is gripped in a pair of spring tongs moving in a metal sleeve through one side of the base. By pressing a small black knob the jaws of the tongs are opened, and with the aid of the ball-socket mounting it is possible to pick up crystals from the base, and also to obtain a coarse adjustment of the contact with the catwhisker.

General Remarks.

A very fine adjustment is possible with this detector, and since the glass



The Efesca Vernistat, a product of Messrs. Falk, Stadelmann & Co., Ltd.

dome provided is held against a rubber ring, the crystal and catwhisker are protected from dust.

Rheostat for Dull Emitter Valves

Messrs. Falk, Stadelmann & Co., Ltd., have submitted to us for test their Efesca Vernistat designed for use with dull emitter valves.

Description of Component.

The resistance element, which is wound in a helical form, lies in a spiral groove of three turns cut in the curved surface of a cylindrical block of insulating material about 1½ in. long. The spiral is actually double, so that the wire only lies in alternate grooves. The grooves thus left vacant are utilised in an ingenious manner to guide the contact arm. This is in the form of a spring mounted on a metal block, which is free to slide on two guide rods parallel to the axis of the instrument.

A short screw projects from the metal block, and its point engages with the spiral not occupied by the resistance. By this means, as the insulating block carrying the resistance is rotated, the contact arm slides up or down, as the case may be, and follows the turns of the spiral. By tightening or loosening the screw mentioned above, its point presses more or less firmly against the groove with which it engages. This enables one to control the friction against which the cylinder revolves. Stops are provided for the contact arm at each extremity of its motion, so that it does not travel beyond the ends of the resistance.

The whole of that part of the rheostat described above is mounted between two aluminium plates. The cylindrical block of insulating material on which the resistance is wound is mounted on a spindle, which passes through these plates. The knob and pointer of the rheostat are fixed to the outer end of the spindle, which does not screw directly into the knob but into a brass nut embedded in the moulded insulating material of which the knob is composed. The pointer can be firmly fixed against the knob by another nut. One-hole fixing is provided, and for this purpose a screwed sleeve concentric with the spindle is fixed into the outer end plate.

The other end plate carries the terminals, one of which is insulated from it by means of an insulating bush and washer and carries a bent spring, which makes rubbing contact with an annular metal plate, mounted on the cylindrical insulating block previously mentioned. This annular plate makes contact through the insulating block with one of the pins keeping the ends of the resistance in place. The other terminal mounted directly on the end plate makes electrical connection with the contact arm through the guiding rods and supporting block.

Laboratory Tests.

The rheostat was tested in a simple valve set, and was found to be almost silent in action. Its resistance was measured and found to be about 30 ohms, which is a convenient value for controlling dull emitters. In fixing or handling this rheostat, great care should be taken not to damage the resistance wire, since a slight rub with the finger was found sufficient to loosen the closely wound turns. This not only caused noises when the contact arm passed the damaged coils, but loosened the whole resistance. It would seem that if the grooves in which the resistance lies had been made deeper this drawback would have been avoided.

Two-Way Coil Holder

Messrs. the Power Wireless Co., Ltd., have submitted to us for test at our Elstree Laboratories a sample of their two-way coil holder.

Manufacturers' Claims.

It is claimed that the moving coil can be locked in any position simply by rotating the coil-handle. Very fine and smooth adjustment can be obtained, and the fixed coil holder can be set in any position. Good connection can, it is claimed, be made with equal facility either from the back or from the front of the panel.

Description of Component.

This two-way coil holder is mounted on a small, square insulated base about 1½ in. across. Four substantial brass pillars are mounted at the corners of this base, and thus support the coil holders. These are cylindrical in shape, being about ½ in. in diameter and 1¼ in. in length. All the metal parts of this component are of lacquered brass.

A brass extension handle is provided for moving the coil holder, and an interesting device is employed to enable this coil holder to be locked in any position. The effect of this is that when the extension handle is screwed in fully it locks the moving coil holder, but when it is loosened to the extent of about half a turn it enables the moving coil holder to be rotated. Four holes are provided in the brass pillars for the purpose of inserting connections, these being secured by means of small brass set-screws.

Laboratory Tests.

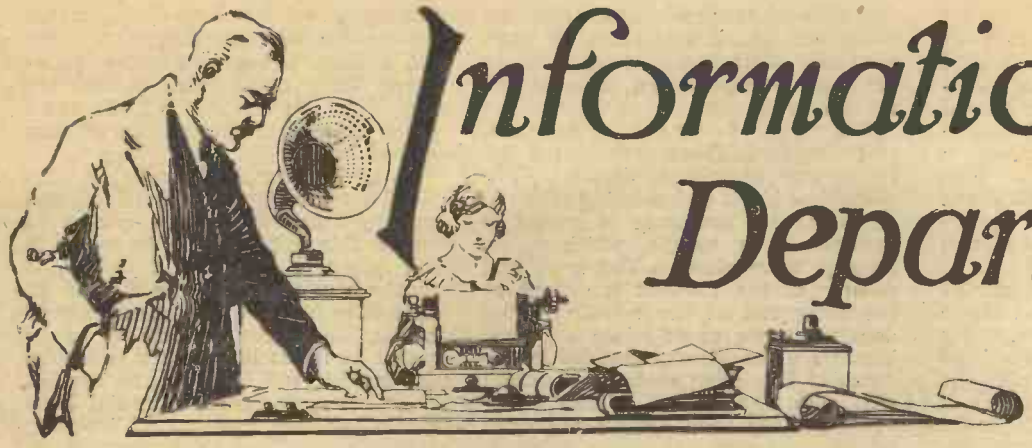
It was found on test that the insulation resistance of this coil holder was infinite, while the resistances between the socket and the corresponding terminal were negligible. The motion of the moving coil holder itself was found to be quite smooth, but there was a slight wobble in the extension handle.

A two-way coil holder submitted by Messrs. the Power Wireless Co., Ltd.

It was found that the fit for several makes of coils was quite good, and all connections were in good order. It was also found possible, as claimed by the makers, to set the fixed coil holder in any position, the control being fairly stiff.

General Remarks.

This two-way coil holder is quite a well finished component, and the drilling template is of considerable assistance in fixing. Apart from the slight wobble in the extension handle this coil holder is mechanically sound, but the extension handle is liable to cause hand-capacity effects if the terminal to which it is electrically connected is not earthed.



Information Department.

M. H. B. (LINCOLN) has a single-valve reaction receiver which works satisfactorily on the Daventry wavelength but will not receive the local station, Hull, at good strength without the earth being removed. An abnormally large reaction coil is required on the lower range.

The employment of too large a coil in the aerial coil socket would account for the receiver not tuning down to the wavelength of the local station, in which case signal strength would be poor. Either series tuning should be adopted or a smaller coil should be inserted in the aerial coil socket, when generally the difficulty may be overcome.

No condenser (or one that is internally disconnected) across the telephones might make it difficult to obtain reaction, and we would therefore suggest that a condenser of .001 or .002 μF be tried in this position.

A very high resistance earth connection may give rise to the symptoms mentioned, and whether this is responsible can readily be determined by trying alternative earths or by rigging up a temporary counterpoise arrangement. This latter may consist of a length of wire erected directly under the aerial, preferably to the full length of the latter, and 6 ft. or so above the ground. It should be as well insulated as the aerial itself, and should be joined to the earth terminal of the receiver in place of the normal earth lead. If with this arrangement the set oscillates readily, tuning is very much sharpened, *and* signal strength is considerably improved, it indicates that the earth is largely responsible for the fault.

J. C. (ROCHESTER) complains that reaction control with his single-valve receiver constructed from particulars given in Radio Press Envelope No. 9, is by no means smooth.

When employing ordinary direct magnetic reaction obtained by coupling two coils together in a two-coil holder it is not always easy to get that smooth passage into oscillation adjustment which is so desirable for the reception of distant weak transmissions. Matters can be considerably improved if as small a reaction coil as will give consistent oscillation over the frequency

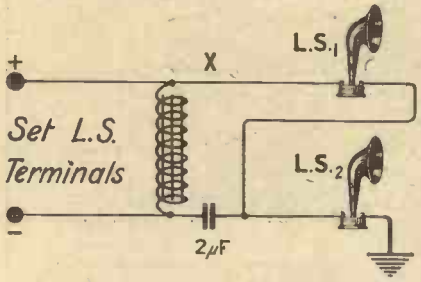
range covered by the aerial coil is employed. Experiment should also be tried with the value of the high tension applied to the detector valve, whilst adjustment of the filament current should be made with some care. Adjustment of the value of the grid leak employed also proves helpful, and if one of reliable variable type is available it should be temporarily substituted for that in the receiver.

R. E. (CRAYFORD) utilises a filter circuit arrangement for running one loud-speaker in a room remote from that in which the set is situated. Leads of twin flex are employed for this purpose. Recently he also attempted to run a second loud-speaker in a shed at the end of the garden, employing an earth return in this case. He noticed that sparks were obtained when connecting up the second loud-speaker.

The trouble in our correspondent's case was that he had short-circuited the high-tension battery through the windings of the two loud-speakers in series. It should be observed that without slight alteration to the usual filter circuit, a direct return and an earth return cannot be employed at the same time. There is, however, a simple way of overcoming the difficulty, which consists of placing a ·2 μF condenser in the return lead from the first loud-speaker, for example, at X in the figure.

L. H. A. (PULBOROUGH) has constructed the selective 2-valve receiver described in the January, 1926, issue of THE WIRELESS CONSTRUCTOR and complains that he has difficulty in separating Bournemouth and London.

It is stated in our correspondent's letter that he employs a No. 75 for the "untuned" aerial coil and a further 75 for the secondary coil,



This arrangement of loud-speakers will overcome the difficulty experienced by R.E.

whilst two No. 50's are used in the reaction and anode coil sockets. The anode condenser tunes sharply, but the secondary tuning is very flat.

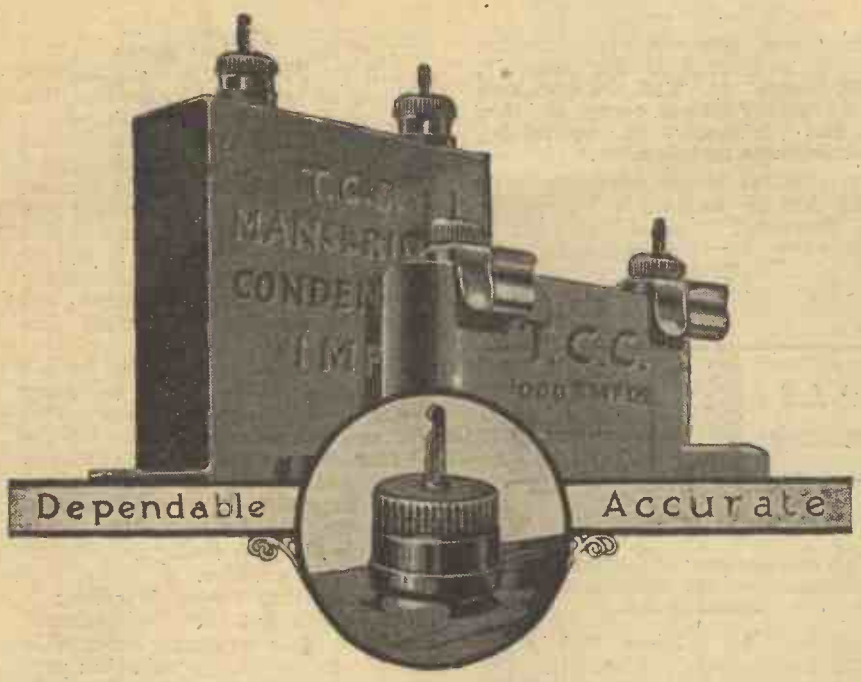
Although certain alterations in components have been made by our correspondent, it is unlikely that the fault is located in the receiver itself, and it is more likely that the trouble is due to the method of tuning or to the aerial and earth system.

Dealing first with the subject of tuning, we would point out that selectivity is improved if the size of the untuned aerial coil is decreased, and in this position we would suggest that a No. 25 or 35 be tried for the reception of London and Bournemouth, whilst these coils should be as loosely coupled as is consistent with good signal strength. This means that in practice the "untuned" aerial coil and the grid coil should be as far apart as will give good signal strength, when it will be found that the tuning on the secondary condenser is greatly sharpened and selectivity consequently greatly improved.

The employment of a No. 50 coil instead of a No. 75 for the secondary might be found advantageous. Two No. 50's are usually suitable for the reaction coil and the anode coil respectively, and the former should be as closely coupled to L_1 as possible without causing the set to oscillate, since this again sharpens tuning and renders the set more selective.

The fact that the anode condenser tunes sharply but that the condenser tuning L_1 does not, may indicate, in addition to too large a coil, that your aerial and earth system is none too good, and generally the fault in this case is located in the earth. Try, therefore, the effect of employing alternative earths in order that a better one may be found.

If due attention is paid to these points, and when more experience is gained in tuning, it is unlikely that any complaint will be made of the selectivity of this set.



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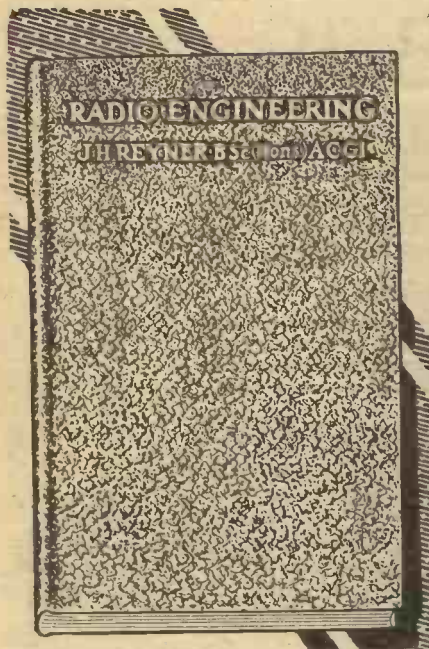

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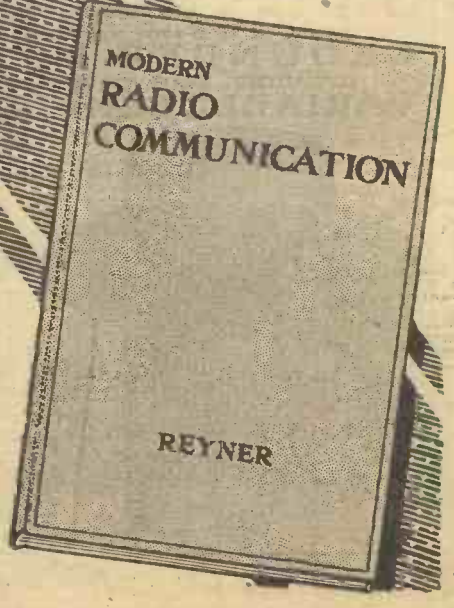

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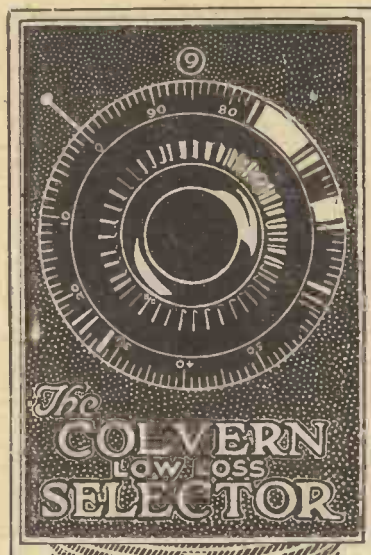

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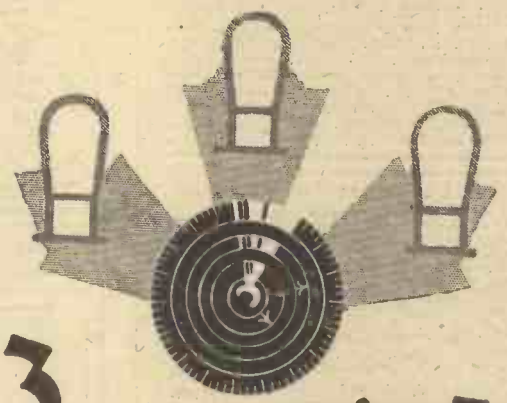

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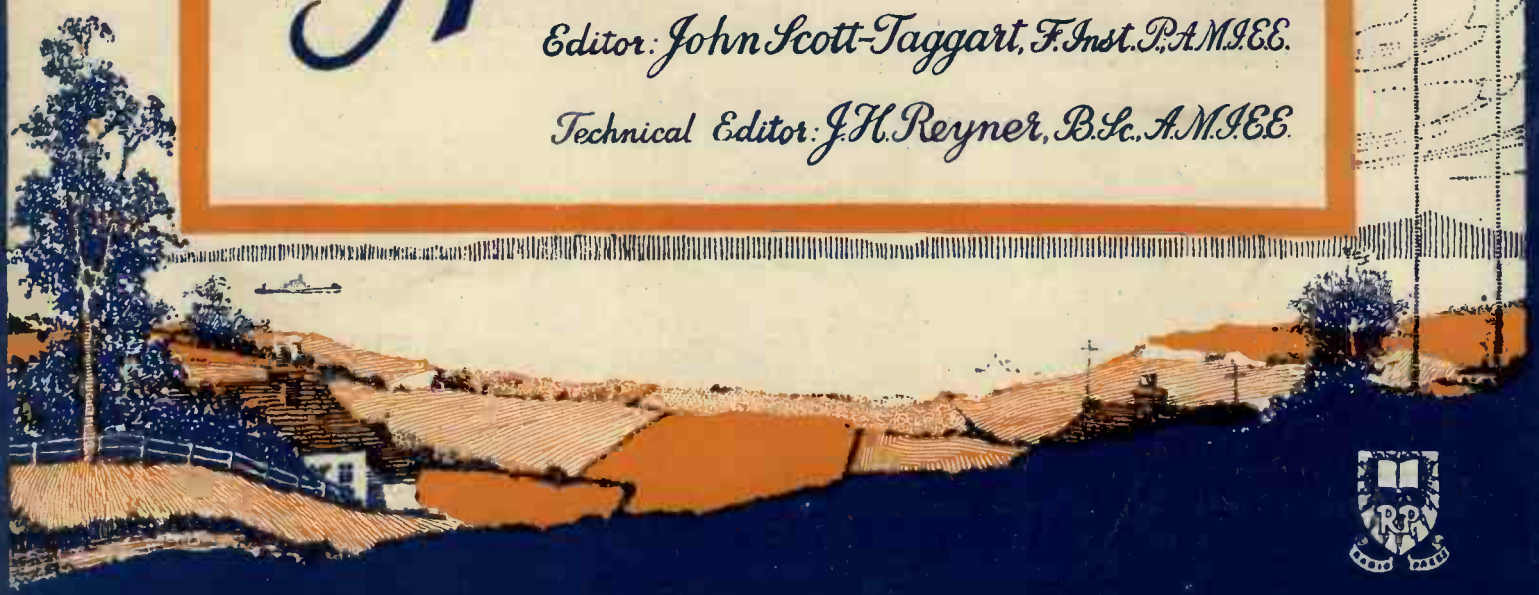

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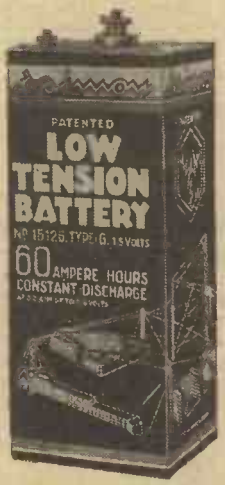

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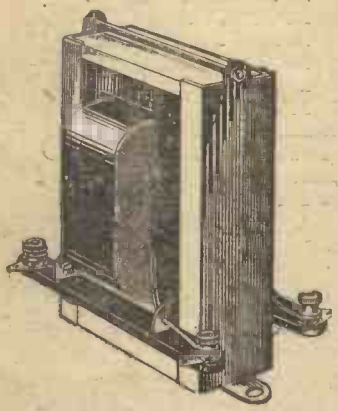

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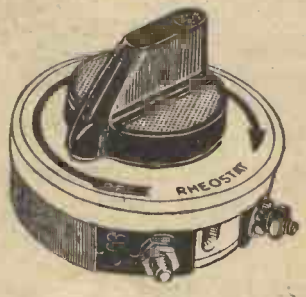

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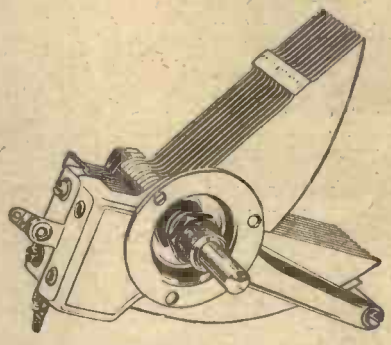

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CONTENTS

RADIO PRESS, LIMITED, Bush House, Strand, London, W.C.2

A "Fieldless-Coil" Three-Valve Set

By PERCY W. HARRIS, M.I.R.E.

An interesting practical application of the principles laid down in recent articles on coil fields will be found in this receiver. It is specially simple to construct and operate.

I HAVE been very interested for some time in the many problems connected with the successful use of tuned radio-frequency amplification in wireless receivers. Most enthusiasts whose work extends over a number of years have successively experimented with crystal sets, single-valve reaction receivers with note magnifiers of all sorts and sizes, and, lastly, with radio-frequency amplifiers of all kinds and types. For a long time the tuned anode method of coupling the high-frequency valve to the detector was deservedly popular, and while a fair amount of selectivity was possible with a carefully designed instrument, any attempt to increase the selectivity by loosely coupling the high-frequency valve to the aerial gave the most disappointing results.

The damping introduced by the direct coupling of the aerial no longer restricted oscillation of the high-frequency valve, and so in order to "hold it down" other damping had to be introduced, usually by means of the application of a positive bias on the grid. Such were the losses introduced in this way that they nullified to a large extent the advantages of loose coupling.

An Improvement

The introduction of numerous neutrodyne methods was a very distinct step forward, and as soon as we had found practical means of applying these ideas it became possible to improve the efficiency of radio-frequency amplifiers of the tuned variety to a very considerable extent. Contrary to the opinions held by many people, there is no special and mysterious new magnification introduced by neutrodyning; we are simply utilising the full magnification possible without having to sacrifice a large portion of it in order to obtain stability.

I am afraid it is not sufficiently realised that in adjusting many of the neutralised circuits we are compensating, balancing out or neutralising not only the capacity between grid and anode of the valve, but also the effects of stray capacities and fields that happen to exist in the receiver. While there are many ways of building efficient neutrodyne receivers, the introduction of the neutrodyning condenser and the accompanying wiring adds to the complication of the set, and it is not always easy to lay out the parts to the best advantage.

The symmetrical lay-out of the panel and the simplicity of the controls are special features of the set.

"Fieldless" Coils

In view of the work I have recently done on "fieldless" coils, it occurred to me that if I were to build a receiver in which the tuning coils have as limited a field as possible, and if I took particular care to simplify the wiring, I might so reduce the interaction between circuits, due to factors other than valve capacity, that very little would need to be done to produce stability. The disadvantage of the potentiometer method of reaction control is that it functions by introducing losses into the grid circuit, thus reducing to some extent the efficiency of the amplification.

If now interaction between circuits is reduced to a minimum, then only the slightest damping due to the imposition of positive bias, applied by means of the potentiometer, should "hold the circuit down." The receiver illustrated

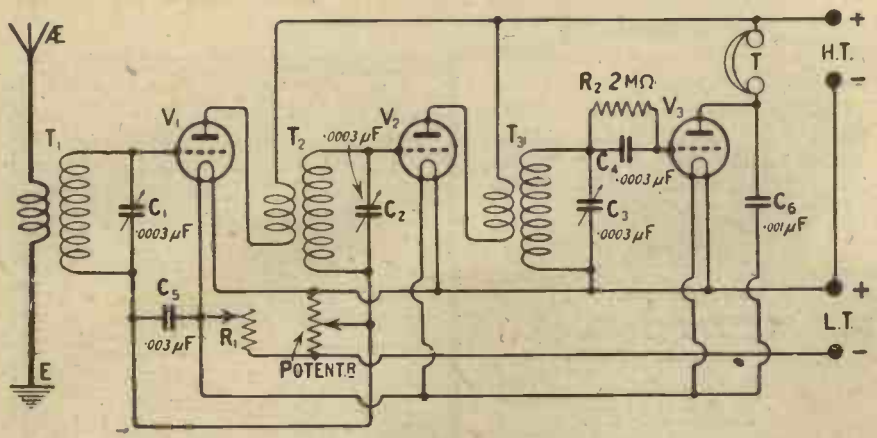


Fig. 1.—The absence of special neutrodyning arrangements renders the circuit notably simple.

and described in this article was therefore built, and works with surprising efficiency. As I had imagined, only a very slight loss needs to be introduced in order to prevent self-oscillation. The diagrams and photographs will show you that the receiver is exceedingly simple to build, while its operation is equally simple.

No L.F. Stages

It consists, in its present form, of two high-frequency valves and the detector, and therefore, without an additional amplifier, it is not suitable for the operation of a loud-speaker. In a subsequent issue I shall describe a companion two-valve amplifier to work with it. The complete set will thus consist of five valves in all.

Selectivity

So far as the capabilities of the present set are concerned, selectivity is of a very high order, it being possible to get Bournemouth without any trace of London on an outdoor aerial at Wimbledon. Furthermore, the sensitivity is sufficient to bring in with very comfortable telephone strength dozens of stations all over Europe, while the reaction control is delightfully smooth over the whole range.

It must not be forgotten that this selectivity is to some degree due to the total absence of "pick-up," due to the nature of the coils. I have dealt with this matter in a previous article, and will not enlarge upon it here. The limitation of the set is that it cannot be used on a wavelength band other than that covered by the particular coils, and therefore one cannot receive Daventry, Paris and other long-wave stations.

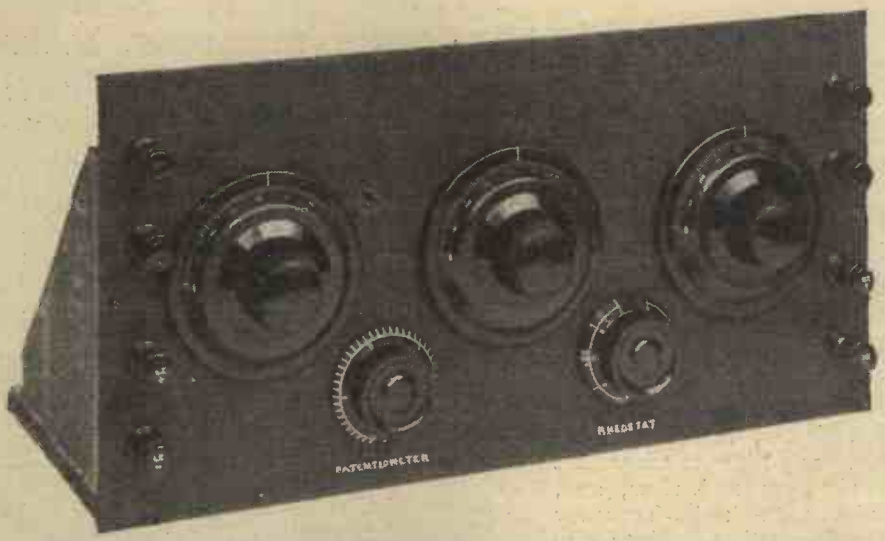
Special Tests

The sensitivity and selectivity is not quite so high as that of the first three valves of such a receiver as my "Special Five," but it is still of a far higher order than that of the great majority of receivers. The absence of pick-up qualities makes it particularly valuable when used very close to a broadcasting station, and in the test report to be published next week you will see some practical details of tests conducted very close to the London station.

The Coils

The coils are a special type known as the "Bodine." They are of American origin, but are available in this country. They are wound with silk-covered wire and are self-supporting except for a very thin layer of special "dope" (probably celluloid). Feet are provided, which enable them to be fixed to the baseboard with two wood screws, and the windings have soldering tags marked grid, filament, plate and B battery (the American name for the high-tension battery).

The circuit is given in Fig. 1, from which it will be seen that there are three transformers, T1, T2 and T3. The primary of T1 is connected to aerial and earth, while the primary of T2 is connected in the anode circuit of the first high-frequency valve. Similarly, the primary of T3 is connected to the anode circuit



The special terminals employed are already engraved. The controls can be marked in the ordinary way with panel transfers.

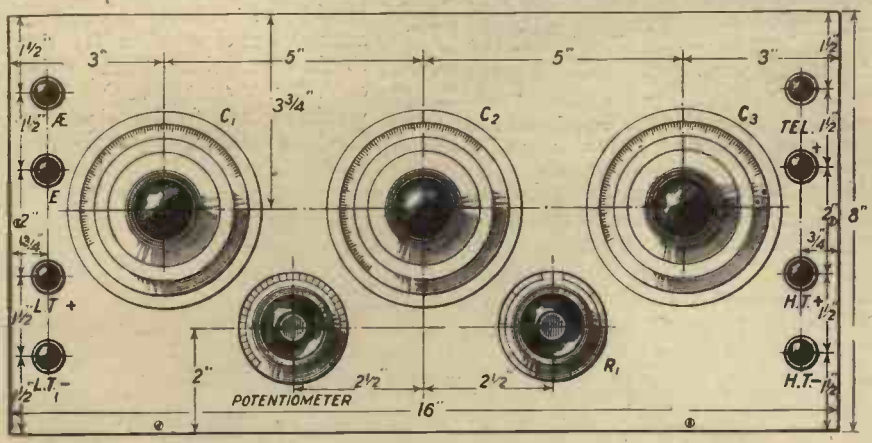


Fig. 2.—Drilling the panel is a very simple operation, the necessary dimensions being given here.

of the second high-frequency valve. The moving plates of the first two variable condensers are connected together and to the slider of a potentiometer, while, following the principle I have already explained, a .001 μF fixed condenser is connected between the anode of the detector valve and negative filament terminal. The filament resistance is in the negative leads of the valves. The tuning of this receiver is so sharp as to make practically essential some form of vernier dial, and I have used with considerable success the Burndept vernier dial supplied with the particular variable condensers used.

Components

The following is a list of the components used in building the set. Those who desire to reproduce it are strongly advised to adhere exactly to the lay-out, as the actual placing of wires is of considerable importance.

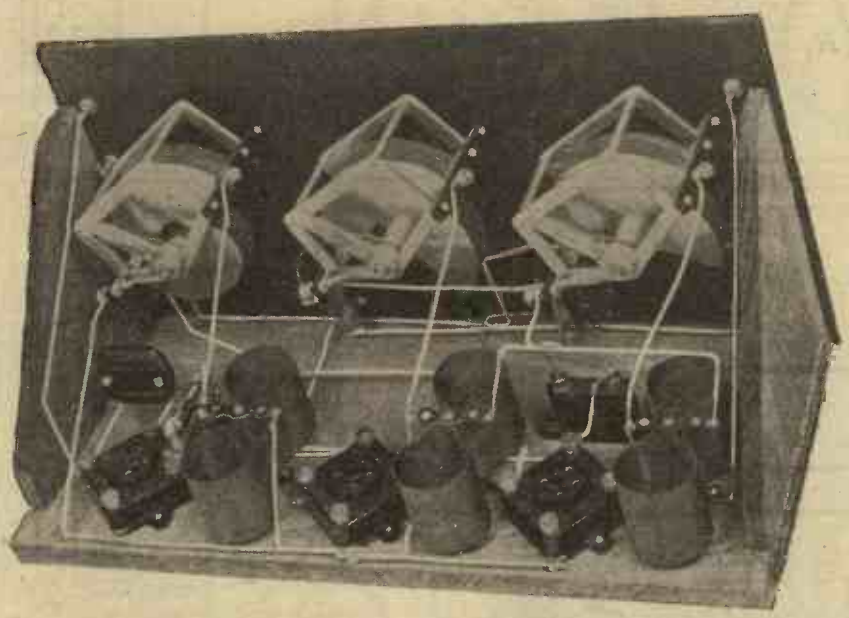
1 panel, 16 × 8 × ¼ in. (Pilot).

8 terminals marked Aerial, Earth, L.T.+, L.T.−, H.T.+, H.T.−, Telephones+, Telephones− (Belling Lee).

3 variable condensers .0003 μF (Wootophone Low Loss fitted with Burndept Vernier Dials).

1 dual rheostat (L. McMichael, Ltd.).

1 potentiometer (L. McMichael, Ltd.).



This view with the valves removed shows clearly how the parts are laid out on the base-board.

3 "Bodine" twin-eight coils (Rothermel Radio Corporation).

3 anti-vibration valve sockets (Benjamin Electric Co.).

1 fixed condenser .001 μF (Sangamo).

1 fixed condenser .003 μF (T.C.C.).

Radio Press wireless panel transfers.

1 fixed condenser .0003 μF with grid-leak 2 megohms (Therla).

Glazite wire, No. 16 gauge, for wiring.

Cabinet complete with baseboard (Caxton Wood Turnery Co.). This cabinet is of the standard All-Concert de Luxe size.

Wiring

In wiring up, study the wiring diagram carefully in conjunction with the photographs. You will find that the wiring is exceedingly simple and straightforward and will take you but a short time.

It is possible to screw one lug of the Therla grid condenser under one of the terminals of the Benjamin valve socket, while under the anode and filament terminal of the same

The set is very compact, yet the coils are well spaced out.

valve socket you can screw the connecting wires for the Sangamo fixed condenser, which can be supported by the stiff wires themselves as close as possible to the socket. There is no need to space the filament and H.T. battery wires, as both can be laid along the baseboard, as shown.

Valves to Use

As these coils are of American origin I was not at all surprised to find that the best working was obtainable with the ¼ ampere small power valves which, as readers may know, are the most popular valves on the American market at the present time. These valves oscillate very readily, and are extremely difficult, if not impossible, to use in the average set using the older type of plug-in transformer and potentiometer control, owing to their tendency to oscillate. In this receiver, however, very little potentiometer control is needed in order to stabilise the set. I have found any of the ¼ ampere small power valves work excellently here, although in the detector socket a D.E.5B. or its equivalent in other makes gives better results than a D.E.5 or its equivalents.

With the .06 ampere valve the set will not oscillate when the potentiometer is fully on the negative side, and, furthermore, the ratio of primary to secondary winding is not suitable for these valves. One

filament resistance only is fitted and this controls all three valves. The ordinary dual resistance will serve, or for that matter a single bright emitter resistance. I fitted the dual resistance, however, in order that I might be able to try experiments with .06 ampere valves.

Operation

When you have wired up the set connect up a suitable battery to the high-tension terminal (you will find 48 to 72 volts good values, the higher being the better) and a 6-volt accumulator to the L.T. terminals. Aerial, earth and telephones are connected in the usual way.

The operation is charmingly simple, for you will find the first two dials are matched, while the third dial is only a few degrees different from the other two. Turn the potentiometer round until you hear the set oscillate, and then turn it back again just below oscillation point. You will soon find a station, and you can then adjust to the best strength by the potentiometer control. You will find the selectivity remarkable, as it is difficult to hear the local station unless all three dials are approximately in tune with it. Unless high-tension accumulators are used, it is generally advisable to shunt the high-tension battery with a Mansbridge condenser of 1 μF capacity.

Addition of an Amplifier

If you have a one- or two-valve amplifier already on hand, you can connect it to the telephone terminals in the usual way, making sure that the correct connections of telephone terminals to amplifier terminals are made. A two-valve transformer-coupled amplifier will give ample volume for loud-speaker work on dozens of distant stations, while a single valve amplifier will give all that is needed for the local station. As many readers will like to have a suitable accompanying cabinet, an amplifier to match this receiver will be described in a subsequent issue.

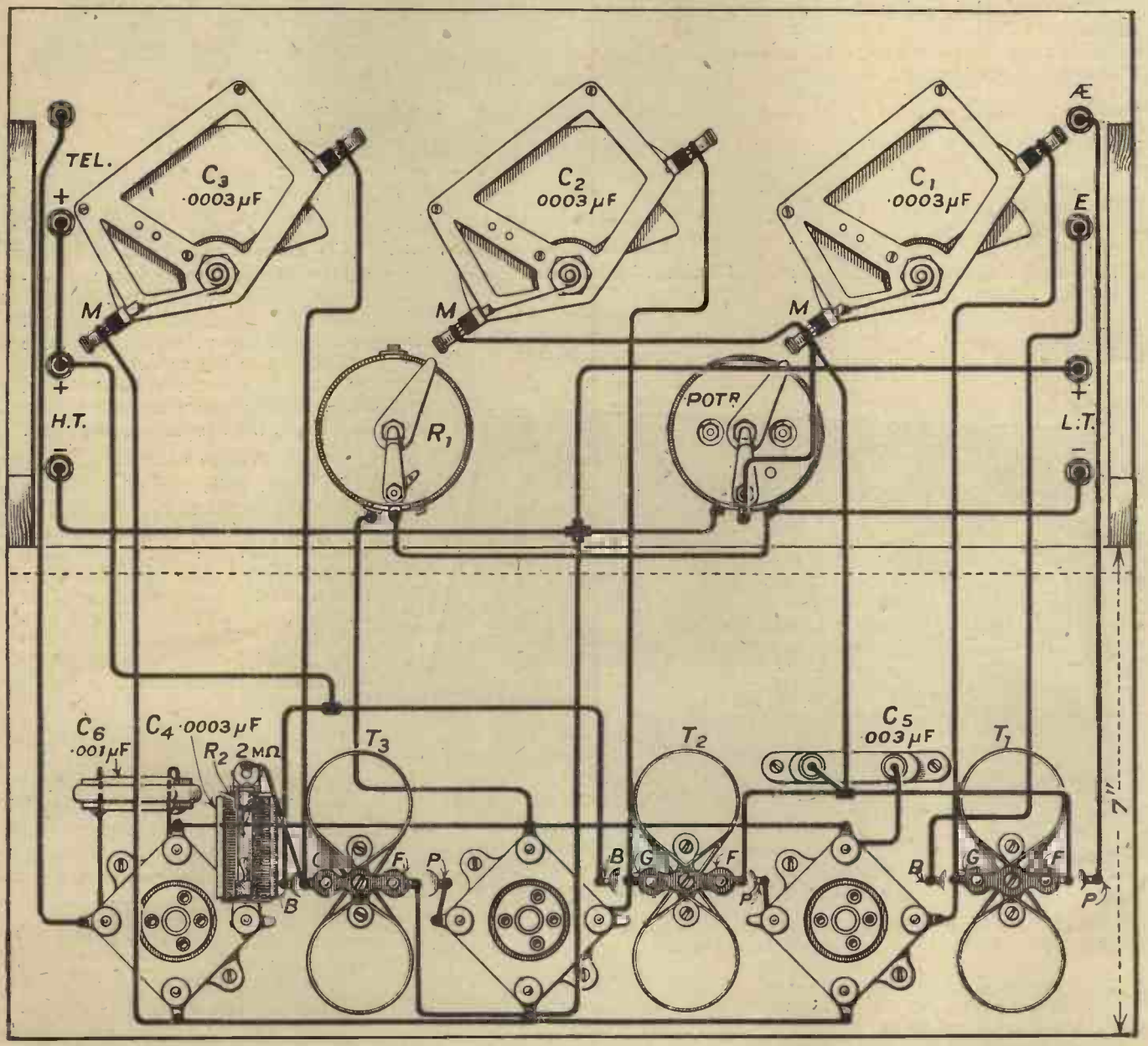
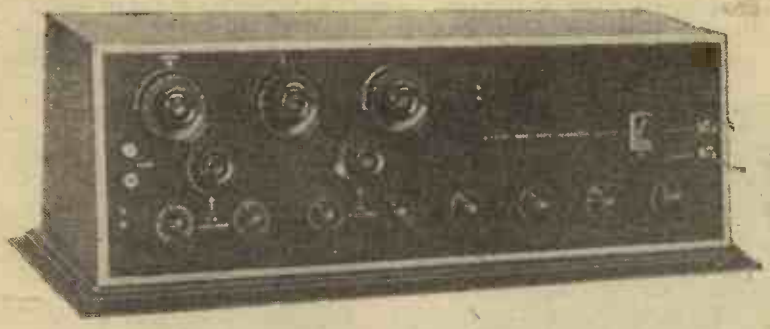


Fig. 3.—The practical wiring diagram. Note that for clearness the lower soldering tags of the transformers ("B" and "P") are drawn as if projecting more than is actually the case. Either the terminals or soldering tags of the valve sockets can be used.

Long-Wave Interference and Your Superheterodyne



An eight-valve superheterodyne designed by Mr. Scott-Taggart, incorporating a stage of tuned H.F. in front of the first detector.

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

Some of the interference experienced with "superhets" is apt to prove puzzling and difficult to eliminate unless its nature is fully understood. In these notes the Editor explains how interference occurs and discusses some of the methods of removing it.

AN important but often ignored aspect of superheterodyne reception is the tendency for receivers employing this principle to pick up certain classes of interference, which in some cases are not noticed by using ordinary straightforward circuits.

A Common Mistake

The superheterodyne receiver has undoubtedly acquired a great reputation for selectivity. This selectivity is due in part to the frame aerial, and in part to the heterodyning of the incoming signals. I am rather inclined to think that the advantages of frame aerial reception are not quite as great as the beginner imagines. He thinks that the rotation of the frame through a few degrees will cut out a station, whereas actually this is not so at all, a variation of as much as 30 degrees often making no difference to the signal strength.

Effect of Surroundings

A frame aerial, provided it is not situated in an unfavourable spot, gives very decided directional effects, best results being obtained when the frame is pointing to the station to be received. In unfavourable circumstances the directional effect of the frame aerial is of little or no advantage. I have come across a number of cases where signals are only received at good strength when the frame aerial is pointing towards the window.

Screening Effects

This, of course, is due to screening effects, the waves coming, as it were, only through the window. Metallic objects of substantial dimensions near the frame aerial will alter the apparent direction of the waves, and you may have your frame placed almost at right angles to the direction of the station you are receiving.

It must be appreciated, however, that the frame will pick up a good deal of interference, because its directive properties are not very marked. It should be mentioned

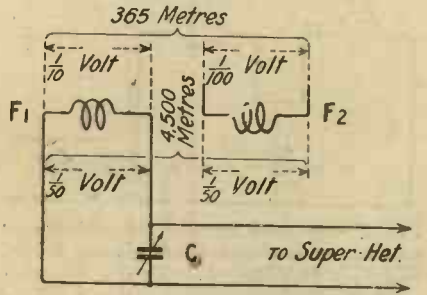


Fig. 1.—Illustrating the relative magnitudes of the e.m.f.'s induced in a tuned and an untuned frame by a signal of resonant frequency and one of widely different frequency.

here, however, that in one particular respect a frame aerial is very directive, and that is owing to the fact that when the frame aerial is at right angles to the direction of the distant station practically no signals will be heard, whereas a small variation on either side will give distinctly appreciable signals. It is not at all a bad scheme when using a superheterodyne receiver to turn the frame while listening to the distant stations until the signals disappear at a certain point. Then re-align the frame so that it lies at right angles to its former position. In its new position the frame may be left.

Uni-directional System

The interference experienced with a frame aerial may be largely reduced by making the reception uni-directional. An ordinary loop, when pointing north and south, will pick up stations both north and south of the receiving apparatus, but it is a comparatively simple matter to ensure that only signals from the north or south respectively are received. The methods employed, which I hope to describe at a future date, are similar to those which are used for direction finding. In the case of a ship or aeroplane, of course, it is an advantage not only to know that a certain station lies either north-east or south-west, but which of these directions is the true one?

The Signal-to-Noise Ratio

Apart from the minor imperfections of a frame aerial a great deal of "mush" and general noise is eliminated. The tendency in receiver design nowadays is not merely to obtain signal strength, but to reduce the ratio of interference to signal strength. It is obviously no good having a strong

signal if there is a background of noise and interference. That is one reason why often a single-valve receiver apparently will give as good range as a multi-valve set: the signal is weaker, but is more "readable."

A Test

An interesting test was carried out at my suggestion at our Elstree Laboratories recently. An efficient single-valve receiver was followed by seven stages of low-frequency amplification. It was possible to receive Cardiff on the loud-speaker 14 miles north of London when the latter station was not working, but the amount of general interference was very bad and the result was distinctly unpleasant. A good superheterodyne receiver, on the other hand, will give a good signal-to-noise ratio.

Long-Wave Interference

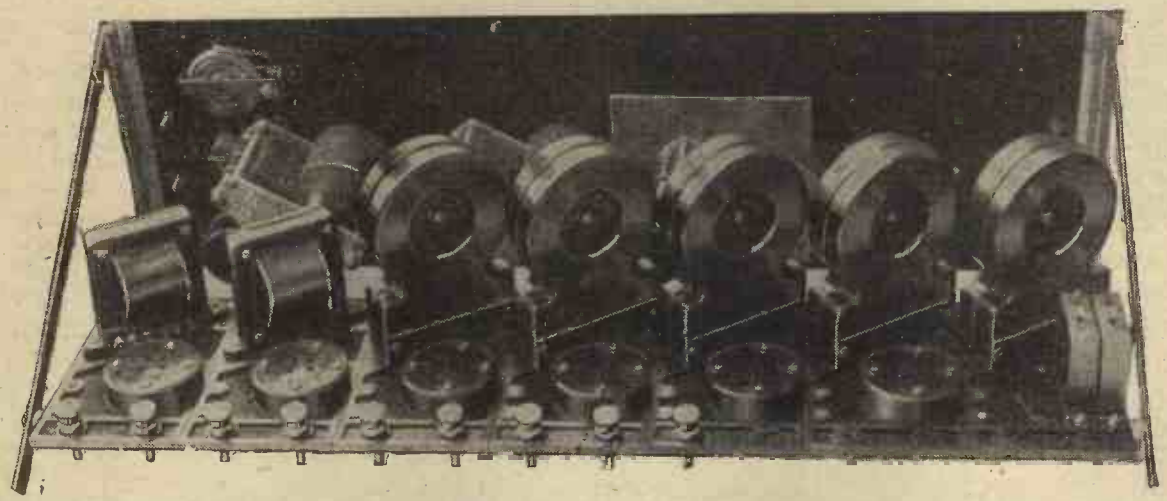
Superheterodyne sets, however, unless specially designed, are liable to pick up long-wave interference. This pick-up effect may occur either as a result of the coils of the receiver picking up the station, or to the frame aerial acting as a collector, not only for the desired signals, but for waves of entirely different frequency.

I propose, first of all, to deal with direct pick-up effects. The simplest of all of these is for the oscillator circuits to pick up signals direct from a nearby station. At last year's Show at the Albert Hall I was examining a superheterodyne receiver which was being demonstrated by one of the firms. The London station was being received, and I casually altered the tuning of the frame aerial circuit, *i.e.*, the initial input circuit. I casually remarked to the demonstrator behind the counter that the frame aerial circuit was not giving any selectivity, signals coming in all over the dial.

Frame Selectivity

Imagining I was a non-technical visitor he became very indignant, and explained that not only was the set an extremely selective one, but that no criticism could be levelled against the frame aerial circuit, because one had to take the over-all selectivity of the set.

He refused to deal with the selectivity of any part of the receiver, and made continual reference to the selectivity demonstrated by varying the condenser controlling the local oscillator. As by this time his increasing vehemence had collected a substantial crowd, I thought discretion the better part of valour, and gave up the struggle, after assuring the demonstrator that frame aerial selectivity was not only desirable but capable of being achieved.



A special lay-out of the intermediate frequency coupling units is adopted in this superheterodyne (Igranic) to minimise interaction effects.

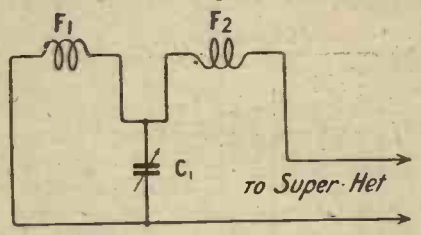


Fig. 2.—In practice the two windings, one tuned and one untuned, are joined in series to obtain the desired neutralisation of the interfering signal.

Forced Oscillations

Of course, what was happening was that he was getting a direct pick-up effect on 2LO, which made any frame aerial tuning of no value. There was nothing really wrong with the frame aerial circuit at all. On distant stations selectivity would have been all that was desirable, but nevertheless tuning was very flat. This effect may be due either to the oscillator valve circuit picking up a station direct, one of the coils acting in effect like a small frame aerial, or it may be due to oscillations "forcing" themselves into the frame, even though the latter may be out of tune. This latter effect, of course, is much smaller than the other, and we have to concentrate primarily on the elimination of direct pick-up effects by the inductances in the receiver.

Oscillator Pick-up

The example I have given is concerned only with the direct pick-up effect of the oscillator. In some superheterodyne sets the effect is so marked that, without the use of any frame aerial, excellent signals may be obtained merely by rotating the set, so that the oscillator coil points in the direction of the station to be received. This effect may be cut out by enclosing the oscillator unit in a metal box or similar arrangement to give screening, or by making the coils of the non-pick-up type, *e.g.*, binocular, toroidal, etc. The coils might also be so disposed that when the set is standing in its normal position on the table there is little pick-up effect. The effect is then similar to that of a frame aerial placed horizontally instead of vertically.

The Predominant Effect

Except when very close to a station, long-wave pick-up effects become distinctly the more impor-

tant. The long-wave (or intermediate frequency) part of a superheterodyne receiver may be tuned to a frequency of, say, anything between 150 kc. and 30 kc. (2,000 and 10,000 metres). Obviously, if the frequency selected happens to coincide with the frequency of some long-wave station, *e.g.*, the Eiffel Tower, Morse or telephony, or even a C.W. station, interference will result. As there are usually several stages of long-wave amplification, this part of the set, followed by a detector and perhaps note amplification, will form an excellent receiver for long waves, so that very considerable interference may be experienced. Even continuous wave Morse signals from a C.W. station will cause interference even while there is no distinctive musical heterodyne note heard in the loud-speaker or telephones. Many C.W. stations at high power sound very much like muffled spark signals, although if received on an

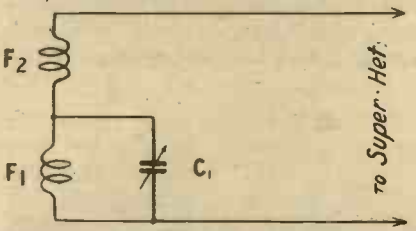


Fig. 3.—These are the connections of the split-winding frame aerial illustrated on this page.

ordinary heterodyne receiver they would give a musical note.

Choosing the Intermediate Frequency

One method of overcoming this trouble is to select the frequency of the intermediate stages of amplification so that it does not coincide with that of any working long-wave station, or harmonic of such station. We can also screen each coil or the whole of this part of the receiver by metal sheets, or we can use some form of non-pick-up coil, or arrange the inductances horizontally. This particular form of direct pick-up is readily diagnosed by seeing if it comes in with the oscillator valve turned out. If the signals still come in, and especially if they increase when the set is rotated to a certain position, you can put your finger immediately on the trouble.

The Most Common Trouble

Perhaps a more common symptom in a superheterodyne receiver is to hear C.W. Morse coming through in the form of a musical note. This effect may be due either to a forced oscillation produced in the frame aerial (which effect will be explained later), or a direct pick-up effect by the intermediate frequency amplifier coils.

These Morse signals frequently come from commercial and military stations working automatic Morse with valve sets. The sound in the loud-speaker or telephones is musical and is not of the muffled spark type, which may also be received by a direct pick-up effect on the intermediate frequency amplifier. It will be noticed that the musical effects are obtained when you are receiving some broadcasting station on your set. It is particularly noticeable in between broadcast items when the superheterodyne set is only receiving the carrier wave.

Where it Occurs

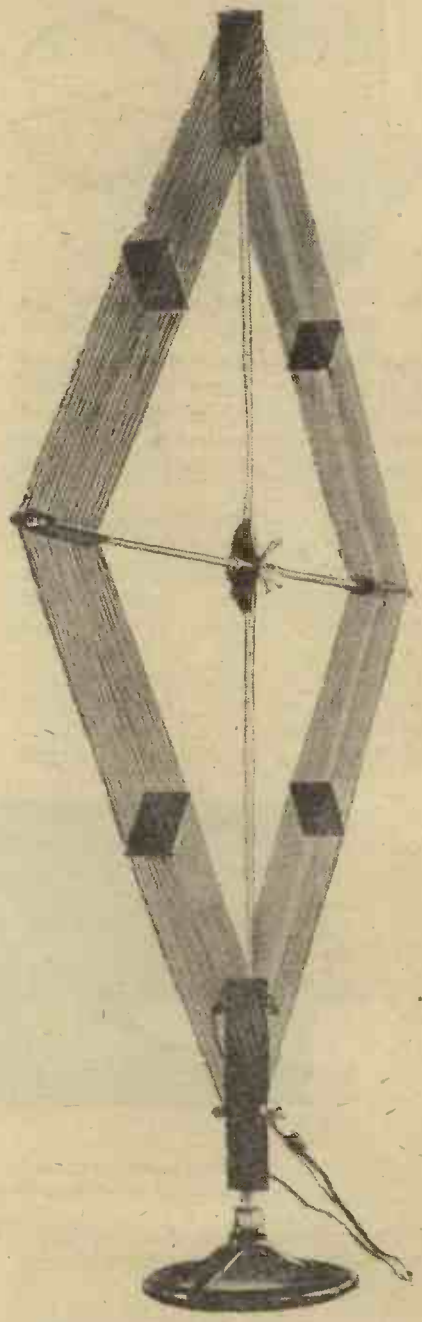
There is obviously some heterodyning going on, and since the local oscillator is, of course, tuned to ordinary broadcast wavelength, the experimenter may wonder how the long-wave stations are being heterodyned. The reason is that when you are receiving a broadcast station, your local oscillator is heterodyning its carrier wave and producing a continuous wave of, say, 50 kc. (6,000 metres), if this is the frequency of the intermediate amplifier.

This continuous wave is amplified right through the intermediate frequency circuits until it comes to the detector valve. Since the currents are pure continuous oscillations, this long-wave carrier produces no sound in the telephones or loud-speaker. If, however, long-wave C.W. stations are directly picked up by the intermediate frequency amplifier, and the frequency of these C.W. signals is close to that of the silent carrier wave, ordinary heterodyning will take place, and the heterodyne signals will be rectified by the detector valve, and will give a musical note, and we thus get musical Morse signals.

How the Beats are Produced

Readers will understand the effect much better if they consider the superheterodyne set operating in between, say, two broadcast items from a certain station. In between the items the frame aerial is picking up the carrier wave of the broadcasting station. This carrier wave is heterodyned by the local oscillator, thus finally resulting in a new carrier wave of, say, 50 kc. (6,000 metres).

If there were no pick-up of long-wave outside stations nothing at all would be heard in between items, but if a 50-kc. carrier wave is joined by long-wave signals also of approximately 50 kc. frequency (6,000 metres) the two will heterodyne each other and produce musical Morse, just as happens in an



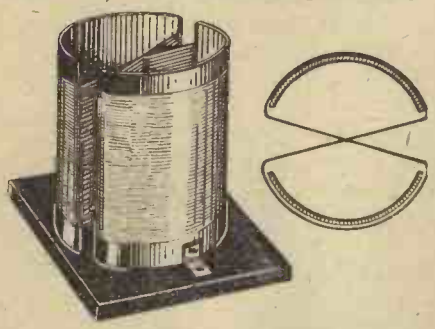
A practical example of a split frame aerial.

ordinary single-valve long-wave receiver, which is oscillating. When a broadcast item begins the Morse can still be heard in many cases. In any case it does not disappear merely because the incoming currents are now modulated, because wireless telephony currents

can really be sub-divided into a carrier wave with other waves of almost the same length on each side.

Elimination by Screening

We can cut out this unpleasant effect by the method previously



The "D" coil, an example of the astatic or non-pick-up type.

described to prevent direct pick-up by the long wave coil, namely, special positioning of the coils and arranging their tuning so that there is no tendency to pick up signals direct.

Even if all these precautions are taken, it is still possible for continuous wave interference to be experienced. The trouble now lies, unquestionably, with the frame aerial. The local oscillator does not pick up the long-wave stations, and we will presume that the intermediate frequency amplifier has been so designed that no pick-up effect is experienced here. The fault must clearly lie with the frame aerial.

Frame Pick-up

What actually happens in such cases is that the long-wave signals ignore the fact that the frame aerial circuit is tuned to, say, 750 kc. (400 metres), and force themselves into the receiver. They leak through, as it were, to the intermediate amplifier, and once there they are happy because this amplifier is very frequently sufficiently closely in tune to their frequency to enable these interfering currents to be amplified.

If, however, we were not actually receiving a desired broadcasting station, any troubles from this source would be negligible. The frame aerial pick-up of long-wave stations is consequently noticeable just at the time when you least want it, namely, when you are receiving existing signals. The explanation of the effect is really simple: long-wave C.W. signals, even though they fail to get picked up directly by the coils in the intermediate amplifier since we have taken special precaution to avoid this, may yet creep into the amplifier via the frame aerial.

How the Frame Responds

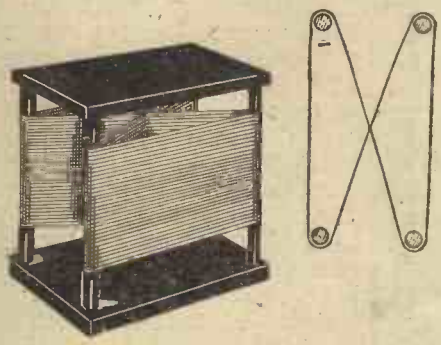
It may strike the reader as very curious that when a frame aerial is tuned to, say, 750 kc., it can still pick up signals having a frequency as low as, say, 60 kc. (5,000 metres). This is, however, the fact, although the voltages induced in the frame aerial are extremely small. It must be remembered that, although the frame aerial is tuned to an entirely different wavelength, yet the continuous wave signals from some of these high-power stations are very strong.

A Simple Remedy

Fortunately, there is a very simple means of overcoming this trouble by means other than mere selectivity. The arrangement is, briefly, as follows, and reference will be made to Fig. 1:—

In Fig. 1 is shown a coil, F1, which represents the ordinary frame aerial which is tuned by means of a variable condenser C1 to, say, 827 kc. This frame F1 will pick up strongly signals due to, say, a broadcasting station, 2LO. The reason the frame aerial picks up 2LO so well is that the circuit F1 C1 is tuned, and is therefore a resonant circuit which will build up the oscillations due to the incoming signals.

Let us now arrange a second frame aerial F2 exactly similar to



An astatic coil of simple construction due to Mr. Harris.

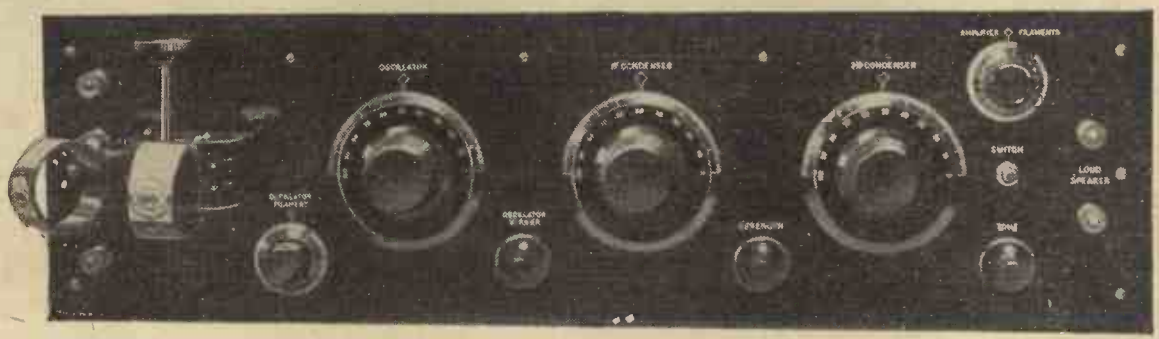
F1 but wound in an opposite direction, and placed next to F1. This frame aerial will be untuned, and will not be resonant to 2LO. Consequently the voltages produced across it will be extremely small.

Magnitude of the Effects

Although I have only taken the figures arbitrarily, it will be seen from Fig. 1 that I assume that the voltage developed across F1 due to the 827-kc. signals is one-tenth of a volt, while that developed across the frame F2 is one-hundredth of a volt. The potentials across F2 are, of course, not utilised in any manner, and the presence of F2 next to F1 makes no substantial difference to the working of the latter frame aerial. The frame F1, however, is connected to the superheterodyne receiver.

Let us now see what the effect of an interfering C.W. Morse signal of 66.7 kc. (4,500 metres) will be. Neither the frame F1 nor the

(*Continued on page 10*)



A further precaution against certain types of interference is taken in the Igranic superheterodyne by providing an alternative tuning arrangement combining an outside aerial with the frame.

Some Practical Notes on L.F. Amplifiers

By Captain H. J. ROUND, M.C., M.I.E.E.

Captain Round is well known to readers of "Wireless Weekly" as an authority on the subject of low-frequency amplification, and in these notes he gives some very valuable advice on the handling of note magnifying circuits.

JUST as in H.F. amplification we have the two schools—the superheterodyne and the straight H.F. school—so low-frequency amplification has produced two schools—the resistance-coupling and the transformer-coupling schools. The real facts of the case are that a resistance amplifier gives more or less theoretically perfect amplification, in that its amplification is independent of frequency.

Defects of Resistance Coupling

Quantitatively that amplification is, however, small, and other troubles occur, so that the transformer was introduced to increase the amount of the magnification without seriously distorting the frequency characteristic. The first attempts at transformers were none too good, but very considerable advances have been made in the last two years.

Practical Difficulties

To build a resistance amplifier correctly to produce reliable results is none too easy for those who have no measuring instruments. Good resistances of high value are necessary; condensers must be very perfectly insulated, and must remain so, otherwise curious troubles, which are hard to spot, develop.

For ideal work, where expense and accuracy are the only considerations, such as on broadcast transmission, resistance amplifiers are probably the best, although even this is not generally agreed, but for general radio reception at least some element of transformer amplification is advisable. I can tabulate certain merits and demerits of the resistance amplifier and transformer amplifier :—

RESISTANCE AMPLIFIER.

(1) Satisfactory silent resistances are not too easy to obtain of sufficiently high value.

(2) Grid condensers must have very perfect insulation.

(3) High "μ" value valves must be used to get big effects with small number of stages.

(4) Grid current effect on last tube limits output.

(5) Liable to H.F. oscillation.

TRANSFORMER.

Only serious demerit is difficulty in obtaining constant amplification over frequency range.

Standard valves may be used.

Less valves can be used, but H.T. battery consumption may be more.

Transformer breakdown is a point which has caused trouble in the past, but should now be practically over.

Conditions for Satisfactory Amplification

The two important factors in L.F. amplification are :—

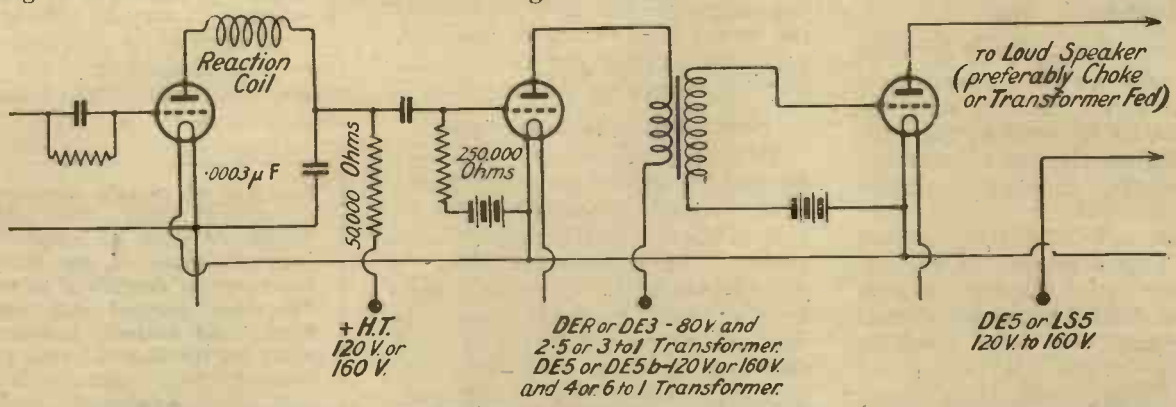


Fig. 1.—This circuit arrangement is recommended by Captain Round, and he gives here the necessary practical details for operating it successfully.

(1) To be able to get the maximum sound from the last valve without serious blasting, and

(2) To be able to deliver enough volts to the grid of the last valve to give the necessary output.

With resistance amplifiers we are practically limited to a sweep just up to grid current. Any serious grid current gives a condenser charge, and a disagreeable sound in the loud-speaker.

With transformers, although distortion does occur it does not sound so bad; consequently we can keep up to a bigger average volume with the same H.T. battery.

The Last Stage

Let us consider the link between the power valve and the one before it. Because of the above point I

A "Zenite" wire-wound resistance of the type specially produced for use in low-frequency amplifiers.

prefer a transformer. This is the one place where blast is liable to occur most, and where greatest care should be taken to prevent it. The act of using a transformer not only prevents an occasional blast sounding bad, but owing to the bigger magnification obtained there is less strain or sweep necessary on the valve before the power valve.

Transformation Ratio

What ratio of transformer to use is a matter for consultation with the transformer makers' curves, as it depends upon the valve before the power valve. In general, a 2.5 or 3 to 1 transformer is satisfactory if the first valve is of the order of 20,000 ohms resistance, such as a D.E.R., or a 4 to 1 transformer if the valve is an 8,000-ohm type, such as the D.E.5 or B4 (a 6 to 1 transformer, if it is the only transformer in the set, will be fairly good). I assume, of course, the correct grid bias and H.T. are put on the valves; H.T.

$\frac{\text{H.T.}}{2\mu}$, or a little more is a fairly good rule.

Coupling to the Detector

Now if we use two D.E.5-type valves as the last ones, we have a magnification over all of 8 x 4 x 8—quite enough for nearly all purposes—and even if we now use another transformer we shall probably have to shunt it besides introducing a second distortion, which the shunt will only partially remove, so that here a resistance stage as a link to the rectifier is not a bad scheme, and over all we shall have an arrangement which will have very little distortion from 60 cycles to 6,000 cycles, and for most purposes the magnification will be quite great enough.

A Warning

If you already have a 3 to 1 transformer between the rectifier and the first L.F. valve, replacing by a resistance will give you *weaker* signals, and if you think the quality you are getting is satisfactory change with caution, as the difference may not be very noticeable on your particular loud-speaker, and you may not like to lose volume.

LONG-WAVE INTERFERENCE AND YOUR SUPERHETERODYNE

(Concluded from page 8)

frame F2 is resonant to the 4,500-metre signals. Consequently we may say that for all practical purposes the minute voltages developed across F1 and F2 will be the same in each case, and will depend upon the dimensions and number of turns of the two coils, those in the present case being equal.

Functioning of the Double Winding

If we now connect the two frame aerials in series, so that only the real frame F1 is tuned by the variable condenser C1, we will cut out the interfering long-wave station altogether, without making any appreciable difference to the desired signal. This is shown in Fig. 2. The frame aerial F2 now acts as far as the desired broadcast signals are concerned, only as an aperiodic inductance in the grid circuit of the first valve of the superheterodyne receiver.

The frame F1 is really the one that does the receiving. The second frame F2, as far as broadcast wavelengths are concerned, is so inefficient, because it is not tuned, that it has no appreciable effect on signal strength, even though the coil is wound in an opposing direction to F1. Exactly the opposite is the case, however, when we consider the effect of the 66.7-kc. signals on the two coils.

Neutralising the Interference

This time the voltages across F1 and F2 will be substantially the same, namely, one-fiftieth of a volt, in the example previously considered. Since the two coils are wound in opposite directions, however, the voltages developed across the coils oppose each other, and therefore become non-effective. Fig. 3 is merely Fig. 2 redrawn, and represents the two frame aerials wound in opposite directions, one-half being tuned.

The whole arrangement is extremely effective in use, and it will be seen from the foregoing remarks that both the double frame aerial and also the elimination of direct pick-up on the intermediate frequency amplifier coils is a refinement which, if not absolutely necessary, decreases considerably the interference caused by long-wave C.W. stations. In actual practice the two aerials are wound on a single frame, the two halves of the coil being wound in opposite directions. It may be expected that in most cases some improvement as regards a diminution of induction noises, etc., will result from this arrangement.

In view of certain erroneous statements that have been made, we wish to emphasise that the tests at our Elstree laboratories described on page 11 were carried out apart from, and entirely independently of, the B.B.C., who performed their own tests at Keston.

A Press Visit to the "Wireless Weekly" Laboratories

When the B.B.C. stations closed down recently for a period of fifteen minutes for the purpose of investigating interference, some interesting tests were made at Elstree at which representatives of the Press were present.

A group taken during the tests at Elstree. Behind the centre instrument is Mr. J. H. Reyner, the Technical Editor of "Wireless Weekly," and behind the sloping-panel apparatus (this is the wavemeter) is Mr. Percy W. Harris. Captain H. L. Crowther is operating the wavemeter.

ON Tuesday, February 9, 1926, representatives of the leading London newspapers and Press agencies accepted the invitation of the Editor of *Wireless Weekly* to visit the *Wireless Weekly* Research Laboratories at Elstree for the purpose of observing the test on broadcast interference.

Object of the Test

It will be remembered that on this evening the British Broadcasting Company had announced that they would close their stations from 10.30 to 10.45 p.m. for the purpose of ascertaining which Continental stations, if any, were causing interference with British stations. During the same period *Wireless Weekly*, with its own special equipment, conducted an independent test and carried out certain measurements.

The party, which included representatives of the *Daily Chronicle*, the *Daily Express*, the *Daily Mail*, the *Daily News*, the *Daily Telegraph*, the Press Association, the Central News, the *Morning Post*, and other papers, were met at Bush House by Mr. J. H. Reyner, B.Sc., and Mr. Percy W. Harris, and other members of the Radio Press staff. They then proceeded to Elstree by car, and in the interval between arrival and the start of the test were given an opportunity of examining the elaborate apparatus, and in particular the standard wavemeter used in experimental work at the Laboratories.

High Standards of Accuracy

Explanations were given by Captain H. L. Crowther, M.Sc., and the technical staff of *Wireless Weekly*, particular interest being shown in the wavemeter and the use of the calibration chart which enables readings to be taken with an accuracy in excess of one part in 3,000, or, as the representative of one daily journal put it, a change of wavelength of as little as 4 inches can be immediately detected.

Results of Measurements

During the test the B.B.C. stations were shut down entirely, and no B.B.C. carrier waves were present. The method adopted by *Wireless Weekly* was, prior to the silent period, to measure the exact wavelengths of the British Broadcasting stations, which were as below at the times given.

During the test period a special receiver was used to listen in on each of these wavelengths to ascertain whether stations were working on any of them. It must not be overlooked that a great number of Continental stations shut down regularly about 10 p.m., and thus the interference was not as great as might have been expected earlier in the evening.

Interference Determined

Actually interference from two stations (which were in fact heterodyning one another) was found on the Bournemouth wavelength; Newcastle had an interfering station about 1 metre below its wavelength, and a powerful Morse station was interfering also. Glasgow would have been interfered with by a station about 4 metres below, this giving a very high note almost beyond audibility, and similar interference would have been caused with Belfast by a station 6 metres below. The wavelengths used by the other main stations were quite clear.

Full particulars of the remarkable wavemeter used in these tests will be published in an early issue of *Wireless Weekly*.

RESULTS OF MEASUREMENTS.

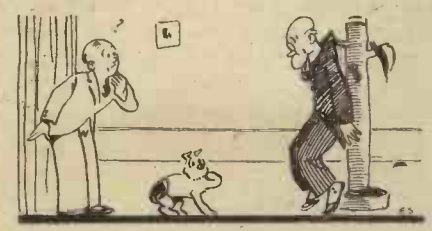
Time.	Station.	Official Wavelength.	Actual Values.	
			Kilocycles.	Metres.
5.30	Cardiff	353	848.4	353.6
5.33	London	365	830.6	361.2
5.37	Manchester	378	794.9	377.4
5.43	Glasgow	422	711.4	422
5.46	Belfast	440	683.4	439
5.50	Birmingham	479	630.4	475.9
5.55	Aberdeen	495	603.4	497.2
5.39	Bournemouth	386	781.5	383.9
5.42	Newcastle	404	742.9	403.8

ENTERING the High Street the other day, I was just in time to see Professor Goop take off his hat to a pillar-box whilst cramming a bulky letter into the mouth which Mrs. Bumpleby Brown had opened in order to wish him good morning. Covering the intervening space at record speed I reached the scene just in time to prevent the good lady from suffocation. The Professor, meantime, made off at the double, calling that he was going to fetch a postman as being the only proper person to administer first aid in such a case.

From what I had seen, it dawned upon me that this might possibly be one of the Professor's absentminded days. When these occur I am generally pretty sure that one of those great ideas which thrill the world from time to time is being hatched.

Signs and Portents

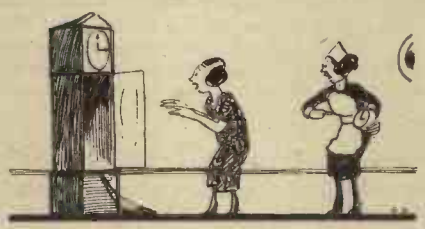
Though Professor Goop had not so far done done anything outstandingly eccentric on the day about which I am speaking, I felt, as I have said, an inkling that he might presently show real signs of absentmindedness. This was confirmed



. . . hung himself up on the hat-stand . . .

when he carefully wiped his gloves upon the doormat and took off his boots in the hall on entering his house. I became perfectly sure of my ground when he placed his overcoat tenderly in a comfortable armchair before his study fire, and then went out and hung himself up on a peg in the hall.

Possibly you would not have realised that anything not quite ordinary was happening, but I, who know him so well, saw at once. Taking him gently down from his peg, I explained that he would dry much better before the fire. He expressed a fear that he might be badly creased if care were not taken



. . . not a clock with innards intact . . .

but he was quite relieved when I fetched a coat-hanger, and pushed it somehow down the neck of the jacket.

He Speaks

"Wayfarer," he said at last, after a period of silence, "I have an idea." There was some more silence, quite a lot of it. At last I ventured to remind him that he had said that he had an idea. "Perfectly true," he declared, after an interval. "I *had* an idea. But I am sorry to say that I have not got it now. It was something particularly fine, though unfortunately it escapes my memory for the moment. Let us see whether our united efforts cannot succeed in recapturing it."

Found!

I did my level best. I suggested all kinds of things. Was it something about batteries? No. Valves? No. Condensers? No. Aerials? No. Earths? No. Transformers? No. Rheostats? No. Circuits? —that seemed a likely one! No. Did it concern wireless? Yes, obviously; what else could it concern? Some little trouble-saving device? I hazarded. "You are on the track," the Professor cried. "One moment. Let me think. Yes, I have it." Then striding about the room, he proceeded to tell me something of the great new scheme for the simplification of tuning that had so nearly been lost to the world.

The Bane of Radio

Let me give you the gist of what he told me. The great drawback to wireless is that in order to tune in one has to twiddle things. It is this twiddling that gives all earnest followers of the art corns upon the forefinger and thumb of either hand. It is this twiddling that is responsible in acute cases of radiomania for the distressing symptom known to the medical profession as wireless man's twitch, in which the half-closed hands are waggled ceaselessly to and fro by the sufferer. It is twiddling again that gives rise to howling.

Is it Possible?

If it is possible to eliminate knob-twiddling, wireless reception will become at once a more pleasant and a vastly less dangerous pastime. But can it be done? Ever since the beginning of wireless it has been held that twiddling is an essential part of the game, and every set has been fitted with a large variety of knobs, each of which is simply asking to be twiddled. Is it not time that these antiquated and

. . . Wireless man's twitch . . .

hideous knobs were done away with once and for all, and that tuning was made simple, rapid and painless by the adoption of mechanical methods?

The Problem

The crux of the whole problem, we agreed as we talked it over, is to

Your dealer is waiting to demonstrate

With the "Lissenola" you can build a powerful loud speaker for less than the cost of headphones. Although this remarkably efficient loud speaking unit costs but 13/6, we ask you to compare the price last—and make this test *before* buying. Go to your dealer—ask him to put on the best loud speaker he has in stock—then use the same horn on the Lissenola, *and see if you can notice any difference.* Ask him also about the horn you can build yourself.

The secret of the Lissenola's remarkable efficiency rests in the effective manner in which the electro-magnetic sound-reproducing system is concentrated. It only needs the addition of a horn to make it a full-sized instrument yielding results equal to a speaker costing several pounds. You can build a horn yourself—with each Lissenola we give you full-size exact patterns and clear instructions how for a few pence you can build a big horn of proved efficiency. The illustration above shows the effective horn you will build. It can be covered with fancy paper or painted so as to resemble a factory-made article. In addition the Lissenola will fit the tone-arm of any gramophone, instantly converting it into a radio loud speaker.

By using the Lissen Reed (sold separately for 1/-) the Lissenola will carry a cone or any other diaphragm working on the reed principle. You can quickly make a paper diaphragm yourself.

Your dealer will gladly demonstrate and supply—or send for the "Lissenola," post free by return, from the makers—price 13/6 or with Lissen Reed 14/6.

BUY THE LISSENOLA

and build your own Loud Speaker

Lissen Limited, 30-32, Friars Lane, Richmond, Surrey

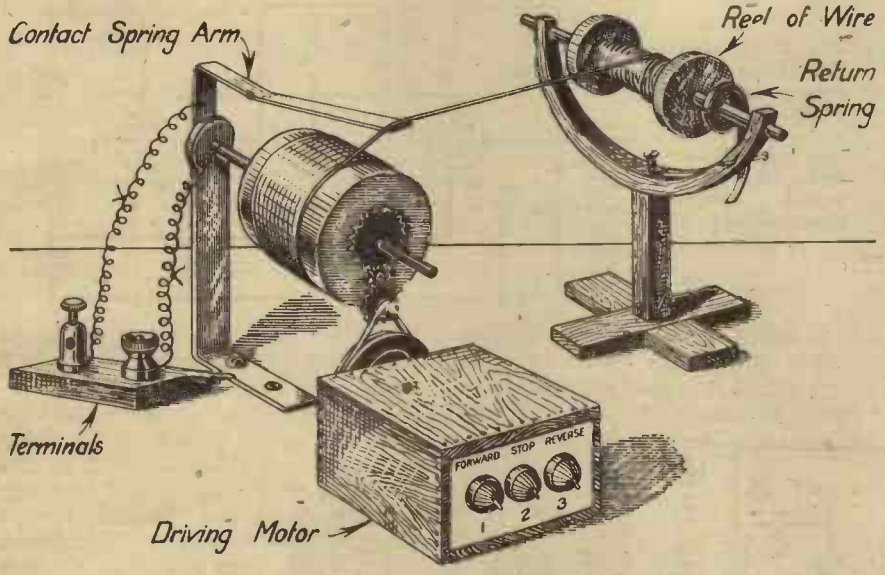
'Phone: Richmond 2285 (4 lines). *'Grams: "Lissenium, 'Phone, London."*

L17

be found in the coils. By means of our remote control coil changer we had already done something to alleviate the sufferings of the great mass of wireless folk, but this wonderful device was not a complete solution since it did not eliminate knobs. The desired end can be attained only if variable condensers are done away with, and to make this possible a means must be found of making the inductances an exact fit, so to speak, for the frequency which it is desired to receive.

What We Want

The broadcast wavelengths can be covered quite simply by making up a set of fifty or sixty coils for each holder and using a rather complicated form of the remote control changer. There are, however, certain drawbacks to this method, into which we will not enter here. What obviously is needed is a coil that is infinitely and automatically variable, and this is precisely what the Professor and I have evolved between us.



. . . *the new invention is really very simple to make* . . .

Solved!

The Goop-Wayfarer automatic inductance coil is certain to leap into instant popularity among wireless enthusiasts. Though it is barely a week since we described the device in a lecture to the members of the wireless club there is now not a variable condenser in Little Puddleton. Nor is there a clock left in the place whose innards are intact, since all have been dismantled in this brief period to provide the gear wheels and the driving mechanism necessary for the operation of the apparatus, as well as the return spring which, as we shall see, is so important a part of its works.

The Apparatus Described

A glance at the drawing upon this page will enable the reader to form at once an idea of the simplicity and the effectiveness of this latest production of our fertile brains. Upon a horizontal spindle, supported by a neat bracket screwed to the panel of the receiving set, is mounted the coil-former, which may be of any convenient design. This may be made to rotate in either direction by means of the driving motor which is yoked to it by pulley wheels and a belt, with a train of gear wheels.

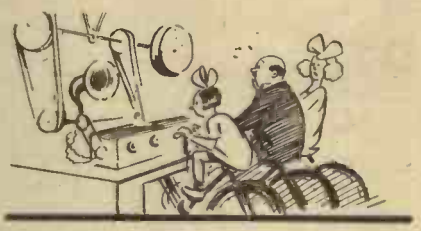
Upon the box containing the driving motor are three buttons, which are pressed as required, but *not* twiddled. Pressure applied to the first of these causes the coil former to revolve in a forward or anti-clockwise direction, the rotary movement continuing until a finger is placed upon the second button, which instantly stops the mechanism. The third is the reverse. When this is pressed the former revolves in a clockwise sense.

Where the Spring Comes From

Mounted upon a suitable stand of artistic design is a reel of bare wire to the spindle of which is fixed a spiral return spring, which is readily obtainable at the present time since the boys are back at school, and their clockwork engines contain exactly what is needed. The end of the wire upon the reel is anchored to a screw on the former, which is in electrical contact with the spindle. The latter passes through a spring bush from which a lead is taken to one of the terminals. From the other terminal a wire runs to the spring contact arm, whose far end presses gently but firmly upon the wire.

Operating the Device

With the Goop-Wayfarer automatic inductance coil tuning becomes a pleasure. Let us suppose



. . . *one of the prettiest sights* . . .

that you wish to receive 2LO. All that you have to do is to press button No. 1, which causes turns of wire to be wound on to the former. Meantime you listen carefully. Faint at first, but growing stronger and stronger, the desired signals are heard. When they have reached their full volume button No. 2 is pressed, upon which the mechanism comes to rest. You see how delightful the process is.

Appreciation

One of the most enthusiastic converts to the automatic coil is Poddleby, who has fitted it as the aerial tuning coil and for both the anodes of his five-valve set. Not being of a strikingly mechanical turn of mind, Poddleby had some difficulty with the clockwork driving mechanism, which he could never get to work satisfactorily. He has therefore discarded motors in favour of pedals. Beneath the table which supports his receiving apparatus he has fixed up the frames of three old bicycles, complete with saddles.

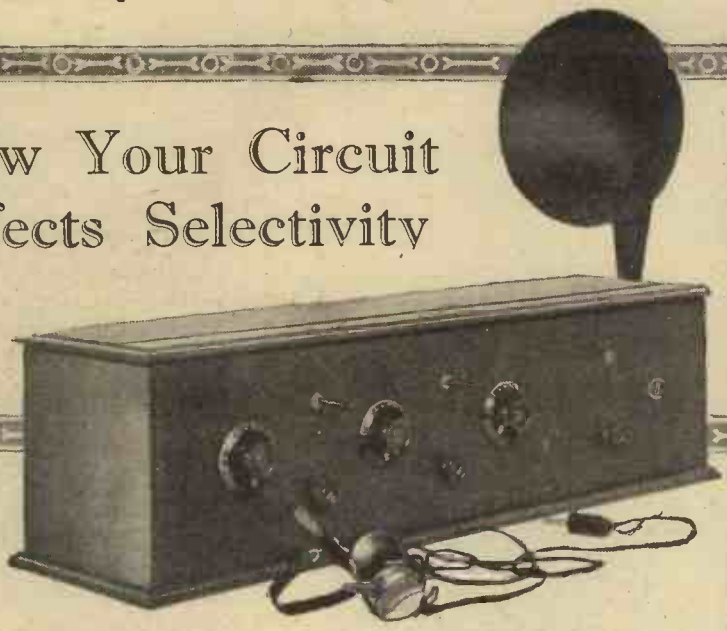
A Pretty Sight

Finding it impossible himself to work the three sets of pedals simultaneously he has trained the two elder children to assist him. It is one of the prettiest sights in the world to see them, Poddleby upon the aerial tuning bicycle and his two little daughters upon those which control the anode coils, pedalling in the transmission that they wish to hear. Always up to date, Poddleby calls the new pastime kilocycling, and adds that nobody engaged in it could possibly think in the old-fashioned wavelengths.

WIRELESS WAYFARER.

How Your Circuit Affects Selectivity

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



IN the attack on the problem of selectivity which has been in progress for some months now, in fact, ever since Mr. Harris returned from America, we have turned our attention to various portions of the complete circuit in a wireless receiver in an endeavour to locate the causes of poor selectivity.

The Aerial Circuit

Recently the aerial circuit has had a great deal of attention. Mr. G. P. Kendall has shown that by the use of auto-coupling or using a separate "tight-coupled" aerial winding it is possible to increase the selectivity of the aerial circuit very considerably. Further, there are certain disadvantages in the method due to the fact that the aerial only tunes over a comparatively small band for any particular value of coupling coil, so that some form of tapped arrangement is desirable.

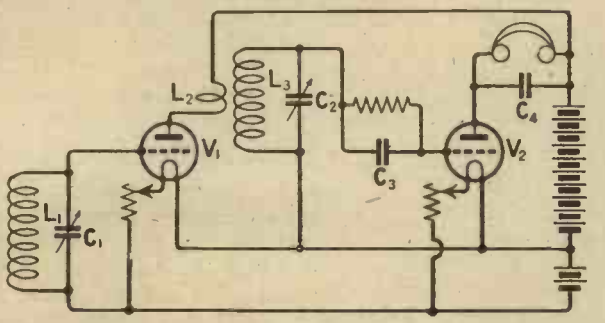


Fig. 1.—To make this circuit stable it is usual to couple L2 only loosely to L3.

Three Circuits Necessary

It is proposed in this article to discuss the question of selectivity in these later stages of the receiver. It is well known that adequate selectivity cannot be obtained with only one tuned circuit, and in order to obtain complete elimination of the local station at ranges of the order of 5 miles and still to receive stations only some 10 or 15 kilocycles away, it is really necessary to employ at least three tuned circuits if satisfactory quality of reproduction is to be obtained.

I propose, therefore, to discuss several types of intervalve couplings, and to indicate to some extent their relative advantages, and defects. In all cases I have not shown the aerial circuit because this may have any one of the various forms which have been considered previously in these columns, and such questions come outside the scope of the present discussion. In most cases two valves only are shown, as further stages may be added in a similar manner if desired.

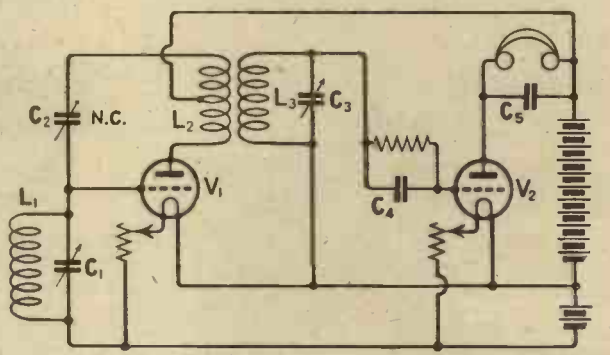


Fig. 2.—A simple "split-primary" scheme of stabilisation. Since the author is discussing intervalve circuits the aerial coupling arrangements are omitted.

Transformer Coupling

The first type of inter-valve coupling is that employing a high-frequency transformer. Fig. 1 shows the simplest type of transformer coupling. Here the coil L2 is in the anode circuit of the valve V1, this coil being coupled to the coil L3, which is tuned, and the voltage developed applied across the grid and filament of the second valve. This type of circuit is not a particularly good one, because if the coupling between L2 and L3 is made reasonably high, in order to obtain a useful degree of amplification, the whole circuit tends to self-oscillate. L2 in practice may be 20 or 30 turns on a former, 1 or 1½ in. in diameter, the actual number of turns depending mainly on the number of stages of amplification employed. L3 may be an ordinary single layer solenoid of sufficient inductance to tune over the required band of frequencies.

Neutrodyning

The circuit shown in Fig. 2 is an improvement on this arrange-

Praesis ut prosis

Latin motto: "Be first that ye may be of Service"

Brown Type H4

THE success of the Brown Loud Speaker runs parallel with the rapid growth of Broadcasting. Each year has seen the Brown more firmly established in public favour. Its long lead—for the Brown was the first Loud Speaker ever built in this country for wireless use—has never been seriously challenged.

True, the immense wave of popularity it has consistently enjoyed has often made a temporary shortage unavoidable. But S. G. Brown Ltd. have remained steadfast to an ideal—the continued production of a series of Loud Speakers worthy of the great reputation enjoyed by Brown Wireless instruments throughout the world.

Not for one moment would they permit a hair's breadth deviation from this most rigid standard of manufacture. Whether a man pays thirty shillings for a Brown H.4 or fifteen guineas for a Brown Q type, he obtains the same quality of materials, the same careful workmanship—and therefore the same dependable Service.

S. G. Brown Ltd., Western Avenue, N. Acton, W.3

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19 Mortimer Street, W.1
15 Moorfields, Liverpool
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Depots (Wholesale Only):
13 Bushy Park, Bristol
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Scottish Depot:
120 Wellington Street, Glasgow.

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Eight Types of Brown Loud Speakers

Type H.1.	Type H.2.	Type H.3.	Type H.4.
21 ins. high. 120 ohms £5 5 0 2000 ohms £5 8 0 4000 ohms £5 10 0	Height 12 ins. 120 ohms £2 5 0 2000 ohms £2 8 0 4000 ohms £2 10 0	15 ins. in height and in resistance of 2000 ohms £3 0 0	The smallest Brown Loud Speaker. Only 10 ins. high. 2000 ohms £1 10 0

Type H.Q.	Type Q.	Cabinet Type	Crystavox
20 ins. high. Resistance: 2000 or 4000 ohms £6 0 0	23 ins. high. In resistances of 120, 2000 or 4000 ohms £15 15 0	In Mahogany or Oak Cabinet, 2000 or 4000 ohms £6 6 0	The only Loud Speaker which works from a Crystal Set. £6 0 0

—three types of Headphones

Type A.	Type F.	Type A.2.
As used by the Admiralty 120, 2000 or 4000 ohms £2 10 0 8000 ohms £3 0 0	Popular Broadcast type. Weight only 6 ozs. 2000 ohms £1 0 0	The New reed-type, unequalled for sensitiveness. 2000 ohms £1 10 0

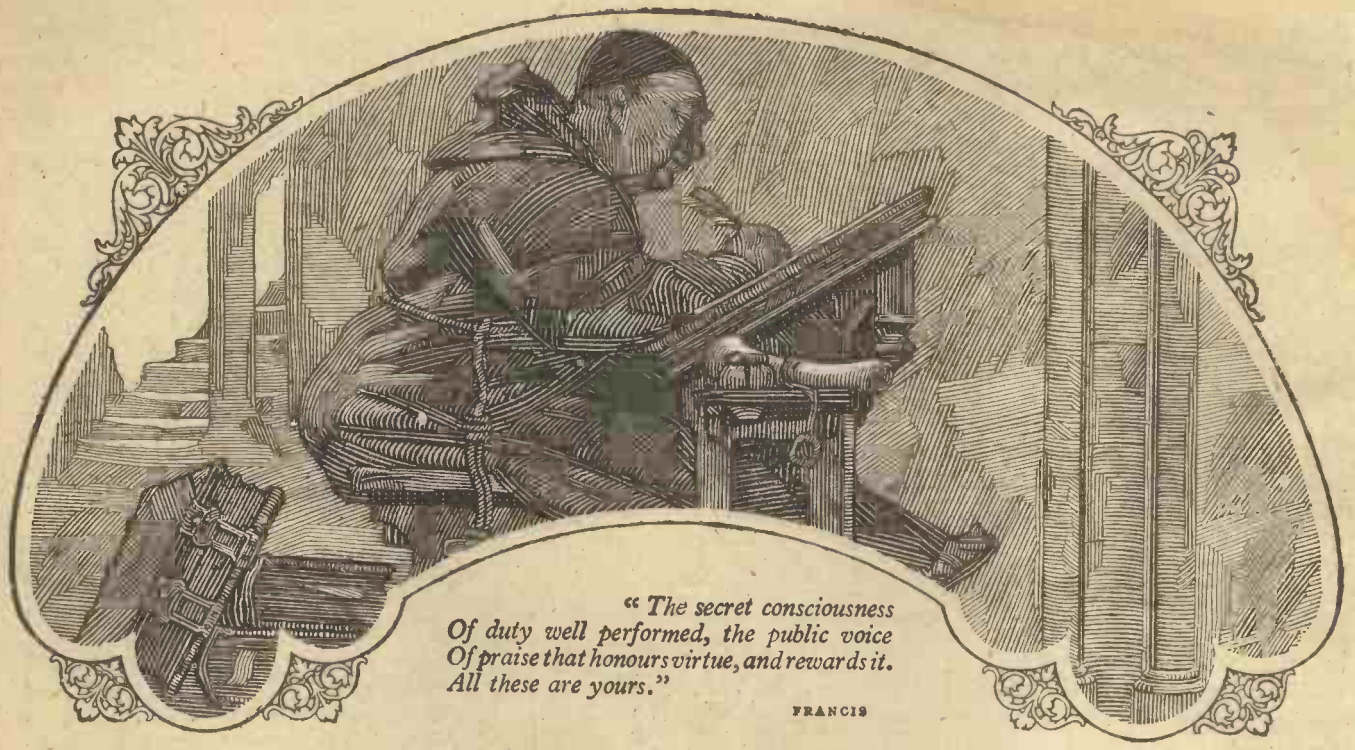
and two Gramophone Adaptors

For converting your Gramophone into a Loud Speaker — H.1 (2000 ohms) £4 10 0; H.2 (2000 ohms) £2 0 0

¶ If the Trade have difficulty in obtaining Brown Wireless Instruments they should write to us without delay.

Above: Type HQ
Below: Type H3

Gilbert Ad. 4627.



"The secret consciousness
Of duty well performed, the public voice
Of praise that honours virtue, and rewards it.
All these are yours."

FRANCIS

Of Duty well performed . . .

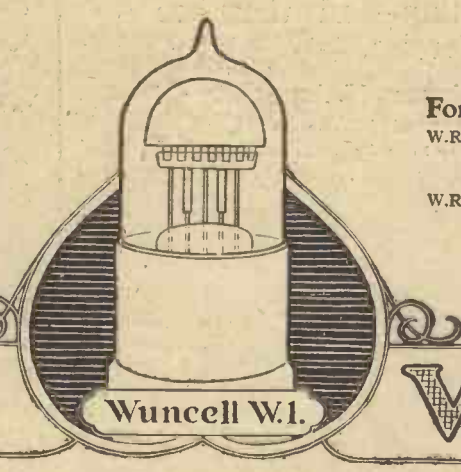
THE monk in his cell—the worker at the bench. Between these two a great gulf, yet by one common bond they are united. The bond of Duty. No monk ever possessed more enthusiasm for his tasks in life than those loyal workers—men and women alike—engaged in the business of making Cossor Valves. Without their co-operation—so cheerfully and willingly given—the nation-wide reputation for long service and dependability enjoyed by Cossor Valves must inevitably suffer.

Whether you buy your Wuncell Dull Emitter in Eastbourne or Edinburgh, in Canterbury or Carlisle, its unique standard of performance will be worthily and creditably maintained.

Long life—exquisite purity of tone—unequalled sensitiveness—supreme economy of operation—all these features are ensured in the Wuncell by reason of its patented design and construction. Only the arched filament in combination with a hood-shaped Grid and Anode—by utilising almost the whole of the electron stream—can achieve such magnificent and unparalleled results.

For 2-volt Accumulators.

W.1. For Detector and L.F. use - **14/-**
Consumption : .3 amp.
W.2. (With red top) For H.F. use **14/-**
Consumption : .3 amp.
W 3. The Loud Speaker Valve **18/6**
Consumption : .5 amp.



For 2, 4 or 6 Volts.

W.R.1. Similar to W.1 but with special resistance which can be short-circuited when not required - - **16/-**
W.R.2. Similar to W.2 but with resistance as above - **16/-**

A. C. Cossor, Ltd. Highbury Grove, N.5

Cossor Valves

Gilbert Ad. 4614

AN ADVERTISEMENT IN "WIRELESS WEEKLY" IS A GUARANTEE OF SATISFACTION TO BUYERS.

ment, because in this case the coil L2 is made twice as large as in the previous case, and the high-tension

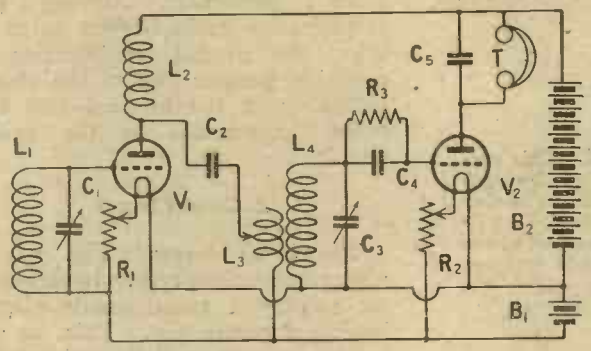


Fig. 3.—In this circuit a shunt coupling scheme is employed.

tapping is taken to the middle of the coil. The other half of the coil is then used as a neutralising winding, being connected by the condenser C2 to the grid of the valve V1. By this means it is possible to make the coupling somewhat tighter, and to obtain a really useful degree of amplification without self-oscillation.

Capacity Coupling Must be Small

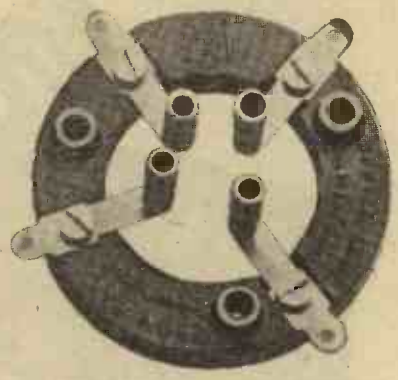
In all cases of transformer coupling it is essential that the actual capacity coupling between the primary and secondary of the transformer shall be kept as small as possible. For this reason it is customary to wind the primary in a very compact form, and place it at one end of the secondary winding. An example of this is the transformer employed by Mr. Harris in his "Special Five."

Other Methods

Still another method of transformer coupling is shown in Fig. 3. Here the high-tension lead to the valve V1 is through a choke coil L2. The high-frequency current then passes through the condenser C2 and the coil L3 back to the filament of the valve. The coil L3 is the primary of the transformer, and the energy is transferred to the circuit L4 C3 in the normal manner. C2 may be fairly large, of the order of .001 μF, and the coil L3 may be tapped in order to obtain the best coupling for any particular arrangement. The total number of turns in the coil L3 should be 30 to 35 turns, as in the previous case, and, in fact, the transformer may be made on similar lines.

Auto-Tapping

We can, of course, replace the separate windings L3 and L4 by a tapped coil, and the circuit in Fig. 4 shows such an arrangement. Here the high-frequency component of the anode current of the valve V1 passes through the condenser C2 on to a tapping on the coil L3. This tapping may be variable if desired, or, as in the case shown, the tapping may be fixed, and the condenser C2 variable. This controls the amount of high-frequency current flowing in a manner somewhat similar to the



To minimise capacity feed-back troubles various patterns of low-capacity valve sockets are now obtainable.

reaction control in a Reinartz receiver, and the amount of energy passed on can thus be controlled. The smaller the condenser the less the damping introduced by the previous valve and by using a very small (neutrodyne) condenser it is unnecessary to tap the coil.

A Practical Point

This arrangement has the advantage that one of the various types of tapped plug-in coil on the market may be employed for L3. The auto-tapped transformer, however, does not give such selective results as are obtainable with a well-designed transformer having separate windings.

Greater Efficiency

Both the last two methods obtain their stability by so controlling the amount of energy handed on from the first valve to the second that there is not really sufficient feed-back to produce self-oscillation. This, of course, means the valve is not developing its full power, and the circuit shown in Fig. 5 employs a neutrodyne arrangement to overcome the trouble due to self-oscillation.

The actual method of inter-valve coupling is the same as in the previous circuit, but the grid coil of the valve V1 is centre-tapped, the tapping being taken to the filament, and the end of the coil remote from the grid being connected by means of a neutrodyne condenser to the anode of the valve.

A Disadvantage

This will enable stable and symmetrical neutralising to be obtained, and, of course, this method could be applied to any of the circuits previously shown. The disadvantage of this type of circuit is that the voltage applied across the grid and filament of the valve V1 is only half of the effective voltage. This is a real disadvantage, because if the valve V1 is working correctly there is no appreciable grid damping, so that there is nothing to be gained by tapping the valve across part of the coil only, and there is a perfectly definite and irretrievable loss from this source.

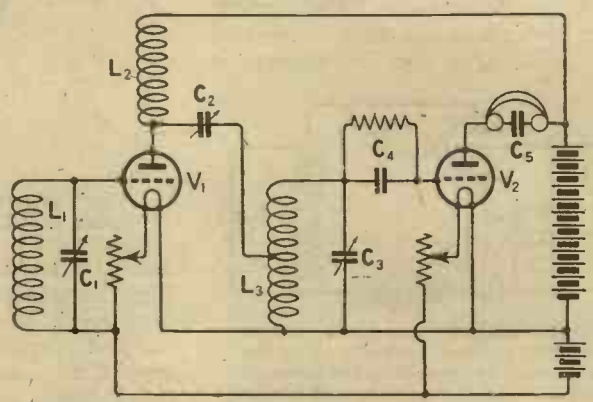


Fig. 4.—By making C2 variable a fixed connection to L3 may be employed (compare with Fig. 3).

Tuned Anode Arrangements

This does not apply in the case of tuned anode circuits, which we shall

consider next. Here the internal impedance of the valve, which is to all intents and purposes a very high resistance, is shunted across the

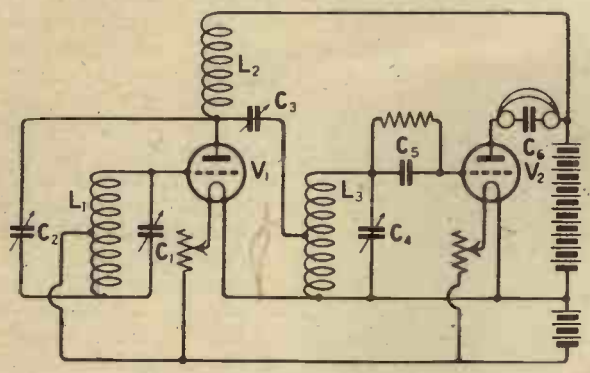


Fig. 5.—This circuit, although capable of being stabilised, only applies half of the available voltage to the grid of V1.

tuned circuit of the valve. It will be clear from the skeleton circuit in Fig. 6, as Capt. Round has previously pointed out in *Wireless Weekly*, that the effect of this resistance, although it is of the order of 20,000 or 30,000 ohms, is quite appreciable, and introduces extra damping into the circuit. This explains the fact often noticed in practice that the ordinary tuned anode arrangement is not very selective.

Improving the Selectivity

This difficulty may largely be overcome by tapping the valve across part of the tuned circuit only, and Capt. Crowther has shown that the effect of tapping is very marked both as regards the selectivity and signal strength.

The lower the impedance of the valve the further down the tapping point has to be. After a really high impedance valve such as is made exclusively for high-frequency purposes, having an impedance of 50,000 or 60,000 ohms, the tapping may be high as the middle point of the coil. As the impedance is

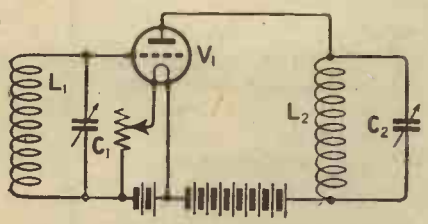


Fig 6.—This skeleton circuit shows that the internal impedance of the valve may be considered as being in parallel with the tuned circuit L2C2.

reduced so the tapping point moves further down the coil, and down as far as one-third of the coil there is not very much to choose between valves of different impedances.

High Impedance Valves

Below this point, however, if the optimum tapping point is obtained to produce the required selectivity, the signal strength begins to fall off somewhat rapidly. With the tuned anode arrangement, therefore, it is essential to use a valve having a high impedance, because this form of circuit is essentially an impedance-coupled arrangement, the whole amplification being developed in the valve itself, and not through any step-up in the coupling between one valve and the next.

An Exception

These remarks concerning valves do not apply to transformer-coupled circuits. In such cases the impedance of the primary is comparatively low so that a lower impedance valve is preferable. Although the amplification ratio of the valve is lower the overall amplification is probably greater due to the closer matching of the internal and external impedances in the anode circuit.

A Good Circuit

The circuit shown in Fig. 7 is of a very convenient type. In this case we employ a tuned anode circuit having a centre tap. This, as we have just seen, will be satisfactory if a high impedance valve is employed for the purpose. The valve itself is only tapped across half the coil, the remaining half of the coil being employed as a neutralising winding operating through the condenser C2.

The "Huntsman Two" receiver, described by Mr. Harris in the March issue of "The Wireless Constructor," employs a split grid coil circuit.

This type of circuit in single stages is very satisfactory. Where more than one stage is employed, however, troubles occur due to the production of parasitic oscillations. This subject was dealt with in the February issue of *Modern Wireless*, and will not be discussed here as it is rather outside the scope of this article.

Grid Current and its Effect

Another method of employing a tuned arrangement is that shown in Fig. 8. Here the full voltage across the condenser C3 is applied across the grid and filament of the valve V2, improved selectivity being obtained by tapping the anode across part of the coil L2 only. The advantage of this is, of course, to a large extent discounted by reason of the damping that is produced by the grid current rectification employed in the valve V2.

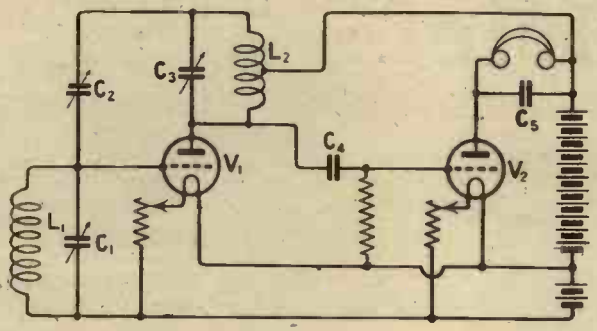


Fig. 7.—This circuit yields improved selectivity as a result of the splitting of the coil L2.

Neutrodyning is obtained by employing a split coil for the grid circuit of the valve V1, the centre tapping of this coil going to the filament, and the end remote from the grid circuit being connected through the neutrodyne condenser C2 to the anode. This is, of course, a definite disadvantage in that as in the previous circuit, only half the effective voltage of the grid circuit is applied across the valve itself. Thus the advantage of this arrangement over the previous one is somewhat problematical.

All Circuits Tuned

In view of the developments which have been made in neutrodyning, it is surprising that we have not attempted the old form of circuit employing both tuned anode and tuned grid circuits. This type of circuit was employed by N. P. Hinton, of the Post Office, to obtain a highly-selective receiver. In order to reduce self-oscillation, however, the coupling between the various circuits had to be extremely weak, and the overall amplification of the arrangement was very poor.

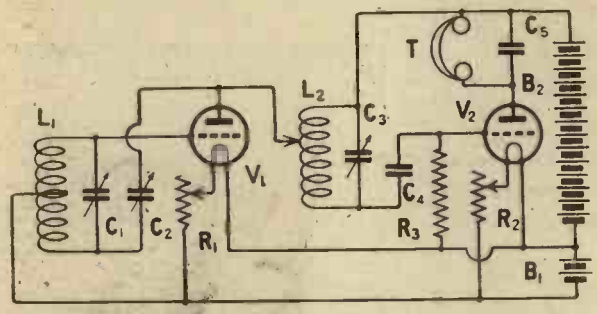


Fig. 8.—High selectivity is obtainable with this circuit.

The circuit shown in Fig. 9 employs a neutrodyned tuned anode arrangement for the valve V1. This circuit, instead of being directly coupled to the valve V2, is loosely coupled by means of a coil L3 to another tuned circuit, L4 C4, which is applied across grid and filament of the valve. In this manner it is possible to obtain the requisite three tuned circuits with only two valves, and in view of the fact that neutrodyning is employed there is no reason why the set should not be stable, and why good amplification should not be obtainable.

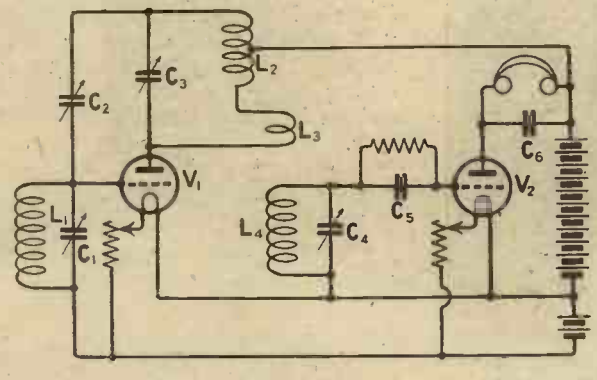


Fig. 9.—A circuit much commended by the author. Both selectivity and sensitivity are high.

WIRELESS LICENCES: The Year's Receipts

A White Paper just issued states that the actual receipts for wireless licences during the year ended March, 1925, was £685,593. In the actual statement of accounts the income for licences issued to the public is returned at £599,261, of which £472,003 is shown to be payable to the British Broadcasting Company, the department retaining £127,258, which is subject to certain adjustment. During the previous year receipts for licences issued totalled £250,055. Licences of the B.B.C. during 1924-25 are returned at £803, compared with £366 in the previous year.

Expenditure

On the expenditure side of the account it is shown that administration expenses at headquarters in respect of the issue of licences were £23,770 (in 1923-24 the figure was £23,560), and issue to the public cost £50,411, against £14,463. The year resulted in a surplus of £54,346, over double the previous figure of £20,729.

A Deficit

Wireless services of the Post Office resulted in a deficit of £27,915, which, with a further sum of £7,736 for experimental work and interest on capital, makes the deficit for the year £53,358. Messages, fees, etc., provided an income of £164,342.

Totals

The following table shows the Post Office income from the principal business transacted :—

	1924-25.	1923-24.
Postal	£35,265,034	£33,415,855
Telegraph	4,981,580	5,146,779
Telephone	14,782,229	14,367,263

Wireless News in Brief.

Forthcoming B.B.C. Items. February 21.—Cardiff (3.0 p.m.): The Squire Celeste Octet. February 22.—London (9.45 p.m.): Boxing at the National Sporting Club. February 23.—Manchester (8.0 p.m.): "The 7.30 Revue," relayed from the Grand Theatre, Bolton. February 24.—8.0 p.m.: Separate programmes from all stations.

* * *

Wireless Licences. That the possession of a wireless set without a licence for it may prove expensive is shown by a recent prosecution. The offender was charged both with possessing a wireless set and with using it without a licence. In another case the magistrate ruled that the licence must be obtained before the parts of a receiver are put together, and that the liability to pay is not obviated if the set will not work.

* * *

Wireless Operators' Strike. We understand that at the time of going to press some progress has been made towards a settlement of the strike of wireless operators. A conference of both parties concerned took place last week, owing to the efforts of the Ministry of Labour to bring about an agreement.

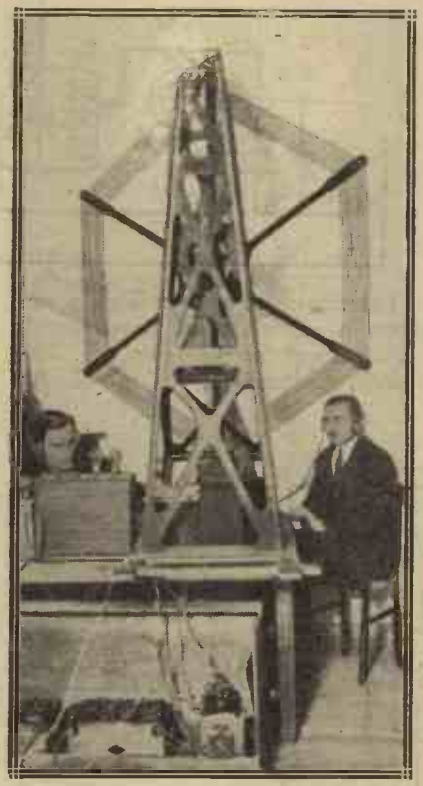
* * *

Crowland Abbey Bells. On the occasion of the second broadcast of the bells of Crowland Abbey, near Peterborough, on February 7, the telephone line was apparently cut within two minutes of the commencement of the broadcast. Other lines were brought into service, and the bells were successfully broadcast at 10.30 p.m. instead of at 8 p.m., as previously arranged.

It may be recalled that when the Crowland Abbey Bells were broadcast last October, some unknown person cut the telephone lines, but the wrong line, so that no interference was caused.

Broadcasting News. The Saturday afternoon programmes are to be revised in future. The talk with which this programme usually opens will be given at 4.45 p.m., and will be preceded by the Children's Corner.

On March 8 a special broadcast



Considerable additions have recently been made to the wireless equipment at the aerodrome at Le Bourget, part of the D.F. apparatus being shown in this view.

will take place from 10.30 to 11.0 p.m., when a submarine diver will tell of some of his experiences. This will be followed by a descent into the River Thames.

* * *

The Musicians' Union. We understand that the proposed ban by the Musicians' Union on theatre and cinema broadcasting was withdrawn last week, when the B.B.C. agreed to enter into negotiations with the Union on the subject of special fees. It was believed that an arrangement satisfactory to both parties could be reached.

* * *

B.B.C. Censorship. The play "Mr. Abdulla," part of which was to have been broadcast on February 8, was not transmitted as arranged. It is stated that Captain Reginald Berkeley, the author of the play, withdrew his permission for the performance owing to the action of the B.B.C. in cutting his play, "The Quest of Elizabeth," broadcast on February 5. The B.B.C. announced that they reserve their rights of censorship of all items submitted for broadcasting, and that they therefore cancelled the proposed broadcast of "Mr. Abdulla" owing to Captain Berkeley's complaint about "The Quest of Elizabeth," and his request that they give an undertaking not to exercise the right they claim of cutting items when necessary.

* * *

Dance Music. Commencing with the first Friday in March, dance music will in future be broadcast from Daventry on the first Friday in each month from 12.0 to 2 a.m. The present arrangement, whereby dance music is provided by both London and Daventry from 8 p.m. till midnight on the last Saturday in each month, remains unaltered.

* * *

German Radio Exhibition. About 400,000 visitors attended the second German Radio Exhibition recently held in Berlin. It appears that the Exhibition was not a commercial success, very little actual business being done.

This Week's Interview

No. 1.—Mr. J. H. REYNER.

These actual interviews, taken down in shorthand, incorporate a series of questions specially framed to benefit the greatest number of readers, all irrelevant matter being rigidly excluded.

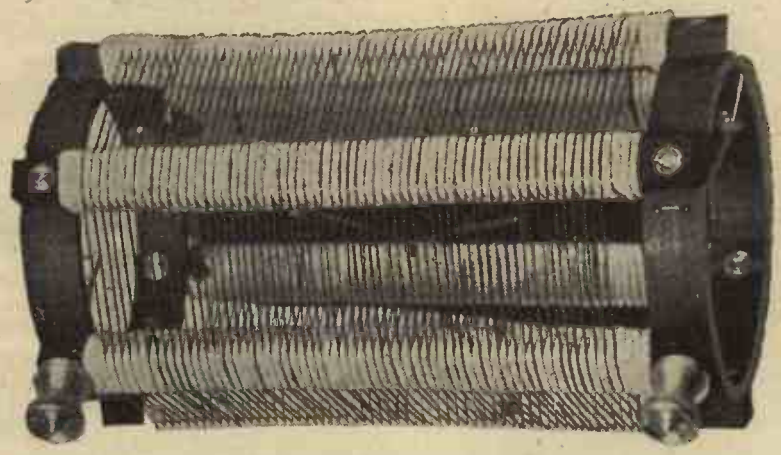
WHAT IS AN EFFICIENT COIL?

A recent portrait of Mr. Reyner, who becomes the Technical Editor of "Wireless Weekly" from this issue.

Q.—I have noticed from some of your research work that there appears to be considerable doubt as to whether thick wire coils are the best. Since thick wire coils have the lowest high-frequency resistance, is it not correct to assume that the best results would be obtained with them?

A.—You are mistaken in assuming that thick wire coils *have* the lowest high-frequency resistance. A straight, thick wire, say, 1 ft. long, will certainly have a lower H.F. resistance than a thinner wire, but in the case of a coil you have to consider its size, shape spacing of turns, etc.

Q.—Supposing I wanted to wind a coil on a 3½-in. tube, which would enable me to tune in 2LO. I presume that in such a case it would be better to use, say, a No. 16 double cotton-covered wire as against a No. 30 double cotton-covered wire?



Mr. Reyner has shown that the long coil of thick wire is not really "low-loss."

A.—No. That is a very common fallacy which has led even experienced research workers into error. The No. 30 gauge wire coil would have a lower H.F. resistance and would give better signals when used in a receiver.

Q.—But such very fine wire as No. 30 gauge would surely have a very much greater ordinary D.C. resistance than the thinner wire?

A.—That is so, but it does not alter the fact that the size and shape of the coil more than balances out the obvious disadvantage of using fine wire. I ought to remind you that by high-frequency resistance the ordinary or D.C. resistance of the wire is included. On this point it should be noted that it is not the full D.C. resistance of the wire which counts, but only the D.C. resistance of the outer layer, since H.F. currents only travel on the outer surface of the wire, this being, of course, what is known as the "skin" effect. To all intents and purposes, the inner portion of the wire might be taken away, thus leaving a tube.

Q.—Of course, I understand the well-established fact that H.F. currents only travel through a very thin skin on the wire, but I do not see quite why you should put this forward as a reply to my suggestion that the No. 30 wire, having a very high ordinary resistance as compared with the No. 16, will also have a very much greater H.F. resistance. I understand that the ordinary D.C. resistance of the wire is only one factor in the H.F. resistance, the other factors, of course, being losses in the insulation of the wire and the former, etc. Surely, if the ordinary resistance of the wire is quadrupled by using, say, a wire of half the diameter, then that part of the H.F. resistance would also be quadrupled.

A.—No. By halving the diameter of the wire you are certainly getting four times the ordinary resistance because the direct current flows uniformly through the wire; H.F. currents, however, flow only on the surface of the wire, so that the ratio of the amount of metal used in both cases is really the ratio of the circumference of the thick wire to the circumference of the thin wire. The circumferences, of course, are directly dependent upon the diameter of the wire. In the particular example the thin wire is half the diameter of the thick wire, and therefore its circumference is only half that of the thick wire. Since the circumference is really the only part of the metal through which the H.F. current flows, it will be seen that the H.F. resistance of the small wire will be twice that of the thick wire, and not four times, as you thought.

Q.—I would like you to explain how the other advantages of thin wire more than outweigh the resistance disadvantage, which I now see

is less than I thought, but which you admit still remains very important.

A.—By using finer wire it is possible to have a much shorter coil. If, for example, a certain coil on a 3½-in. former is 6 in. long, then if the same coil is wound with wire half the diameter, the length of the coil will be reduced to 3 in. By using a shorter length coil the whole efficiency improves very greatly.

Q.—I do not see how merely shortening the coil is going to make any difference to its H.F. resistance. If you keep the number of turns the same, surely the inductance and other properties of the coil will remain more or less the same?

A.—Reducing the length of the coil makes a very appreciable difference to the inductance. It is quite commonly thought that the inductance of a coil is proportional to the number of turns; that is to say, a 100-turn coil will have twice the inductance of a 50-turn coil. This would be correct if we had two separate coils separated from each other but joined in series. If, however, the two coils are wound in the form of a single coil of 100 turns, then there is a mutual effect between the coils helping each other so that the total inductance is much greater.

Q.—I remember now the famous Nagaoka formula for inductance, which states that the inductance is proportional to the square of the number of turns. In other words, I suppose a 100-turn coil would have four times the inductance of a 50-turn coil?

A.—That would be perfectly true if the length of the coil were the same, but of course the ordinary coil containing double the number of turns would be double the length if the wire were the same. Nagaoka introduces into his formula the important factors of length and diameter of the coil which act in an opposite direction to the "square of the number of turns effect" elsewhere in the formula. The net result is that the inductance would be somewhere between two and four times as much for a 100-turn coil as for a 50-turn coil, assuming the same wire is used in each case.

Q.—Well, you propose winding your coil with fine wire and so getting a shorter coil. How will the inductance of this coil compare with the inductance of the longer coil of thicker wire?

A.—The inductance will be considerably greater owing to the shortness of the coil, the reason being that there is a better linkage or coupling between the various turns of the coil, and it is this coupling effect which builds up the inductance. If you take an extreme case and had one turn of a coil at one end of a room and the last turn at the other end, these turns would have practically no effect on each other, whereas if all the turns are wound closely together a greater inductance for the whole coil is obtained.

Q.—Well, admitted that by having a shorter coil you gain a greater inductance, how does this affect the high-frequency resistance of the coil, which is what I am chiefly concerned with?

A.—The finer wire coil would have a high-frequency resistance greater than the longer coil of thicker wire, but since the inductance has been greatly increased by getting the turns closer together we can take a large number of turns off the fine wire coil in order with a given condenser to tune over a certain wavelength band. When comparing one coil with another as regards H.F. resistance, we have to compare coils of equal inductance, not coils having the same number of turns. By taking off turns from the fine wire we are, as it were, taking off losses all the time, so that the remaining useful portion of the coil ultimately becomes more efficient and has less high resistance than the original long thick wire coil.

Q.—Would you say, then, that thick wire coils are less efficient than fine wire coils?

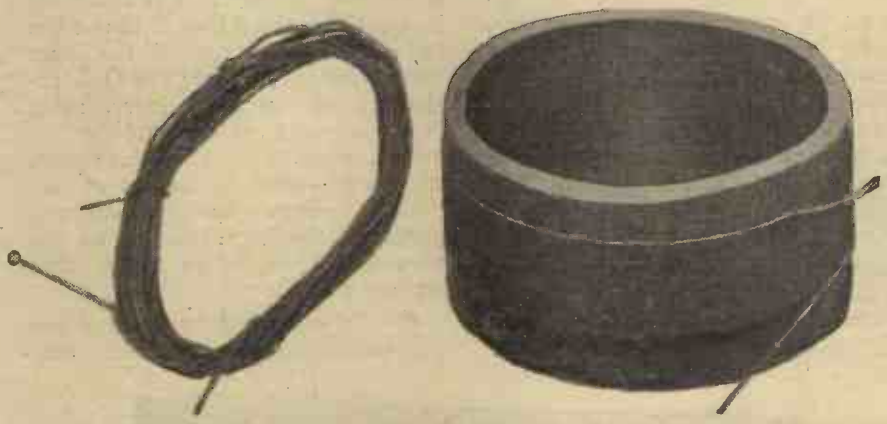
A.—No such sweeping statement can be made. I think a fine wire coil is best where space is confined and a compact coil is necessary, which is usually the case.

Q.—I have quite frequently seen recommended by designers of standing the use of thick wire in preference to thin. How do you explain this?

A.—Provided the coil is not long compared to the diameter, then, as I have already said, thick wire has its advantages. You will usually find that thick wire coil enthusiasts wind their coils of large diameter and avoid having them too long. Such coils are perfectly satisfactory, but take up a large amount of space. On the other hand, those who use *long*, thick wire coils are defeating the object they have in view. It is impossible to say that thick or thin wires are best unless the circumstances are explained.

Q.—What about the thick bare wires so frequently used on very short wavelengths?

A.—This is a case where only a few turns are used, and it is possible to use thick wire without making the coil long.

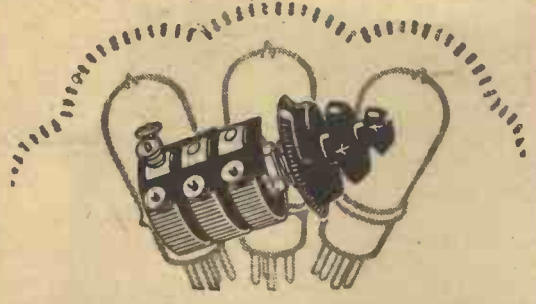


Short coils, even though they may have been wound with thin wire to keep down their size, may be designed to give quite a low resistance.

Q.—What about the other factors which govern the high-frequency resistance of a coil such as dielectric losses, spacing of turns, etc.?

A.—The dielectric losses which cause H.F. resistance are due to the electrostatic field set up between different turns of the coil. This varying field sets up waste currents in the dielectric which has its temperature increased, although, of course, in a receiving circuit this wastage of energy is not perceptible in the form of heat. In the case of the Leafield or Northolt arc stations it is very important to use suitable material for supporting the giant inductances which carry hundreds of amperes of H.F. current. Many excellent insulators which were tried either split, became disintegrated or even caught fire. I might mention

(*Continued on page 35.*)



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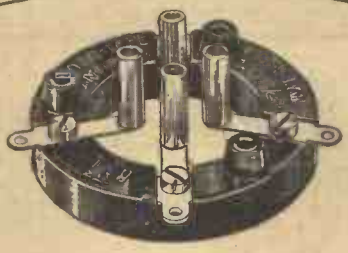
Send for particulars of the 'Radiopal'—the four valve portable receiver described by the 'Wireless Times' as far and away the most interesting instrument at the Horticultural Hall Show.



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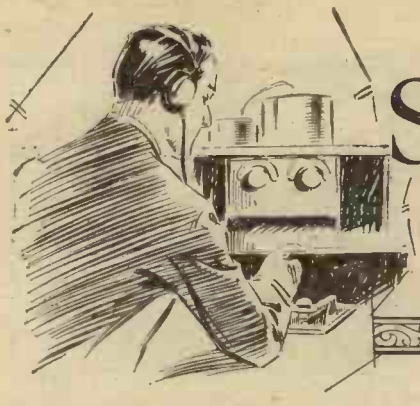


SHORT-WAVE Notes & News

JUST as the writer was beginning to get rather tired of short-wave work, and evacuated the 6,667-kc. band with a view to doing some work on 3,333 kc. (90 metres), or even 2,000 kc. (150 metres), a striking improvement in conditions occurred. On Sunday, February 7, some very good "DX" work was done by several of the British stations.

Another Record

2LZ and 2KF have at last established communication between this country and New Zealand in the evening. 2KF worked Z-2AC at 17.30 G.M.T. His signals were reported as R5, though he was only receiving 2AC at R2. He also worked O-A6N, and attempted to put him in touch with Z-2AC, but A6N reported that, though he could hear that 2AC was there, he could not possibly read him.

Crystal Control at 2KF

2KF has now got his crystal-controlled transmitter working properly, and boasts a note "like NKF"! His receiver is not neglected apparently, as he reports hearing PI-1CW, FI-8QQ, FI-8LBT, FI-3MA, and some Canadians early in the evening. All this work was done on February 7.

6NF believes in what might be termed "mass working"! He has been in communication with 260 U.S.A. stations, and has been heard in all the U.S. districts, not to mention Australia, New Zealand, China, India and any other places that are left! His signals seem to be reported as R6-7 everywhere.

South African Schedules

South African stations are very anxious to arrange tests with and receive reports from British stations. They are keeping the following times especially for this purpose:—

Mondays, Wednesdays and Fridays.—15.30-16.30 G.M.T.

Tuesdays.—15.30-18.30 G.M.T.

Saturdays and Sundays.—15.30-17.00 G.M.T.

Every day.—20.30 G.M.T. onwards and 03.00 G.M.T. onwards.

If the addresses of any South African stations heard are unknown, cards may be sent to Mr. Heywood (O-A3E) at 91, Berea Park Road, Durban, Natal, South Africa.

Good Low-Power Work

6QB has received reports from Egypt and Russia, and, during the charging of the many accumulators that he uses to drive his generator, worked Belgian H6 with an input of less than .3 watt. This was derived from 90 volts of dry batteries, giving an anode current of 3 milliamps. Signals were reported a steady R4 and heard in Dublin at R5.

The size of a quartz crystal, which may be used to control a transmitter of almost unlimited power, is strikingly shown by the above photograph of one of those used at the U.S. Bureau of Standards.

Z-3AL has been in communication with this country twice with an input of 2.5 watts, giving him the fine record of 5,000 miles per watt! The best of this "ultra-low" power work is that if *any* results are obtained, they are generally spectacular; also, hardly any apparatus is needed to produce the results!

An Extreme Case

The writer has a card from Finnish 1NA, on which he states that he has worked N-0BA (900 miles) with an input of 0.046 watts. This gives a figure of 18,000 miles per watt; but, of course, this is not theoretically sound, as the distance workable is by no means proportional to the input.

3,333 Kc.

2ZB seems to be working on 3,333 kc. at all times of the day with an input of 6 watts or so, and never fails to get into communication with 6KO of Forfarshire. This seems to indicate that there is still some workable ether left at that frequency, if one may use the phrase, but still no one seems to do anything there.

On 6,667 kc. there are now rather too many stations to be pleasant. It is absolutely necessary to use a slow-motion condenser of some kind to "sort them out." The writer expects great results from the higher bands (15,000 kc. and above), however, as the summer approaches.

Amateur "Magic Carpet"

2LZ had an extremely interesting time between 4 p.m. and 10 p.m. on Sunday, February 7. He worked the following stations:—

16.00 G.M.T.—Worked PI-1HR, and was heard by NIPM (submarine S.41 at Manila, Philippines).

16.20.—Worked Z-2BX, whose power was only 27 watts.

18.00.—Worked FI-8QQ.

18.30.—Worked R.A.F. station at Cairo on telephony.

20.25.—Worked Australian 3EF and heard several other Australians.

20.55.—Worked O-A6N.

21.34.—Worked C-2BG, who reported bright sunshine at his end.

22.00.—Worked U-1CAL and heard numerous other Americans.

THE WEEK'S DIARY

An entirely new Feature commencing in this issue.

I see the papers keep harking back to the Father Knox episode, and the broadcasting of the "Quest of Elizabeth" has proved to be a good opportunity of referring to "another blunder." The B.B.C. certainly deserve sympathy; they are rapidly becoming a national institution, and, like all public institutions, they will have to get used to plenty of kicks and few ha'pence. Let us hope it will be some time before their skins thicken; sensitiveness to public comment is very necessary until more experience is gained.

* * *

As regards Father Knox's burlesque of a revolution in London, it is at first impossible to imagine people considering the whole thing as anything but a joke. The B.B.C. virtually repeated, "This is a joke" throughout the burlesque, but nevertheless many people were deceived. Interference, breaking into the programme, weak reception and similar factors would contribute to a misunderstanding.

* * *

Even, however, if everyone understood it was a joke, there are grounds for believing it would have been wiser to allow Father Knox to exercise his acknowledged wit on some other topic. Questions of good taste enter into the matter. What is even more important is that there is just a danger that if really serious news is ever broadcast, listeners will wonder if there is a catch in it. I personally have a premonition that broadcasting may play a very great part if we ever have a national crisis, such as a universal strike. Newspapers would not be distributed and would probably not be printed. What other means than broadcasting would there be for an immediate distribution of national instructions? Having taken an active part in organising the emergency army C.W. communication system in the spring of 1919 (when there were threats of serious labour troubles), I realise the importance of having an additional means of communication, and the public should have the fullest faith in what is broadcast on matters of national interest.

* * *

The "Quest of Elizabeth" business is far more straightforward. Either the public wants harrowing "Grand Guignol" plays or it doesn't. Although the B.B.C. are intent on improving us against our will by much talk, yet the radiation from their stations of gruesome plays is no part of their forcible feeding policy. They do it because some of us like it, and if they did not tingle our nerves a little now and again, we should grouse about the "poorness of programmes," "lack of enterprise," etc. Personally, I dislike "Grand Guignol," and it is for others to say if they want it. The B.B.C. were justifiably surprised at the Press outburst on the unsuitability of the "Quest of Elizabeth." From other stations they had broadcast this play eight times and had only *two* complaints! If newspapers had superheterodyne sets we might have had the outburst sooner.

* * *

Alternative programmes would enable listeners who dislike "Grand Guignol," talks or other items, to switch over and still be entertained. When real alternative programmes are in force we must make sure we do not have the choice of a talk on "Reptiles and their Origin" from London as against "The early life of Krasnobalivitch" from some new station. Programmes at any given time should be entirely different.

One of the sensitive receivers used at our Elstree laboratories for finding the distant stations on the occasion of the B.B.C.'s fifteen minutes' silence.

Someone has suggested having a higher power station for talks, another for dance music, one for plays, and so on. The disadvantage of this scheme is that each station would have to be powerful enough to cover the whole country so that all crystal users would be satisfied. Imagine the feelings of the Aberdonian desiring to entertain his family by a loud-speaker demonstration of Grand Opera when the high-power opera station is situated on the south coast! Of course, the argument that some need only one and others four valves applies to-day to Daventry, but there is always an alternative station giving a varied programme.

* * *

If each station were confined to a particular form of programme, there are several people we know whom we would like to transplant to within half a mile of the "talks" station—with a flatly tuned crystal set!

* * *

Talking of alternative programmes, did you see that Captain Eckersley said the other day that alternative stations would be a great boon to grousers, because they would then have two programmes to grouse about instead of only one? Why does not "Eck"—as he is affectionately known to his intimates—keep to this line (which endears him to us) instead of going off the deep end now and again and writing articles which get him into trouble with his directors? His recent piece of advice to members of the public about not building their own sets was a flagrant *faux pas*, quite apart from the fact that the greater part of the wireless industry considers that experimenting and home construction is essential to its progress and the maintenance of sales.

* * *

The B.B.C. cannot very well make a public declaration on the matter without making the position worse, and an official repudiation of their Chief Engineer wouldn't be nice. Inside 2, Savoy Hill, however, we believe he has been told, "Don't do it!" Meanwhile, we hear that the set he constructed at home for his father-in-law is working very well and has not yet hindered the wireless industry!

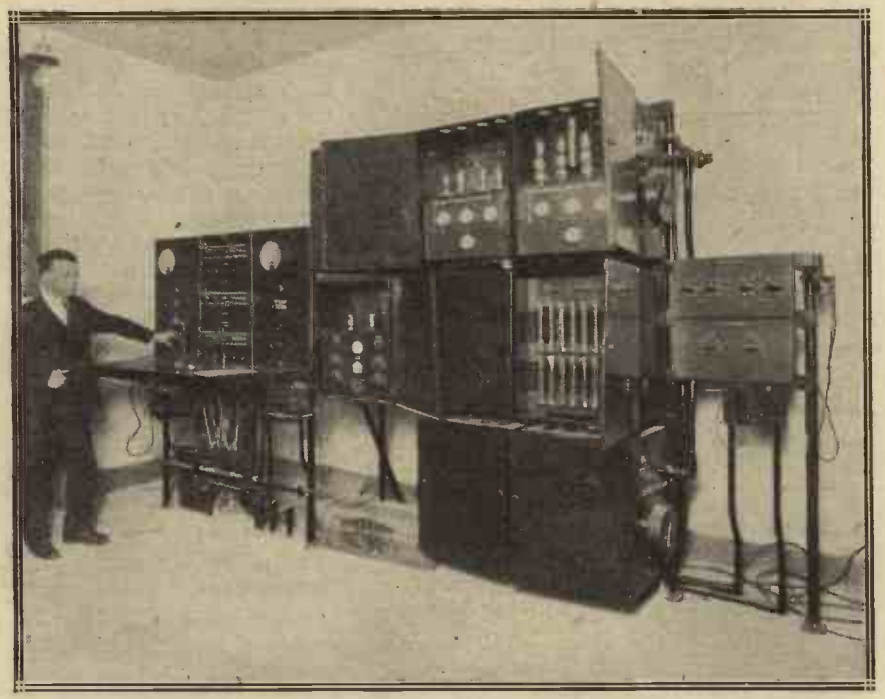
* * *

When you see in the newspapers, "The B.B.C. stated officially yesterday that . . ." you may safely assume that behind this information is the mystery man of the B.B.C. His name is Major Gladstone Murray. As far as I know, he has no defined position in the company, although everybody connected with newspapers knows him as the fountain-head of information for the Press. He seems, however, to have a finger in many pies, and though the public know him not, he is an important figure behind the scenes at the B.B.C. He is a Canadian (his speech betrayeth him), and many of those who know him well are not aware that during the war he greatly distinguished himself as a fighting pilot. He was an "ace" and was awarded many tributes to his gallantry. After the war he acted as Publicity Official of the League of Nations Union. His appointment to the B.B.C. has been a most successful one, in spite of the difficulties involved. Unassuming in demeanour, he is always prepared to hear the other side, and is quite prepared to modify his views if sound arguments throw more light on any controversy. He is thoroughly frank and honest, which, in the case of a negotiator, are qualities which carry one much further than subtlety.

* * *

Elsewhere you will notice that Mr. J. H. Reyner has been appointed Technical Editor of *Wireless Weekly*. This important post has been filled by one who is a brilliant example of one of the younger trained radio engineers. His whole training has been first in electrical engineering and then in radio. Leaving college (where he gained first place and acquired a first-class honours degree in electrical engineering), he joined the Post Office and became one of the principal radio engineers. Author of two books (one of which, "Radio Engineering," is already a standard work,) he rapidly adapted himself to the work involved when he joined the Radio Press. His sound technical knowledge, combined with practical experience and an enterprising realisation of what readers want, has resulted in his articles gaining the widest appreciation. His future close association with this journal will undoubtedly be to its great benefit.

WAVE-TRAP.



The Control Room of Station 2XAR (WJZ) the high-power experimental broadcasting station of the Radio Corporation of America. Note the "S.B." apparatus in front of the operator.

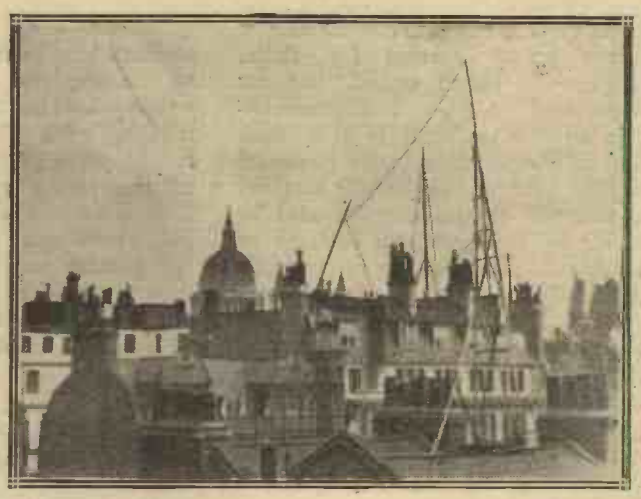
"PLOTTING COIL FIELDS"

It is regretted that exigencies of space have compelled the holding over of the continuation of Mr. Barton-Chapple's interesting account of his investigations upon coil fields.

SOME OBSCURE AERIAL FAULTS

By G. P. KENDALL, B.Sc.

Do you hear Noises in Windy Weather?



WE have most of us read articles upon fault-finding in different types of sets and circuits, and have, maybe, acquired some skill in the art in the hard school of experience, yet I imagine that the idea of the aerial as a source of faults and erratic behaviour upon the part of a receiving set may be new to a good many readers. Nevertheless, the aerial is a much more fruitful source of faults than many of us are apt to imagine, and a lengthy experience of its vagaries has led me to the conclusion that many of the variations in results from night to night, of which some people complain, may really be laid at its door.

A Trap for the Unsuspecting

The first time that I realised what a trap for the unwary is even the simplest of faults in the aerial circuit was when I was using for some experiments a large twin outdoor aerial of the inverted "L" type. This aerial was being used for the reception of long-wave C.W., tests being carried out in particular upon the American station at Annapolis. This station was heard at its best, as a rule, between 7 and 8 a.m., and I found that on certain mornings its strength was unaccountably poor, and that there was considerable difficulty in getting the receiver to oscillate. The trouble manifested itself in a quite erratic fashion, and led to much puzzled searching into the interior of the set, but quite without result.

Was it the Aerial?

Everything else having been tested, and, where possible, replaced by a substitute, suspicion at length fell upon the aerial, and it was lowered for examination and cleaning of insulators. For a considerable time nothing could be discovered which could account for the trouble, until at last the leading-in insulator was examined. This consisted of a simple porcelain tube, inserted in a hole drilled in the window frame. Upon examination it was found that a large spider had made its home inside the tube, and had very thoroughly filled it with web, and extended the web outside the mouth of the tube and down on to a metal stay, which was in contact with the earth connection.

What had been happening was apparently this: upon certain mornings a heavy dew had fallen and covered the spider's web with moisture, and so set up quite a heavy leak to earth. Examining the fine strands of the web it seemed hard to believe that so great a leak could be produced in this way; but the fact remained that upon some occasions it had been quite difficult to persuade the set to oscillate, even with the large reaction coil, which was normal upon the very long wave which was being received.

The aerial is a part of the installation which many people are apt to leave out of consideration when they are seeking for the location of a fault. The "sky wire" is quite capable of originating some very puzzling faults, however, as Mr. Kendall shows in this article, especially when it is erected under town conditions.

A Bad Weather Fault

My second experience of a really puzzling aerial fault took the form of a loud crackling noise, which was only heard during windy weather, so that it became fairly obvious that the trouble was to be found in the aerial system rather than in the receiving set itself. It was observed that the crackling was most pronounced, either when receiving a broadcasting station or when the set was actually oscillating, and, moreover, it was found that there were moments when, following a particularly loud noise, signals would be lost altogether, until, with another crackle, they would suddenly return.

A Break?

All the symptoms seemed to point to an intermittent break in the aerial circuit, and the aerial was accordingly lowered for inspection, in full expectation of finding that the soldered joint where the two wires were joined to the down lead had given way, but actual examination revealed no such condition. The aerial appeared to be perfect in every way, but it was nevertheless, for the purpose of test, replaced by a temporary single wire one all in one piece. Upon re-erecting the aerial, however, the noise was found to be as bad as ever under the particular weather conditions which had previously produced it!

Where it Was

Attention was next turned to the earth lead, which consisted of a length of heavy cable about one yard long, which passed out through the window frame and was soldered to a long strip of lead sheet which formed the joint between the wall of the house and the roof of an outbuilding. At its lower end this long strip of lead approached within about 5 ft. of the ground, where a further length of heavy cable was taken down

from the lead surface to a buried waterpipe, sound soldered joints being made in every case. These were inspected with microscopic thoroughness, but no sign could be found of a poor joint of any description.

The Solution

The mystery appeared to be thickening, and the next step taken was to examine the arrangement during one of the spells of windy weather which had been found to produce the noise in question. It was then discovered that when a particularly strong gust of wind arrived the strip of lead was lifted from the surface of the roof, only to fall again a few seconds later. By using a long extension lead to the telephones it was possible to watch the strip of lead and listen-in at the same time, and it was observed that the crackle always took place when the strip of lead was lifted, and again when it fell.

Further examination then revealed the fact that beneath the strip of lead there was an iron bar, forming part of the framework of the roof beneath, and that when the strip of lead lifted it no longer made contact with this bar, whereby the capacity of the aerial system was evidently being altered to a sufficient extent to cause a considerable variation of tuning.

An Insulation Fault

Another experience which considerably raised my opinion of the aerial as a capable provider of mysterious faults occurred only recently, upon the aerial of a friend. The symptoms were that the set had apparently gone absolutely dead, only the faintest of signals coming in from the local station. It was impossible to make it oscillate when connected to the aerial, and there were all the signs of a practically complete short circuit from aerial to earth. A test was accordingly made with a sensitive milliammeter and small battery in series, connecting them between the aerial and earth, and a considerable reading was obtained. An examination was therefore made of the aerial without actually lowering it, but no signs of trouble whatever could be discovered.

A Concealed Fault

The aerial was of the simplest single-wire type, with a good large porcelain insulator at each end, and an effective leading-in insulating scheme. Since nothing could be seen, the aerial was lowered for closer inspection, and then the trouble was discovered.

What had happened was that one of the porcelain insulators, namely, the one at the free end of the aerial, had split in halves, in such a way that the aerial wire had come in contact with the end of the halyard, and since the halyard in question consisted of a flexible steel cable, whose lower end was secured round an iron spike driven into the moist wood of the mast only a foot or so above the ground, it was evident that a fairly effective short circuit had been produced.

Beware of Ivy

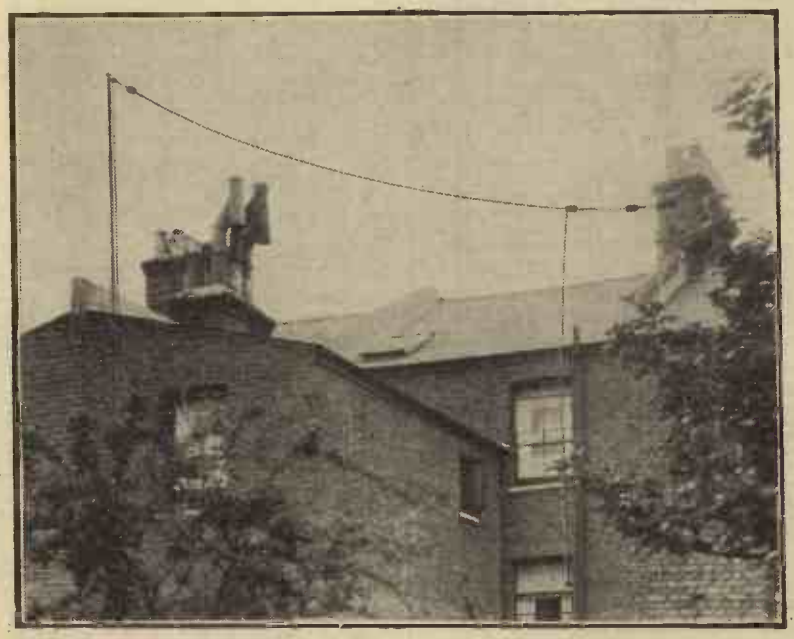
By this time the reader will have realised that there are quite a number of possibilities of curious faults occurring in the aerial circuit, and it seems an opportune moment to mention that whenever a mysterious noise is heard which is produced only in windy weather, an immediate inspection of the aerial should follow. It may be mentioned that the most recent aerial fault which has been brought to my notice exhibited these general symptoms, and was found to be due to one of the most prolific causes of this particular trouble, namely, to the blowing of wet creepers against the down lead.

This particular point should receive careful attention from all those who have ivy or other creepers in close proximity to the down lead, and it is well worth while to keep it closely trimmed, lest a most annoying state of affairs may be set up whenever there is much wind.

An Extraordinary Episode

Probably the most extraordinary fault of which I have ever heard in connection with aerials was that brought to me by a very much perturbed reader of *Wireless Weekly*, who reported that every time he used his set, a simple crystal receiver, the result was to turn out the local fire brigade! Upon my professing polite incredulity, he informed me that this had happened three times, and that some friction was resulting between himself and the local fire brigade in consequence.

No connection could at first be discovered between the aerial and any telephone or other wires in the neighbourhood, but upon further investigation it was found that some iron wires on the flat roof of his house upon which it was customary to dry clothes ran across to the roof of a similar block of flats a short distance away, and here a trailing telephone wire was discovered. This wire was resting upon the iron wire already referred to, and it appeared that whenever the set was used an earth was established upon the telephone line, which happened to be one of those connected with a street fire alarm. This had apparently the effect of sounding the alarm at the fire station, and hence the extraordinary experiences of the owner of the set.



When noises are heard in windy weather the down-lead should be examined; if it is slack it may be swinging against some part of the house.

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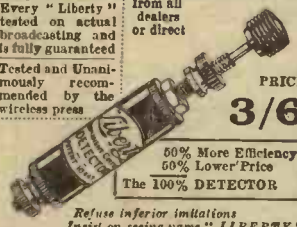

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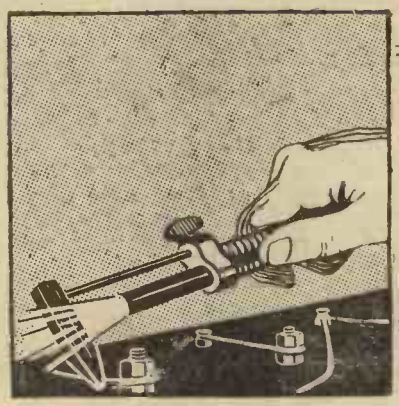
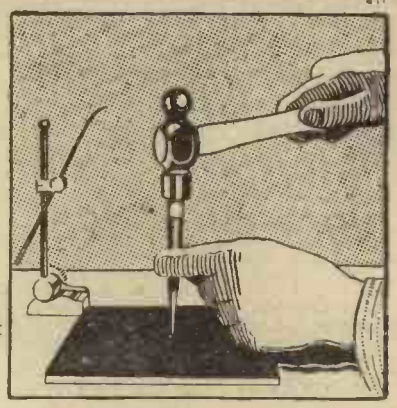


CONSTRUCTIONAL HINTS AND TIPS

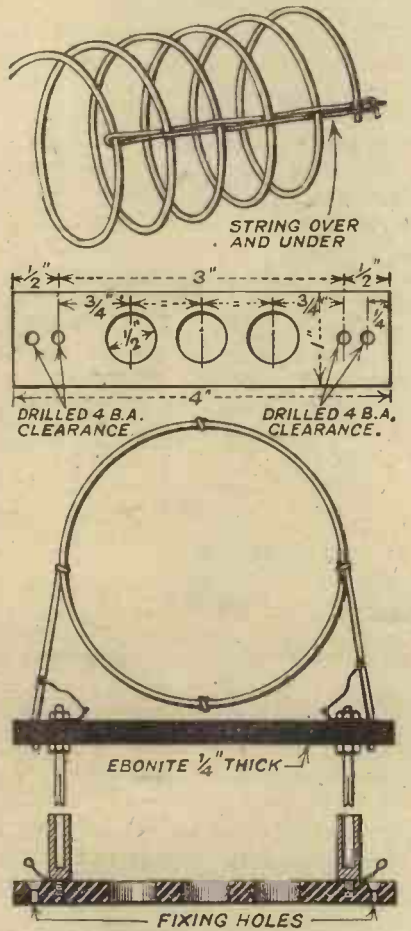


A LOW-CAPACITY COIL AND MOUNTING

WHEN designing a receiver for use upon the very short waves, one of the most important points to consider is the question of coils. Among other features they must have the minimum of self capacity or else it will be impossible to obtain the efficiency so much desired. They must therefore be as nearly self-supporting as possible, and, further, the diameter to length ratio should be as favourable as possible. The closer the spacing between the turns up to a certain point the better, and it is advisable to eliminate as much dielectric as possible from the field, while a fairly heavy gauge of wire should be used.

Using coils of the type described it is quite a simple matter to arrange tappings if desired.

The first coil to be made on the principle to be described is attached to an ordinary plug-in mounting, and the wire is spaced and supported by string being passed under and over each turn of the coil, finally being knotted on the outside. As this coil only consisted of four turns, two lashings of this description only were required.

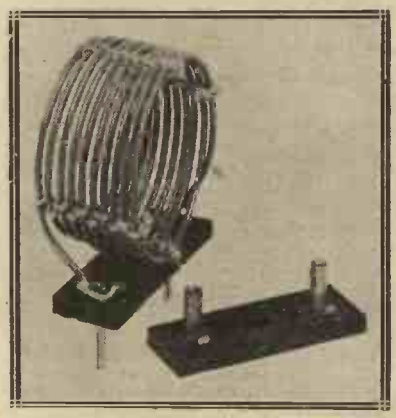


Constructional details of the coils and coil socket.

The larger of the coils shown consists of nine turns, and here thinner string has been used so as to get the turns closer together, thus making the coil more compact. This has been lashed in four places, and the exact method of doing this is shown in the sketch. The method of mounting, too, is novel.

Mounting the Coil

Two valve pins are mounted on a strip of ebonite by means of nuts on either side of the strip. Under the nut on the top of this strip is a small soldering lug. Between the outer edges of the ebonite strip and the two valve pins are two holes which merely serve to hold the ends of the coil in position, contact being made to the lugs by two short lengths of copper wire soldered to them and to the ends of the coil. The coil is made of No. 12 bare copper wire, and it is wound closely on a former for the required number of turns and then sprung off. If hard-drawn wire is used the diameter of the finished coil will be considerably greater than that of the former, but, if soft, there will be little difference. The coil is pulled out a little after having removed it from the former, and the string is threaded through it in four places, loosely at first and then pulled tight afterwards. The ends of the string should be tied with a reef knot, otherwise the string may



A nine-turn coil is held quite securely by the author's method, when used in its special socket.

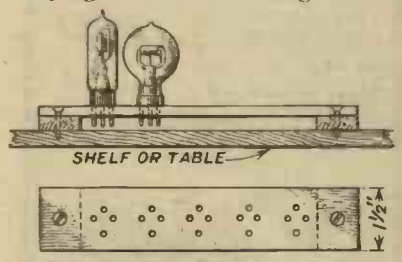
become loose in time. Large holes have been drilled in the ebonite mounting strip so as to reduce the capacity of the mounting.

The socket mounting is made from a similar strip of ebonite to that used for the coil mount, only valve sockets are used into which the valve leg pins may be inserted. The sockets may either be screwed into the strip and cut off flush, or else fixed with nuts in the usual manner. Lugs may again be used to make connections to these, and two small holes on the outside edges allow the mount to be fixed to a baseboard by means of screws.

* * *

A RACK FOR SPARE VALVES

When carrying out experiments which involve constant circuit changing, or when comparing the performance of different types of valves in a receiver, a rack in which to put the valves when not in use will be found very handy; valves placed loose on the table have an annoying habit of making for the



The construction of the rack.

floor, and also they are exposed to the risk of being broken by tools, etc., falling on them.

The only materials required for the rack are a strip of wood 1½ in. wide, ½ in. thick, and of a length suitable for the number of valves to be placed in it; two small blocks of wood to be used as supports, and two long wood screws. In the wooden strip holes for the valve pins are drilled as shown in the sketch, a valve template or any other convenient method being used.

The two blocks of wood are placed under the ends of the strip, and two long screws secure the rack to the back of the workshop table or to a shelf. The valves are then ready to hand at any time, while they are reasonably immune from risk of damage.

* * *

"OCCASIONALLY VARIABLE" CONDENSERS

The small condensers described here can be easily made from scraps of copper foil and mica. These condensers have the advantage that should too much or too little capacity be incorporated, it can be instantly changed by just undoing three small screws.

It is advisable to cut a small cardboard shape as shown in Fig. 1, and to lay this on the copper foil,

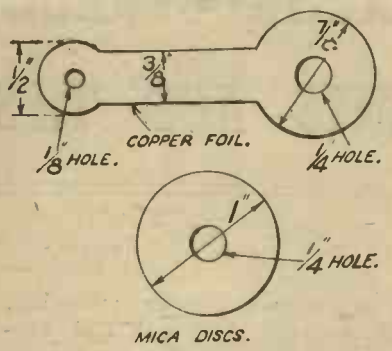


Fig. 1.—The foil and mica are cut to the dimensions shown.

and mark round the shape with a sharp pointed instrument.

In Fig. 1 the dimensions of the mica discs are also indicated.

Two discs, the same size as the mica, of fairly thick brass, should be used as end plates.

To construct the condensers, place a 1 in. 6B.A. screw through the hole in the brass end plate, then slip on a mica washer, then a copper foil, then a mica and so on until a sufficient number of plates have been used, finishing with a mica washer and the other brass end plate. A 6B.A. nut is placed on the screw, but before tightening up alternate copper foils are placed in convenient positions, and a 6B.A. screw passed

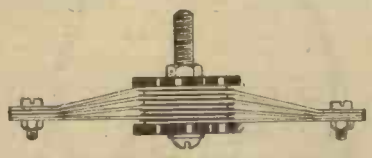


Fig. 2.—When assembling, the central screw must not touch the copper foil.

through the small holes in their ends.

Fig. 2 shows the completed condenser.

* * *

A COMBINED MOUNT AND BEARING FOR VARIOMETERS

A simple method of mounting a variometer or vario-coupler which may be interesting to the constructor is described below.

A variometer or vario-coupler, light in weight, preferably made of thin ebonite tubing or cardboard, should be used in conjunction with this mounting.

Details of Mounting

The mounting consists of a ¼ in. brass tube about 2 in. long, with an inside diameter large enough for a ⅛ in. brass rod to rotate freely inside, this rod to be about 1¼ in. longer than the tube. The tube should be threaded at both ends for about ¾ in. A brass washer should be threaded to fit a ¼ in. tube. A nut and a plain washer are now placed on one end of the tube, and the tube is inserted through the panel from the rear, through a ¼ in. hole.

Assembly

The threaded washer should be screwed on the projecting tube so that the end is flush with the face of the washer.

The nut on the inside is now tightened and the tube is rigidly held at right angles to the panel.

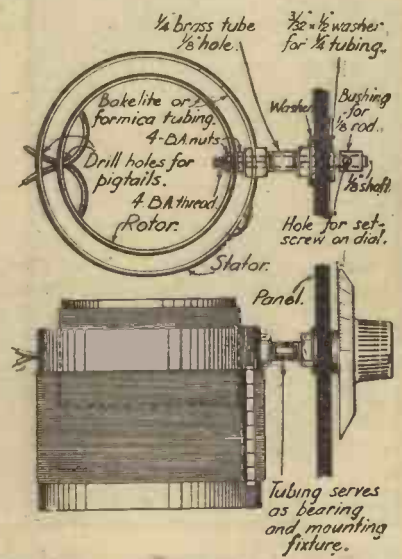
Two nuts are now screwed on the other end of the tube with the primary of the variometer or coupler between them, but these nuts are not tightened until the secondary is in place.

The Secondary

To mount the secondary, the rod is inserted in the tube from the outside and the secondary securely fastened on it between two nuts.

The secondary can be centred in the primary by moving the nuts on the tube backward or forward.

When the correct position is found, these nuts are tightened.



Constructional details of the bearing.

A bushing is made of a piece of ¼ in. brass tube ½ in. long, to be slipped on the rod so that a standard dial may be employed. This bushing should have a small hole drilled through one side so that the dial set screw may be fastened on the rod beneath.

GETTING THE BEST FROM YOUR SET

Hand-capacity effects — Extension handles—Slow-motion dials — Choosing a reduction ratio—Friction gears.

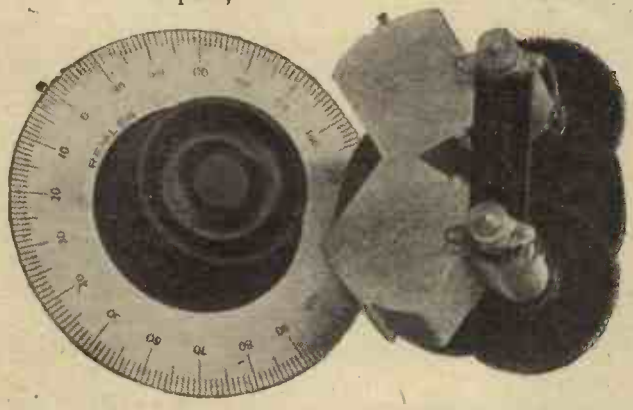
THE choice of suitable dials for the tuning controls of a receiver has been the subject of a previous article in this series. The comfort of the operator is an important factor in fine tuning, for which reason special dials are often an advantage. A further trouble which may be encountered, especially at the higher frequencies, is that of hand-capacity.

Hand-Capacity Problems

On the broadcast band the presence of the operator near the receiver will rarely have a noticeable effect on tuning. Movements of the hand near the tuning controls, however, will often be troublesome in this respect, the operator becoming on occasions virtually "tied" to the controls if weak signals are to be kept audible. At the higher frequencies, above 3,000 kc. (100 metres) or so, these effects are liable to become more pronounced, so that as the frequency of reception increases it becomes more and more necessary for the operator to consider his own position and movements relative to the receiver as important factors in its efficient operation.

A Simple Remedy

The simplest and most commonly adopted remedy for hand-capacity effects with receivers for frequencies above 3,000 kilocycles is to fit extension handles to the variable condensers. They have their disadvantages, although for experimental work they will generally prove satisfactory enough. They are inexpensive, since a wooden arm will usually serve quite well. On the other hand, they cannot be recommended for use where appearances are a consideration.



The Remler condenser provides a slow-motion drive with a ratio of two to one.

Methods of Fitting Extension Handles

The position of an extension handle on the dial of a condenser will depend on the arrangement of the rest of the receiver panel. The usual trouble experienced is that if several knobs and terminals project from the panel, limitations are imposed on the length of the handles, assuming that they are fixed at right angles to the condenser spindles.

Other positions of attachment, while not so easily carried out, may partially, at any rate, get over this difficulty. Either the handles can be set out at an angle from the knob on the dial, or they may be fitted as extensions in line with the spindle.

Objections

The use of the former of these two methods means usually that considerable ingenuity has to be employed in fixing the handle securely to the knob. The latter method is not open to this objection, but anyone who has handled an extension of this kind will know that, even though hand-capacity effects are reduced, fine tuning is not made much easier.

A long extension will mean "whip" in the arm, and steady movements of the dial will become practically impossible. The type of handle which is attached at right angles, or nearly so, to the spindle at least gives the advantages of a gearing effect, in that small movements of the outer end of the handle will cause still smaller movements of the moving vanes of the condenser.

Long Handles for High Frequencies

So long as care is taken to arrange extension handles so that they do not obstruct each other or foul other controls, for the very high frequencies they will usually be found quite satisfactory to handle with a little practice.

At such frequencies it is often unnecessary to turn the tuning con-

denser through its full range of movement, a limited band of capacity variation being all that is required. Under these circumstances the type of handle attached at right angles to the spindle will be the simplest to fit and will give the desired "gearing ratio" for fine tuning.

Conditions on the Broadcast Band

Receivers designed for reception on the broadcast band and for frequencies up to about 3,000 kilocycles are not so liable to exhibit really troublesome hand-capacity effects. Devices to reduce hand capacity are therefore less likely to be needed, provided that due attention has been paid to the problem while the receiver is still in the design stage.

Such features as the arrangement of the components relative to each other and to the hands of the operator, and also the layout of the wiring, must be taken into consideration in this connection.

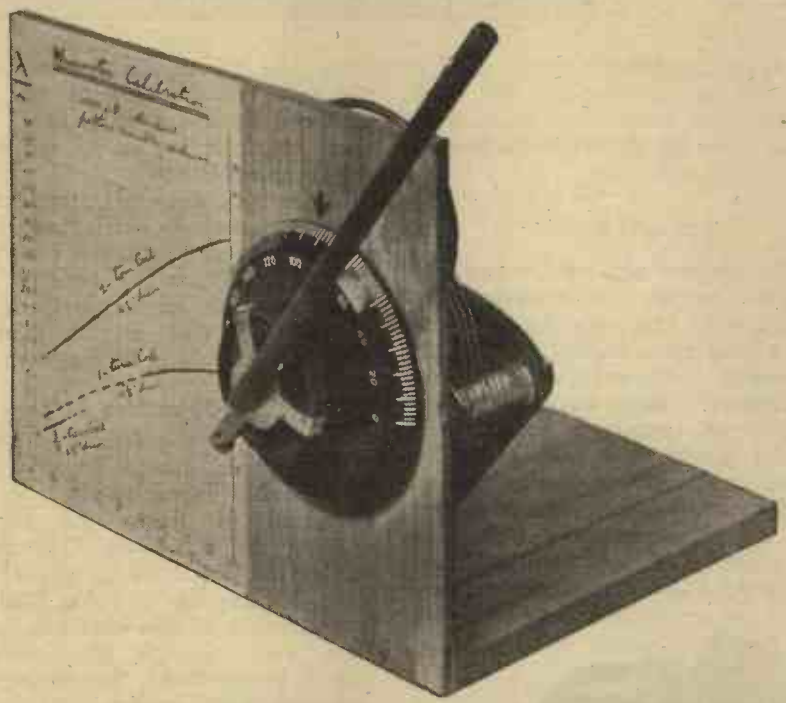
Fine Adjustment Needed

Assuming, then, that hand-capacity troubles have been satisfactorily reduced, if not eliminated, it still remains to provide some means of making fine adjustments of the tuning controls, especially of the variable condensers. This will not apply, of course, to a receiver used purely for the reception of local programmes, or for the occasional selection from the transmissions of a limited number of stations within easy range.

A Clumsy Method

The operation of a selective receiver, however, which is to be used in searching for distant stations, will be greatly simplified by the provision of some means of making the search for stations as thorough as possible.

It is not denied that extension handles can be used to facilitate fine tuning. They are, however, a somewhat clumsy means of obtaining the desired result, and when several tuning circuits are involved, the arrangement and manipulation of a number of such handles will be no easy matter.



Extension handles are helpful on the higher frequencies, since it is difficult to eliminate hand-capacity effects by any other simple method.

Appearances, too, must suffer, a point which may appeal to those who hold that neat and workmanlike appearance in an instrument is a not inconsiderable aid to careful and efficient operation.

A Better Arrangement

An alternative method of control, which disposes of these difficulties, is provided by the slow-motion dial, of which a number of varieties are now obtainable.

It must be conceded that as a general rule these dials are expensive; certainly they cannot be so cheap as a simple extension handle. The feeling of "full control," however, which is given by the employment of a well-designed dial of this type, will in many cases amply justify the extra expense.

Desirable Features in Slow-Motion Dials

There is no intention here to recommend any particular type of dial as being superior to others. There are many good types available, but a few points to note in the selection of a slow-motion dial or condenser may be helpful.

The principal defect to guard against is "back-lash" in the movement. This applies particularly to gearing with a considerable reduction ratio, since small movements of the dial independent of the condenser vanes will not then be so easily felt by the operator.

With only a slight reduction brought about by the gearing, the operator will more easily be able to feel when the vanes actually start to move, when turning the dial backward and forwards through a small arc, so that a small amount of back-lash will not be so serious a defect. It is naturally desirable, however, to have as little back-lash as possible in any gearing.

A Point for Care

Particular care needs to be exercised with some forms of gearing that the gears are not strained by continued turning of the slow-motion knob after the vanes have reached the stops limiting their rotation. Friction gears will, of course, slip when the stops are reached, and such gears generally give a very smooth movement. Too great freedom of movement and the possibilities of slipping of the frictional parts are the points to watch here.

Choosing a Ratio

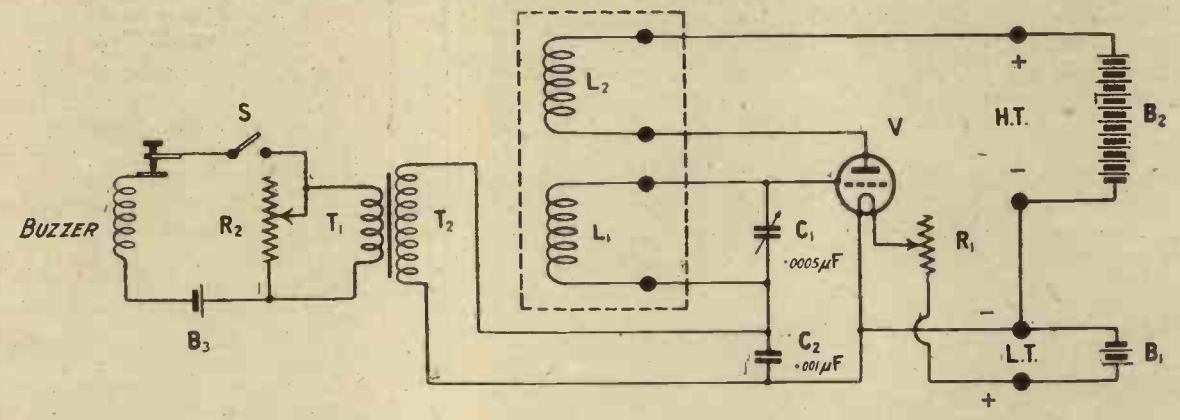
When slow-motion dials are to be fitted to existing condensers, the degree of freedom of movement of the moving vanes will largely determine the choice of the type of dial to employ. Little advantage will be gained by fitting, for instance, a 2 to 1 ratio dial to a condenser with stiff bearings. A greater reduction should be used, in order to obtain the full advantage of the gearing to secure a smooth and steady movement.

When to Use a Low Ratio

If, on the other hand, the moving vanes normally turn quite freely, it will often be found that adequate control can be provided by a 2 to 1 ratio or thereabouts. It is obviously not worth while to fit a really good slow-motion dial to a variable condenser which is itself defective, either owing to faults of design and workmanship or to wear and tear.

Circuits for the Experimenter

No. 5.—A MODULATED-OUTPUT WAVEMETER



TO construct a buzzer wavemeter capable of giving really sharp and accurate readings is one of the most difficult tasks which can confront the experimenter, and anyone who has attempted this feat will have realised that the apparently simple buzzer instrument is in reality more difficult to bring up to a high standard of accuracy of reading than the apparently more complicated heterodyne type.

Heterodyne Advantages

To achieve sharp and accurate reading with a buzzer wavemeter it is necessary in general to employ a special circuit, and to reduce the damping of the calibrated circuit to quite a low figure, and it is arguable that it is easier to attain the desired effect by means of a heterodyne wavemeter, with the addition of some scheme for modulating the output of the oscillating valve. When the source of high-frequency current is an oscillating valve there is no special need to secure the same degree of low damping in the circuits, and the arrangement of such a wavemeter is a relatively simple matter.

A Dual Purpose Circuit

This week's circuit illustrates a convenient and practical arrangement, which can be used either as a simple heterodyne wavemeter, or to give a modulated output which will sound very much like that of a buzzer wavemeter, but which will be found to possess a considerably greater degree of sharpness, so that much more accurate readings are possible than with the common type of buzzer instrument.

The main oscillating circuits will be seen to be of the conventional type, with a tuned grid circuit composed of a coil L1 and variable condenser C1 of .0005 μF capacity, with a reaction coil L2 fixed in a permanent relation with L1. Upon the left of the circuit diagram will be seen the arrangement for modulating the output of this valve, which consists of a small iron-core transformer or induction coil T1 T2, and a buzzer driven by a small battery B3, the switch S being provided to shut off the modulating system when it is not required.

CIRCUIT No. 5
SPECIAL FEATURES

1. **Sharp readings in the receiving circuits.**
2. **Pure or modulated output at will.**
3. **Adjustable degree of modulation.**
4. **Special buzzer not required.**

Adjustment of Modulation

The variable resistance R2 connected in parallel with the primary winding T1 is intended to serve as an adjustment of the degree of modulation imposed upon the output of the oscillating valve, by varying the proportion of the buzzer current which flows through the primary winding T1. In this way it is possible to secure a small degree of modulation of the high-frequency oscillations, so that a very sharp reading is obtained from the wavemeter.

The resistance R2 will vary as to its value according to the nature of the transformer T1 T2, but in most cases one of the dull-emitter type filament rheostats will serve the purpose quite well. Alternatively, the resistance element of a potentiometer can be used, making connection to one of the terminals upon the end of the winding, and to the slider.

Induction Coil Details

The small transformer T1 T2 may quite well be one of the small induction coils sold for use in telephone installations, obtainable for the sum of 2s. or so from any general electrical dealer. At a pinch, a small transformer can be made by winding 50 turns of No. 24 d.c.c. wire upon a bundle of iron wire ½ in. in diameter and 3 in. long, following this with a secondary winding consisting of 200 turns of No. 32 d.c.c. wire.

The coils L1 and L2 should preferably be wound upon the same piece of tube, a space of about ½ in. being left between them. For the broadcast range of frequencies L1 can consist of 40 turns of No. 36 d.c.c. wire, upon a 3-in. tube, and L2 will usually be of about 20 turns. The exact number of turns upon the reaction winding, of course, will depend upon the type of valve used for the oscillator. If it is desired

that the wavemeter shall cover more than the single frequency range, the complete unit composed of the coils L1 and L2 may be made interchangeable, as is indicated in the diagram by their enclosure within a broken line.

Filament Control

Since the calibration of a heterodyne wavemeter depends upon the use of the same valve in all cases, it is desirable to economise the length of life of that valve as much as possible, and therefore the filament resistance R1 is shown. This should preferably be placed inside the box of the wavemeter, so that when it has once been adjusted to the value which is found to give the minimum filament current capable of maintaining the valve in a sufficiently strong state of self-oscillation it can be left without further adjustment and without risk of that adjustment being accidentally upset.

H.T. Requirements

Quite a small value of high-tension voltage will usually suffice for a heterodyne wavemeter, something in the neighbourhood of 15 volts being suggested for a general-purpose valve. The voltage of the low-tension battery will depend, of course, upon the type of valve which is employed, and that which is provided to run the buzzer will again depend upon the type of buzzer and the nature of the transformer T1 T2. As a rule, one or two dry cells will be sufficient. The buzzer should, of course, be one of the high-note type, and it is a wise course to purchase a really good instrument for this purpose.

The Condenser

The variable condenser C1 should, of course, be of the straight line wavelength or straight line frequency type, according to the inclination of the constructor, and some sort of slow motion drive or geared dial is recommended. In choosing such a drive or dial, it should be noted that the graduated dial itself is rigidly locked to the condenser spindle, and that there is no possibility of any back-lash in the slow motion drive showing up in the readings of the dial.

Provided that the drive is separate from the dial itself, that is to say, that any back-lash does not show up in the dial readings themselves, practically any type of instrument will serve.

VALVES FOR SUPER-HETERODYNE RECEIVERS

SIR,—I was interested to read Mr. Collett's letter in reply to my previous letter (*Wireless Weekly*, January 27) on the subject of suitable valves for the intermediate frequency stages of my superheterodyne receiver. At the same time I must confess myself disappointed in the reply, since Mr. Collett puts forward no suggestions in answer to my original queries.

I am quite satisfied with my present circuit and am not anxious, at present at any rate, to try any so-called "simple" superheterodyne circuits.

I should be very grateful for the opinions of your readers on the problems which I quoted in my original letter.—Yours faithfully,

P. R. WILSON.

Wimbledon, S.W.19.

ACCUMULATOR FROTHING

SIR,—With reference to a letter published in your correspondence columns on February 3, perhaps my own experience in this connection may be of interest.

I must confess that the theory of chemical action between the electrolyte and the celluloid container of an accumulator causing the frothing was new to me. I cannot therefore express an opinion on this question. My own experience has been that the material and possibly the arrangement of the separators between the positive and negative plates controls any frothing which may take place on charge.

I have observed that when celluloid separators, creased and punched with small holes, are used, the frothing is often violent. This does not seem to occur so much with wooden separators. One accumulator which I have which has no separators between the faces of the plates is quite immune from the trouble.

My opinion is that if the separators are much "broken up," as in the punched celluloid type, frothing occurs owing to the turbulence created in the electrolyte when gassing is taking place on charge. Wooden separators present a smoother surface, and so do not give rise to frothing to the same extent, while when no separators are used, a practically free passage between the plates is provided for the gas formed.

I should be glad to know the opinions of other readers on this subject.—Yours faithfully,

H. DYSON.

London, N.W.

THE BEST SHORT-WAVE RECEIVER

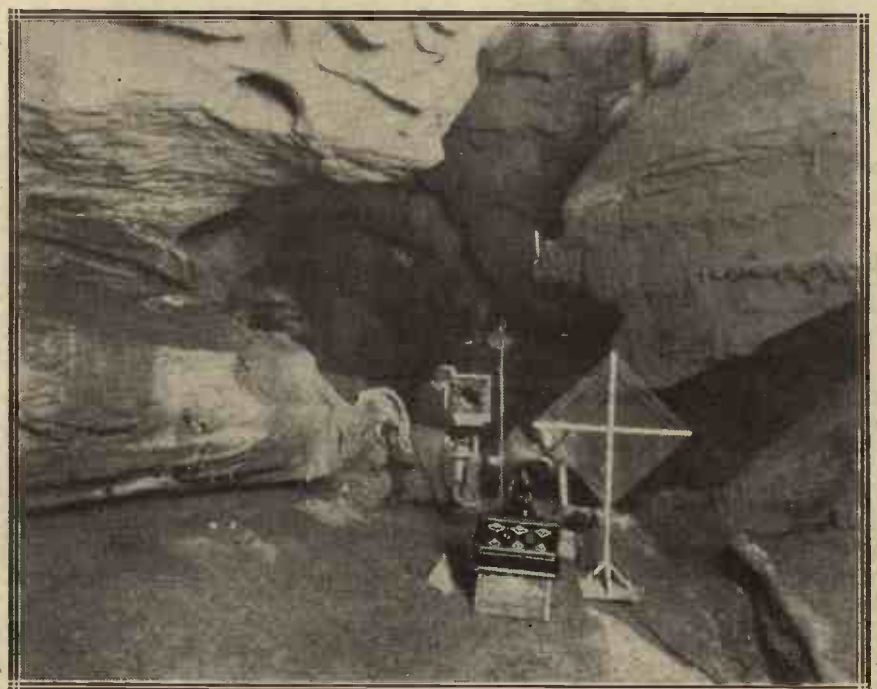
SIR,—It is with a truly altruistic regret that I read Mr. Stingleberry's reply to my letter (*Wireless Weekly*, February 3) on the Superheterodyne for the reception of the higher frequencies. I cannot help feeling that if Mr. Stingleberry were as thorough in his investigations into the art of reception at the higher frequencies as he is in his criticism of my chosen method, the science of wireless might be considerably benefited.

The question of selectivity does not seem to me to arise at the high frequencies under consideration. I think there may be here some confusion between selectivity and critical tuning. On this latter point the Superheterodyne decidedly scores; it too has only two tuning controls, and the adjustment of these need not be critical.

I think that anyone who has listened to the excellent quality of music and speech which can be received from KDKA with a Superheterodyne would hardly be satisfied again with the throaty rumble produced by a detector and a stage of L.F. with reaction pushed to its limit and fading and parasitic noises combining to distort the best efforts of the distant studio.

I may say that I have had considerable experience with "one valve and no trouble," though I disagree with the latter part of the quotation. It was this experience which led me to experiment with the Superheterodyne, and I am quite satisfied that I have found the solution of my difficulties.

I should like to suggest in my turn to Mr. Stingleberry that he gives the Superheterodyne a fair trial, before condemning it on grounds which I



Wireless in strange surroundings: An artist of the staff of the Milwaukee Museum making a model in one of the "endless caverns" of New Market, Va., with a Grebe receiver for company, 300 feet below ground.

gather from his letter must be for him purely hypothetical. — Yours faithfully,

Norwich. L. R. BRAND.

"THE QUEST OF ELIZABETH"

SIR,—I have seen a good deal in the papers about "The Quest of Elizabeth," the play which was broadcast a few nights ago, and I really cannot see what all the fuss is about. I listened to the play myself, and I must confess that I was not particularly struck with it, but that is not the point. To label it as "gruesome" or as "Grand Guignol" seems to me absurd. The "Comedy of Dangers," broadcast a few months ago, was gruesome enough, and there was no such outcry then as there has been over this dramatic effort.

I rather suspect that if the B.B.C. had not made their preliminary announcement about invalids not listening, and so on, we should have heard no word of protest.—Yours faithfully,

J. W. NEWMAN.

Chelsea.

BROADCAST NEWS

SIR,—If I may be permitted so far to trespass on your space, I should be glad to put before your readers for their consideration a point which arises in connection with the broadcasting of news and the attitude of the Press, as expressed before the Committee of Inquiry.

We regard the printed newspaper as so much a part of our daily lives that perhaps we forget that it has not always existed. It is no very long time since news was disseminated by word of mouth, when the town-crier was the official agent for the publication of interesting events. Have we so far forgotten the need for constant progress that we wish now to turn back and hear our news cried to us from a loud-speaker?

I hold no brief for the Press in this matter, but surely the printed page can furnish us with a more permanent foundation for our knowledge and our views than the announcement which leaves no such definite record of its subject.—Yours faithfully,

T. G. ELTHORNE, Col. (retired).

Cheltenham.

APERIODIC TRANSFORMERS

SIR,—I read with interest the article on a Three-Valve T.A.T. circuit in your issue of February 10. In this arrangement the aperiodic coupling between the first and second valve is shown as a transformer. This raises the whole question as to whether high-frequency transformers *do* transform. In the old days, when we used to work on 1,000 metres and over, the point was not so important, but is not the idea that a transformer does transform now exploded?

Surely such a transformer is merely an inefficient and roundabout way of showing an air-core choke. After all, what is really happening is that the high-frequency potential end of the primary winding passes on to the grid of the next valve through the capacity formed between the windings. Why not, then, be honest and substitute a fixed condenser between the anode of one valve and the grid of the next and provide a grid-leak? The aperiodic transformer has had its day; why not bury it?—Yours faithfully,

NO-TRANS.

London.

QRA SECTION

In addition to the calls printed last week, we hold cards for the following, and will be pleased to forward them upon application :—

British: 2HW, 2IA, 5BU, 5FQ, 5IN, 5PO, 6EZ, 6GW, 6MY, 6OP, 6OX, 6YX, 6ZK, 6ZM, GHA.

French: 8SAX, 8DK, 8DGS, 8SOT, 8TVI, 8JMS, 8IM.

Swedish: SMRI, SMYU, SMSR, SMXR, SDBG.

Dutch: OF3, ONF, PC2.

Miscellaneous: SQ1, BZ-6QA, U-5AGN, O-A6N, L-1AG, P-3FZ.

QRA's Wanted

RAU, RRP, 6EA, Y5, O44, U-8RIT, F-8TVI, P-3FZ.

QRA's Found

NUQG: O. T. Cooper, U.S.S. "Pillsbury" (277), Asiatic Station, c/o Postmaster, Seattle, Washington, U.S.A.

U-1AOF: H. C. Wing, 62, Pierce Street, Greenfield, Mass.

U-1AS: B. B. Coleman, 360, Thatcher Street, Milton, Mass.

U-1BAD: H. A. Chinn, 39, Coral Avenue, Winthrop, Mass.

U-5AGN: W. L. Willis, 625, North Sixth Street, Oklahoma City, Okla.

U-6CTO: E. Burgman, 1200, Tamarind Avenue, Hollywood, Calif.

G-2BPN: P. Shurety, 100, Uphall Road, Ilford, Essex.

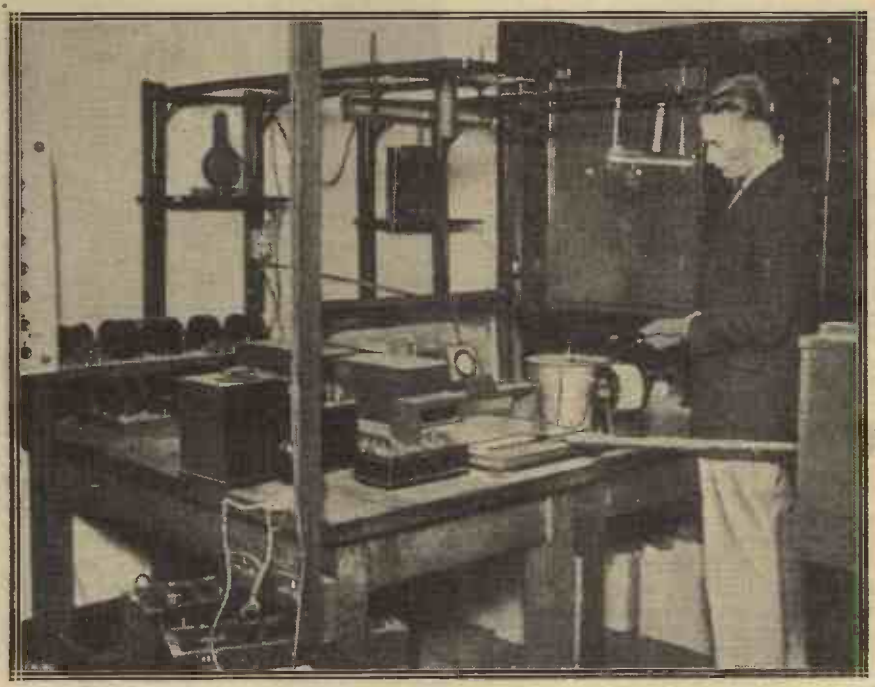
Notes

Mr. L. F. Aldous (2ZB), of 48, Harpenden Road, West Norwood, S.E.27, is now transmitting regularly on 3,333 kc. (90 metres), and is particularly anxious to receive reports and to arrange tests with British stations. Communications may be sent via *Wireless Weekly* or direct to him.

Misuse of Call Sign?

Mr. F. A. Bevan (G-2BY), of Vine House, London Road, Kingston, complains of persistent misuse of his call-sign, followed by complaints from the G.P.O. that he has been transmitting on an unauthorised wavelength.

We suggest that the reports are intended for either Q-2BY or U-2BY, both of which stations are very frequently heard at good strength in this country.



Extensive experiments are being conducted on tuning coils by the Radio Laboratory of the United States Bureau of Standards in Washington. Mr. H. B. Degroot is here seen using some of the measuring apparatus.

THIS WEEK'S INTERVIEW
(Concluded from p. 20)

that, curiously enough, wooden "formers" were in these cases ultimately chosen as being best. The losses in these were small.

Q.—I can understand the wire insulation (*e.g.*, cotton) affecting the dielectric losses, because this covering separates the turns, but the "former" is normally inside the coil. How, then, can the "former" affect the H.F. resistance?

A.—The electrostatic field between the turns is not an absolutely defined field going directly between two adjacent wires; it distributes itself and dips into the substance of which the former is made. Moreover, the field extends not merely between turns, but to a weaker degree across the coil through the former from, to take an example, one part of the wire to a point on the other side of the coil.

Q.—How can these dielectric losses be reduced?

A.—By making the coil as far as possible self-supporting or supported with a minimum of insulated supports. Bare wire is the ideal, but as it is liable to oxidise, enamelled wire is usually more practicable.

Q.—The dielectric losses being due to electrostatic fields, what losses may arise out of the magnetic field, which seems to be the only one which we really need in an inductance?

A.—Varying magnetic fields will set up what are called "eddy currents" in any conductors within the field, and this represents losses. If any metal objects are placed inside or near to the inductance coil eddy currents will be set up in them which will increase the H.F. resistance of the coil. No such losses, however, occur in any former made of insulated material.

Q.—One more question. What bearing has spacing of the wires on the efficiency of an inductance coil?

A.—There is a good deal to be said for well-spaced coils, and the reason is that by spacing the turns the electrostatic field becomes less concentrated and the amount of air between the turns is increased.

Q.—But is not the air a dielectric and consequently liable to cause dielectric losses?

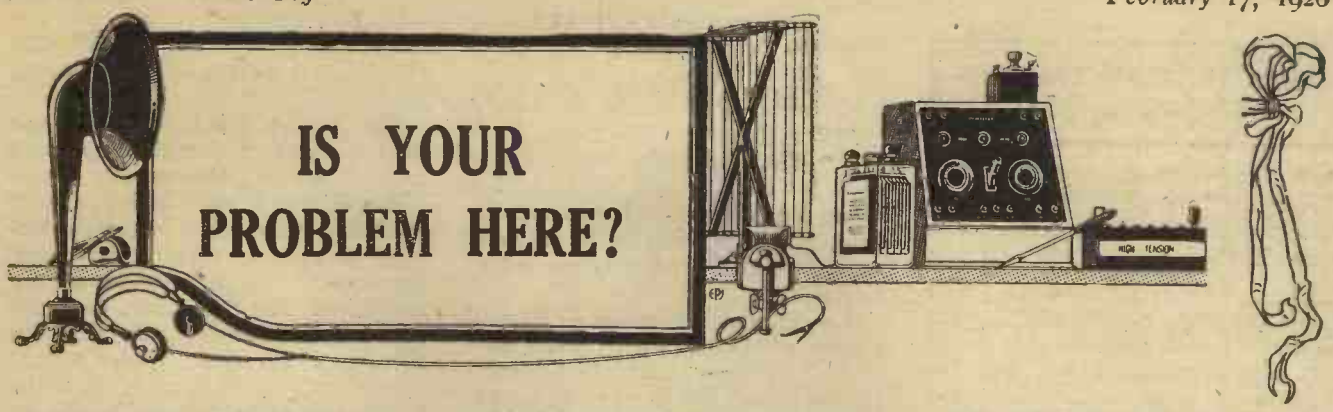
A.—No. The air may be considered as a perfect dielectric having no losses.

Q.—Well, if this is so, and we use bare wire, there should be no great merit in spacing the turns?

A.—There is some point in your remark, but there is a further advantage of spacing which I have not mentioned. If adjacent turns are too close, the skin effect becomes still worse, this raising the H.F. resistance of the wire. Under normal conditions (*e.g.*, a straight wire) the H.F. current travels uniformly on the surface of the wire. Where turns are close together the amount of metal used by the current becomes still less as the current tends to crowd to that part of the surface of the wire which is next to the adjacent turn. This means that reasonable spacing is a help whether the wire has an insulated covering or not.

Q.—Would you say that spacing turns could be accepted as a universal rule?

A.—No, because if spacing is carried out in the case of some coils, their length will be greatly increased and then we will have all the troubles which I explained earlier on.



A RESISTANCE FOR ACCUMULATOR CHARGING

"In order to avoid carrying my accumulator to the charging station I propose to charge it from my 240-volt direct current mains, employing a wire-wound resistance in place of a bank of lamps. My accumulator is rated at 6 volts 30 actual ampere-hours. Can you give me the length of Eureka resistance wire which I shall need?"

A generally suitable charging current for an accumulator is obtained by dividing its actual ampere-hour capacity by ten, which gives a charging current of 3 amperes in your case. To carry this current without undue heating 18-gauge Eureka wire should be employed. The value of the series resistance required is therefore of the order of 80 ohms, which figure is obtained by dividing the voltage of the mains by the charging rate in amperes; 18-gauge Eureka resistance wire has a resistance of, roughly, 372 ohms per 1,000 yards, so that a rough calculation will show that you will need approximately 220 yards.

Although you will overcome the difficulty of carrying your accumulator, it should be observed that the method of charging in series with a resistance across the mains is by no means an efficient arrangement, since a very large voltage has to be dropped across the series resistance, which voltage multiplied by the charging current gives the power wasted.

A RESISTANCE COUPLING PROBLEM

"I have constructed a four-valve receiver consisting of a transformer-coupled high-frequency stage, a detector with reaction and two resistance-coupled note magnifiers, with a switch so that I can tune in on telephones on two valves and then throw the note magnifiers into circuit for working the loud-speaker. This arrangement is such that the telephones replace the anode resistance in the plate circuit of the detector valve. I find that when a station is obtained at good strength on the telephones and is switched on to the loud-speaker retuning is necessary. How can I overcome this difficulty?"

Your trouble is a common one, and is due to the fact that the anode resistance replaces the telephones in the anode circuit of the detector when four valves are used, thus dropping the voltage on that valve, which in turn necessitates a readjustment of

reaction, in order to bring signals up to full strength again. A better scheme is to arrange that the anode resistance is always in series with the telephones when tuning on two valves, whilst the latter are cut out of circuit when the note magnifiers are switched on. The by-pass condenser (of about .0003 μF) should be arranged so as to be across both the telephones and the anode resistance of 80,000 ohms. This simple system of switching will obviate any need for serious readjustment when the telephones are cut out of circuit.

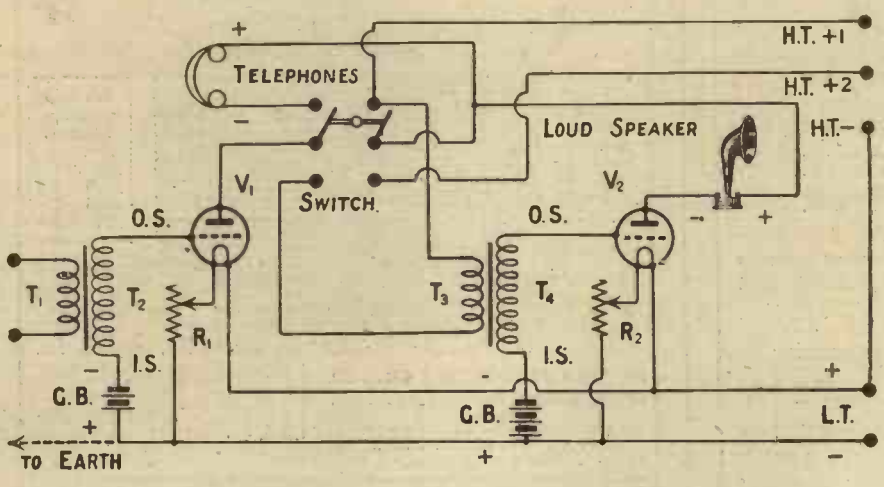
DESIGNING A 2-VALVE AMPLIFIER

"I am designing a two-valve transformer-coupled amplifier for use with my crystal set, and should like your criticism. Can you also give me a theoretical circuit diagram to incorporate a two-pole two-way switch to cut out the last valve and to enable me to listen with telephones on one note magnifier or with a loud-speaker when both valves are in circuit? If possible, I should like you to provide for separate high-tension supplies to the two valves, and also for separate grid-bias batteries."

It is not a difficult matter to arrange for the switching you require, and a suitable theoretical circuit will be seen in the figure. Here it will be observed that with the switch in the upward position, the telephones are inserted in the plate circuit of the first valve, which is fed from the H.T. + 1 terminal.

When the switch is in the downward position the primary winding of the second low-frequency transformer replaces the telephones in the plate circuit of the first valve, whilst the loud-speaker is placed in the anode circuit of the second, which is fed from H.T. + 2. With this arrangement the last valve will have to be switched off on its own filament resistance when not required.

In the layout which you have submitted the transformers are placed somewhat close together, namely, about 2 in., and it would be better to separate these to a greater distance if possible. Try also to arrange them with their axes at right-angles. Except for this one point the arrangement would appear to be a sound and practical one, but should the amplifier show a tendency to howl when both valves are employed, the connection shown dotted from low-tension negative to the earth terminal of the crystal set should be made.



With the switch in the "one valve" position, the filament circuit of the second valve must be broken by means of the rheostat R2.

Radio Press Information Dept.

2/6 QUERY COUPON 2/6

WIRELESS WEEKLY. Vol. 8. No. 1. February 17, 1926.

This coupon must be accompanied by a postal order of 2/6 for each question, and a stamped addressed envelope.

THE March issue of "The Wireless Constructor," now on sale, marks another step forward in the production of sets for home constructors.

The special feature of this issue is *The "Huntsman" Two* by Percy W. Harris, M.I.R.E., "A sensitive non-radiating two valve receiver for long-range work."

Simple and easily constructed, the circuit comprises a stage of H.F. amplification followed by a detector valve. As its name suggests, this receiver can be used for "hunting" stations, and made to oscillate freely without interfering in any way with nearby listeners. Tests have shown that another receiver used in the same room is not affected by persistent oscillation in the "Huntsman."

An article of great interest to all experimenters and home constructors is *Fine Wire Coils* by J. H. Reyner, B.Sc. (Hons.), A.C.G.I., D.I.C., A.M.I.E.E. In this article the author discusses the effects of the gauge of wire employed for winding coils, and suggests various experiments whereby the reader can test for himself the truth of his theories.

EXTENSION OF FREE BLUE-PRINT SERVICE

With each past issue of "The Wireless Constructor" the proprietors have presented a free blue-print of one particular set described. In order to help those who desire to build one of the other sets described, a free back-of-panel blue-print of any set in this and future issues of "The Wireless Constructor" will be supplied on receipt of the coupon in that issue.

Selection from Contents

The "Huntsman" Two
By Percy W. Harris, M.I.R.E.

A Useful Selective Three-Valve Receiver
By E. J. Marriott.

The "Two-in-one" Receiver
By Philip H. Wood, B.Sc., F.P.S.L.

The Variometer Tuned Single Valver
By G. P. Kendall, B.Sc.

Fine Wire Coils
By J. H. Reyner, B.Sc., A.C.G.I., D.I.C., A.M.I.E.E.

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EVERY MONTH

The Wireless Constructor

EDITED BY PERCY W. HARRIS, M.I.R.E.

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Wireless Weekly. February 24th, 1926.

28

3d.

Wireless Weekly

Vol. 8. No. 2.

A WIDE-RANGE SHORT-WAVE RECEIVER

FOR TRANSATLANTIC RECEPTION

Silvertown

WIRELESS ACCESSORIES

Quality guaranteed by over 50 years' electrical manufacturing experience.

B.570. 10-WAY INDUCTANCE OR CAPACITY SWITCH (Patent 226245)

This is a simply and compactly constructed component, suitable for numerous and varied circumstances where it is desired to vary the impedance of a circuit, or for opening and closing a plurality of circuits by the manipulation of a single member. It enables the experimenter to build up large capacities and is an invaluable addition to any set. Price 5/6 each.

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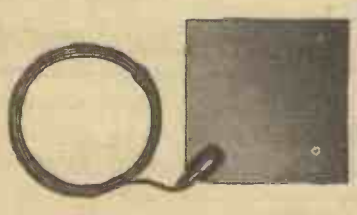
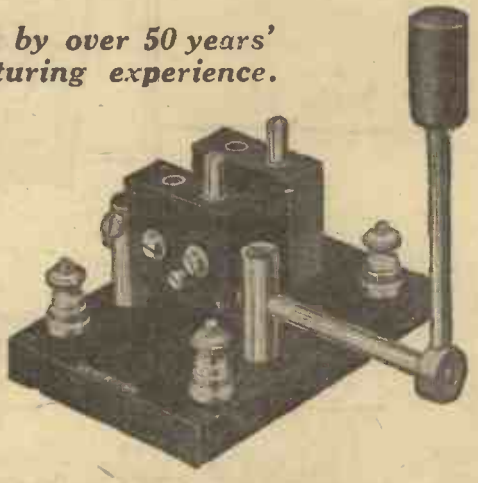
Strongly constructed. Moving vanes are shaped to give low minimum capacity. Fitted with a stop to allow of a movement of 180 degs. only. From 5/6 each.



1572. EARTH PLATES

Size, one foot square, complete with 19 ft. of insulated lead-in wire well soldered on. Price 4/- each.



B.565. DOUBLE COIL HOLDERS.

Comprising one fixed and one moving coil holder, mounted on ebonite panel 3¾ in. × 2 9/16 in. × ⅜ in. thick together with four finished and lacquered double terminals. Weight 8½ oz. Price 6/6 each.

No. B.601. SILVERTOWN VERNIOMETER. (Patent applied for.)

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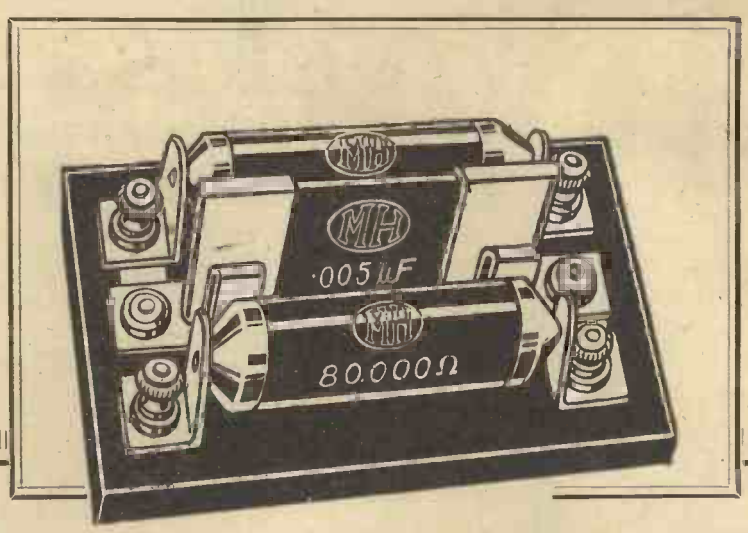

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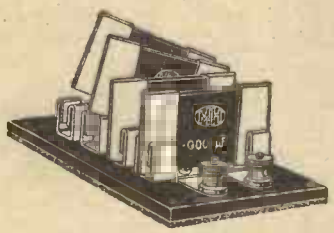

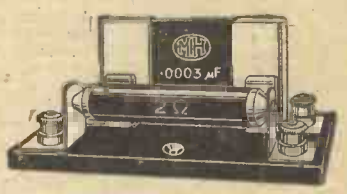

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Phone: City 9911

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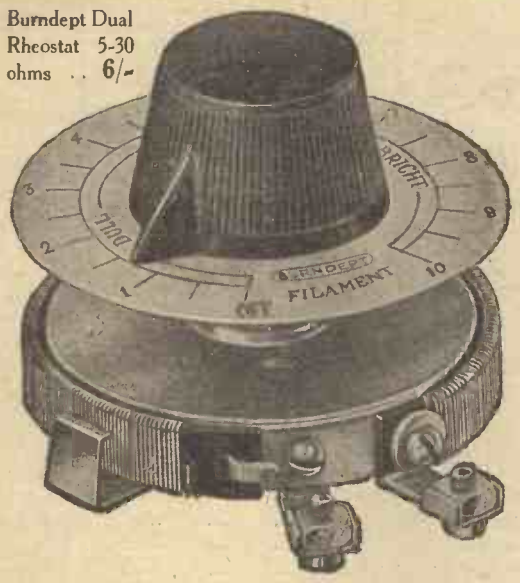

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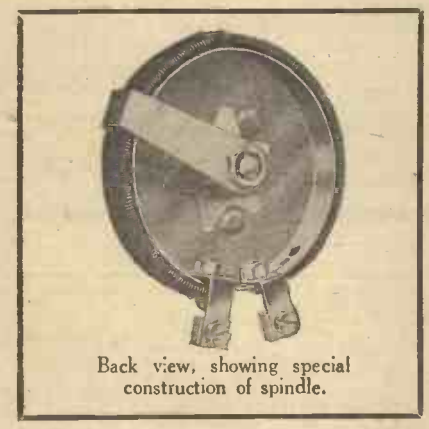

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Some Experiences in Building an "Isofarad" Receiver

By H. ANDREWES, B.Sc., A.C.G.I., D.I.C. (2TA)

A description of the "Isofarad" circuit which appeared in "Wireless Weekly" for December 16, 1925, has aroused considerable interest, and this interesting article has been written to give would-be constructors the necessary assistance in building the set with British components.

SINCE the original publication of the "neutrodyne" receiver by Prof. Hazeltine in America, many different designs of neutrodyne receivers or so-called neutralised high-frequency amplifiers have been brought out. In all these circuits the object of the designer has been to balance the inherent self-capacity of the valve in some manner to prevent self-oscillation of the high-frequency stages.

Advantages of the "Isofarad"

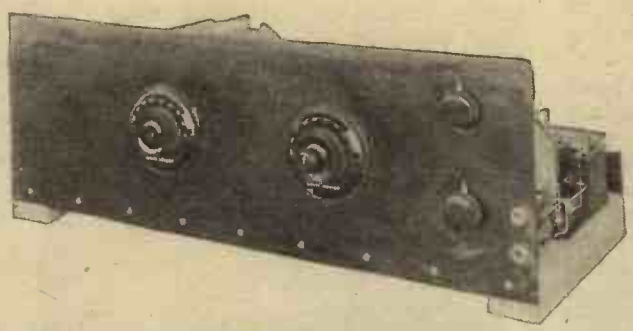
In the opinion of the author, by far the most satisfactory solution, from the practical and constructional point of view, has been the circuit called the "Isofarad" recently described in *Wireless Weekly*. The theory of this receiver has been fairly fully dealt with, and so need not be discussed in detail here.

Principles

In principle each high-frequency stage is constructed in the form of a four-condenser bridge, so that if the bridge is balanced no regenerative feedback occurs from one stage to another, and hence the object explained above is achieved.

The writer's attention was first drawn to this circuit by an article which appeared in the issue for May of last year of the American magazine, *QST*, to which the reader is referred. This article describes a receiver built on this principle in some detail, and with a number of modifications the receiver to be described follows this design.

This design differs somewhat from that described recently in *Wireless Weekly*, and is perhaps a little simpler from the constructional point of view. These modifications will be referred to later when the receiver is described in detail.



The use of mechanically-linked condensers enabled the author to simplify the panel lay-out very considerably.

Circuit Details

Fig. 1 shows the complete circuit diagram of the receiver, the values of the various components being given in the reference table. The plugs and jacks have been omitted for the sake of simplicity, and the double condensers are shown as separate capacities.

Simplicity

It will be seen at once that the controls of this receiver are very simple, as there are only two tuning dials and the usual filament controls. Parallel jacks for the 'phones are used, with filament switches, so that the receiver is put into operation by merely inserting the telephone plug.

It will be noticed that no L.F. stages are included in this receiver. This was done to simplify the set, and also because the author has found that, for the experimenter with more than one receiver, it is very much more economical to have one good power amplifier which may be plugged into any receiver at will. Obviously one or more L.F. stages could be very easily added to this design.

Some Experiences in Building an "Isofarad" Receiver—*continued*

Permanent Adjustments

It should be noted that, owing to the simplicity of the controls, once this receiver has been initially adjusted, its operation is practically fool-proof, oscillation, with its attendant ills, being impossible; also, as only two controls are used, the usual "three-handed" operator required for most neutrodynes is unnecessary.

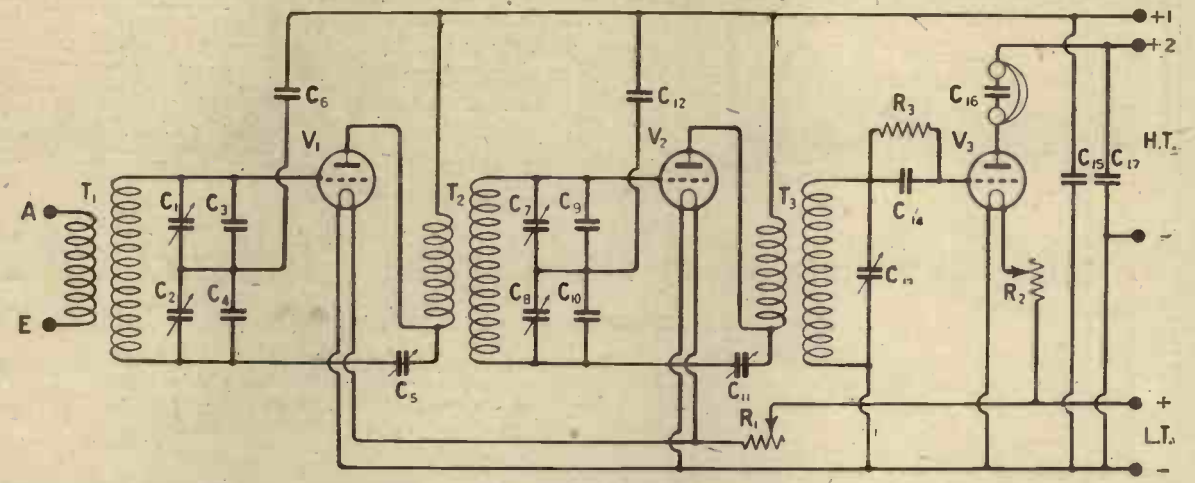


Fig. 1.—The form of the "Isofarad" circuit used by the author, who takes the grid return lead of the detector valve to L.T. negative. The jacks have been omitted for the sake of clearness.

Constructional Details

Turning now to the construction of the receiver, details of the components required are given at the end of this article. Perhaps the simplest method of attack will be to go through the receiver, starting with the aerial circuit.

It will be noticed that this circuit is "untuned," but fairly tightly coupled to the secondary coil. This is, of course, necessary, owing to the arrangement of the grid circuits, and it has been found in practice that no advantage is to be gained by fully tuning the aerial circuit, but that the arrangement has the advantage that the receiver may be calibrated, and the calibration is not sensibly affected by considerable changes in the aerial capacity, etc.

The First Transformer

The first H.F. transformer may be readily seen in the photographs, and couples the aerial to the first balanced grid circuit as described above. This is tuned by the double condenser mounted on the left of it. This condenser is coupled mechanically to an exactly similar one which tunes the second H.F. valve grid circuit. In this way both H.F. stages are tuned simultaneously.

Tuning Condensers

The coupling and arrangement of these tuning condensers may be readily seen in the photographs, and further description is unnecessary. In the particular receiver in question Dubilier Double Vanicons were used, as these lend themselves to the above arrangement.

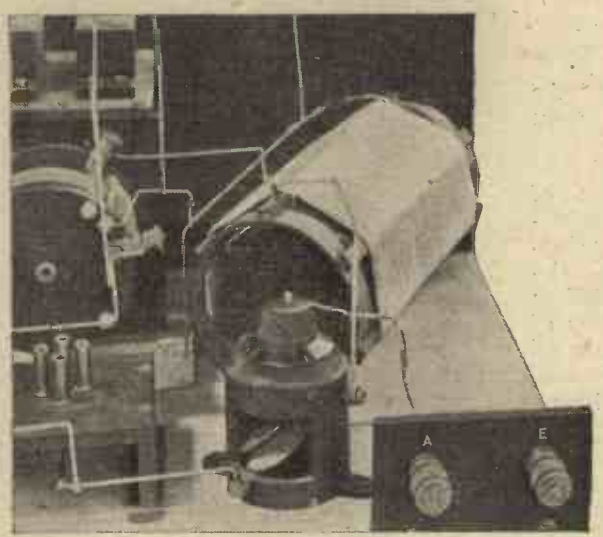
The second and third H.F. transformers are seen again to the left, looking at the panel from behind. A third condenser, in this case a single variable, tunes the grid circuit of the detector valve. In the case of the first two transformers, as the maximum capacity of the tuning condensers is small, being only 0.000125 μF (effective), the turns on the secondaries are necessarily larger than would be normal for broadcast frequencies, whereas in the case of the detector valve transformer, as no balancing is necessary, a smaller coil and larger condenser are used. Between the H.F. transformers may be seen the H.F. by-pass condensers, C6 and C12, in Fig. 1. These are 1 μF paper condensers.

Other Details

The valve-holders, filament controls, and jacks are quite normal, and need not therefore be described in detail. In front of the terminal board may be seen two paper condensers connected across the H.T. terminals, the set being arranged for separated H.T. supply to the H.F. and detector valves, to prevent interaction and also allow better operation of the detector.

Balancing Condensers

In front of the first two H.F. transformers may be seen the two balancing condensers.



This view shows how the small balancing condensers are constructed.

On these condensers depend the satisfactory working of the receiver, and for this instrument special ones

Some Experiences in Building an "Isofarad" Receiver—*continued*

were constructed. Theoretically, the balancing condensers C_5 and C_{11} must equal the capacity between the grid and anode of the valve. This may vary with different valves fairly considerably, and hence a balancing condenser having a reasonably high maximum capacity, say, .00001 or .000015 μF, is required. It must also be capable of fine adjustment and have a low minimum, say, .000001 or .000002 μF.

Construction of Balancing Condensers

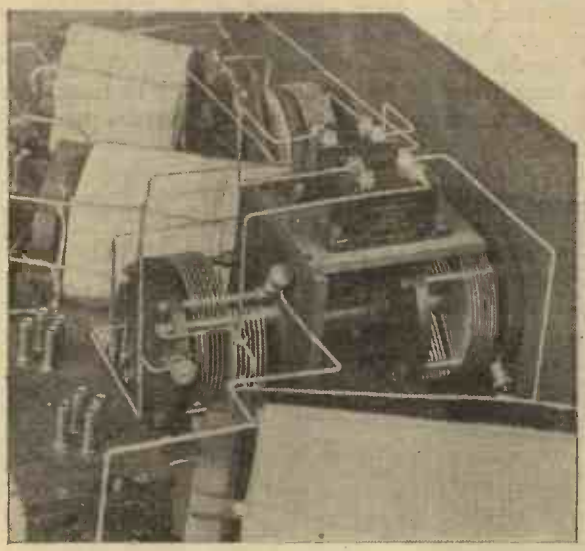
The construction of the condensers used may be seen in one of the photographs. In these components the vanes, two in number, are mounted at 45 deg. to the controlling shaft and are sickle-shaped. By this arrangement, although the plates are parallel at the position of maximum capacity, at minimum they are at right angles, so that a low minimum with a reasonably high maximum may be obtained.

Low Minimum

The metal in the construction is reduced to a minimum to reduce further the zero capacity. A small knob and dial are mounted on the controlling shaft for use when adjusting the receiver. The side of the ebonite containing box has been cut away to permit adjustment of the plates. (This construction of condenser is protected under British Patent Application, No. 25,963/24, P. R. Coursey.) Any reader having workshop facilities could probably fairly easily construct these condensers, or they may be purchased ready made.

Equalising Condensers

The only other feature which calls for comment in the construction of the set are the four fixed condensers, C_3, C_4, C_9, C_{10}, in Fig. 1, placed in parallel with the double condensers.

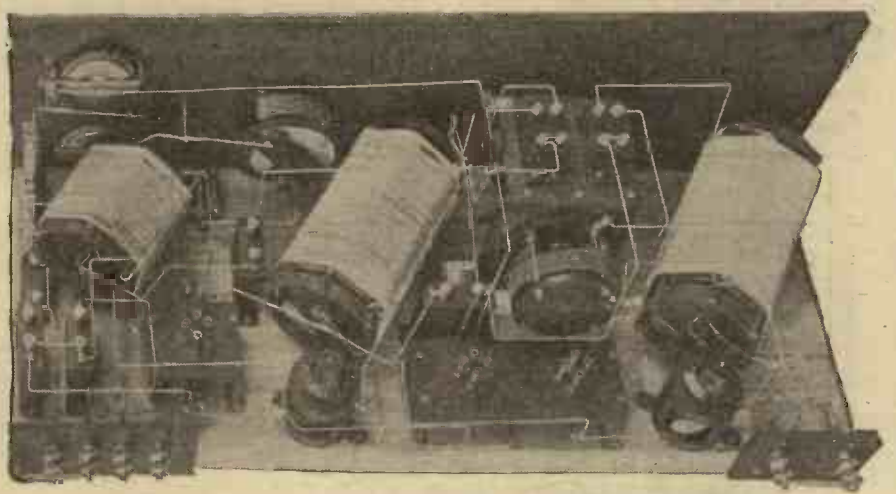


Showing how the double condensers are linked mechanically by means of an ebonite spindle between them.

These are of small capacity, from .00003-.00005 μF, and are inserted for the following reason:—It was found in practice that, owing to the comparatively large inductance of the secondaries of the first two H.F. transformers, difficulty was experienced in balancing the receiver and preventing oscillation when the double condensers were at or near zero setting, due presumably to small variation of the value of $\frac{C_1}{C_2}$ at the small capacities and also the high value of the ratio of inductance to capacity under these conditions.

Limiting the Minimum

This was obviated by the insertion of the condensers mentioned, as these limit the minimum value of capacity across the secondary and also tend to keep the ratio $\frac{C_1}{C_2}$ sensibly constant at the low settings. It is obvious that these condensers should all be as nearly alike as possible, so as to keep the ratio $\frac{C_1}{C_2}$ as near unity as is practicable.



The positions of the transformers are clearly seen here.

H.F. Transformers

The H.F. transformers perhaps call for a little comment, as in this receiver it has been found desirable to use windings of a special type. Approximately a 5 to 1 ratio of primary to secondary has been used, the primaries having only about 20 turns. This results in good amplification, although operation is still kept perfectly stable.

Operation of the Set

Turning now to the operation and adjustment of the set. On setting the receiver up the first adjustment is to get the two H.F. stages tuned to the same frequency with similar condenser settings by adjusting the number of turns on the secondaries (only slight adjustment being, of course, necessary), and this had best be done with the aid of a wavemeter.

Final adjustment may also be made by the alignment of the

Some Experiences in Building an "Isofarad" Receiver—*continued*

double condensers, but this should not be altered more than a degree or so, to allow for differences in the fixed condensers in parallel with them.

Balancing

Having then decided on the valves to be used and adjusted the H.T. and L.T. values for best operation, the receiver should be balanced. This is not a lengthy or difficult operation, and must, of course, be performed every time the valves are changed. The method is as follows:—A loud signal from a local B.B.C. station is tuned in and then the first H.F. valve is removed from its socket and held so that only three pins are touching the corresponding sockets, the filament being open-circuited.

The First Step

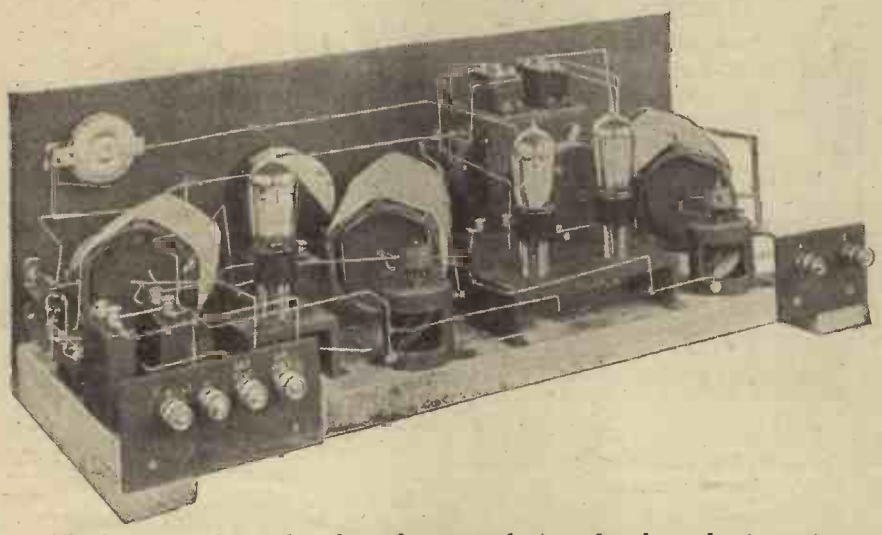
The first balancing condenser is then adjusted until the signal disappears and quite a good "silent point" should be obtainable. This operation is then repeated with the first H.F. valve in and the second removed and a similar balance obtained. The receiver is now balanced and ready for operation.

If on tuning in a distant station the set appears rather dead and results poor, a little regeneration may be introduced by slightly unbalancing one H.F. stage, but this should be done with great care and only to a very slight extent. In the receiver described, Mullard "Red Ring" valves were used with an anode voltage of 50-100 volts.

Good Results

In operation the author has obtained excellent results with this receiver. It will be found to be very selective, Bournemouth having been received at good strength and with no interference at only six miles from 2LO.

It is also very easy to tune, there being no reaction knobs to tempt the operator, and drive the neighbourhood desperate, and, of course, it is a very simple matter to calibrate both the dials to make station finding simple.



The battery and aerial and earth terminals are placed on ebonite strips at the rear of the baseboard.

Ideal for Unfavourable Localities

For those who live near a main B.B.C. station and have never heard, or perhaps one should say enjoyed, any other station's programme while the local station is working, the author can strongly recommend this very excellent circuit.

A Transformer Point

As already explained, the tuning condensers are of somewhat smaller capacity than is conventional, and therefore it is necessary to use transformers of large inductance. To cover a wide tuning range under these conditions it is essential that the windings shall be of really low capacity, and it will be noted that a special construction has been adopted.

Improvised Balancing Condensers

The figures given for the maximum and minimum values of the balancing condensers will enable the constructor to improvise these components from odd materials at hand, if desired. This will be found an easy matter with a few standard condenser vanes if a method of construction is adopted which ensures that the fixed and moving plates are very widely separated at the maximum position.

Parts required for "Isofarad" Receiver.

	Component.	*Reference Fig. 1*
1	Ebonite panel, about 8 × 21 inches, according to the designer's requirements	—
1	Wood Base	—
3	Valve holders	—
2	Terminal strips	—
2	Jacks (with filament contacts)	—
2	Filament rheostats (Igranic)	R_1 & R_2
2	Double condensers (Dubilier Double Vanicons)	C_1 C_2 & C_7 C_8
1	Single condenser (Dubilier Vanicon)	C_{13}
4	Fixed condensers (Dubilier type 620, 0.00005 μF)	C_3, C_4, C_9, C_{10}
4	Fixed condensers (Mansbridge 1 μF)	C_6 C_{12} C_{15} C_{17}
1	Fixed condenser (Dubilier type 600, 0.0003 μF)	C_{14}
1	Fixed condenser (,, ,, 610, 0.002 μF)	C_{16}
2	Balancing condensers (Special)	C_5 C_{11}
1	Grid leak 1 MΩ	R_3
2	H.F. transformers: Primary, 22 turns, 20 D.C.C., 2¾ in. dia. Secondary, 102 turns, 20 D.C.C., 3 in. dia.	T_1 & T_2
1	H.F. transformer: Primary, 12 turns, 20 D.C.C., 2¾ in. dia. Secondary, 56 turns, 20 D.C.C., 3 in. dia.	T_3
	(Both transformers are wound on skeleton formers, Primary opposite end from grid lead.)	

Improving Reproduction with Resistance Amplifiers

By A. G. D. WEST, M.A., B.Sc.

In this preliminary article Capt. West outlines the main practical considerations involved in the problem of securing the desired tone from a resistance amplifier.

Present day broadcast transmitting apparatus gives an almost perfect output.

A VERY large proportion of the sets used by listeners suffer so much in their reproduction because they contain indifferent transformers and are worked in conjunction with indifferent loud-speakers. The result is that one often hears complaints about lack of quality in the transmission which should not really be directed against the transmission system.

Receiver Deficiencies

For instance, some people complain of the failure of transmission of bass instruments in an orchestra or of the pedal notes in organ solos, whereas these particular notes are more than likely lost in the transformers of the receiving set or is the telephones and loud-speakers. The microphone and transmitter are quite capable of dealing with them.

These notes are written in an attempt to show that with the proper form of low-frequency amplification and careful design of the circuits some of these difficulties can be overcome, and satisfactory musical reproduction obtained as much like the original transmission as it is possible to get.

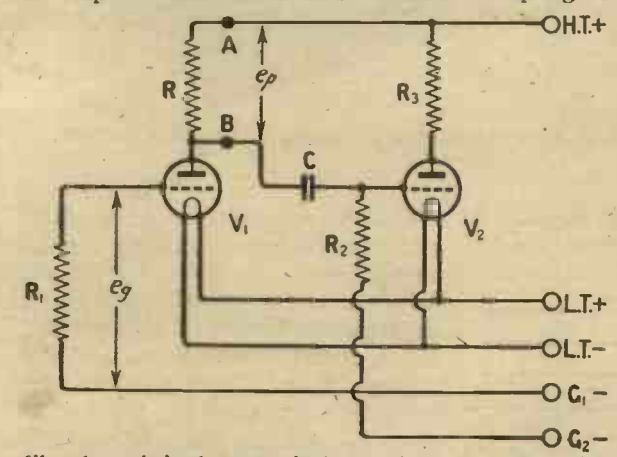


Fig. 1.—The author explains how the quantities shown here may be used in working out simple factors governing quality in a resistance amplifier.

Advantages of Resistance Amplification

A set designed for quality reproduction must have resistance-capacity low-frequency amplification; firstly, because it is the only kind of low-frequency magnification that is capable of giving an equal amplification at all musical frequencies; secondly, if any corrections are to be made they can be calculated with some degree of accuracy; and, finally, a not at all unimportant point, a resistance-capacity amplifier can be constructed and maintained,

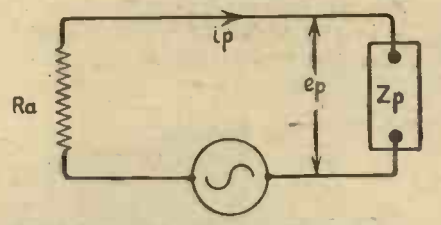


Fig. 2.—In this diagram the valve is represented as a source of alternating voltages.

giving approximately the same amplification as a transformer-coupled amplifier at the same or less cost than the latter.

I mention this because there is a feeling prevalent amongst experimenters that resistance-capacity coupling is less efficient and more costly than transformer coupling. It is quite easy to work out, and to find that a three-valve resistance-capacity amplifier costs very much the same as a two-valve transformer amplifier, and gives more or less equivalent average amplification.

The Use of Correctors

These notes are given to assist in the working out of corrector circuits to be applied to resistance-coupled amplifiers. Their practical use is suggested in many ways. For instance, in correcting for the distortion of a loud-speaker, if the response curve — that is, the efficiency of conversion from electrical energy into sound energy for all frequencies—for the loud-speaker can be obtained then values can be worked out to give an approximate correction. In other words, the overall curve of the amplifier and the loud-speaker can be made more approaching a straight line to give equal response over all frequencies.

An Ideal System

Supposing such an arrangement is possible, it would mean that if the transmitter system and the detector of a receiving set were working in such a way that equal voltages at the output of the detector corresponded to equal pressure variations of sound in front of the microphone for all frequencies, then a straight line system throughout the whole broadcasting chain would be obtained, and the result would approach what is really meant by perfect reproduction.

The Requirements

The general requirements in a resistance amplifier are well known, but, for the sake of completeness, I will repeat them:—

1. The valve for any particular stage of the amplifier must be chosen so that it can handle the amount of power that will be passing through the amplifier at that stage.

Improving Reproduction with Resistance Amplifiers—*Cont.*

2. The high-tension voltage and grid bias for that particular valve must be correctly adjusted so that there is no grid current nor bottom-bend distortion.

3. In working with an anode resistance the valve characteristics are not the same as those given in the ordinary valve curves published. In other words, the dynamic characteristics of a valve operating under these particular conditions must be worked out and followed.

4. The intervalve condensers must be large enough to pass satisfactorily currents of all the frequencies under consideration. The satisfying of this condition depends on the choice of the grid-leak of the following valve, the value of which must not be too high, or rectification will take place; nor must it be too low, or it will have a serious effect on the amplification of the previous valve. Good average values for these components are 0.1 μF intervalve condensers, with quarter megohm grid-leaks. These give practically a straight line result from thirty cycles per second upwards. The intervalve condensers must have a very high degree of insulation.

5. The anode resistance is best chosen at a value of from three to five times the value of the valve impedance, and the high-tension voltage must be sufficiently great to maintain a high enough voltage on the anode of the valve. In making the calculations, the impedance and magnification factor must be determined for the actual point of operation of the valve.

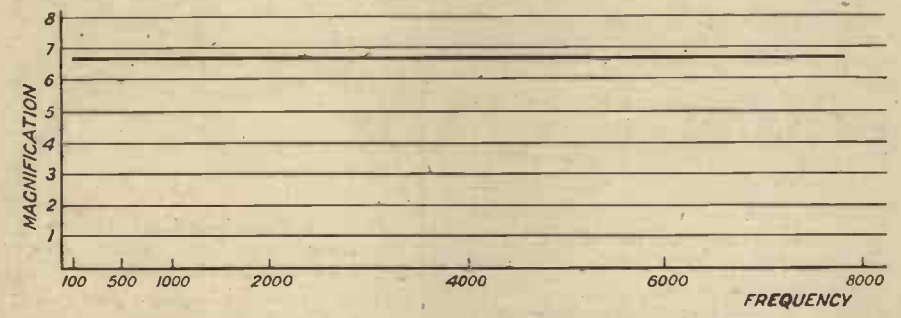


Fig. 3.—The "curve" given by a perfect resistance amplifier.

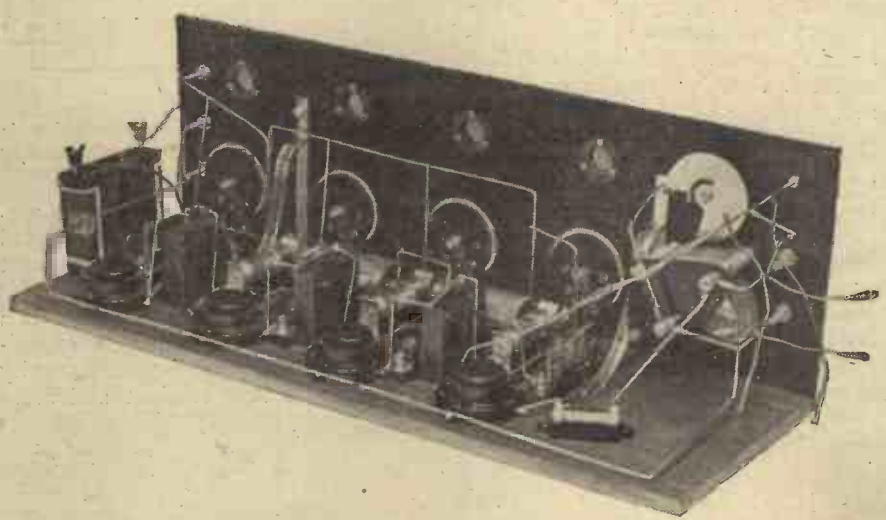
An Example

In the circuit given in Fig. 1, V_1 is the valve to be considered, under the understanding that there is no load by the valve V_2 on the circuit of V_1, and we are mainly going to consider the effective amplification of voltage given by the valve V_1 under various conditions in the anode circuit of this valve.

We shall connect various circuits across the points A and B, these circuits existing together with or replacing the anode resistance R. We shall then work out the magnification at the various frequencies under these conditions. The calculations in some cases are rather laborious, but may be very much simplified by careful consideration of what terms can be neglected in comparison with others.

Magnification

The voltages in the grid and plate circuits are respectively e_g and e_p, the magnification being the ratio of e_p to e_g. We can best represent the circuit of the valve V_1 by the simpler one given in Fig. 2, the batteries being omitted for the sake of clearness.



The design of a set with three resistance stages calls for some care in lay-out.

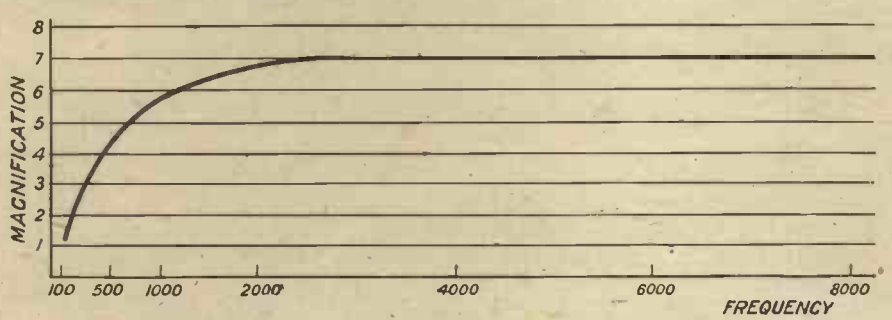


Fig. 4.—Showing the effect of using a choke coupling of unsuitable impedance.

The valve can be taken as an alternator producing alternating current at all frequencies with voltage μe_g where μ is the magnification ratio, or, as some people call it, the "m" value of the valve.

The internal impedance of the valve is represented by the resistance R_a and the external impedance, that is the impedance of the circuit connected in the anode of the valve, by $Z=R+jX$. Then it is quite easy to obtain a formula for the voltage amplification.

We have to represent the various variables as vectors and consider the

Improving Reproduction with Resistance Amplifiers—*Cont.*

real and imaginary parts, and finally we arrive at the expression

$$M = \mu \sqrt{\frac{R^2 + X^2}{X^2 + (R + R_a)^2}}$$

where M is the voltage amplification obtained and X is the external reactance.

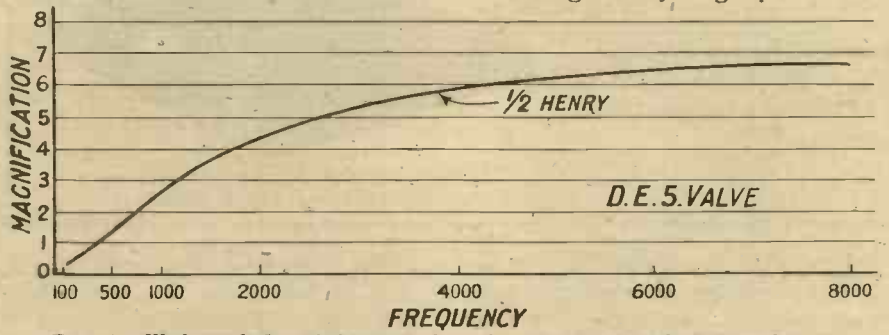


Fig. 5.—With a choke of lower value the result is still worse than in the case of Fig. 4.

This is the absolute value of the voltage amplification. We do not need to worry about difference of phase between grid and anode alternating voltages. We now consider various simple cases where this formula may be applied.

1. *Pure resistance-capacity coupling.*—The usual formula is obtained immediately: $Z = R$, $M = \frac{\mu R}{R + R_a}$ Taking the case of a power valve with, say, $\mu = 7$, $R_a = 8{,}000$ (for instance, the Marconi D.E.5 valve, or the B.T.H. B4 valve, or the Mullard D.F.A.1 valve), we get $M = 6.75$, and the result is independent of frequency as given in the curve of Fig. 3.

2. *Case of an inductance or choke in the anode circuit* (that is to say, a choke R_1 connected across points A and B in Fig. 1). We can neglect R in comparison with R_1, then

$$Z = R_1 + j p L_1 \left(\begin{matrix} \text{where } p = 2\pi n \\ n = \text{frequency} \end{matrix} \right),$$

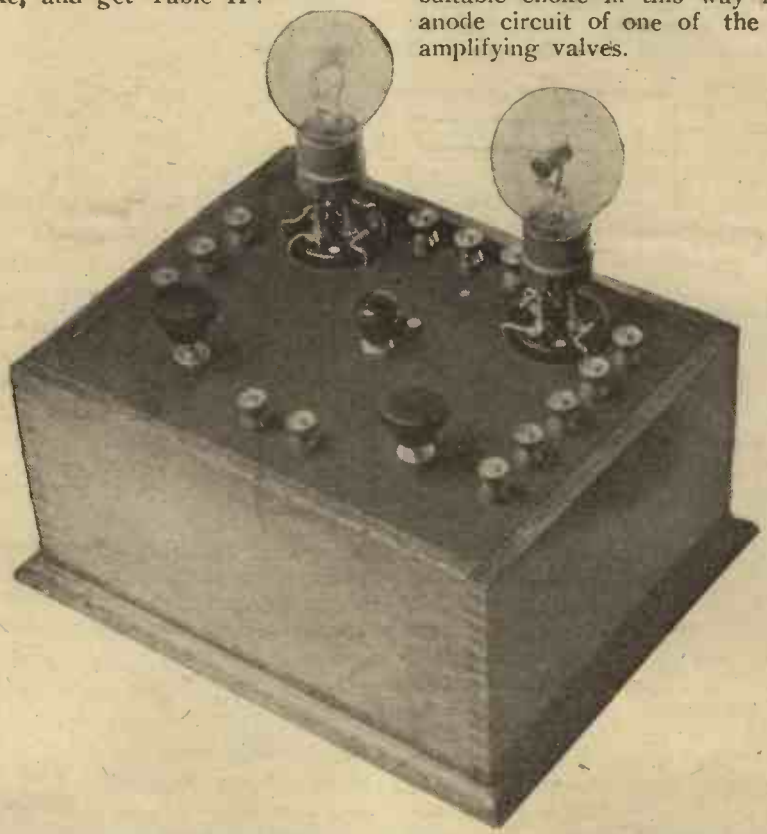
$$M = \mu \frac{\sqrt{p^2 L_1^2 + R_1^2}}{\sqrt{p^2 L_1^2 + (R_1 + R_a)^2}}$$

We can take two practical examples of this. In these cases we can usually neglect the R_1 term, as R_1 is small in comparison with R_a or pL_1.

(*a*) Taking the same valve as before with a 2-henry choke, we can calculate out the magnification for the various frequencies, and we get Table I.

The frequency magnification characteristic in this particular case is given by Fig. 4.

(*b*) In this case we take a ½-henry choke, and get Table II:



For experiments with resistance amplifiers a very simple instrument is to be preferred.

TABLE I.

Frequency n	100	250	500	1,000	2,000	4,000	8,000
M	1.08	2.55	4.30	5.91	6.7	7	7

TABLE II.

Frequency n	100	250	500	1,000	2,000	4,000	8,000
M	.24	.68	1.35	2.56	4.35	5.9	6.7

and the resulting curve is then given in Fig. 5.

A Method of Tone Adjustment

Both these cases give effectively a raising of the tone, and may be used as a very rough correction for broadcasts which are particularly low-toned, and the result is to cut off the lower notes of the musical scale in various proportions.

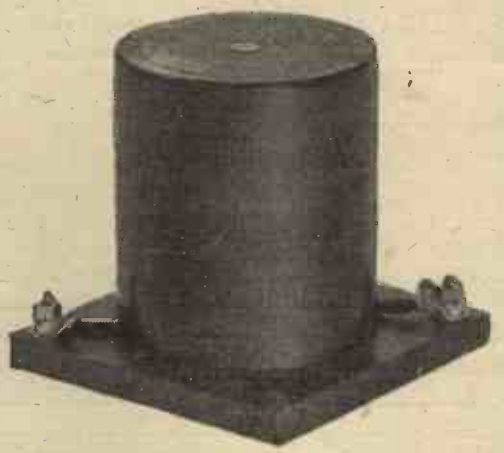
Case (*a*), it will be noticed, gives a sharper cut-off of the bass notes than case (*b*), and could be used, say, when frequencies below 500 a second appear to be predominant. An example when this type of correction may be useful is in long-distance reception, when a certain amount of reaction has to be used to get selectivity or strength; the result is the reception is very low-toned, and the tone can be put right again by the insertion of a suitable choke in this way in the anode circuit of one of the L.F. amplifying valves.

In a later article I shall work out the results for types of correctors using resistances and capacities, and after that more complicated forms of correctors, and how they may be used in actual practice for the correction of distortion in receivers and loud-speakers.

The Dangers of Unwanted H.F. Currents

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

In this article the author gives some striking figures obtained in actual experiments which show that the danger of the production of undesirable effects in L.F. circuits by parasitic currents is a very real one.



The ordinary L.F. choke acts also as a high-frequency coupling unit.

"WHAT the ear doesn't hear the heart doesn't grieve over" would be an appropriate proverb to apply to many wireless experimenters. Up to a point this is all very well, but many baffling faults in receiver design, especially when several valves are used, can be traced to faults in circuit design, which are quite "invisible." Without desiring to be unduly scare-mongerish, I would like to warn all experimenters to be very much on their guard against insidious currents and potential differences which play no desired part in the operation of a receiver but which may completely or partially upset the stability of a receiver, the signal strength or the purity of reproduction.

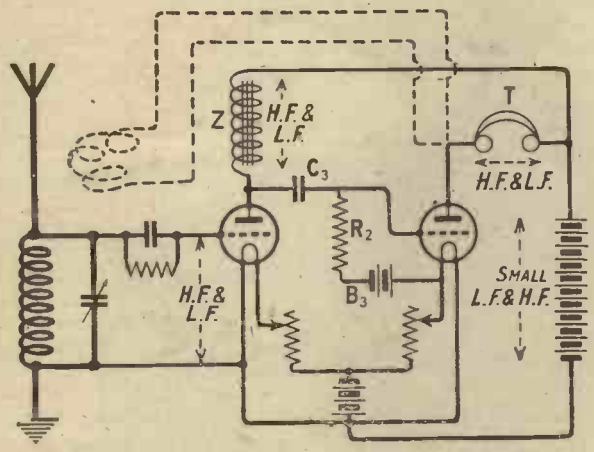


Fig. 1.—If the reaction coil shown by dotted lines is inserted it can be shown that considerable H.F. currents are flowing in the anode circuit of the second valve.

H.F. Currents in L.F. Circuits

I propose in the present article to deal with what is undoubtedly the most common fault, namely, the presence of high-frequency currents floating about in the receiver and producing the most aggravating and baffling effects. I can best express what I mean when I say that many five-valve receivers consisting of two H.F.s, detector and two note magnifiers are really acting as five-valve high-frequency amplifiers of which only two stages are being employed for useful purposes! The other three stages (the detector and two L.F. valves) are amplifying the high-frequency currents, the only effect being that these high-frequency currents often amplify to a very considerable strength and make the whole receiver unstable and difficult to handle and often cause serious distortion.

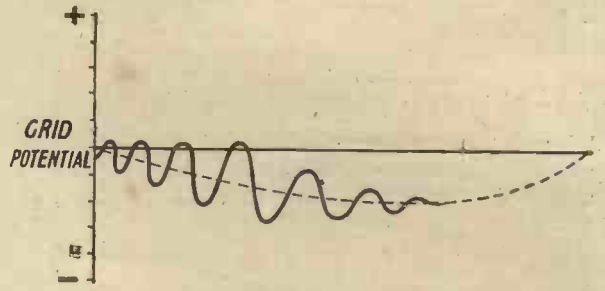


Fig. 2.—Illustrating the effect on the detector grid potential of an incoming signal.

The best circuit to show the effects which undesirably mixed L.F. and H.F. currents have on a receiver is that shown in Fig. 1.

There is no reaction in the circuit, and, at first sight, it might appear perfectly straightforward. As a matter of fact, however, the circuit is not merely a plain detector and note magnifier, but also embodies two stages of high-frequency amplification which are not turned to any good purpose!

The Anode Currents

It ought to be stated straight away that whenever a rectifier is used, we not only get the rectified low-frequency currents, but also the high-frequency impulses. Fig. 2 shows the well-known diagram illustrating the effect on grid potential of high-frequency currents when a grid condenser and leak are employed. It will be seen by the dotted line that the grid potential becomes more and more negative on the average, although all the time there is a high-frequency variation. Both the average high-frequency variation on the grid of the detector valve, but also the high-frequency variation are amplified. In the case of a detector using reaction, the reaction coil has passing through it the high-frequency variations which are made use of, but where no such reaction is employed, the high-frequency part is thrown away, as it were, and only the low-frequency currents are utilised, these, of

course, operating the telephone receivers.

How the Energy is Transferred

Referring to Fig. 1 we will see that the grid of the first valve is varying both at high and low-frequency potentials, the low-frequency variations being produced by the grid condenser and leak rectification. The low-frequency element, which is what we require in the Fig. 1 circuit, is amplified by the first valve and sets up low-frequency potential variations across the choke coil Z, the end of this choke coil being connected through the second grid condenser to the grid of the next valve. The other end of the choke coil Z is connected to the positive terminal of the high-tension battery, the negative terminal of which is connected to the filaments. This end of the coil Z is, therefore, at the same potential as the filaments, as regards low-frequency currents, since the high-tension battery acts, in so far as high- and low-frequency currents are concerned, as a direct connection.

The choke coil Z, across which the low-frequency potentials are established, may therefore be considered as being not only in the anode circuit of the first valve, but as being connected across the grid and filament of the second. This second valve acts as a low-frequency amplifier, and the low-frequency currents now pass through the telephones T. There is no need to explain the object of the grid condenser C_3 and the gridleak R_2; they merely serve as a means of insulating the grid from the positive terminal of the high-tension battery, which would otherwise impress its potential through the choke on to the grid.

The Dangers of Unwanted H.F. Currents

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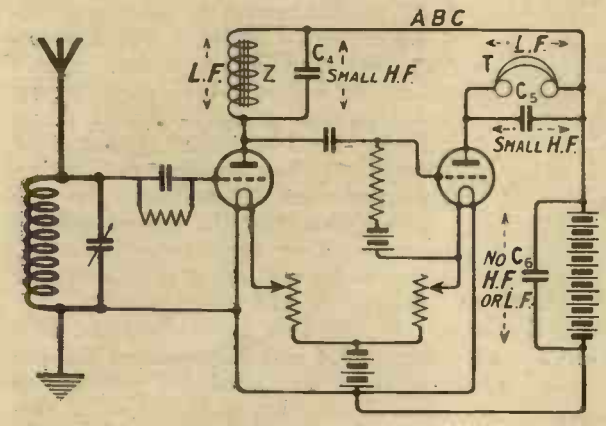


Fig. 3.—The condenser C4 helps to reduce the parasitic H.F. troubles.

For experimental work any simple home-made coil of adequate size can be used as a choke.

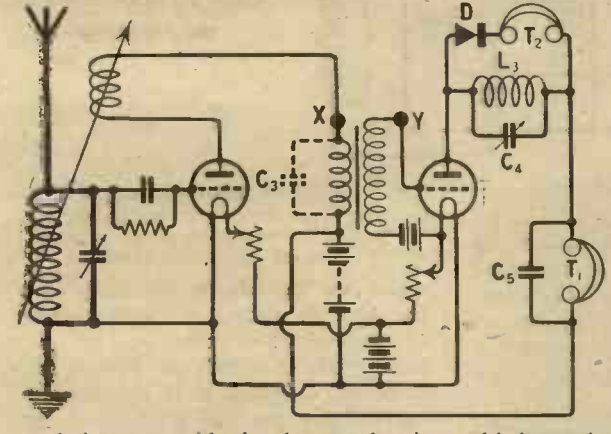
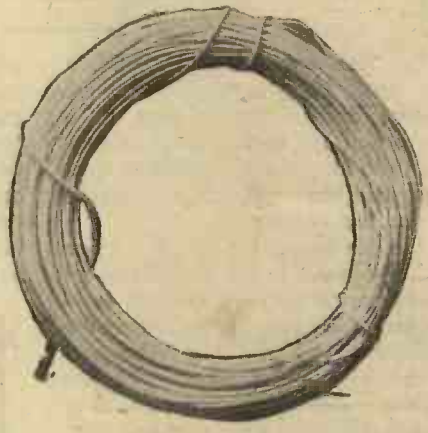


Fig. 4.—Signals in the telephones T2 demonstrated the presence of an H.F. component in the anode current of the second valve.

Parasitic Currents

The trouble with this circuit is that not only does it act as a low-frequency amplifier, but the high-frequency currents are also amplified. These currents are parasitic; they are hangers-on which are not wanted, but which try to follow the low-frequency currents unless we stop them. The choke Z acts as a coupling not only for the low-frequency currents but also those of high-frequency, and these are passed on to the grid circuit of the second valve which amplifies them. In the anode circuit of the second valve we therefore have quite strong high-frequency currents, which are not in any way utilised. They pass round the anode circuit through the self-capacity of the telephones and telephone leads. In this particular circuit they travel round the anode circuit of the second valve without doing any particular harm, but in many circuits such currents would produce self-oscillation and render the circuit very unstable. Moreover,



unless the grid potential and characteristic curve of the second valve are properly adjusted, the high-frequency currents impressed on the second grid are liable to be rectified so that we would get in the anode circuit and the telephones, not only the low-frequency amplified currents, but also some additional new rectified currents, which would contribute distortion.

A Test

Anybody having any doubt as to the existence of strong high-frequency currents in the anode circuit of the second valve of Fig. 1, could connect a length of insulated wire, as shown in the dotted line, between the anode of the valve and one side of the telephones. By making this wire into a rough coil and coupling it to the aerial inductance, decided

reaction effects may be obtained, and in a more complicated circuit stray reaction effects, due, for example, to long telephone leads, can cause serious trouble.

Remedies

We can checkmate high-frequency troubles to a considerable extent by the use of by-pass condensers. Fig. 3 shows how this can be done in the Fig. 1 circuit. We now connect a condenser C4 across the choke coil Z. This condenser will offer a ready path for the high-frequency currents, and virtually acts as a short circuit for them. Such a condenser will act as a much better conductor for high-frequency currents than for low-frequency.

If the condenser C4 has too large a capacity it will begin to act also as a short-circuit for the desired low-frequency currents. It will decrease signal strength in the telephones and will cut out some of the higher speech and musical frequencies, thus affecting purity of reproduction. If, on the other hand, we made the condenser too small, it will not effectively prevent the pass-on of high-frequency currents to the second valve. Hence, in such an arrangement a compromise has to be effected. The condenser C4 should have a value in general of from .0003 μF to .001 μF. With regard to the anode circuit of the second valve, we have high-frequency potentials established across the telephones, and these may be largely cut out by connecting a condenser across these telephones. Here again it is a question of compromise, and the condenser C5 may have a value of .001 μF or .002 μF.

Battery Shunts

It will be noticed that in Fig. 3 I have inserted a condenser C6. This may conveniently be of 2 micro-farads capacity. If of this size the condenser will tend to prevent "frying" noises, etc., due to irregularities in the voltage of the battery. Another advantage, however, of this condenser (although this further advantage could be obtained by using a much smaller value) is that although in Fig. 1 I assume that the high-tension battery had no resistance or inductance, yet in actual practice it possesses both. The inductance, of course, is very small, but the resistance may become quite appreciable, especially as the battery grows older. Since both high- and low-frequency currents are passing through this resistance, potentials will be set up across the battery and may cause obscure reaction and other interference effects. These may be cut out by the short-circuiting process of using a condenser in parallel with the battery.

The Dangers of Unwanted H.F. Currents

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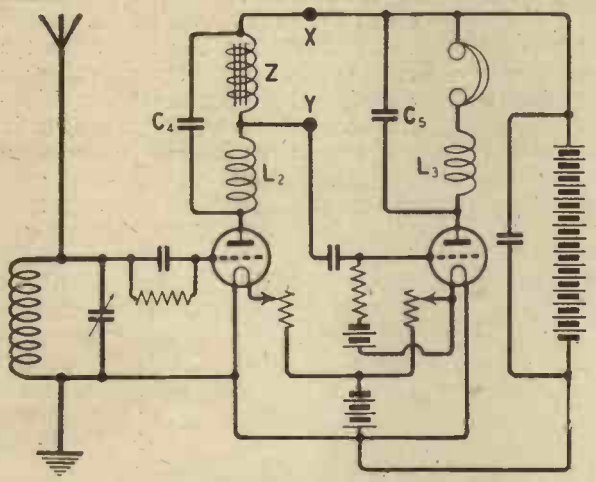


Fig. 5.—A high-frequency choke (L2) may be included to eliminate the passing-on of H.F. potentials.

An Interesting Experiment

Those who may be a little sceptical regarding the amount of high-frequency current which gets into the low-frequency side of a receiver will be interested in the circuit of Fig. 4, which I arranged to find out the amount of high-frequency current which got in to the L.F. circuits. It will be noticed that the first valve is an ordinary detector using reaction, the second valve being a low-frequency amplifier. The low-frequency coupling apparatus is this time an ordinary L.F. transformer. Across the primary of this transformer is a condenser C3 of .002 μF capacity; this condenser could be disconnected if desired. In the anode circuit of the second valve I connected an oscillatory circuit L3, C4, which was shunted by a crystal detector D and telephones T2.

In the first experiment the condenser C3 was disconnected and the receiver was used for picking up broadcast from 2LO, 14 miles distant. Good signals were heard in the telephones T1, as would be expected, but very good signals were also obtained in T2 when the circuit L3 C4 was tuned to the incoming wavelength! What was obviously happening was that the high-frequency currents did not end up in the anode circuit of the first valve, but were passed on to the grid circuit of the second, were amplified by this second valve and developed in the circuit L3 C4. In other words, we were getting, quite apart from the normal action of the circuit, two stages of high-frequency amplification! This is a simple experiment that any amateur can perform.

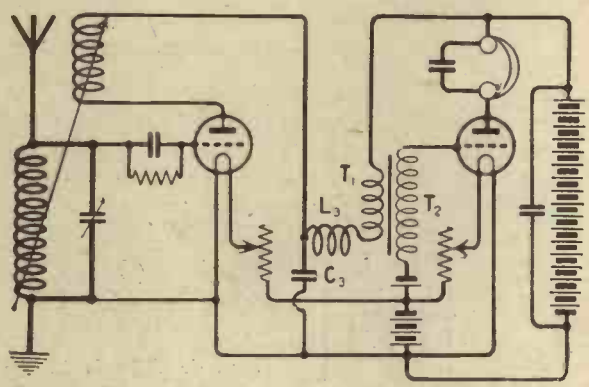
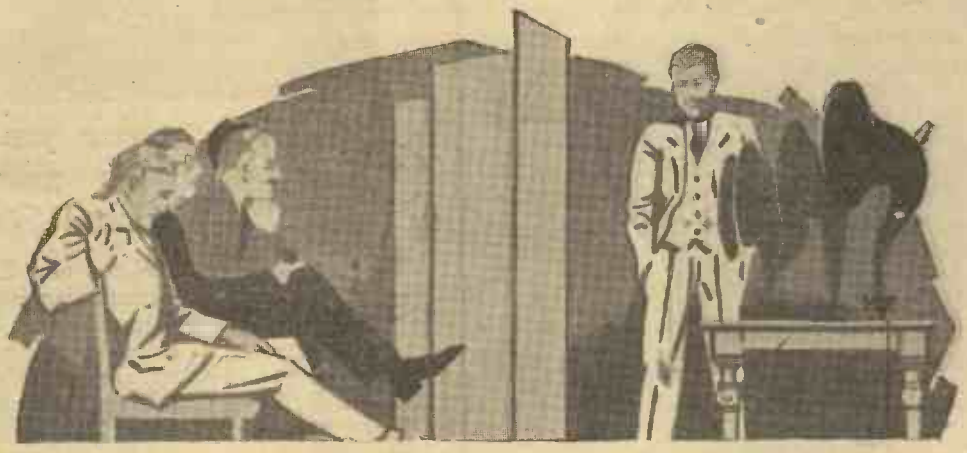


Fig. 6.—This arrangement of choke (L3) and by-pass condenser (C3) may sometimes be advantageous.

Actual Measurements

As the signals in the telephones T2 were so strong a microammeter was connected in circuit and actually registered as much as 500 microamperes. When it is remembered that telephones will give good signals with only 30 microamperes, it is quite clear that strong high-fre-

(Continued on page 60)



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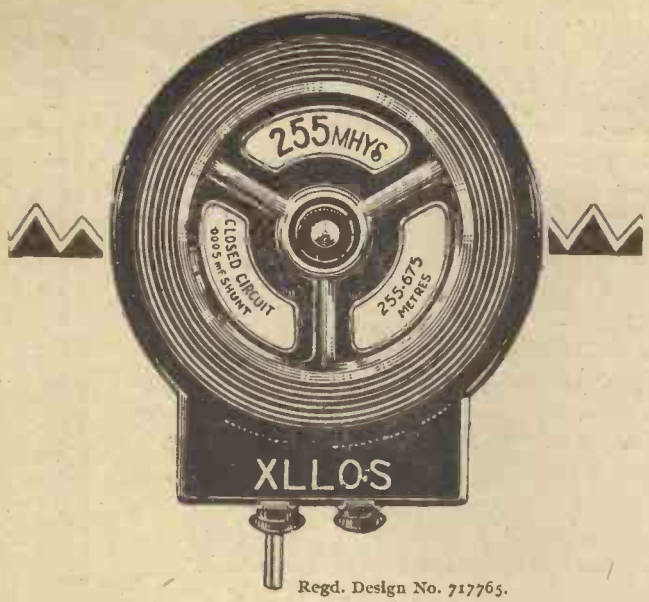

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Does Reaction Compensate for High Losses?

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

Argument has long gone on concerning the question of whether reaction can really compensate fully for a circuit of high resistance: if so, why use a low-loss coil? Mr. Reyner gives in this article some valuable and illuminating data upon the point.

WHEN the era of "low-loss" coils first commenced the older types of coils were discarded for the time being in favour of the newer types which were designed. These new coils, however, were often bulky and inconvenient, and many people were wondering whether their use in a valve receiver was really necessary.

If we have a single-valve receiver so arranged that we can apply reaction to the tuning circuits connected across the grid and filament of the valve, then theoretically we may continue to increase the amount of energy reacted round the valve until the effective resistance of the grid circuit is reduced to nothing. Any further increase in the amount of feed-back will then cause the valve to oscillate.

A Practical Limitation

In practice, of course, as is well known, it is impossible to attain this theoretical limit, because the conditions in the region thereof are unstable, but it is possible to reduce the effective resistance by a considerable amount, and to operate the circuit in a sensitive condition just below the oscillation point. The question which was asked was whether the initial resistance of the grid coil has any appreciable effect upon the final results obtainable.

Low-Loss and High-Loss

If the coil is one of comparatively high resistance, then obviously the voltage developed across it without reaction will be less than with a low-loss coil. If we apply reaction, however, and continue to increase the feed-back until the circuit is operating at the point of oscillation, then at first sight one would imagine that the resistance of the circuit should again be reduced to zero, so that the final result with the circuit just off the oscillation point would be the same as with the low-loss coil.

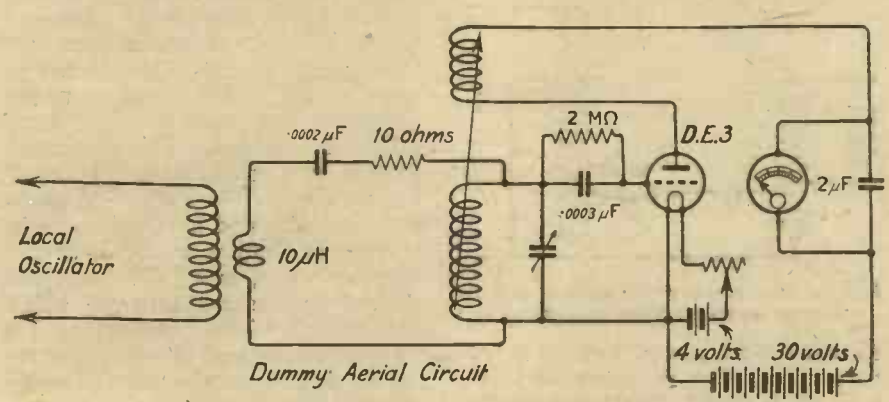


Fig. 1.—A local oscillator was used as the source of "signals."

Practical Investigations

This is an interesting point which has remained in doubt for some time. In some practical cases there has appeared to be a slight improvement in the favour of the low-loss coil, although theoretically there does not appear to be any reason for this. If a high-loss coil is as good as a low-loss coil when reaction is applied, then what is the use of taking special precautions to adopt the low-resistance type of construction? With the object of obtaining some definite information on the matter some experiments have recently been carried out on the subject.

Difficulties

The actual measurement of the signal strength when the receiver is just off the oscillation point is not a very definite one. The adjustments in this region are very often somewhat critical, so that it is conceivable that inconsistent results might be obtained if they were taken on the question of signal strength alone. We can obtain, however, a very good gauge of the relative merits of the two types of coil by plotting the complete resonance curves in both cases. If the two curves are similar, we then know that the two coils are identical as regards efficiency.

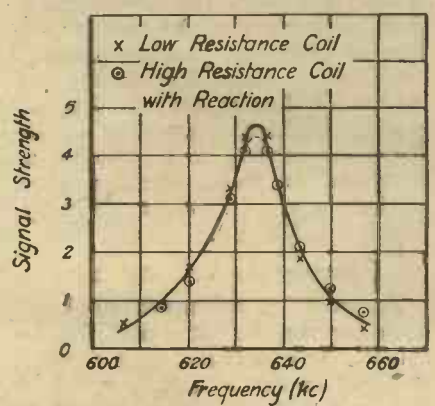


Fig. 2.—The first experiment seemed to show that the answer to the question is "Yes."

Experimental Details

The experiments were made from the point of view of the single-valve

receiver, with reaction, operating on an outside aerial. The apparatus employed consisted of a calibrated high-frequency oscillator, giving a more or less constant output, of

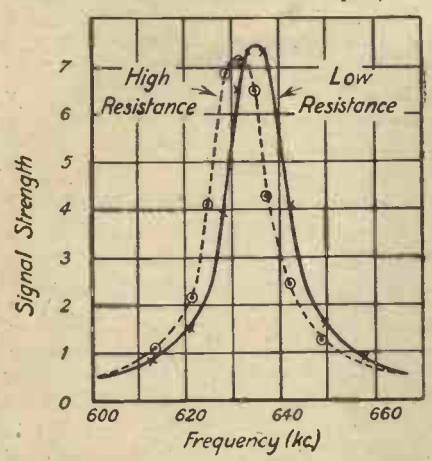


Fig. 3.—A further test was made in which reaction was applied in each case.

which the frequency at various scale readings was known, and a simple form of single-valve receiver, in which a milliammeter is inserted in place of the telephones. For these experiments a dummy aerial circuit was employed, consisting of a small coupling coil of about 10 μH inductance, a series capacity of 200 $\mu\mu$F, and a resistance of about 10 ohms. This dummy aerial circuit was connected across the aerial and earth terminals of the single-valve set, and the coupling coil was loosely coupled to the oscillator.

Circuit Used

The actual circuit employed is shown in Fig. 1. By using this method it is possible to maintain the applied E.M.F. under control, and it also simulates the actual conditions in a receiver, so that we obtain as nearly as possible practical conditions. The oscillator employed for the purpose was the calibrated oscillator on the high-frequency testing unit, which was described in these columns some weeks ago (*Wireless Weekly*, Volume 7, No. 16).

Battery Coupling Effects

Separate batteries are employed both for the oscillator and the receiver. If this is not done there is a slight amount of coupling, which is obtained through the medium of the battery leads, and this, of course, means that the voltage induced into the circuit does not come via the pick-up coil, and is thus not under control. Moreover, we have not made an accurate copy of the conditions obtaining in an ordinary

Does Reaction Compensate for High Losses ?
(Continued)

aerial circuit, and the results may be different in some particulars.

Signal Measurement Method

After preliminary tests had been made to make sure that the circuit was behaving correctly, the experiments proper were commenced. The measurement of signal strength was carried out by means of the Moullin voltmeter method; in this case, since grid condenser rectification was employed on the receiving circuit in question, there would be a steady anode current flowing; the arrival of signals would cause this anode current to decrease.

The actual decrease in current produced was taken as a measure of the signal strength in arbitrary units. As a matter of fact the decrease in current is proportional to the square of the voltage applied,

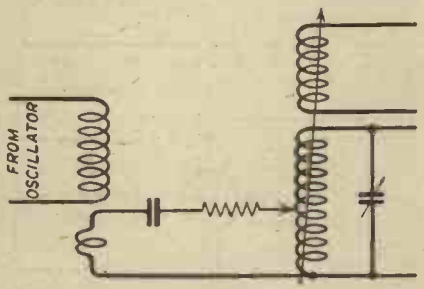


Fig. 4.—For one experiment an equivalent of auto-coupling was used.

so that the resonance curves are not true ones. For purposes of comparison, however, they serve admirably, and no error is introduced by considering the curves as they stand.

The First Test

The first experiment consisted in plotting the resonance curve for an ordinary plug-in coil. After this had been done, a resistance of about 50 ohms was inserted in series with the coil, and a certain amount of reaction was brought into play in order to bring the maximum signal strength approximately to the same value as that given by the original coil without the resistance. A resonance curve was again plotted, and the results are shown in Fig. 2.

It will be seen that all the points, whether for the coil without resistance or with the resistance, both lie upon exactly the same curve. The only difference which is noticeable is that the curve for the coil with resistance (with appropriate reaction) is slightly more flat-topped than that for the coil alone.

Reaction in Both Cases

Further experiments consisted in obtaining the resonance curves once again, but in this case the reaction was adjusted up to the point of oscillation in each case. It should be mentioned that for this and subsequent experiments it is necessary that the receiver shall be preferably adjusted to slide into oscillation gradually instead of going into oscillation with a bump. This is a matter of suitable adjustment of H.T. and filament voltages, and also of the grid leak. With the values given in the diagram there were no difficulties at all, although it should be observed that the negative of the high tension should be connected to the negative of the low tension.

An Interesting Effect

When this correct condition of affairs has been obtained, it will be found that an increase in the reaction coupling causes no variation in the steady anode current until a certain point is reached, when the needle rapidly falls to a comparatively small value. This change is not sudden, but comparatively gradual if the correct condition of affairs is obtained. The significant fact is that the maximum signal strength when the receiver is oscillating, as denoted by the change in current in the anode circuit of the detector valve, is no different from the maximum signal strength which is obtained when plotting the resonance curve and bringing the reaction right up to the point of oscillation.

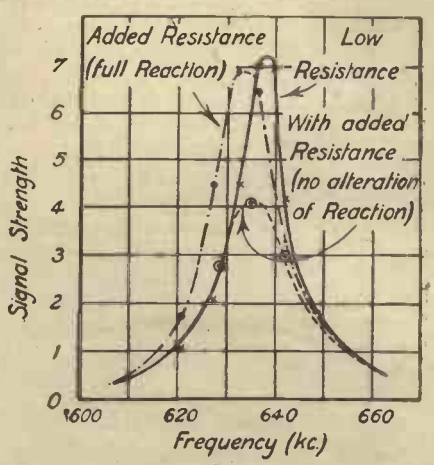


Fig. 5.—These are the results of the auto-coupling experiment.

In fact, in many cases it could not be detected that the receiver was oscillating during the plotting of the resonance curve, and conse-

quently a special point was made on each occasion of switching off the oscillator whenever any alterations to the reaction adjustment had been

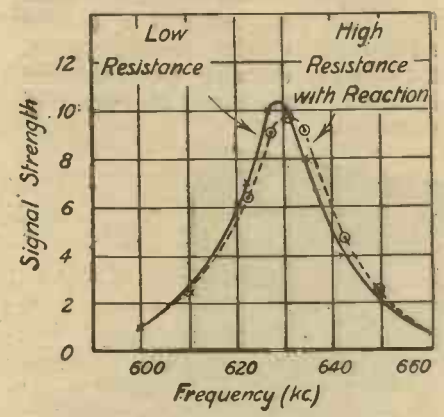


Fig. 6.—The last test was to insert the added resistance in the aerial circuit.

made, in order to make sure that the current returned to normal, and that the receiver was not oscillating.

The Result

Having adjusted the receiver, therefore, to respond correctly, as has just been described, the next series of readings were taken. These results are shown in Fig. 3. It will be seen that the maximum signal strength is considerably greater than that in the previous case, and the curves are generally similar, again as before. There are, however, certain differences. The signal strength with the high-resistance arrangement is less than with the low-loss coil and the resonance curve is more flat-topped.

The curve is also slightly broader, giving poorer selectivity; but this difference is not very marked.

It will be observed that there is a slight difference in the frequency at which the maximum or peak value is obtained, and this is due to the fact that the reaction adjustment in the two cases is different. As the receiver employed is of a simple type, employing a swinging reaction coil, it is obvious that, as the coils are brought together, there is a slight change in the tuning. This tuning was not compensated for on the condenser, with the result that the frequency at which the maximum value occurs is slightly different in the two cases.

Coupled Circuits

These results so far have been obtained with a direct-coupled aerial—that is to say, the aerial and earth are connected across the whole part of the grid coil. Many receivers nowadays employ an

Does Reaction Compensate for High Losses?

(Continued)

arrangement in which the aerial is tapped across part of the tuning coil only, and the set of experiments therefore was carried out with this type of aerial. The circuit was modified, as shown in Fig. 4, and the results obtained are shown in Fig. 5. The first curve is that obtained for the simple coil itself, with the reaction up to the point of oscillation. The second curve is the curve obtained with a resistance of 50 ohms inserted in series with the coil, the reaction adjustment remaining as before. The third curve is for the same arrangement, but with the reaction again increased to the oscillation point. It will be observed in this case, and in the previous one, there is an appreciable difference between the first and last curves.

A Clearer Case

In this case the effect of the aerial damping is minimised, so that the true effect of the coil resistance is more noticeable. The maximum signal strength is only 6.8 with the resistance inserted, as against 7.2 without it, while the selectivity is definitely worse. At half the resonant signal strength the band width is 16 kc. for the high-resistance coil, as against 12 kc. only with the low-loss coil.

Resistance in the Aerial

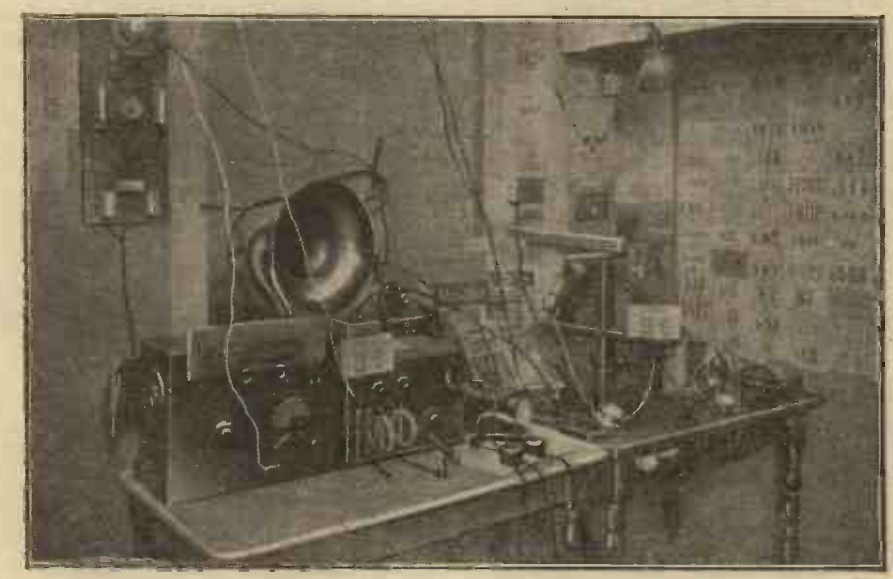
Another effect has been investigated: that of adding resistance in the aerial circuit instead of in series with the coil. This, of course, would duplicate the conditions obtained by changing over from a comparatively good aerial to a bad one. The first curve is for the original aerial circuit adjusted to the point of oscillation. The next curve shows the effect of adding resistance and increasing the reaction to the oscillation point again. The results are the same as before, namely, that the maximum signal strength is slightly less and the selectivity is noticeably worse.

The Reasons

These effects, namely, the decrease in signal strength and poorer selectivity, using the high-resistance arrangement, are noticed in all the experiments. To explain this it requires somewhat complicated mathematical investigation, but there is an aspect of the subject which will help to show why this condition of affairs should exist.

It will be obvious that the actual oscillating current obtained in the circuit with a given setting of the valve will be dependent upon the resistance in the circuit. With a given adjustment the valve will feed back a certain amount of energy, and this energy will make up the losses in the circuit, and, if sufficient, will cause the valve to oscillate continuously.

The energy losses in an oscillat-



A very active short-wave station at the present time is Belgian H6, as evidenced by his varied collection of "QSL" cards.

ing circuit are given by the expression I^2R, where I is the current flowing in the circuit, and R is the resistance. If the resistance is increased, then the current in the circuit will be reduced, for any given setting of the valve, so that a higher resistance circuit will not oscillate quite so strongly as a lower resistance one.

A Simple Rule

Now we have just seen that in a valve adjusted to give the best result, if the reaction adjustment is increased, so the signal strength gradually increases until the whole circuit glides into oscillation, so gradually that the oscillation can hardly be detected. Under these conditions the current is practically the same as that in the condition of maximum signal strength just short of oscillation. If, therefore, with the resistance in circuit the current in the oscillating condition is slightly less than with a low-loss coil, then it follows that the current obtainable on the threshold of oscillation must also be slightly less.

These results seem to indicate, therefore, that there is a slight improvement to be obtained by using a low-loss coil, but that the difference is not very noticeable under ordinary conditions. The signal strength is slightly worse at the resonant point with a high-loss coil, but the difference is so small that it is doubtful whether it would be detected in practical reception, while the reduction in selectivity is so small that it may be argued to be of rather academic interest.

Does Reaction Compensate for High Losses ?

(Continued)

Practical Reception

In order to ascertain how far the results just quoted are borne out in practice, some tests were carried out on actual reception of signals, using the same receiver as was employed for the experiments. The receiver was tuned to a distant station, and a resistance inserted in the tuning circuit. The difference between the two was hardly noticeable when the circuits had been correctly readjusted, but the receiver was slightly more difficult to handle with the high-loss arrangement.

The source of "signals" in the tests was the oscillator in Mr. Reyner's "auto-resonator."

This, of course, is what one would expect, since the sensitivity depends more on the reaction adjustment in the high-resistance arrangement. One may say, therefore, that while there is a definite advantage in using low-loss coils, the effect of reducing the resistance is much less than is popularly supposed.

A Proviso

It should be remembered that these remarks apply to single-circuit receivers only. As the number of tuned circuits is increased, the effects which have been outlined in this article become cumulative and the difference at the end would probably be considerable. Moreover, in multivalve receivers, the use of reaction adjustments is to be avoided as far as possible, so that in such cases there is no doubt as to the superiority of low-resistance circuits.

An extravaganza recently broadcast by WJAZ (Chicago) included items reminiscent of "Treasure Island." One of the scenes appears to have been enacted in the control room!

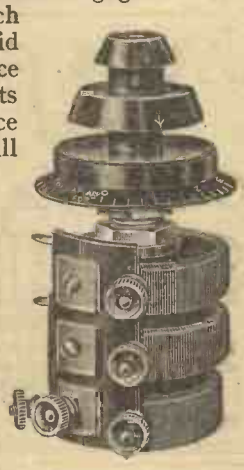
A NOTE ON THE TRANSATLANTIC BROADCASTING TESTS

As the result of information received from America we are now able to announce that WJZ, the station at Bound Brook, New Jersey, which uses a power of 50 kw., was heard in this country at 3.45 a.m. on January 26 by a listener in Surrey. This transmission was carried out at a frequency of 659 kc. (455 metres), and it is probable that a listener at Nuneaton, who reported the reception of a station at about 667 kc. (450 metres) at the same hour, was also listening to WJZ.

3 controls in 1

THE MULTISTAT will do all the work of two or three filament controls by itself, and do it easier and better. It saves panel space, simplifies internal wiring, improves the appearance of the set, and costs less than the usual separate controls.

Three independent knobs fixed to separate concentric spindles control the action of the contact arms. These arms engage on the resistance windings which are wound on a solid casting. Each resistance is thus controlled by its respective knob. A glance at the illustration will make this clear.



SPECIFICATION:

Heavily nickel-plated brass metal work. Resistances of best Eureka wire. Solid Ebonite knobs engraved and highly polished. Terminals for necessary connections. One-hole fixing. Highest class workmanship.

The MULTISTAT is made in the following standard units:—

Type A Double Filament 7/6
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The resistance elements may be of 6, 8, 10, 25, or 30 ohms.

The perfect filament control the—

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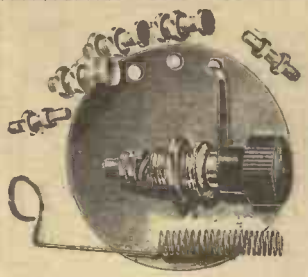
Send also for particulars of the 'Radiopal'—the four valve portable receiver described by the 'Wireless Times' as far and away the most interesting instrument at the Horticultural Hall Show.

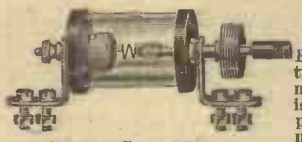


"DUCO" STUD SWITCH

An ideal tapping switch for inductance coils, or as an "on-and-off" switch. Contact studs fit almost flush on the panel, and the one-hole fixing bush allows a neat and simple fitting to be made. Complete with brass template for marking position of studs, and a length of wire for connections.

No. RS70/2. 2-, 3-, 4-, or 6-way 2/3 each. 10-way 2/6 each.

"DUCO" CRYSTAL DETECTORS



"Duco" Crystal Detector.

Enclosed Horizontal Type. Dust-proof. Micrometer adjustment.

No. RC95/1. N.P. 3/6 each.

"Duco" Crystal Detector. Enclosed Vertical Type. A neat, well finished detector providing minute adjustment and perfect stability.

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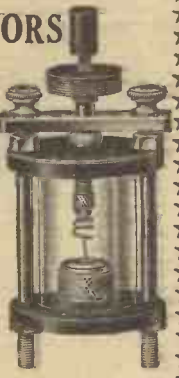

The "Duco" Crystal Detectors here shown are constructed from brass and ebonite, are provided with micrometer adjustment, and rendered perfectly dustproof by means of close fitting glass cylinders.

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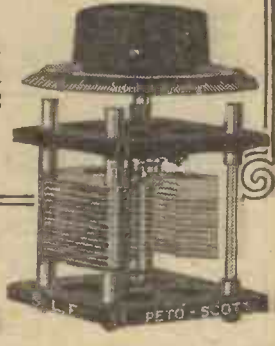

PETO-SCOTT S.L.F
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P.S. 4680.

Wireless News in Brief.

From the Programmes. February 28.—Birmingham: Schubert programme. London: Orchestra from Eastbourne. March 1.—Daventry: Welsh programme from Cardiff. March 3.—London: "The Pied Piper," a musical comedy. Birmingham: Popular classics. Bournemouth: Winter Gardens night, a programme of Russian music. March 4.—London: The Hallé Orchestra, relayed from Manchester. March 5.—Glasgow: Popular programme by the Station Orchestra. March 6.—London: Sir Harry Lauder. Aberdeen: Opera, "Orpheus and Eurydice" (Gluck). Glasgow: Third anniversary of the station.

* * *

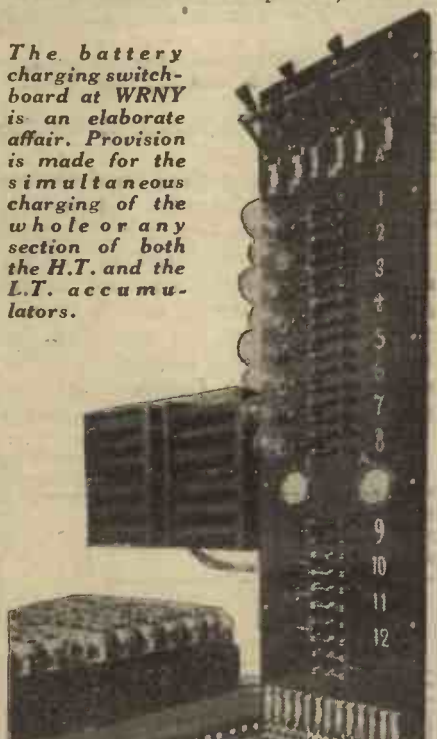
Reykjavik Broadcasting Station. The broadcasting station which has recently been erected at Reykjavik, in Iceland, uses a power of 500 watts and works at a frequency of 698 kilocycles (430 metres). As this station is some 800 miles distant, the reception of its transmission should prove a useful test for the efficiency of receivers.

* * *

B.B.C. Expenses. In a discussion in the House of Commons on February 17 on a supplementary estimate of £223,000 to be handed over by the Post Office to the B.B.C., Viscount Wolmer explained that this sum was due to the increased number of licences over the original estimate. Mr. Ammon expressed the idea that the B.B.C. is being run on extravagant lines and that there should be more publicity on the subject of its expenditure.

In replying to this and other criticisms the Postmaster-General (Sir W. Mitchell-Thomson) said that he did not wish to discuss the relations between the B.B.C. and the Post Office before the presentation of their report, next month, by the Committee of Inquiry.

"Silence" Tests. The B.B.C. wishes to thank listeners for their loyal co-operation in the scheme of the silent period, which took place on February 9. A notable absence of disturbing oscillators was observed, and it was possible to obtain much valuable data.



The battery charging switchboard at WRNY is an elaborate affair. Provision is made for the simultaneous charging of the whole or any section of both the H.T. and the L.T. accumulators.

A full report of the special tests carried out at our Elstree Laboratories was published in last week's issue of *Wireless Weekly*.

* * *

Broadcasting News. Mr. H. Fearon ("Poy") will on March 5 broadcast from the London Station a drawing lesson similar to that given recently by Mr. Heath Robinson.

Having formed its own military band, symphony orchestra, radio dance band and revue party, the B.B.C. is now endeavouring to establish its own concert party, of which leading variety artists will form the nucleus.

The programme from the Newcastle station on March 11 will be relayed to Daventry. It will include Act 3 of "Lohengrin" and a scene from "Il Trovatore." Items of a lighter character will also be provided.

* * *

European Broadcast Wavelengths. The Office International de Radiophonie has arranged to hold a conference at Geneva on March 25 and following days of all the European broadcasting organisations. Proposals resulting from recent tests and investigations will be put forward for dealing with the problem of the distribution of frequencies among the broadcasting stations of Europe.

* * *

Did You Hear It? During the evening of February 14 and on the following morning an attempt was made by a broadcasting station in Sydney, N.S.W. (call-sign 2BL) to reach this country with a special transmission. This station normally transmits at 909 kilocycles (330 metres), and for this test a frequency of 8,108 kilocycles (37 metres) was used. It is reported that a faint carrier wave was heard in England, but the programme could not be distinguished.

* * *

The Savoy Bands. The B.B.C. announce that, as a result of recent negotiations, it will be possible to continue the regular broadcasting of the Savoy Hotel Bands for at least another year.

* * *

Transatlantic Telephony. On February 13 a successful telephonic transmission was carried out by the new Rugby station, speech being heard clearly in America.

A Short-W
for
Transatlanti

By L. H. T

This simple but effective sh
to use interchangeable coil
frequencies may be covered
· KDKA may th

The tuning controls are placed in positions which make for ease of operation; the rheostats are mounted on the left to simplify the wiring.

THE short-wave receiver described in this article was constructed on the lines of the popular "Schnell Tuner" so greatly used in America, but not very well known in this country; various details were, however, altered after the original "testing-out" of the receiver, so that it can now hardly be described under the original title.

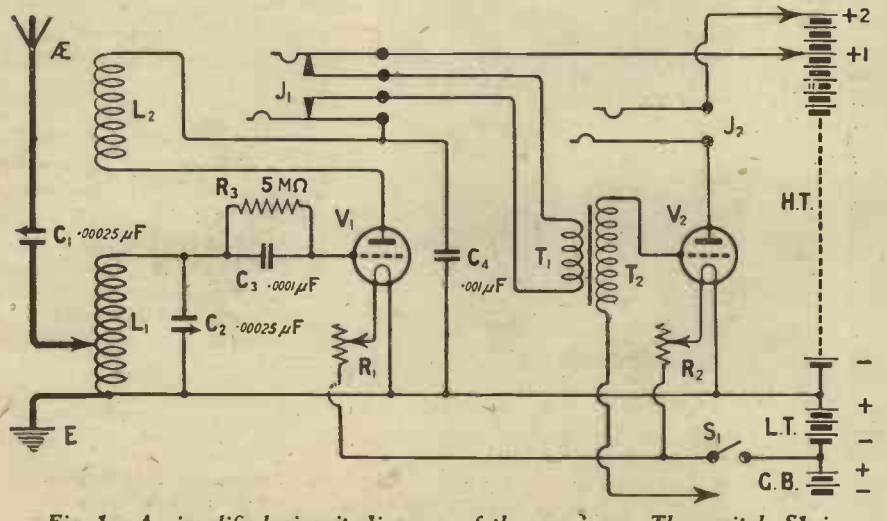


Fig. 1.—A simplified circuit diagram of the receiver. The switch S1 is provided so that the adjustments of the rheostats need not be upset.

The Circuit

It will be seen from the circuit diagram, Fig. 1, that it consists of the usual detector with reaction, followed by a stage of transformer-coupled L.F. amplification. Reaction is controlled by a variable condenser, but in a somewhat unusual way, which will be discussed later.

Now, the chief requirements of a receiver intended exclusively for short-wave reception are these: selectivity and critical tuning, easy control of reaction, and facilities for a rapid search over a fairly well-defined, but not too large, band of frequencies, coupled with a fair amount of certainty in "getting there," as most short-wave enthusiasts have at some time to keep schedules with certain transmitting stations who wish for reports.

These points were therefore put foremost by the writer on designing this receiver, and, from his own experiences with it, it certainly seems to have fulfilled its purpose.

Reaction Control

In the original receiver the reaction control was accomplished by the "throttle condenser" method. This was an admirable control while both valves were in use, but had the disadvantage that the condenser settings were considerably altered when the 'phones were plugged into the anode circuit of the detector, no matter what size H.F. choke was in use. A fixed condenser of .001 μF capacity was therefore substituted for the variable, which was placed in series with the aerial.

It is usual in a short-wave receiver to employ an inductively coupled aerial circuit; the writer, however, after fairly extensive experiments, decided to use auto-coupling. This not only gives very good selectivity, but also makes possible the use of the writer's favourite form of reaction control. The aerial, through the variable series condenser, is tapped on to a point about one-third of the distance up the grid coil L1, which is itself tuned by means of a parallel condenser.

Smooth Adjustment

It is found that, by careful adjustment of the H.T. and L.T. voltages on the detector valve and also the position of the aerial tap on L1, it is possible to find a setting of the aerial series condenser which will keep the receiver *just* oscillating over practically the whole range of the parallel condenser C2, this being, of course, the best adjustment for C.W. reception. By increasing the

ave Receiver

the

c Stations

OMAS (6QB).

t-wave set has been designed , so that a wide range of . Such stations as WGY and as be received.

The set may well be used without a cabinet, but one is helpful in keeping it free from dust.

amount of C1 in circuit (thereby increasing the effect of the aerial damping) the set can be made to stop oscillating for telephony reception. This form of reaction control gives a very nice " sliding in and out of oscillation " effect, which is most desirable in a receiver of this nature.

Fixed Coupling

This being so, it is feasible to mount the inductances so that the coupling between them is practically fixed; further, one pair of coils can almost certainly be made to cover the entire frequency range over which it is desired to use the receiver at any given time. We may, therefore, fix the coils in a manner which does away with all such undesirable features as flexible leads, and also may use a low-capacity mounting without making provision for varying the coupling. In the actual receiver shown in the photographs, the coils are attached to " telephone " terminals, and can easily be changed occasionally should the operator wish to listen on another frequency band. Coupling may also be roughly varied.

Suitable Valves

The valves used should preferably be of the D.E.5 type, as valves of this type make admirable detectors, which will function quite efficiently with an H.T. voltage as low as 20 volts. For a silent background this was found to be a decided advantage. Another point is that, as all Morse short-wave signals are usually fairly strong, it is not necessary to use a high anode voltage for the note-magnifier; in fact, to do so usually produces uncomfortably strong signals.

No grid-bias is employed as a rule, as it has been found that, with the particular valves and transformer in use, C.W. signals have a peculiar " piercing " effect when this is omitted, rendering them much easier to read through atmospherics or " mush." This adjustment at once renders the set absolutely unsuitable for the reception of telephony, but it is a simple matter to arrange a switch or a plug so that grid-bias may be used when desired.

The Grid Condenser

The next point is the value of the grid condenser and leak. In short-wave receivers the writer has found it an advantage to use a much smaller value for the former than the conventional .0003 μF; in this case one of .0001 μF capacity has been employed. The grid-leak is also of a higher resistance (5 megohms) than usual. These two departures from convention certainly have been an improvement with the particular valves and components in question, and seem to make all the difference between good and mediocre operation. The connection of the by-pass condenser C4 to the filament circuit, instead of the more usual connection across the primary of the transformer, also is important, as this seems to provide greater ease of reaction control. It is also easier to

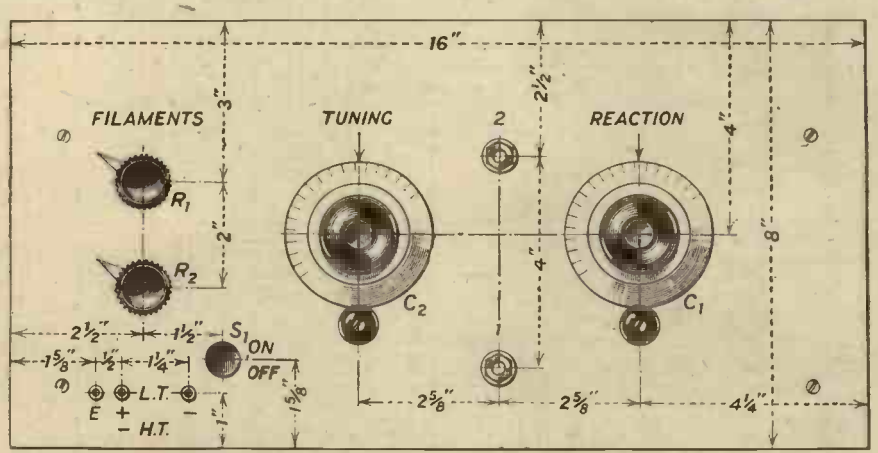


Fig. 2.—A three-pin plug with connections corresponding to the markings on the sockets is used for the L.T. connections. On inverting this so that the " E " pin is on the right of the " L.T.— " socket the L.T. is reversed, and the earth cut out of circuit at the same time.

A Short-Wave Receiver for the Transatlantic Stations

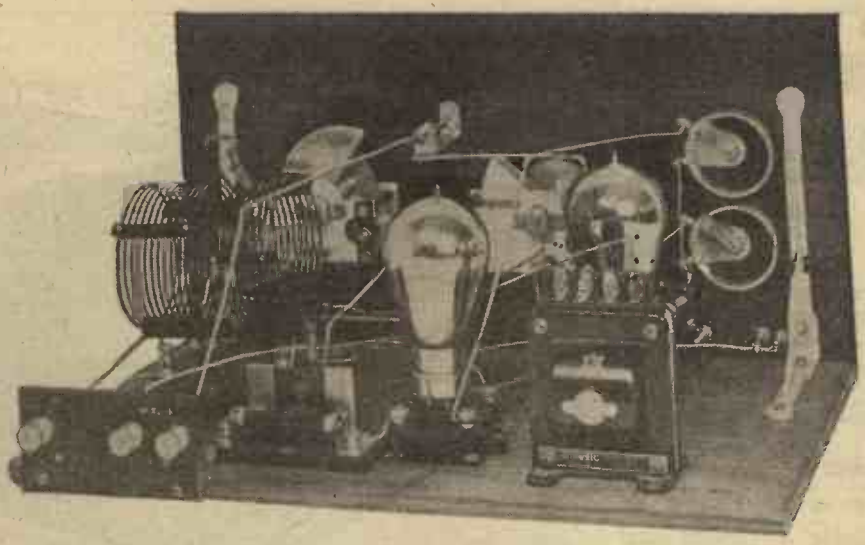
(Continued)

get the receiver to oscillate in the first place when this connection is employed.

The Coils

The coils used are supplied by the manufacturers on plugs which are more or less of the standard type, but these were removed in favour of a mounting with a lower capacity. Should the reader wish to construct his own coils, it might be mentioned here that the two used for the 6,667 kc. (45 metre) band are of 9 turns (for the A.T.I.) and 12 turns (for reaction), the diameter being about 3 ins. and the spacing between turns about $\frac{1}{8}$ in.

A sufficient length of wire should be left over at the end of each coil to be bent out at right angles for connection to the telephone-type terminals in which they are mounted. These latter are mounted on a small ebonite "platform" which is held away from the baseboard by means of four very small reel-type insulators.



The high-tension positive and aerial connections are made to a strip at the rear of the set. The position of the coils is clearly visible.

Coils for Other Frequencies

Should it be desired to use this receiver on the 3,333 kc. (90 metre) band, the same reaction coil will serve, the A.T.I. being a coil of 15 turns. For 15,000 kc. (20 metre) reception the A.T.I. should have five turns and the reaction coil six or seven (all the above figures only referring to coils of approximately the same spacing and diameter as those mentioned).

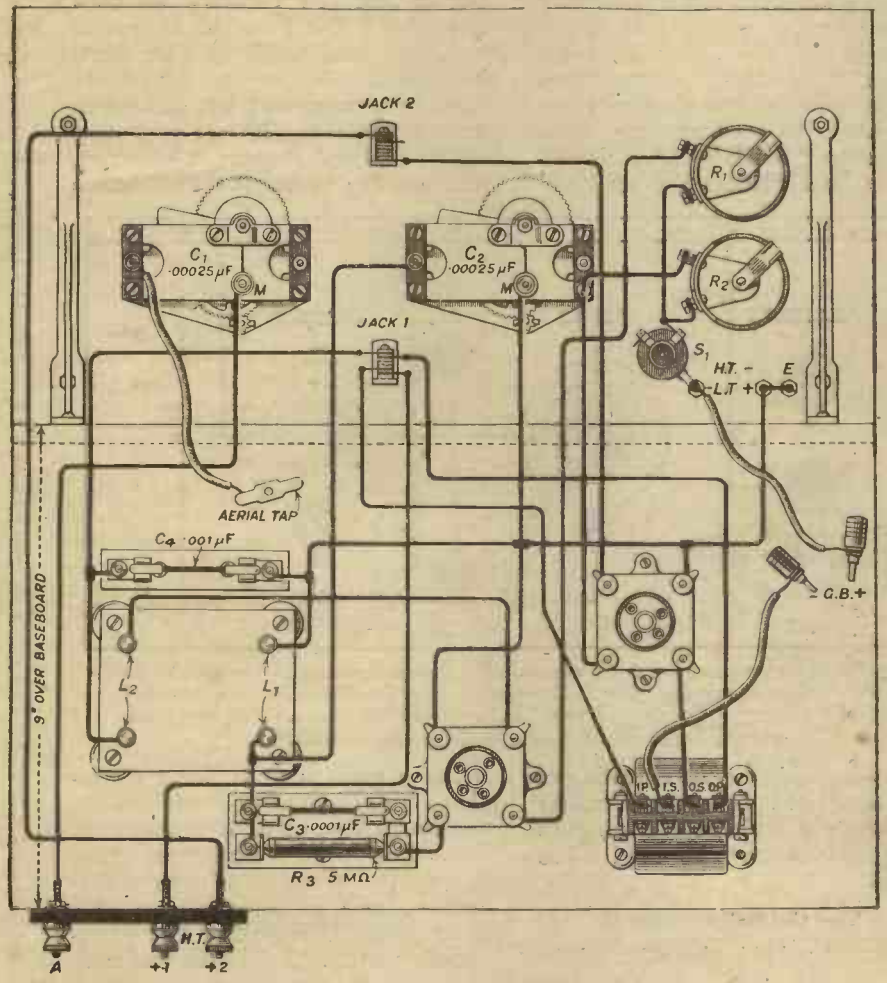


Fig. 3.—The "platform" for the coils should be kept as free from the other components as possible, all wires being taken well to the sides of it.

Terminal Arrangements

Three terminals are provided on a strip at the rear of the receiver, these taking the connections to the aerial and the two positive high-tension terminals. The negative high-tension is connected to the positive low-tension externally; the low-tension connections are taken to three sockets on the left of the panel, these three sockets being unevenly spaced for the reason that the writer sometimes wishes to reverse his low-tension connections, and at the same time remove the earth, which is connected to the right-hand point of the three-pin plug employed. This, however, is only necessary because a transmitter is in use which employs the same L.T. as well as the same earth, and need not be duplicated by readers, who can provide the usual pair of terminals.

Components

For those readers who wish to construct a set which follows this design fairly closely, a list of the components used is given herewith :—

One ebonite panel, 16 ins. by 8 ins. by $\frac{3}{16}$ in. (Radion.)

One cabinet for the above, with loose baseboard 9 ins. deep. (Camco.) (This is one of the cabi-

A Short-Wave Receiver for the Transatlantic Stations

(Continued)

nets made for the " All Concert de Luxe " receiver.)

Two .00025 μF variable condensers, low-loss type, geared. (Jackson Bros.)

Two 30-ohm " Peerless " rheostats. (Bedford Electrical and Radio Co.)

One set of " Eddystone " low-loss coils. (Stratton & Co.)

One double-circuit jack,

One single-circuit jack, and

Two telephone plugs. (Ashley Telephone Co.)

One .0001 μF and one .001 μF clip-in condensers, with bases. (L. McMichael, Ltd.).

One 5-megohm grid-leak, with base. (L. McMichael, Ltd.)

Two " Clearer-Tone " valve holders. (Benjamin Electric Co.)

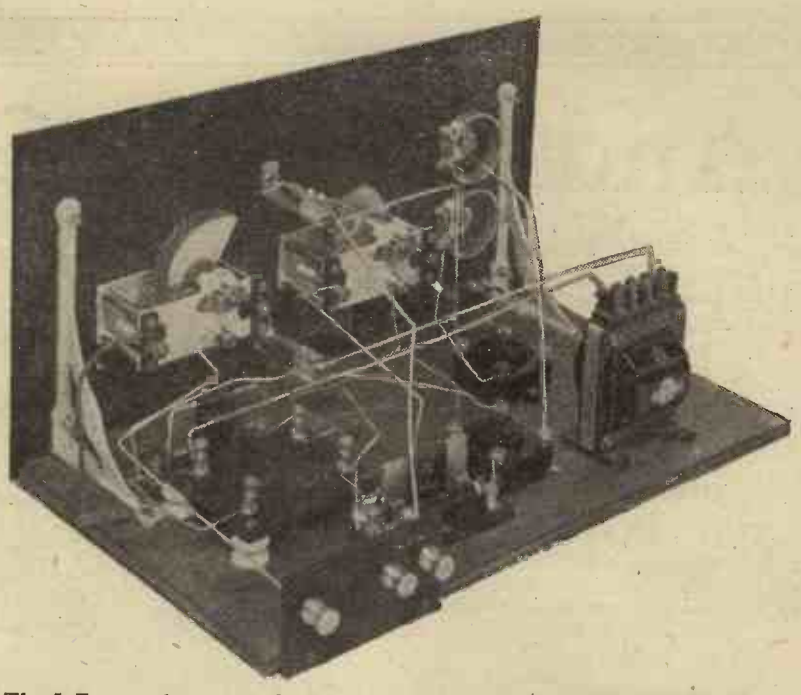
One L.F. transformer, ratio 5 : 1. (Igranic Electric, Ltd.)

Two aluminium panel brackets. (Camco.)

One push-pull switch. (Lissen, Ltd.)

Various small pieces of ebonite, terminals, brass bolts, etc., square tinned copper wire, and a packet of Radio Press panel transfers.

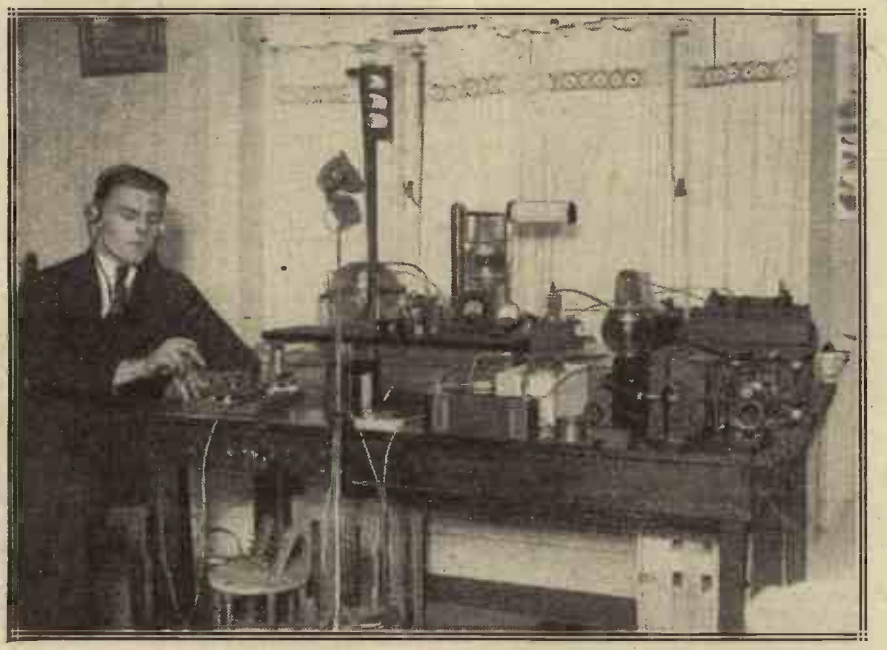
No difficulty should be experienced in the construction of this receiver, all the wiring being quite straightforward. The wiring diagram, together with the photographs, should prove quite sufficient for this.



The L.F. transformer is kept as far away from the other components as possible.

Results

A few words as to the results obtained with this receiver will probably not be out of place. Strong signals were received between 10.30 and 11.30 p.m. on a single night from over forty American amateurs and from several Brazilians. Between 9 and 9.30 one morning two New Zealanders and four Australians were heard, and signals have been logged from practically every country in which amateur transmitters work, often only using the single valve. Consistency has been one of the most pleasing features of its performance. The aerial with which it has been used is only of average efficiency, being very badly screened by the overhead wires of an electric railway, trees, etc. An indoor aerial will be found to give excellent results for short-wave work.



The transmitting equipment of Mr. R. L. Royle (2WJ), of Palmer's Green. Note that the transmitter itself is raised well above the table by means of insulators.

Use of a Counterpoise

In some circumstances a counterpoise may be found to function more satisfactorily than the usual earth connection. The writer is himself in this position, finding that the noise from the electric railway is considerably reduced by this means.

Should it be found necessary to adjust the aerial series condenser C1 at all frequently, no trouble will be experienced from hand-capacity effects, providing that the aerial itself is connected to the moving plates.

The set of low-loss coils supplied consists of a 9-turn, a 12-turn, and a 15-turn coil. Using the two smallest, as previously mentioned, a band of frequencies ranging from about 10,000 kc. (30 metres) to about 5,000 kc. (60 metres) will be covered. By using the 15-turn coil as A.T.I. the receiver will tune to about 2,727 kc. (110 metres), most of the frequencies on which any-

(*Continued on page 67*)

And now the Cossor P.3

Milestones in Valve History

1923—the Cossor P.1
—the valve which eventually became the standard British Bright Emitter.

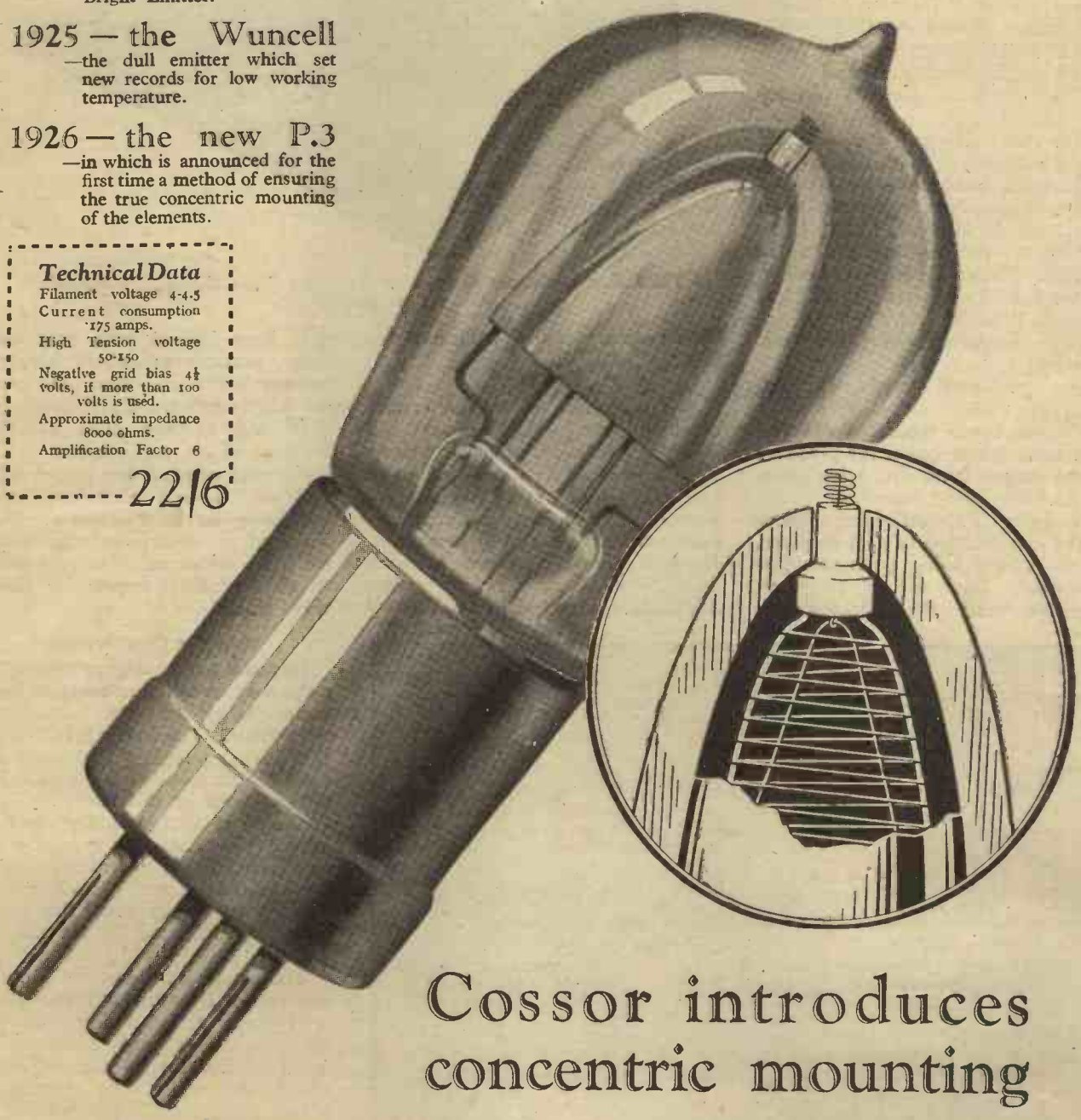
1925 — the Wuncell
—the dull emitter which set new records for low working temperature.

1926 — the new P.3
—in which is announced for the first time a method of ensuring the true concentric mounting of the elements.

Technical Data

Filament voltage 4-4.5
Current consumption .175 amps.
High Tension voltage 50-150
Negative grid bias 4½ volts, if more than 100 volts is used.
Approximate impedance 8000 ohms.
Amplification Factor 6

22/6



Cossor introduces concentric mounting

A. C. Cossor, Ltd, Highbury Grove, N. 5

Gilbert Ad. 4658

—incorporating new constructional features of paramount importance

THE great fundamental feature originally adopted in the P.1—the arched filament functioning within a hood-shaped Grid, the whole being surrounded by an electron-retaining Anode—has been consistently incorporated in every type of Cossor Valve. After three years it has not been found possible to improve upon this widely accepted principle.

But in the new P.3 Valve there is utilised in addition a constructional feature which is likely to exert a far-reaching influence upon the whole future trend of valve design. We refer to the new method of *automatically* maintaining the filament, grid and anode in their exact relative positions during the whole life of the valve.

WITH the rapid development of Radio the announcement of any new valve is of importance, but the first particulars of a new method of concentric mounting is certain to create intense interest among wireless enthusiasts throughout the country. Dating right back to the first Cossor valve in 1923—the famous P.1—each Cossor valve has possessed many exclusive features. It is a Cossor habit not to follow in the well-worn beaten track, but to pioneer improvements which will lead to greater efficiency.

What is this new system of concentric mounting?

Inserted at the top of the hood-shaped anode of the P.3 and projecting also through the top of the hood-shaped grid situated immediately beneath it, is a seonite tube. Through the centre of this seonite tube—which of course is a perfect insulator—runs a fine wire. One end is shaped to form a hook to act as an additional support for the filament, while the other is curved spiralwise into a spring. It will be obvious that the filament, grid and anode—in addition to the usual electrodes rigidly supporting them at the foot of the valve—are now inflexibly held in three distinct positions. Not even the hardest knock can disturb their relative positions.

What are its advantages?

It is well known that any change in the relative position of the filament, grid and anode of any valve during its life will exert a profound effect upon its working characteristics. Let us explain it more fully in another way. Supposing three valves of the ordinary type (with straight tubular anodes) are assembled as follows: No. 1 has its filament, grid and anode mounted concentrically. No. 2 has its filament mounted diagonally through the grid—without, of course, actually touching it. No. 3 has its filament mounted nearer to one side of the grid than to the other. What would be the result? All three valves although assembled from identical elements, would possess entirely different characteristics. Obviously such a lack of uniformity among these three valves would prevent any Receiving Set using them from functioning as it should.

Actually, of course, the valve manufacturer aims to set the filament concentrically within the spiral grid, but after a while the filament sags and imperceptibly the valve begins to change in characteristic. No longer does it give the same good tone—no longer is it so sensitive to weak signals.

The inherent disadvantage of the straight filament has long been known to Cossor—indeed it was the earlier experience gained through the manufacture of R-type valves during the War that led to the introduction in 1923, after more than five years of incessant experimental work, of the now famous arched filament and hood-shaped grid and anode.

What are the uses of the P.3?

Primarily this new P.3 is a power valve. That is to say it should be used in place of a general purposes valve after the Detector in any Receiving Set using bright emitter valves. Provided the set incorporates a good L.F. transformer and that a high tension voltage of from 100 to 150 is employed, an exceptional volume of pure mellow sound will result. Every note in the harmonic scale will be faithfully reproduced. Even the bass notes — frequently harsh and unnatural—will be heard in their true value.

When the P.3 is used as an L.F. amplifier the Loud Speaker becomes richly endowed with a rare beauty of tone. Gone is the "tinkle tinkle" of the old gramophone, and in its place comes Music—real Music—just as the Old Masters would have us enjoy it.

For Super-Hets., too.

Owing to its enormously greater emission and the new concentric principle of mounting, the P.3 is also eminently suitable for Super-Heterodynes and Neutrodynes. These receivers require, above all, valves which are absolutely uniform in their characteristics. One valve, not up to standard, will disturb the delicate balance of the whole Receiver and destroy not only its sensitiveness but its selectivity as well.

An economical Power Valve.

If you count the price of your valve in terms of life and maintenance—the business-like way—you'll appreciate that the P.3 is one of the most economical valves you can buy. Because it utilises the new Cossor triple-coated filament it functions at a dull red glow which is practically invisible in daylight. Heat—the culprit which brings most valves to an untimely end—is almost eliminated. The new concentric method of construction is responsible also for protecting the filament from shocks and jars. In fact, in so far as the filament—the only vulnerable part of any valve—is concerned, it is difficult to conceive any improvement.

Finally, the P.3 consumes only ·175 amp. at 4 volts—less than one-fourth of the current required by the ordinary bright emitter. Taking into consideration its greater sensitivity and higher rate of emission, you'll agree that this is indeed a notable achievement. Get acquainted with this wonderful new valve and enjoy the pleasures of Broadcasting anew.

Wuncell Dull Emitters from 14/- each.

Cossor Valves

Cossor Bright Emitters now 8/- each.

A. C. Cossor, Ltd, Highbury Grove N.5.

Gilbert Ad. 4658

A "Fieldless-Coil" Receiver

By PERCY W. HARRIS, M.I.R.E.

Some further notes on the manipulation of the interesting receiver described in the last issue.

THE further tests on the "fieldless coil" receiver described in last week's *Wireless Weekly* have only confirmed the views I formed quite early in the experiments with it. Its selectivity is of a high order, while the strength of signal on distant stations is most gratifying. As indicated in the first article, separation of Bournemouth from London at Wimbledon is quite easily effected, even on a fairly large outside aerial, while Dublin and Bournemouth can also be tuned in quite free of one another.

Results

All of the British main stations and several other relays are easily receivable, while the strength of many of them in favourable conditions is such as to require only one stage of low-frequency amplification to give full loud-speaker strength. I am now having tests conducted within a mile or two of 2LO, and will publish the results as soon as completed.

The wavelength range of the Bodine coils with the .0003 μF condensers is just sufficient to cover the Aberdeen wavelength at the top of the scale. At the lower end the coils go down well below 250 metres, and thus include such short-wave stations as Brussels.

Modifications

As many readers may desire to receive wavelengths somewhat longer than that used by Aberdeen, the following notes on means of extending wavelength range may be useful. First of all we could substitute condensers of a capacity of .0005 μF for those of .0003 μF, as shown in the set described. If, however, we do this, the numerous stations receivable will be crowded even closer on the dial, while at the upper end of the scale there will be comparatively few stations we wish to receive.

For this reason I do not recommend the use of .0005 μF condensers here. A much more effective way is to take three fixed condensers of .0002 μF and solder one lug of each to one of the terminals of each of the variable condensers. From the other lug of each fixed condenser take a flexible lead with a spade connector, and when it is desired to receive stations longer than the Aberdeen wavelength, slip the spade connector under the second terminal of each of the variable condensers. The upper end of your wavelength scale will then be extended and will include such stations as Vienna and Zurich.

Reaction Hints

The additional capacity in shunt across the coils will probably make it difficult to obtain enough reaction to bring the set up to the oscillation point, and, indeed, in some cases there may already be difficulty in obtaining this reaction effect, even when a potentiometer is fully on the negative side. In such cases an additional reaction effect can be obtained by including in the positive or negative high-tension lead (*not* shunted by a Mansbridge condenser) a small inductance, which can be readily made by winding ten or fifteen turns of insulated wire of practically any gauge round a small tumbler or other cylindrical object. The turns may be tied together with cotton, if desired. The resistance of this coil is not important—it is the inductance that matters.

A Substitute

A convenient variable inductance of quite a suitable value is provided by a wire-wound dull-emitter filament resistance. That it is the inductance and not the resistance that gives the effect desired is proved by the fact that the substitution for the wire-wound resistance of a non-inductive resistance of the same value had no effect whatever on oscillation. If such a small variable inductance is used, only just sufficient should be included in the circuit to provide the reaction effect desired when the potentiometer is fully on the negative side.

The Dangers of Unwanted H.F. Currents

(Continued from page 48)

quency currents are produced in the anode circuit of the second valve.

The first valve was now made to oscillate and the current through the microammeter increased to 750 microamps. Needless to say, precautions were taken to prevent any high-frequency currents getting into the circuit L_3 C_4 except through the amplification effect of the second valve, and the currents in the telephones T_2 and the microammeter were only obtained when C_4 tuned in the station; this eliminated any possibility of low-frequency currents in the anode circuit of the second valve causing the effects mentioned.

Effect of a Shunt

The next experiment was to connect the condenser C_3 across the primary of the intervalve low-frequency transformer. This immediately cut down the microamps, when receiving 2LO, from 500 to 4 or 5, showing that a by-pass condenser is of great advantage, but by no means a cure. Those 4 or 5 microamperes represent a high-frequency current which might be a distinct nuisance, more especially if amplified, accidentally, by a subsequent low-frequency valve.

Use of Chokes

A very useful device for eliminating still further stray high-frequency currents is that illustrated in

The Dangers of Unwanted H.F. Currents

(Continued)

Fig. 5, where a choke coil is now used. The choke coil L2 is connected in series with the low-frequency choke Z, while a by-pass condenser C4 is connected across the two chokes. The choke coil L2, being an air-core choke of low self-capacity, chokes back the high-frequency currents in the anode circuit of the first valve and makes them go round through the condenser C4. Practically no high-frequency current, therefore, goes through the iron-core choke Z, and the potentials established across the points Y and X are purely low-frequency.

It is to be noticed that the grid of the second valve is connected to the bottom of the choke Z and not to the anode of the first valve. If the latter connection were made, we should not be in any better position than before; the high-frequency current would not go through the choke Z certainly, but the high-frequency potentials established across C4 would still be passed on to the second grid to a certain extent. I would like to point out at this stage that the use of chokes in this and other circuits is for the killing, as far as possible, of the unwanted high-frequency currents, and not merely for preventing the high-frequency currents going through a transformer or iron-core choke winding.

There are, of course, still in the Fig. 5 circuit high-frequency potentials on the anode of the first valve, but as long as the leads to C4 and to L2 are kept short, no trouble is likely to be experienced.

Isolating the Telephones

Although we have practically cut off the possibility of high-frequency currents getting to the grid of the second valve, yet I have shown the use of a choke L3 in series with the telephones to prevent any high-frequency currents floating round the telephone leads, which is quite a common trouble in some multi-stage receivers. I give the arrangement of L3 and C5 as an example of what may be done, this inductance and condenser, of course, being inside the set, while the telephones and leads may be outside.

The use of chokes and condensers in low-frequency amplifiers using iron-core transformers has already been described by Mr. Percy W. Harris. A typical circuit is that illustrated in Fig. 6. The air-core choke L3 is now connected in series with the primary T1 of the inter-valve iron-core transformer, T1 T2. The by-pass condenser C3 has its lower side connected directly to the filament. This is an alternative to making the connection to the top of T1. There is not much difference between the two arrangements, but

"Resistance-coupled amplifiers are bad offenders."

the idea of connecting direct to the filament is that a shorter path for the high-frequency currents is often provided, whereas a lead, such as ABC in Fig. 3, carrying high-frequency currents, may travel a considerable distance and go near other wires and cause reaction effects.

Action of Transformer Primary

In my experimental arrangement of Fig. 4, with the by-pass condenser C3 not connected, the primary of the iron-core transformer probably acts as a high-frequency choke and the capacity between the two sets of windings serves to pass on the high-frequency currents to the grid of the second valve. Even when C3 is inserted, this effect is, to a certain extent, still present, but by the connection of a choke as in Fig. 6, the chances of H.F. getting on to the grid of the second valve are still more remote. Of course Fig. 6 is by no means the last word, and where there are several stages of low-frequency amplification, choke and condenser schemes may be tried at different points.

Resistance Amplifiers

Resistance-coupled amplifiers are bad offenders, as they encourage all sorts of unwanted high-frequency amplification. Very often you are getting high-frequency amplification, detection and low-frequency amplification in a valve when you only want the latter effect.

Fig. 7 shows how, by the use of chokes L2 and L3 and by-pass condensers C4 and C5, the high-frequency element can be practically killed, although care should be taken to see that the chokes L2 and L3 are not of the same size. At any rate, care must be taken that the introduction of chokes associated with anode circuits does not set up any kind of high-frequency oscillation.

In conclusion, these remarks indicate that, especially where there are several cascaded stages of amplification, there is a grave risk of introducing instability, due to not killing the unwanted high-frequency currents. Any variation of the performance of the high-frequency part of the apparatus by touching any part of the low-frequency side should be a warning to look for the troubles I have described, and the use of the principles mentioned will overcome the objectionable effects.

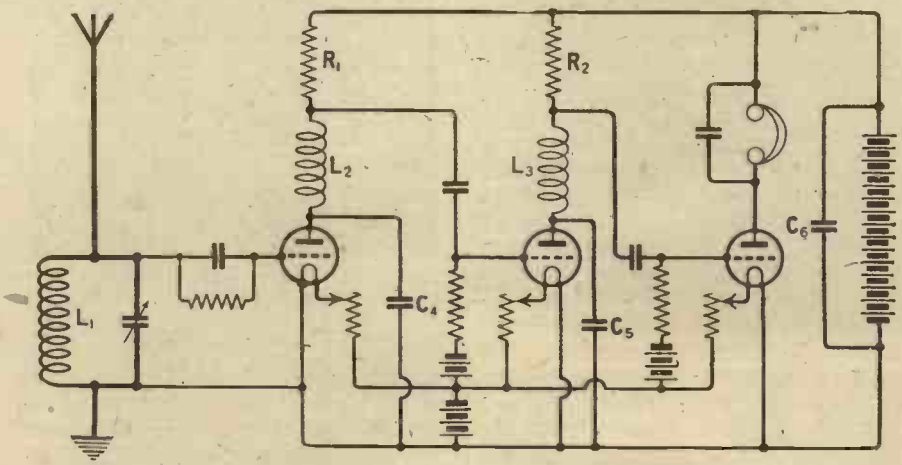


Fig. 7.—How a resistance amplifier may be compelled to function in a correct manner by means of chokes and by-pass condensers.

The WEEK'S DIARY

The other day I had the pleasure of meeting Mr. Gambier Parry, who has recently joined the British Broadcasting Company as personal assistant to Captain Eckersley. Mr. Parry (I am following the latest B.B.C. convention in cutting out military titles) comes from the Air Ministry, and is very keenly interested in the development of broadcasting.

Captain Eckersley, by the way, in spite of this general dropping of military titles, retains the "Captain" to distinguish him from Mr. Roger Eckersley, his brother, who is also on the staff of the British Broadcasting Company. Anyhow, that is the reason given, but I doubt whether the officials, the public or anyone else could ever be brought to refer to "P. P." as anything but "Captain." Fancy referring to the Chief Engineer of the British Broadcasting Company as "*Mr.* Eckersley"! Impossible!

* * *

After the war the Marconi Company suffered very badly from what has been called "militaritis." The famous building in the Strand was alive with Colonels, Majors and Captains in all kinds of positions, each particularly anxious that he should be referred to by his proper military title. I remember one particularly bumptious underling complaining to a high official of the company that he had not been addressed (by the said official) in the proper manner. He had, however, reckoned without his host, who, holding a commission in the Regular Army (a fact that he had tactfully concealed) immediately turned the complaint back upon its maker by complaining that *he himself*, and not the complainant, had the real reason to take offence.

* * *

Have you noticed any changes in, or improvement of, the quality of broadcasting lately? A number of different microphones have recently been employed both for inside and outside broadcasting. There is no question that the microphones now used by the British Broadcasting Company are definitely superior to those generally employed in the U.S.A., although on many occasions in the past the B.B.C. have used Western Electric microphones of the American type. At one time the Savoy bands were broadcast by their aid.

* * *

After the Road Fund the Wireless Licence Fund! Is Mr. Churchill really contemplating a raid in this direction? There is more than a suspicion that he has his eye on this

The transmitting gear at the Stuttgart station appears to be of the simplest nature. The station nevertheless achieves very good ranges.

particular henroost. In any case, it is high time the half-a-million limitation of revenue was lifted from the shoulders of the B.B.C. The company has already shown that it can make good use of the money, and there is a great deal yet to do before the programmes reach the level at which they are aiming. If Mr. Churchill thinks that he can appropriate any portion of the licence revenue before the B.B.C. share is increased, he will find that those who pay the piper will have a great deal to say.

* * *

I hope the B.B.C. will not proceed with the idea of using trained elocutionists to broadcast talks by eminent persons. Whatever value there is in a talk given by a notability, the public very much appreciates hearing the voice of the person himself, however bad his delivery may be. On those rare occasions when some prominent person has been unintentionally prevented from broadcasting and his talk has been delivered by one of the announcers, the general impression has been of a soulless and uninteresting delivery, quite devoid of personality and conviction.

* * *

I was very much amused to hear that the morning after the papers published the reports of the *Wireless Weekly* "silent-period" tests at Elstree twenty or thirty people rang up the offices at Savoy Hill to know why the British Broadcasting Company had asked Radio Press to conduct their tests for them! Of course, the *Wireless Weekly* tests were quite independent of those conducted by the B.B.C., who, by the way, found that their own wavemeter checked up accurately to that used at Elstree.

* * *

John Henry, I hear, has now become a film actor. The first of a series of comedies "featuring" this well-known broadcast entertainer will shortly be issued by the firm of Gaumont. He has already made six films and I believe others are in preparation. The first of his films deals with wireless subjects, and he is aided by Blossom and her mother.

* * *

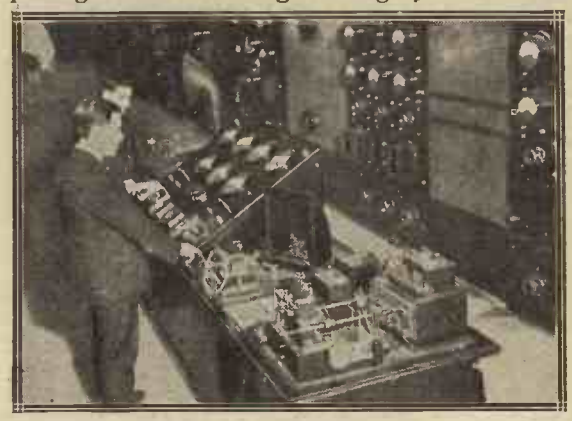
It will be very interesting to see whether these films catch the public fancy, and I am sure *Wireless Weekly* readers will wish our Yorkshire friend the best of success with them. After all, the movies are quite different from the "speakies" (as broadcasting has sometimes been called in America), and while John Henry's microphone reputation will

The Week's Diary—*continued*

serve as excellent publicity for the film, his success as a motion picture actor can have no relation to his success as a broadcaster.

* * *

I hear that Mr. Percy Harris and Mr. Kendall are jointly contemplating some interesting and highly



practical tests with portable sets. Both are enthusiastic motorists, and while they burn much midnight oil during the week, they consume an equal quantity of daylight petrol on Saturdays and Sundays. Part of their scheme is to find out whether many of the reputed dead spots are really as "dead" as they are claimed to be, and whether the "deadness" is purely local or extends over a wide area.

* * *

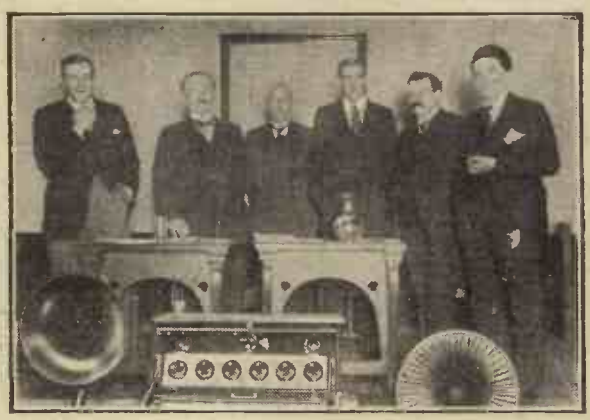
Have you heard the story of a dear old lady who, on being persuaded to instal dull emitter valves in place of the bright emitter type she had previously used, complained to the local dealer that the set was no longer satisfactory? Being a conscientious dealer who believed in service, he called round to try the set himself. "There is nothing wrong with the set, madam; you are getting excellent quality and strength," he said, after listening for a short time. "You put the old valves back, young man," replied the old lady with determination, "I can't abide these new ones!" The valves were accordingly replaced, and once more the bright filaments cast their light upon the panel and the space around. "That's better," remarked the old lady, with a sigh of relief. "Now I can get on with my knitting!"

* * *

Millions must have listened last week to the speech of the Prince of Wales at the dinner held at the Mansion House to mark the opening of the 11th British Industries Fair. The Prince has an excellent voice for broadcasting and a clarity of enunciation which might well serve as a model for many of the professional announcers. I wonder just how far the Prince's voice was heard? Nature plays strange freaks with wireless waves, and it is just possible that the speech was picked up directly in some distant part of the Empire. 2LO has been heard on a number of occasions in South Africa, and in view of the Prince's recent tour, nothing would be more dramatic than to pick up his voice in such a distant part of the Empire. I feel it may not be long before all such speeches are rebroadcast throughout the Empire, some of those magic shorter wavelengths being used as "S.B. lines" between England and the distant stations.

Reports are already being heard of new harmonics appearing on the broadcast band which are alleged to emanate from Rugby. The photograph shows some of the control apparatus.

Capt. Eckersley (left), recently gave a lecture to the Hounslow Wireless Society. Note the "Straight-Eight" receiver in the foreground.



One of the earliest songs to be broadcast by the Savoy Bands was the famous (or infamous) "Yes! We have no bananas!" I notice, in a recent advertisement, a reference to the influence bananas have had upon the development of radio. In case some readers may imagine that this refers to the well-known song, I had better correct the impression at once.

Messrs. Elders & Fyffes, Ltd., the well-known banana importers in this country, are associated with an American house which own the Tropical Fruit Company. This company very early realised the immense value of radio in connecting distant points in tropical jungles, and in all such places where the ordinary wire telegraph connection proves impracticable.

After innumerable breakdowns of land-line communication, due to falling trees or even marauding savages, the company installed radio stations on their various plantations. It is essential, if fruit is to be kept in good condition, that it should be shipped just as soon as possible after being picked. By means of radio communication it was found possible to advise the impending arrival of a ship, and to have the crop gathered so as to time its arrival at the port with that of the steamer. The Tropical Fruit Company spent huge sums in radio equipment, and undoubtedly did much in this way to develop the art.

* * *

The lunch-time organ recitals broadcast from 2LO seem very popular among the womenfolk at home. Not only is the music appreciated, but the B.B.C. reproduction of organ music itself is particularly good, and such music suits itself very well to the average loud-speaker. I have often thought that many of the criticisms of the B.B.C. programmes have been due not to the items themselves, but to the fact that some kinds of music reproduce particularly badly on inferior apparatus.

WAVE-TRAP.

Improving Your Results

□ □ □

Another calibration tip—Using an "absorption" circuit—Harmonics for short-wave calibration—Grid leaks for short waves—Overlap.

THE following idea may possibly be useful to readers who wish to possess an accurate calibration for their receiver, but I find that, on account of the presence of a reaction control, the setting of which may vary considerably with different values of H.T. and L.T., they are unable to do so to any extreme degree of reliability by the ordinary methods.

The First Step

First of all, settle the frequency band (or bands) over which the receiver must be calibrated. Then take a note of the number of turns in the secondary (or, in direct-coupled circuits, the aerial tuning) inductance, together with the size of condenser necessary to cover the whole band.

The Absorption Circuit

A similar condenser, with a coil of about the same size in parallel with it, may then be fixed in the set, if there is room, or if not on a vertical panel, or even in a small box by the side of the set.

It is better to incorporate this in the set if possible, and this arrangement is really an auxiliary absorption wavemeter. If it is placed outside the set the coil should be arranged so that it is in the same plane as, and on a level with, the aerial tuning inductance, and not more than about eight inches away from it. This coil and condenser should then be calibrated by the "click" method, which is as follows when the operation is performed on short waves.

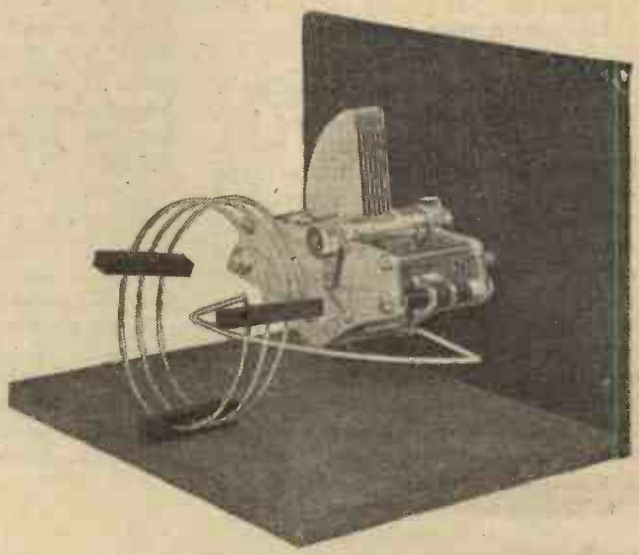
Calibration

Tune in on the receiver one of the many stations of known frequency, of course with the set oscillating. Then rotate the "wavemeter" dial slowly, and note the points at which the receiver goes out of oscillation and starts oscillating again.

If this does not happen, increase the coupling between the coil and the A.T.I.; if the receiver stops oscillating over a wide band, loosen it. The ideal position is that in which little more than a single click is heard. Note this position, and obtain as many more of these calibration points as possible, plotting frequency (or wavelength) against scale readings in the usual manner.

Use of Harmonics

If no standard frequency stations are available, and you are within eight or nine miles of a B.B.C. station, harmonics of that station will be very useful for the purpose of short-wave calibration. You will probably know roughly the frequencies of these various harmonics, and they may be worked out exactly if the frequency on which the station is working at the time is accurately known. They are easily picked up on the short-wave receiver, and the usual clicks obtained when the wavemeter is swung through the appropriate reading.



An "absorption" wavemeter is a very simple thing to make as a separate unit, consisting merely of a coil and condenser. The one illustrated is intended for short-wave purposes.

Constant Calibration

Once the curve is plotted, you will have a reliable calibrated dial actually in the receiver which will give readings independent of the

Improving Your Results—*continued*

degree of reaction, the aerial in use, or the L.T. and H.T. voltages.

If the receiver is intended to operate on two or more frequency bands, some plug-in coils may conveniently be made for this purpose.

Interchangeable Coils

The writer uses an ordinary variable condenser with a valve pin soldered to one terminal and a valve socket to the other. Three coils are used for the higher frequencies, the connections being taken out to plugs and sockets mounted the correct distance apart on small ebonite strips.

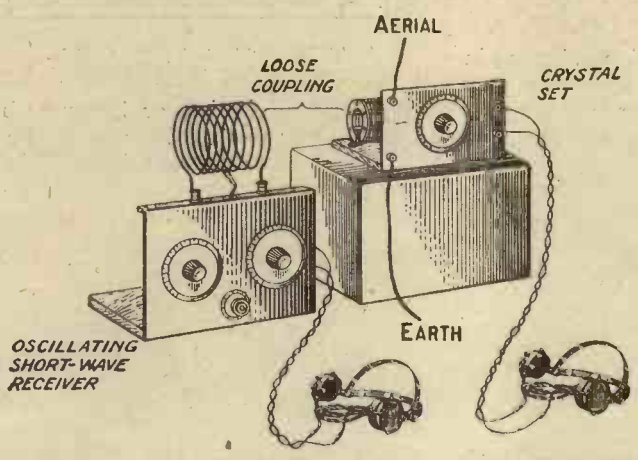
Other Uses

This "self-contained wavemeter," as it really is, may now be used for a variety of other purposes. The writer actually has used such an arrangement as a reaction control on short waves, although it is not very good for the resolution of carrier waves. When the right degree of coupling between the "wavemeter" coil and the A.T.I. has been found, the set will "glide" in and out of oscillation quite silently, and it also has the advantage that adjustment of the "wavemeter" condenser has very little or no effect on the frequency to which the receiver is tuned.

Use on the Broadcast Band

On the broadcast band of frequencies the method of calibration is somewhat different, since it is obviously undesirable to make the set oscillate. Instead, tune in a station of known frequency, and bring up the reaction to give the loudest signals without oscillation.

On turning the wavemeter dial, you will now find a clear indication of resonance with the receiving circuits: signals will suddenly die down and come up again as the wavemeter passes through the reading, and you may even get a click effect if the coupling is tight enough.



If the short-wave set is placed beside a crystal receiver strong harmonics of the local station can be picked up with ease.

Grid-Leak and Condenser Values on Short Waves

It will sometimes be found that the values of grid condenser and leak which give the best signal strength on short waves are different from those appropriate to the broadcast band. A recent contributor to "QST" mentioned that the most satisfactory results had been obtained with a grid condenser of about .0001 μF capacity and a grid-leak value of as much as 12 megohms! One must not forget, however, that in America the soft "tube" is still popular as a detector.

Short Waves and Overlap

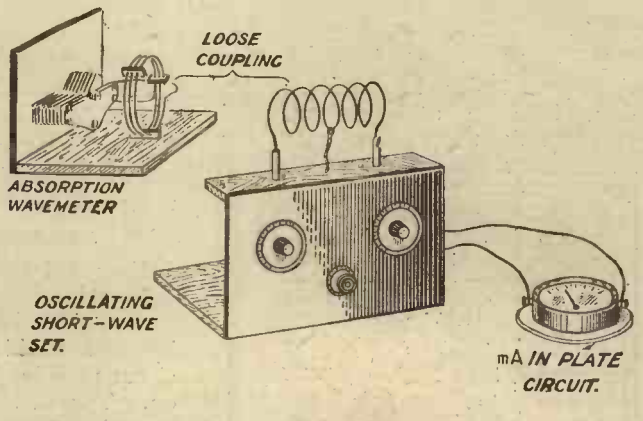
There are various little "snags" that frequently cause some worry to the operator of a receiver until he is properly used to it. Perhaps the most troublesome of these is "overlap"; this is present when the set refuses to stop oscillating gradually and smoothly when the reaction coupling is loosened, but suddenly stops with a "plop."

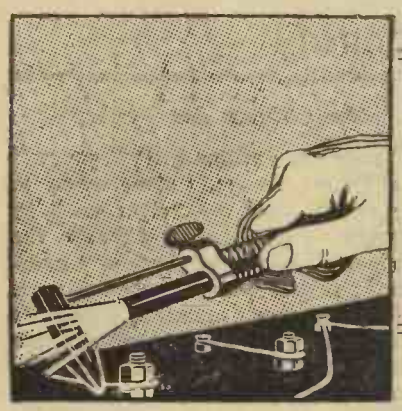
This is particularly troublesome in the case of short-wave receivers, and frequently occurs in another form. This shows itself in a tendency to "howl" as the set stops oscillating, and renders the efficient reception of C.W. signals very difficult indeed. In the writer's experience this is due to incorrect adjustment of the grid-bias on the note-magnifier (assuming, of course, that one is used), and also to an incorrect value for the condenser across the transformer primary.

A Cure

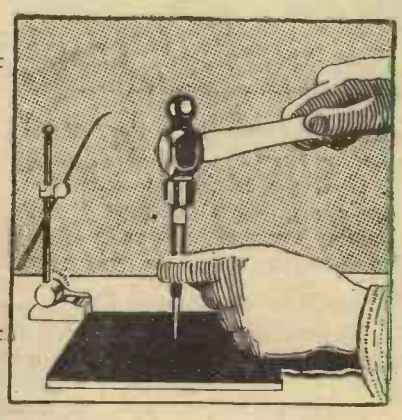
If the set is found to oscillate satisfactorily over the whole frequency band with a by-pass condenser of as low a value as .0002 μF, this will generally cure the trouble. Incidentally, it is a great advantage to make provision for fine adjustment of the grid-bias; this may be done by means of a potentiometer or any of the other well-known methods. The more usual form of overlap is, of course, usually due to an unsuitable value of grid-leak, or incorrect H.T. and L.T. voltages. If, therefore, it occurs on substituting a different valve for the one usually employed, do not forget to try the effect of a readjustment of these factors.

After carrying out the operation shown above the points determined can be transferred to the absorption circuit. Either phones or a milliammeter can be used to indicate the "click" point.





CONSTRUCTIONAL NOTES



A NON-MICROPHONIC VALVE-HOLDER

A VERY useful and efficient valve-holder for the experimenter can be made from materials usually found in the scrap-

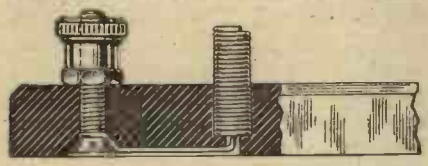


Fig. 1.—A coil of wire wound round a two-inch nail makes good contact with the valve legs.

box, which also has the merit of being anti-microphonic.

The materials required are as follows :—One piece of ebonite, 2 in. square by $\frac{1}{2}$ in. or $\frac{3}{8}$ in. thick (thinner material would do, but the thicker sort is better), four 1-in. brass 4BA screws and nuts, four brass 4BA terminal tops and a length of copper or hard brass wire.

Construction

Proceed by marking diagonals on the squared piece of ebonite, drill a $\frac{1}{8}$-in. hole in each corner, and countersink them deeply on the

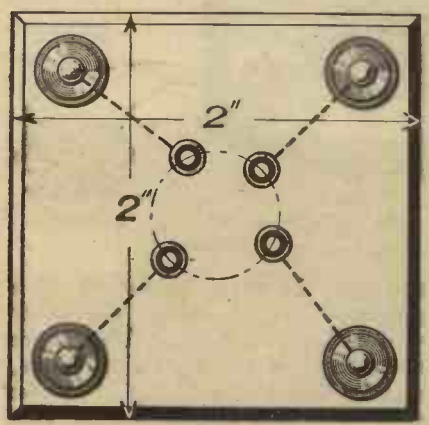


Fig. 2.—The drilling diagram for the valve-holder.

under side. Mark out from a template the holes for the valve legs, and drill four 1/16-in. holes right through in the position shown in Fig. 2. Two more holes can now be drilled to receive screws for fastening to a baseboard or panel where convenient.

Channels for connecting wires may be burnt with a red-hot screwdriver on the under side from each countersunk hole to each hole for a valve leg.

Now take a 2-in. French nail, and, holding it firmly in a vice, wind on about 20 turns of the brass wire, leaving about 2 in. of straight

The finished article has a distinctly professional appearance.

wire at the end, as sketch. Four of these are needed.

Mounting the Springs

Now enlarge the four valve-leg holes with a drill the same size as the outside diameter of the spring, but do not drill right through ; leave about 1/16 in. for the spring to rest on. Thread the straight portion of the wire through the hole so made, and push in the spring as far as it will go. Bend the free end of the wire along the channel, and take one turn round the 4BA screw of one of the terminals, and tighten up with the nut on top of the ebonite ; then run on the milled terminal top. Open the tops of the four springs slightly with a 3-in. French nail to take the valve easily.

A. J. G.

A TEMPLATE FOR COIL-WINDING FORMERS

WHEN basket or honeycomb types of coils are to be wound on pegs inserted in the periphery of a wooden rolling-pin or other convenient cylindrical

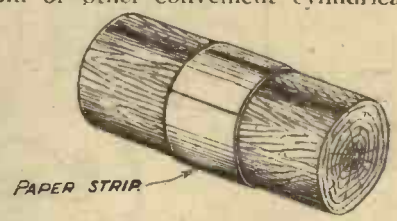


Fig. 3.—The paper strip is wrapped round the wooden cylinder as shown.

former, some difficulty may be experienced in marking out the holes for the pegs accurately, especially if the angle between adjacent pegs is not an exact number of degrees. This trouble can be overcome in a simple manner as follows :—Round the cylinder wrap a strip of paper, and cut it where the ends overlap, so that the strip exactly encircles the cylinder and no more, as in Fig. 3. Then lay the strip out flat and divide it up by geometrical construction, or simply with the help of a graduated ruler, into the required odd number of equal sections ; it is convenient to locate one peg at the extreme end

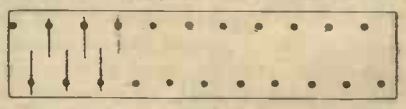


Fig. 4—The paper strip is removed and divided up into the required odd number of equal sections.

of the strip, as shown in Fig. 4, which indicates the marking for a double row of pegs ; note in this case that as the two ends meet round the cylinder, the other end is not marked. When this paper template is completed, glue it on to the cylinder and drill the holes for the pegs at the marked points, taking care that the direction taken by every hole forms a true radius

Constructional Notes—*continued*

of the section of the cylinder, as otherwise the pegs will not stand in proper alignment.

A SERIES TELEPHONE BOARD

IT is often necessary to connect two or more pairs of phones in series, but if this is done by means of ordinary two-screw brass links there is always the possibility of at least one pair being cut out of circuit by the links accidently touching. The little device described below will take up to three pairs of phones, and can be stood on a table or carried to any part of the room.

The materials required are quite inexpensive, and are as follows :—

One circular ebonite disc, 4 in. diameter, about 3-16 in. thick.

About 2½ in. of ebonite tubing.

A wooden baseboard, about 4¼ in. square by ½ in. thick.

Eight 4B.A. terminals (preferably six telephone type and two ordinary W.O. pattern).

Four 1¼ in. brass screws, and some connecting wire.

First drill eight 4B.A. clearance holes in the positions shown to take the four pairs of terminals and four further holes, which should be countersunk, to take the brass wood-screws. Fix the terminals in position and wire up as shown. The ebonite tube should be cut into four equal lengths, each, say, ⅝ in. long, the screws slipped through the holes in the disc and through the pieces of tube and then screwed into the wooden base. The leads from the set are connected to the pair of ordinary terminals, and the phones in the unconnected "gaps" in the wiring. Any pair of phone terminals not being used must be shorted by means of a length of copper wire.

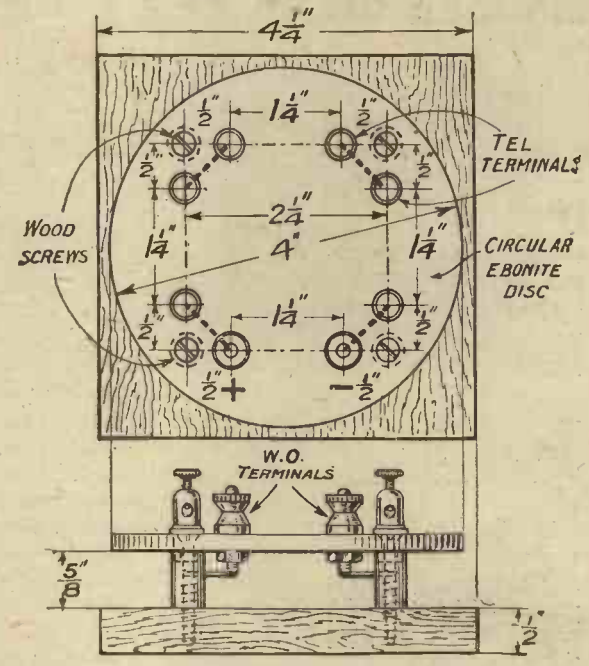


Fig. 5.—The board is mounted on four short lengths of ebonite tubing.

A Short-Wave Receiver for the Transatlantic Stations
(*Continued from page 57*)

thing of interest is to be heard thus being covered.

Plug and Jack Switching

Provision is made for using either one or two valves by means of plugs and jacks, two plugs being used, one for the headphones and one for a loud-speaker, which is occasionally used to entertain the family on KDKA's 4,918 kc. (61 metres) transmission. This can generally be received at excellent strength after 10.30 p.m. When it is desired to receive KDKA, the grid-bias battery (4½ volts) is brought into use, and the anode voltage on the note-magnifier increased from the normal 35 volts to 80 or 90 volts.

Flexibility

Though this particular receiver was definitely designed for use on short waves, it may perfectly well be used on the broadcast waves if suitable coils are employed. For the sake of convenience, two standard baseboard-mounting coil holders might be provided with short lengths of wire so that they could be connected to the special terminals, and the coils plugged into them. The reaction control will be found quite effective even on the broadcast band.

It is an absolute necessity that the detector valve should be provided with a *really* efficient socket of the non-microphonic type, otherwise the mere adjustment of the condensers will produce the objectionable ringing noise with which we are so familiar. This is mentioned for the benefit of those who do not wish to adhere strictly to the types of components used by the writer.

LATE NEWS

Strike Settlement

As a result of the mediation of the Ministry of Labour, the strike of wireless operators has been settled, and work is being resumed. It is stated that the men are returning to work at the new reduced rates pending further negotiations.

A Re-arrangement of Wave-lengths

It is learned at the moment of going to press that the Geneva Bureau has now issued details of its proposals for the reduction of interference between European broadcasting stations.

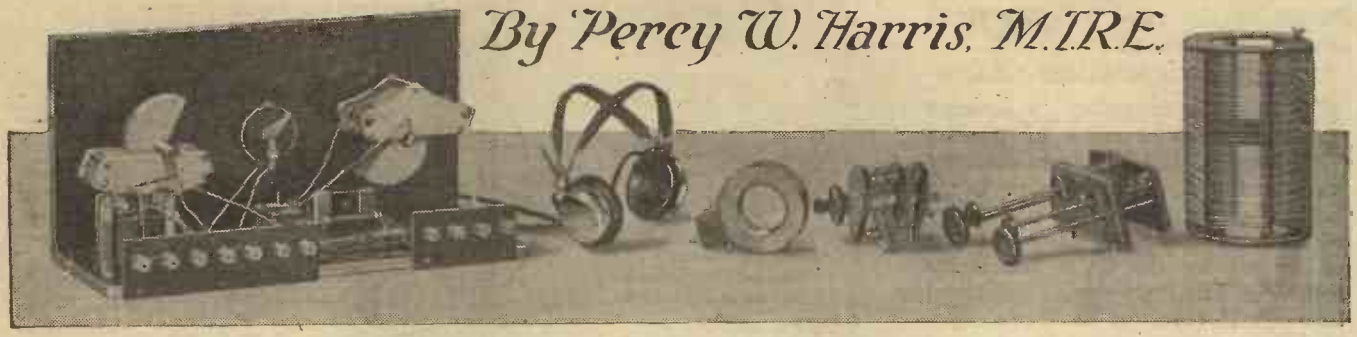
It is understood that modifications will be proposed which affect London, Daventry, Sheffield and Liverpool, but the new frequencies have not yet been confirmed.

The table which follows gives the proposed new allocations of the main Continental stations. (The figures are quoted as given by the Bureau—in metres.)

Station.	Metres.	Station.	Metres.
Amsterdam	1,055	Madrid	392
Barcelona	325	Munich	414
Berlin	531	Muenster	287
Bremen	226.5	Nuremberg	298.5
Brünn	2,800	Oslo	380
Brussels	265	Paris (PTT.)	458
Cassel	228	Paris (FL)	2,200
Breslau	282	Paris (SFR)	1,780
Dresden	276.5	Prague	559
Dortmund	397.5	Stettin	241
Elberfeld	504	Stockholm	427
Frankfort	382	Stuttgart	368
Hanover	220	Rome	425
Hamburg	317.5	The Hague	1,070
Gleiwitz	251	Toulouse	315
Koenigsberg	472.5	Vienna	530
Leipzig	444.5	Zurich	515
Hilversum	1,060		

Random Technicalities

By Percy W. Harris, M.I.R.E.



FOR some extraordinary reason reception conditions for American signals have been particularly and consistently bad this winter. Last year, if you took the trouble to sit up three or four nights running (and many of us did), you could be sure of hearing at least *some* American broadcasting stations, on any reasonably efficient receiver. This year, with much better receivers available, long night vigils have failed to find anything more than an occasional whisper.

Disappointing Results

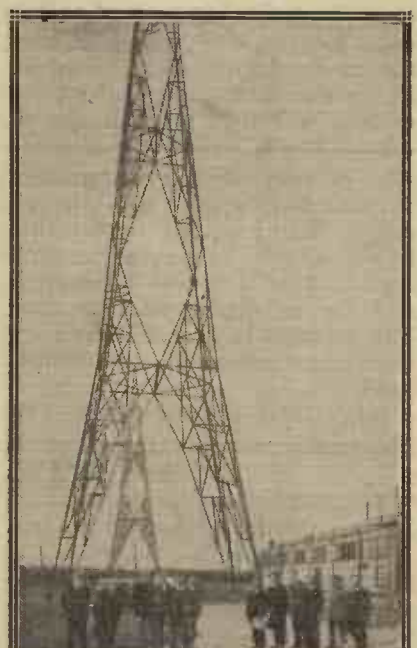
Most surprising of all, the new station at Bound Brook, New Jersey, erected to take the place of the old WJZ-WJY station on the Æolian Hall, 42nd Street, New York City, and provided with many times the power of the old WJZ station, has failed to make itself heard at all well here. Capt. Round told me the other day that even with the best apparatus he can muster (and he is undoubtedly the greatest receiving expert in this country), he has been unable to hear a sound from Bound Brook.

The Weakness of WGY

WGY, which is now provided, when necessary, with power exceeding that available at Daventry, makes a far worse showing than it used to do. I have just had a letter from Mr. Arthur Lynch, Editor of *Radio Broadcast* (the magazine which organised the Transatlantic Tests in America), telling me that the east to west conditions are just as bad, and that results of this year's tests have been very disappointing at the American as well as the British end.

Good Conditions in America

North and south receiving conditions appear to be good, however, and good long-distance records were put up in the United States. Even the short-wave receiving conditions, which we have come to look upon as fairly constant, have deteriorated badly during the last few weeks. KDKA, although the signal distortion has been reduced to a negligible quantity by the introduction of crystal control at the transmitting end, gives quite an anæmic signal compared with the full-blooded shout which it put up a month or two ago.



A very elaborate system of mast construction is evident in this view of the Hilversum station.

WGY on 40 metres is now practically hopeless so far as my own receivers are concerned, although there was a time when he came in at least twice the strength of KDKA.

Aerials for KDKA

I have carried out quite a number of tests with KDKA signals on 63 metres, particularly with different kinds of aerial, to see what changes of signal strength take place. For example, I have used my main receiving aerial, 50 ft. high and about 40 ft. long, consisting of a single wire, and underneath this, running out at a level with the receiving desk, a single-wire counterpoise, carefully insulated. Beneath there is an earth system, consisting of a number of wires buried beneath the lawn and flower beds, forming a kind of lengthy grid-iron.

Signals with the 50-ft. single-wire aerial and the counterpoise are slightly better than with the same aerial and the direct earth system, but, using the counterpoise as the aerial and the direct earth system, I get signals at least as good as those obtainable with the aerial and either earth or counterpoise. In my location I have not been able to obtain very good results with an indoor aerial from KDKA, although many people find this just as good as the outdoor aerial.

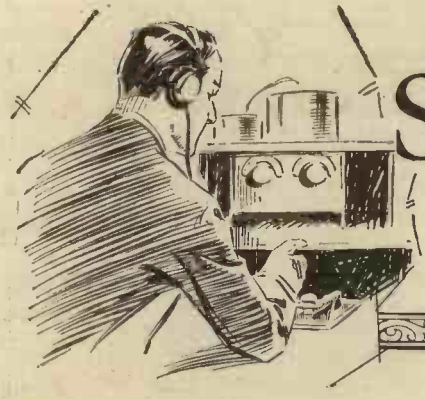
A Good Accumulator

Congratulations to the makers of the Tungstone high-tension accumulator for producing a really practical job. I have had one of these batteries in continuous use for some little time, and have learned to appreciate the eminently practical form of its make-up. It stands a far higher charging rate than is usual for such an accumulator, its cells are robust and of adequate size, and I greatly appreciate the ability not only to tap off at every two volts, but to pick the voltage I want without having to count up the holes, as is generally the case with high-tension accumulators.

A Convenient Arrangement

This is made possible by the insulating sheet which covers the tops of

(*Continued on page 71*)



SHORT-WAVE Notes & News

TRANSATLANTIC conditions not having been particularly favourable during the past week, a good amount of "inter-European" work has been done by the British stations. The time at which European stations "fade out" is now as late as 19.30 GMT on occasions, but seems to vary considerably from day to day. As a general rule, however, it seems to be about 5 or 6 minutes later each day just at the present time.

An Advantage of 6,667 kc.

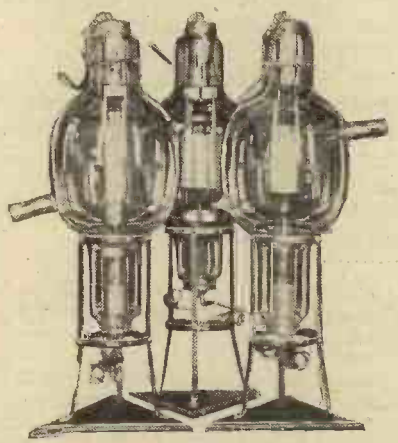
The absence of atmospherics on the 6,667 kc. (45-metre) band is certainly a great point in its favour; two or three nights just recently the writer has found atmospherics quite troublesome on the 2,000 kc. (150-metre) and 3,333 kc. (90-metre) bands, while they have been almost inaudible, and certainly not strong enough to be a nuisance, on the 6,667 kc. band. Another point is that the average strength of distant signals on the higher frequencies is considerably greater, so that even if the "strays" were as strong as on the lower frequencies, they would not be nearly so troublesome.

More Low-Power Work

While a certain amount of short-distance work is still being done, it is only natural that transmitting amateurs should turn their attention to low-power tests. 6QB has been working with anode voltages between 22½ and 90 volts, and with a power of 0.27 watt (90 volts, 3 milliamps) he worked Belgian H6, who reported signals as a steady R5. He received a report from Dublin on the same transmission, signals being reported the same strength. He went a stage further while conducting tests with a station in Holyhead (250 miles), reducing his power to .02 watt (22½ volts, 1 milliamp). This puts up a "miles-per-watt" record of 12,500! He is very anxious to know whether this is a world's record, or whether someone has tried lower power over the same or a greater distance.

Low-Power Telephony

2ZB has also been doing low-power work on the 3,333 kc. band, having worked 6KO (Forfarshire) on telephony with an input of about 5 watts. One does not hear of many low-power tests on "fone," which seems to be left to the "miniature broadcasting stations" on the 6,667 kc. band. There is still a wide field for experiment left.



This little group of "bottles," which were exhibited at the Imperial College of Science recently, is calculated to arouse the amateur transmitter's envy. They are of the size used in the B.B.C. stations.

Horizontal Reception

Our American contemporary "QST" has brought up a very interesting point, that may have an enormous importance in connection with short-wave development, in an article this month on "Horizontal Reception." This describes some experiments conducted on the top of a twenty-foot tower with a receiver and an aerial which can be moved into any plane. The results obtained indicate that all waves shorter than about 45 metres are considerably stronger in the horizontal plane than in the vertical, this ratio sometimes being as great as 5:1.

Various well-known American amateurs have followed the original experiments up by using a horizontal aerial with the receiver attached at the centre, and all of them seem to hear numerous distant stations that they have never heard before. It is, of course, only the comparative tests of one of these aerials against one of the usual type that are of any value, but they all seem to agree that stations only just audible on their usual aerial have been tuned in at good strength with the greatest of ease with the new arrangement.

Only Effective on Short Waves

The receiver used in the original tests was a superheterodyne, and the tests were conducted over a very wide frequency-range. No advantage was found, however, on the broadcast frequencies. This should open up a very interesting field for experiment for some of our short-wave receiving enthusiasts, as even a horizontal indoor aerial split in the middle, with one half joined to the aerial terminal and the other to the earth terminal of the receiver, was in some cases found to be a great advantage over the conventional type.

Activity in Ireland

GW-11B reports his first communication with America on Wednesday, February 10, having worked U-1CH for three-quarters of an hour with an input of 7 watts. He is all the more pleased as it was his first attempt at "getting over."

Incidentally, an attempt is being made by the amateurs of the Irish Free State to form an Irish section of the International Amateur Radio Union, which will "draw the amateurs together" and make "collective work" much more easy.

All those interested are asked to communicate with Mr. D. Fisher at 115, Anglesea Road, Ballsbridge, Dublin, I.F.S.

This Week's Interview

No. 2.—Captain H. J. ROUND, M.C., M.I.E.E.

These actual interviews are reported verbatim, and they consist of a series of questions and answers which have been specially framed to interest the widest number of readers.

A TALK ON SELECTIVITY

The "Straight-Eight" receiver, which was designed by Captain Round, incorporates six tuned circuits, and gives a high degree of selectivity.

Q.—Everybody seems to want selectivity in these days, Captain Round. Do you think that high selectivity is difficult to obtain in, for example, single-valve sets?

A.—That is a very difficult question to answer. So much depends upon what you are prepared to put up with in the way of quality and strength.

Q.—Do you mean that quality must be sacrificed if we would obtain high selectivity?

A.—Not necessarily. Selectivity without loss of quality can be obtained without great difficulty by using a number of tuned circuits, but, of course, this makes the control of the set rather complicated.

Q.—Some people say the use of reaction spoils quality. Is this really so?

A.—It is only partly true. Take the case of a single detector valve without reaction, used on signals of medium strength. If we introduce a reaction coil into the circuit and utilise the reaction effect, the strength of signals can be increased two or three times before we reach the point when any distorting effect is noticeable. After this, although the strength will increase rapidly, quality will deteriorate until at the point of maximum sensitiveness, the quality will be very bad indeed.

Q.—But the use of reaction improves the selectivity of the set, does it not?

A.—Not directly, unless the interfering wavelength is very close to the wavelength we wish to receive. While the use of reaction tends to reduce the effective resistance of the circuit and thus allows of a greater build up of signals, the change of the resistance is only effective on the wavelength to which the circuit is tuned. This means that the interfering signal will come in just as strongly as before, but that the wanted signal will be much stronger, so that the ratio of the desired signal increases by the use of reaction.

Q.—Why are some aerials more selective than others?

A.—Perhaps you are referring to the fact that on a small indoor aerial less interference is often experienced than is found with a bigger outdoor aerial. To understand this we must consider how the unwanted signal is received. On a large outdoor aerial the unwanted signal may come in very powerfully, while the wanted signal may be weak. By the use of reaction we can increase very considerably the wanted signal (I am speaking at the moment of a direct-coupled single-valve circuit) while the strength of the unwanted signal remains practically the same. On small indoor aerials, however, the initial power of the unwanted signal is small and remains small, while we can probably increase the strength of the wanted signal up to a point nearly as great as is possible with the larger outdoor aerial.

Captain Round is well known to readers of "Wireless Weekly" as an authority upon receiver design, and his views upon the question of selectivity, elicited in the course of this interview, will be read with great interest. His explanation of the effects of reaction in the case of aerials of various sizes may surprise some of his readers.

Q.—What is the best way of obtaining higher selectivity with a large outdoor aerial?

A.—There is no one best way, as so much depends on the circumstances; loose coupling will do a great deal to help. A loose-coupled circuit reduces the voltage supplied to the valve, just as a small aerial reduces the voltage compared with that given by a big aerial.

Q.—But surely the strength of the weaker wanted signal is reduced in the same proportion?

A.—Yes; but by using reaction on the valve circuit we can possibly bring the desired signal up to the required value.

Q.—Which is the better way of obtaining selectivity: to use a loose-coupled receiver with tuned primary and secondary, or to introduce some kind of wavetrap?

A.—General experience seems to show that if the number of resonant circuits is small, a wavetrap is more effective, particularly for cutting out the local station. There is no reason, however, against combining the two methods.

Q.—A number of *Wireless Weekly* readers are troubled with disturbances from electric railways, trams, and so forth. Many of them have tried loose-coupled sets without success in an endeavour to tune out these disturbances. What do you think is the best way to get rid of this problem?

A.—Unfortunately, I know of no really effective cure. Moving one's residence, or possibly by voting for a change of the tram service to a 'bus service, would be effective!

Q.—I have heard it said that even in a three- or four-valve set, to obtain high selectivity (sufficient, for example, to give Manchester free of London at seven or ten miles from the latter station) signal strength must be sacrificed. Is this true?

This Week's Interview—*continued*

A.—Yes, in general, signal strength must be sacrificed to obtain selectivity.

Q.—I understand that if we make our receivers too sharp in tuning, we cause distortion by cutting off some of the frequencies which give us pure reproduction. What is the effect of cutting off these side bands? How do you recognise the deterioration in signals?

A.—The signals sound more rounded, or even possibly muffled. Speech will not be quite so intelligible, particularly when weak. Violins will tend to sound like wind instruments, but the general effect on music is not always disagreeable.

Q.—I see in the "Straight-Eight" receiver, which I believe was made to your design, that there are six tuned circuits. Is this for the purpose of giving high selectivity without reduction of quality and is this the minimum number of tuned circuits which, in your opinion, is necessary in order to give selectivity without loss of quality?

Metal shields are placed between each stage in the "Straight-Eight."

A.—Yes, it is to give selectivity with good quality. Such a receiver is always a compromise depending upon the cost one is designing to. Actually better results could be obtained with more circuits still, but very fair results can be obtained down to three circuits.

Random Technicalities

(Continued from page 68)

the cells and has marked on it the various voltages available. The holes in the sheet come just above the tappings, so that while the tapping holes are accessible for the wander plug, the cells themselves are protected from dust (which can easily set up annoying leakages). I also appreciate the provision of a small lead funnel and adequate holes for filling. The only criticism I would make is that, owing to the placing of the individual cells, it is very difficult to see when one has poured in enough acid. In spite of rather heavy drains upon it and long periods of inactivity, the battery is holding its charge remarkably well.

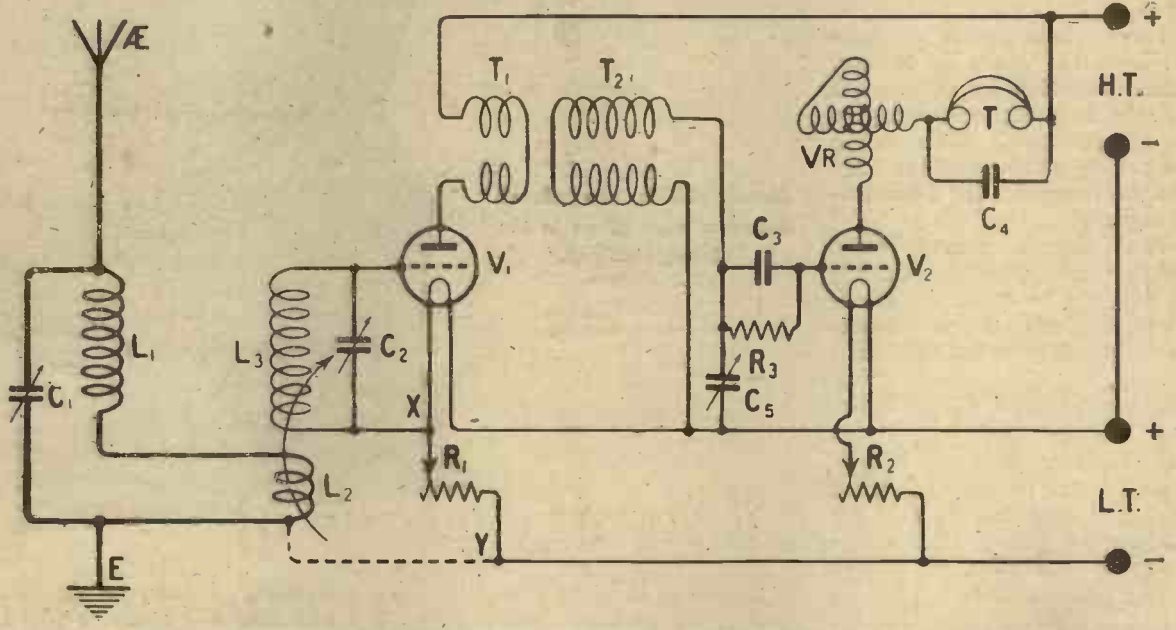
Much experimental work is being done by the R.A.F. wireless section in directional transmission, the building and small aerial illustrated being devoted entirely to this purpose.

'Ware Garages

Speaking of accumulators reminds me that there is still a great deal of gross ignorance on the subject in many garages. For example, some little while ago, being short of distilled water and wanting to "top-up" the accumulator on my car, I ran it into a strange garage, lifted the floor boards, and asked for distilled water. The man at the garage looked at me with a kind of withering contempt. "It's acid you want, not water," he said. Acid for accumulators! When I insisted on having distilled water, and distilled water only, he seemed quite annoyed at my ignorance. Incidentally, I saw the same man pouring acid into another accumulator through a tin funnel!

Circuits for the Experimenter

No. 6.—A "FIELDLESS-COIL" CIRCUIT.



THERE are now several types of coils available upon the market specially designed to give a reduced stray field, such as the binocular coils employed by Mr. Harris in his design for a 3-valve receiver published in the last issue.

One of the difficulties concerned with the use of these coils in a single stage of high-frequency amplification is concerned with the application of reaction in the inter-valve circuit; that is to say, to the detector valve grid circuit. A set consisting of one high-frequency valve, coupled by means of one of the transformers employed by Mr. Harris to the detector valve, whether followed or not by low-frequency amplification, will often be found to be perfectly stable without any neutralisation scheme, so that additional reaction is desirable in some cases.

Difficulties

The application of reaction to one of these binocular H.F. transformers is not a particularly simple matter, and this week's circuit has been arranged to illustrate an effective method of overcoming the difficulty.

Only two valves are shown in the circuit in question, these being the high-frequency amplifier and the detector, but it is, of course, understood that one or two stages of low-frequency amplification can be added in the ordinary way. The binocular transformer is represented by the windings T1 and T2, and it is assumed that this will be of the same type as that referred to by Mr. Harris in his set, or of some similar variety.

CIRCUIT No. 6
SPECIAL FEATURES

1. High selectivity.
2. Stability without special devices.
3. Reaction on the intervalve circuits.
4. Fully-tuned aerial circuit.

The winding T1 is fairly small, so that it is unlikely that the valve V1 will oscillate of its own accord, and the application of reaction to the secondary circuit T2 C5 is desirable. Since it is difficult to couple any windings to the transformer itself, the little-used method of producing reaction which depends upon the use of a variometer in the anode circuit of the detector valve is suggested.

Low Damping Essential

This method of producing reaction is only successful when the damping of the preceding grid circuit is fairly low, since if this is a highly damped circuit, it will not as a rule be possible to bring it up to the verge of oscillation.

The method, of course, functions by the transfer through the inter-electrode capacity of the valve of a sufficient amount of energy to give the desired reaction effect in the grid circuit, and it is therefore necessary that a variometer of suitable size should be used in the anode circuit. For this purpose a rather large instrument is desirable, such as that used in secondary circuits, or for tuning aerial circuits to the lower frequencies.

Size of Variometer

If the preceding grid circuit is of really low damping, one of the ordinary small variometers used for tuning aerial circuits upon the broadcast band of frequencies will suffice. In general, however, it is safer to use a somewhat larger instrument, in order that an adequate reserve of reaction control may be available, whatever type of valve may be used as a detector.

CIRCUITS FOR THE EXPERIMENTER

(Continued)

It is desirable to place this variometer at some little distance from the intervalve high-frequency transformer, in order to eliminate direct reaction effects which might make the circuit somewhat difficult to adjust. The semi-fieldless nature of the intervalve transformer, of course, means that this separation need not be so great as it would have been if an ordinary type of coil were employed in the last circuit, but a minimum of something like three or four inches should be adopted.

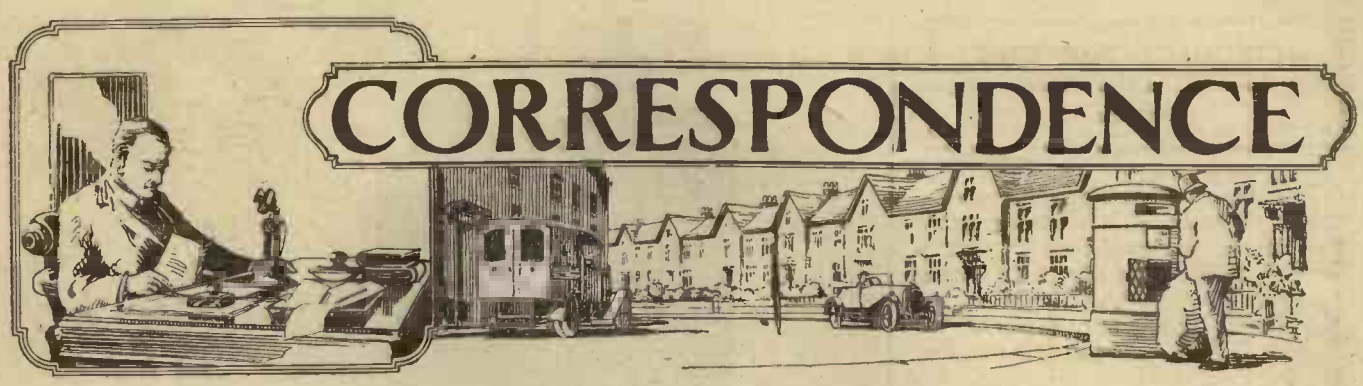
Aerial Coupling Arrangements

The aerial coupling arrangement requires a little explanation in this week's circuit, since it will be observed that it consists of the fully-tuned primary and secondary scheme known as loose coupling. This method of tuning, to achieve full success, depends upon the use of a really weak degree of coupling between the primary and secondary, and this is very difficult to obtain in the ordinary two-coil holder with a full-sized aerial and secondary coil. A better plan is undoubtedly to use three coils, one in the aerial circuit for tuning purposes, one in series with this of very small size for coupling to the secondary winding, and one constituting the secondary inductance L_3.

Weak Coupling

The coil L_1 may be a standard No. 25 or 35, according to the part of the frequency band upon which it intended to work, and pains should be taken to separate it fairly widely from L_2 and L_3. L_2 may consist of about five or six turns placed close up against L_3, which should be of the ordinary size for a secondary circuit, say a No. 60 or 75, or its equivalent. In this way a really good degree of weakening of coupling is obtainable, and the effect on selectivity is quite marked. The actual degree of coupling which will be needed will no doubt vary with different aerial and earth systems, and so on, and it might be advisable, if the full advantage of the circuit is to be obtained, to make L_2 a small tapped coil, to permit of adjustment.

(Continued on page 76.)



THE BEST SHORT-WAVE RECEIVER

SIR,—I have been using a super-het. receiver for the last two years within sight of the masts of Northolt, and the problem of receiving distant telephony through an appalling roar of mush has occupied a considerable amount of my time. I have tried several types of low-loss single-valve sets, but taking all-round results, I cannot see how anything can touch the "super" down to 50 metres. I believe Mr. Alford can work his super down to 20 metres.

By means of a double frame aerial wound in opposite halves with a centre tapping and no H.F. before the first detector, I can cut down the mush to a small roar, and receive most German and one or two Spanish stations as well as Scandinavian stations at very loud strength. This, in virtue of the fact that my frame is at right angles to Northolt. There is, however, a band between 830 and 1,100 kc., which is completely blotted out at any position of the frame. When working on short waves there are only two controls on my own instrument; there is no reaction coil or condenser to juggle with into the bargain, whilst tuning is nowhere near dead sharp.

My own estimation as to time spent on hanging about on the edge of reaction or hectic searches for instability in a super works out with a balance in favour of less time lost with a super. My own longwave side consists of three tuned stages, using Igranic coils as transformers, with DER valves and 80 v. H.T., no damping or potentiometer control being found necessary.—Yours faithfully,

Pinner. E. T. PIERCE.

SHORT-WAVE INTEREST

SIR,—I notice with interest the fact that *Wireless Weekly* will shortly be 3d. This is splendid, so long as its present S.W. features are included. It would be a very great service if R. P. could publish a "Call List" of the world's wireless amateurs' stations.

I note with interest "6QB's" letter *re* reports from B.C.L.'s. There is a certain type of report which goes something like this:—"Ur sigs hrd hr on such and such date. Pse QSL bi cd."

These reports are absolutely useless, and it is obvious that all the listener wants is a nicely-coloured card to stick on his wall.

When reports are sent they should contain remarks about quality of note, strength, and fading, and a few remarks about the weather conditions at the receiving end.

Wishing the new *Wireless Weekly* the best of luck. Very best 73's to it.—Yours faithfully,

G. S. SAMWAYS, G6OH.

Stafford.

CHARGED RAIN

SIR,—With reference to Mr. K. L. Jeffrey's letter in the February 3 issue of your excellent journal. I have frequently noticed similar phenomena at Bolton during the spring and in changeable weather. During showers of rain or hail reception was often made impossible by a sizzling sound in the telephones which was of such an intensity as to obliterate the strongest signals.

On several occasions during heavy showers of rain a stream of sparks was obtained across a small gap between two electrodes, which were connected to the aerial and earth leads respectively.—Yours faithfully,

GILBERT N. HASLAM.

St. Annes-on-Sea.

The standard wavemeter used at the "Wireless Weekly" laboratories at Elstree for the tests described last week. It gives a standard of accuracy in excess of one part in 3,000.

PRESS STUNTS

SIR,—Is it not high time that something were done to prevent the continual scares which appear in the general Press of this country? Almost day after day we are treated to the most childish journalistic efforts which, although, no doubt, possessing wide interest to the lay public, really discredit the paper in the eyes of wireless listeners.

When it is considered that there are 1,500,000 licencees, of which a good many undoubtedly have some technical knowledge, it is astonishing that a paper will risk its name by publishing what can only be termed "tripe."

One day it is a wonderful super-crystal set which will give loud-speaker results all over the house; the next day it is the well-worn heading, "What is wrong with the B.B.C.?"

Of course, there are some papers who have quite good wireless men employed on the staff, but whether they are overruled or not is an interesting problem. I always picture a newspaper having a severe struggle between a conscientious statement of a moderate character and a desire to get the last ounce out of a scoop.

Many papers, provided there is adequate news interest, will publish facts about the most impossible wireless inventions, originated either by professional inventors of the sponging type or by some poor ignorant person who, knowing little about wireless, finds that he suddenly gets good results and imagines that he has produced some wonderful circuit.

While a lot of this merely sickens the wireless experimenter and makes him wonder whether all news he sees in his paper on other subjects is dealt with in the same way, yet it unsettles many lay people who decline to buy a set "because they saw in the papers the other day that all existing sets will soon be obsolete" or because they read that "Crystal sets working loud-speakers would so soon become the fashion that valves would disappear."—Yours faithfully,

R. L. HENSON.

Newcastle.

REFLEX SUPER-HETERODYNES

SIR,—I have followed the correspondence on super-hets with interest, as I had exactly the same experience as Mr. Wilson. I have had no success with any of the autodyne methods of reception, due, I think, to my set of I.F. transformers working on too low a wavelength.

The small power valves vary a great deal, and I find the only position where

CORRESPONDENCE—*continued*

they can be used with any advantage is the first detector and oscillator.

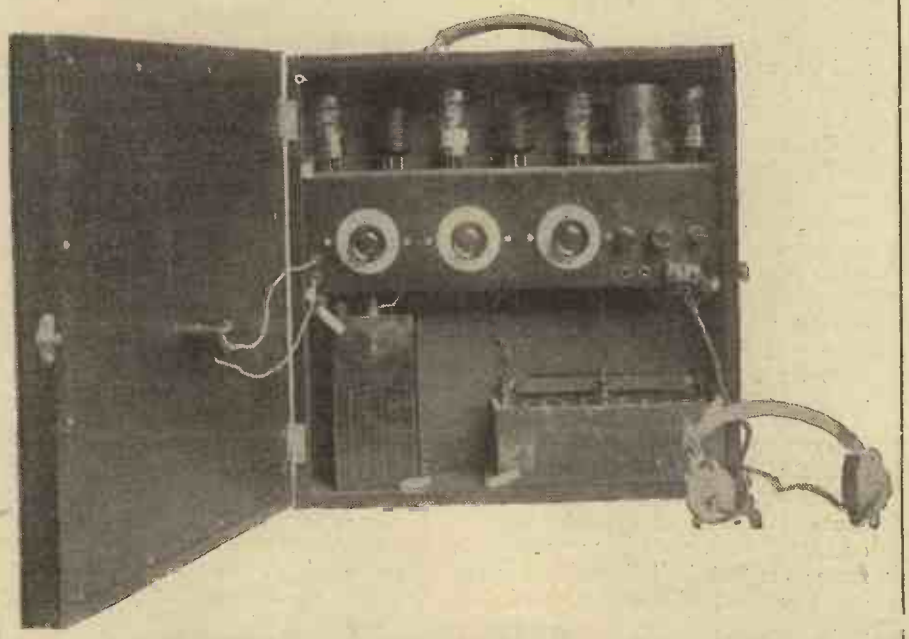
Perhaps the difficulty could be got over by having each stage tuned as in the nine-valve Superheterodyne described in *Modern Wireless* by Mr. Scott-Taggart. I have tried reflexing the valves to make them amplify at I.F. and L.F., but the selectivity becomes very poor.

I next made up a reflex to amplify at H.F. and I.F., as described in *Modern Wireless* for December, 1924, by Edwin Armstrong, and *Wireless Weekly* for April 24, 1925. When I switched on I got nothing but a multitude of harmonics and C.W. After consulting the circuit again I realised at once what was wrong. The frame tuning condenser was across both frame and the secondary of the filter, which state of affairs with English fixed transformers is hopeless.

A curious thing I cannot account for is lack of directional effects on certain nights. On dry nights (a rare thing) rotating the frame makes no difference. As I am only 17, I have a lifetime (I hope) in front of me to rectify these faults.—Yours faithfully,

G. N. W.

London.



An ingenious portable set designed by Mr. Guy C. Beddington, whose name is familiar to "Wireless Weekly" readers in connection with the Prince trigger circuit. The frame aerial is wound inside the door of the cabinet. The door can be slipped off its hinges and replaced with another containing the frame for 5XX.

APERIODIC TRANSFORMERS

SIR,—May I be permitted to reply to your correspondent, "No-Trans," who writes on the above subject?

Your correspondent's arguments strike me as entirely fallacious, and it seems to me that they should not be allowed to pass unchallenged. The question as to whether high-frequency transformers *do* transform has little to do with the question as to whether they should be used in actual practice, and need not be considered here. The point at issue is as to whether it is preferable to use an aperiodic transformer, or an aperiodic anode coil with a grid condenser and leak coupling.

Surely this is largely a matter of cost, since we are considering home-made components in particular. Looking at it from this point of view, there can be little doubt as to which the constructor will choose, since a good grid condenser and leak will cost something in the neighbourhood of 5s., whereas to put a secondary winding on top of the first one, so converting the anode coil into a transformer, will cost about 6d.!

For this reason alone I would strongly contest the statement of "No-Trans" that . . . "the aperiodic transformer has had its day," but there is another reason for using such a component which "No-Trans" ignores. By adjusting the natural frequency of the primary winding of a transformer to fall at a slightly different point upon the frequency-scale from that of the secondary, it is possible to spread out the resonance curve of the transformer in a way which enables the component to respond much more uniformly over a wide band of frequencies than is possible with an aperiodic anode coil.

I think that if "No-Trans" were to consider these points, he would realise that his question, "Why not bury it?" is fully answered.—Yours faithfully,

L. R. BRAND.

Norwich.

Wireless Weekly Small Advertisements.

RADIO PRESS INFORMATION DEPT.

2/6 QUERY COUPON

WIRELESS WEEKLY.
Vol. 8. No. 2. Feb. 24, 1926.

(This coupon must be accompanied by a postal order of 2/6 for each question, and a stamped addressed envelope.)

CIRCUITS FOR THE EXPERIMENTER—(*continued from page 73*)

Condensers

The condenser C1 should be a fairly large size, say a .0005 μF or a .00075 μF, in order to make it easier to cover the wide frequency band now in use, without a change of coil in the aerial circuit.

The secondary circuit is tuned by a condenser C2 which can be of .0005 μF, while C5, which tunes the secondary of the intervalve transformer, may be of .0003 μF or .0005 μF, the second value being desirable if this is intended to cover the complete band of broadcast frequencies.

Method of Tuning

The tuning of the aerial circuit will not be found to be very sharp, and much of the searching can be done upon the condensers C2 and C5 with occasional readjustments of C1, since it will usually be found that a station can be heard faintly even when the aerial circuit is slightly out of tune. Tuning of the circuit L3 C2 is moderately sharp, while the circuit T2 C5 will be found extremely critical, and a geared dial upon this tuning condenser is most desirable.

Ensuring Stability

No special provision is made for preventing the valve V1 to oscillate, and will not, as a rule, be necessary, but if it is found that some special type of valve should oscillate, the ordinary potentiometer control is indicated, a very small amount of positive bias being sufficient to stabilise the circuit. It will be noted that the return from the lower end of the grid circuit of the valve is connected to the point X—that is to say, at the negative end of the filament—but with some valves it may be desirable to connect to the point Y, a somewhat higher value of anode voltage then being indicated. If two stages of low-frequency amplification are added to this set, it may be desirable to introduce the dotted connection between earth and the point Y, in order to stabilise the low-frequency amplifier. This will be particularly desirable when two stages of transformer-coupled L.F. amplification are used.

Choice of Detector Valve

To obtain the best results from this circuit, or indeed from any circuit employing variometer reaction, it is most important that a suitable type of valve be employed for the detector. The D.E.5B. type is eminently satisfactory here, and will probably be difficult to improve upon. In choosing a valve for this position, it should be selected with a view to securing the smoothest possible reaction control, since with this scheme it is possible to creep up to the edge of self-oscillation extremely gradually, and it is worth while spending some little time in finding a valve which gives the most satisfactory results, in view of the very good use which can be made of reaction when the proper conditions have been obtained.

The H.F. Valve

For use in the first socket, it is desirable to use a valve which does not oscillate particularly readily when used as a high-frequency amplifier. A valve which oscillates too readily may involve the use of some stabilising scheme, with the consequent loss of the special feature of the circuit; that is to say, its simplicity.

Amateur Transmitting Notes

BELGIAN Z22 and Belgian U2 are both transmitting on the 6,667 kc. band, and are particularly anxious to receive reports. These should be sent to "Réseau Belge," 11, Rue du Congrès, Brussels.

QRA's Found

A-3EF: H. W. Maddick, Spray Street, Elwood, Victoria.

F-8IF: M. Loras, 46, Avenue Street, Lambert, Nice.

G-5PW: Leafield Short-Wave Experimental Station

S-2NCG: S. R. Manner, Konstantiinink 12B, Helsinki, Finland.

S-6NF: T. A. Rytkönen, Kirkonkylä, Kaustinen, Finland.

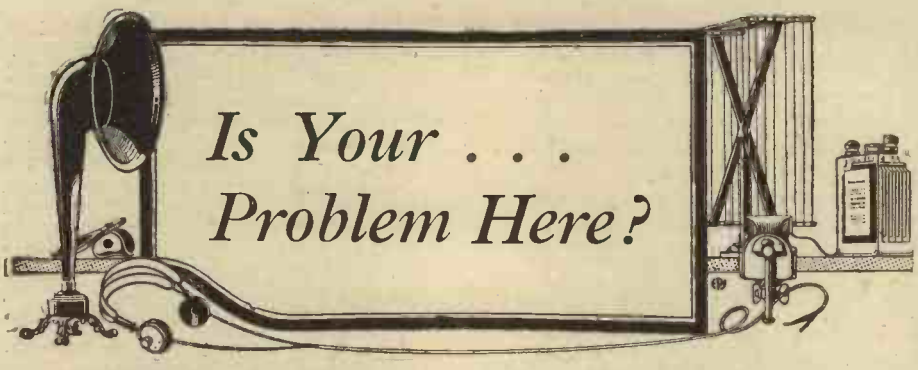
SMUI: E. Aulin, Humlegatan 19, Malmö, Sweden.

S-2CO: Radiokoulu Santakamina, Helsingfors, Finland.

SMUF: Robin Hult, Qvisberg, Vadstena, Sweden.

G-5CR: J. S. McLeod, 327, Blackburn Road, Bolton, Lancs.

G-5WP: W. E. Russell, 5, Walton Road, Woking.



AN IMPROVISED AERIAL

"Soon after Mr. Harris published a design for a "3-Valve Portable Receiver," in the May, 1925, issue of "THE WIRELESS CONSTRUCTOR," I built this set and obtained excellent results in various parts of the country, more especially from 5XX. In open country and at the seaside difficulty was, however, often experienced in erecting a sufficiently good aerial. The trouble was considerably aggravated in coastal areas where often a strong wind made the erection of anything like an efficient temporary aerial impossible. Can you offer any suggestions as to how a good aerial can be erected under such circumstances?"

Since your difficulty in coastal areas and open country is largely due to the wind we would suggest that you harness this source of trouble and make it erect your aerial for you. Where the wind is fairly steady this can be effected quite easily by flying a fairly large box-kite at a suitable altitude, the lower end of its retaining string consisting of your aerial wire. Ordinary silicon bronze aerial wire of a fairly fine gauge proves suitable for this purpose, or alternatively, a fine gauge of steel piano wire may be successfully substituted. This latter is exceedingly strong and will stand considerable strain.

With such an arrangement certain precautions must be taken in order that steady flying be obtained. A trial flight should therefore be made, and then the kite should be brought down and the aerial wire should replace the lower part of the retaining string. Suitable insulators should be placed at the end of the aerial and the lower one should be secured by stout kite string to a strong stake driven into the ground, whilst the aerial lead to the set should be taken from just above the bottom insulator. Due attention should be paid to staking down the kite, as otherwise you may have your receiving set carried away!

In practice, with your receiver, good loud-speaking should be possible almost all over the British Isles with a high kite aerial.

ACCUMULATOR CHARGING FROM D.C. MAINS

"In view of the fact that you state, in your last week's issue, that charging a 6-volt 30-actual ampere hour accumulator in series with the mains is somewhat expensive, it would be interesting to learn how much one charge would cost assuming for example that the rate is 6d. per unit. Is there any way of overcoming the difficulty?"

Assuming that the accumulator has not been discharged beyond the normal and that we have only to put into the accumulator the amount of energy we have taken out, which is not quite true in practice, at a charging rate of 3 amperes 10 hours would be required for a complete charge. Three amperes at a pressure of 240 volts is equivalent to charging at 720 watts. For ten hours, therefore, at 6d. a unit, the cost works out at:—

$$\frac{720 \times 10 \times 6}{1{,}000} = 43.2 \text{ pence} = 3/7 \text{ approx.}$$

If the time taken in charging is not of material consideration an inexpensive method of charging the accumulator is to place this in series with one

of the house main leads, close to the main switch. The lead which is earthed should be broken, and if the accumulator is inserted the correct way round, that is, with its negative terminal to the negative terminal of the mains, the accumulator will charge all the time the house lights are on. No extra cost above and beyond the normal lighting bill is involved when this system is adopted, since the only effect of placing the accumulator in series with one side of the mains is to drop the voltage across the house supply by slightly over six volts which will only dim the lights to a negligible extent.

FINDING THE INTERNAL RESISTANCE OF A VALVE

"I have a D.E.4-type power valve and wish to calculate its internal resistance, with 90 volts on its plate, from the makers' published curves. Will you show me how this may be done?"

The internal resistance of a valve cannot be found by dividing the anode voltage by the anode current at any required point, but must be obtained from noting the change in anode current for a small change in anode voltage about the working anode voltage.

Referring to the anode-current grid-volts characteristic curve in the makers' catalogue it is found that working with four volts negative bias and 100 plate volts that the plate current is 4.5 milliamperes. With the same value of grid bias and 80 volts on the anode the plate current is reduced to 2.6 milliamperes. A change in anode voltage of 20 therefore results in a change of anode current of 1.9 milliamperes. From these figures the internal resistance of the valve with a mean anode voltage of 90 is—

The latest type of D.E.4 valve has a pipless bulb.

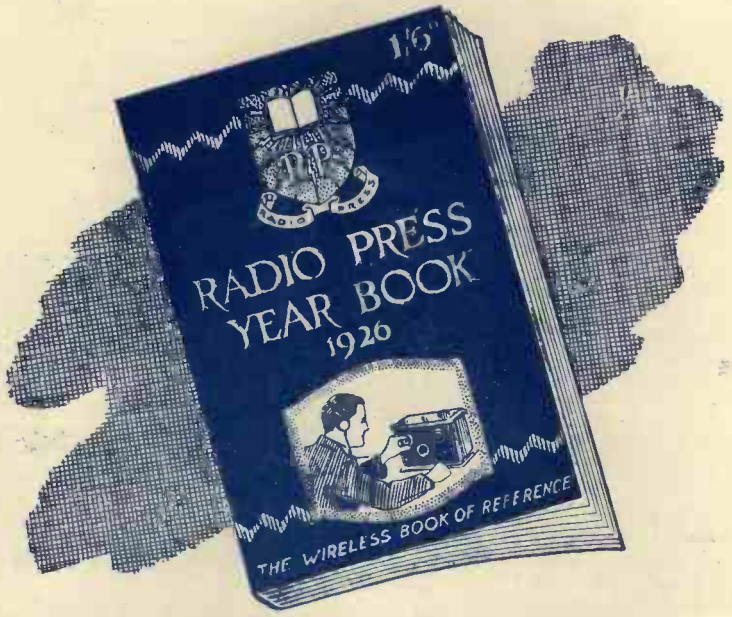
$$\frac{100-80}{.0045-.0026} = \frac{20}{.0019} = 10{,}500 \text{ ohms.}$$

It should be observed that this figure is one for pure resistance, and it will be slightly modified under working conditions.

AUTO-COUPLING FOR 5XX

"To improve the selectivity of my 3-Valve Receiver I recently purchased a type of tapped coil of correct size for the reception of 5XX, but on inserting this into my set and connecting the aerial to a tapping as per instructions, I found that selectivity is not improved and that the coil will not tune down to 1,600 metres. Can you tell me where the fault is likely to be found?"

Although you give no particulars of the receiver into which you have inserted your coil it would appear likely that the whole trouble is due to the way in which the aerial coil socket is wired. It should be realised that with a tapped type of coil the few so-called "aperiodic" turns should be connected towards the earth end of the aerial coil, and that if the aerial coil block is wrongly wired, instead of these few turns the major part of the coil is included in the aerial circuit proper. This would account for your difficulty in tuning down to 1,600 metres, and for your lack of improvement in selectivity. You should therefore reverse the connections to the aerial coil block, when the expected increase in selectivity will be obtained.



Joint Editors { John Scott-Taggart, F.Inst.P., A.M.I.E.E.
Percy W. Harris, M.I.R.E.

Facts at the Finger-tips.

The Radio Press Year Book—an indispensable reference book for the wireless constructor and experimenter—is now available for the small sum of 1/6. The brief summary given below provides only a slight idea of the great value of this book.

SPECIAL ARTICLES BY EXPERTS.

Listening to America. By Capt. A. G. D. WEST, M.A., B.Sc., known to all as the B.B.C. engineer in charge of the reception and relaying of American broadcast.

Some Facts About Valve Filaments. By Capt. H. L. CROWTHER, M.Sc.

Getting the Best from Your Aerial. By Capt. JACK FROST, of the B.B.C.

Is your aerial as efficient as it can possibly be? This article will give you numerous hints on its erection, insulation, and other practical matters.

Low-Frequency Magnification. By Capt. H. J. ROUND, M.C., M.I.E.E.

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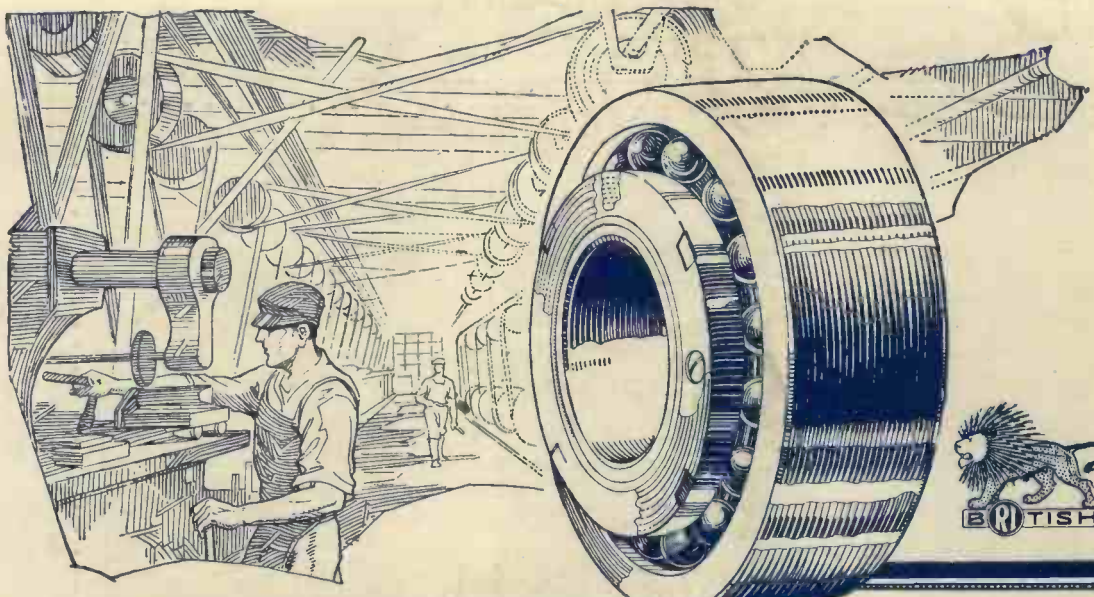

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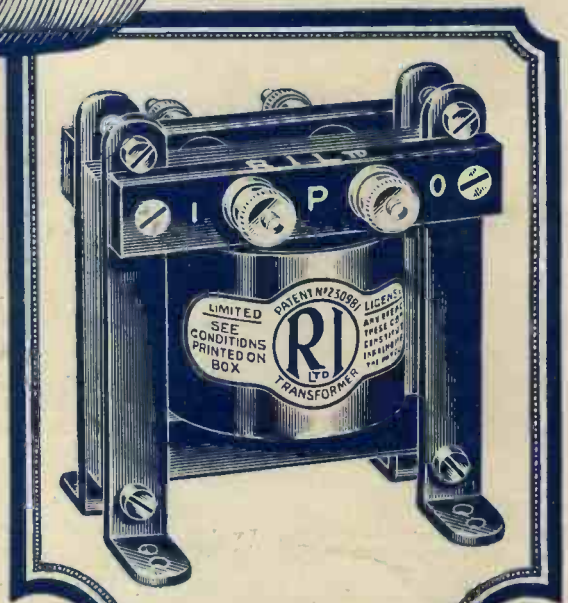

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