Wireless Weekly, 6d. Net. Wednesday December 2nd, 1925

Wireless Weekly

Vol. 7. No. 11.

A party of Canadians listening at the Cockspur Street office of the Canadian National Railway Company to CNRA, Moncton, Canada, the Company's station. The receiver is an Ethodyne.

From the "Wireless Weekly," November 18th

"A noteworthy achievement . . . loud-speaker reception of CNRA"

IN a recent issue of this journal it was reported that "The transmissions of CNRA at Moncton, Canada, were picked up successfully in this country by the Canadian National Railway Company, to which the station belongs. Despite unfavourable atmospherical conditions . . . in London, a noteworthy achievement at the Cockspur Street office was loud-speaker reception of CNRA, using a frame aerial and a seven-valve super-heterodyne receiver." The receiver with which this was accomplished was a standard Burndept Ethodyne. The same instrument also received no less than SIXTY-SEVEN broadcast stations in one night, in nearly every case at loud-speaker strength.

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The Future of the B.B.C.

WILL the British Broadcasting Company come to an end on December 31, 1926? This is the question which intimately concerns everyone interested in broadcasting. Nobody knows yet what will be the report of the Broadcasting Committee now sitting, and we understand that it will not be made available to the public until the end of January. On Thursday evening, November 26, the Radio Society of Great Britain held a meeting in London for the purpose of discussing the present system of broadcasting. A motion was put by Dr. Eccles that the present system of broadcasting, with a monopoly by the British Broadcasting Company, was the best possible system for this country, and it was soon obvious that the meeting was by no means unanimous. From the many excellent speeches made, it would appear that there is some confusion in the minds of critics on this question of monopoly. Many of the criticisms directed against the British Broadcasting Company are not necessarily criticisms which could be applied to any monopoly. Radio Press, Ltd., has held the view for some time that the only satisfactory way of conducting the broadcast service in this country is to place it in the hands of one organisation, and although we have found it necessary on many occasions to criticise the British Broadcasting Company and their policy, there is no question that much of their work has been done exceedingly well.

It is highly probable that the Broadcasting Committee will recommend the continuance of a monopoly, with a recommendation that the control be radically changed. After a vigorous discussion at the Radio Society meeting, a motion was finally put, and carried with very few dissentients: "That the present system of broadcasting, as represented by a single monopoly, is the best for this country." There is no doubt that had the motion been put in a form suggesting that the British Broadcasting Company, with its present constitution, be continued, it would have been lost, and the fact that a practically unanimous vote was obtained, with the modified resolution, has a special significance, seeing that the meeting was made up of delegates from all parts of the country, and represented some 200 affiliated societies.

One fact stood out above others at this meeting, and confirms the opinion we have formed from a perusal of numerous letters from correspondents. The B.B.C. policy in regard to Daventry has certainly done the company a great deal of harm. This station was built with a promise to the public that it would provide alternative programmes, and the impression was certainly given that on several nights in the week any listener within the range of the Daventry Station would be able to switch over from the local station and hear a different programme. At the present time Daventry relays the London programme for six days out of seven, with the result that on these days some six million people are deprived of the alternative programme, which they were led to expect would be theirs.

The Lobby Correspondent of *The Daily Express* foreshadows that the Committee will recommend a public Corporation operating under the direct control of the Postmaster General, with part of the money from licences used for the benefit of public funds. We venture the opinion that any such scheme would meet with such a storm of protest that it would not have the slightest chance of getting through Parliament. The British public has not forgotten the extreme difficulty with which the Post Office opposition to broadcasting was originally overcome.

CONTENTS.

Edited by
JOHN SCOTT-TAGGART,
F.Inst.P., A.M.I.E.E.
December 2, Vol. 7, No. 11.

The Transatlantic Broadcasting Tests

Arrangements for January, 1926.

It would seem that tests of broadcast transmissions between Europe and the United States are likely to become annual events. This article shows how preparations are under way for the most comprehensive tests yet attempted. The times provisionally decided upon are from January 25th to February 1st.

The control room at WJZ and WJY in New York. These two stations operate simultaneously with different programmes on a pair of aerials suspended between the same masts. WJZ has been heard on several occasions in this country.

ALL listeners with sensitive receiving sets will be interested to hear that during the last week in January next a valuable and instructive series of broadcast tests will take place between Europe and the United States. The general lines of these tests were indicated in last week's *Wireless Weekly*, as were a few indications of the special arrangements which will be made by Radio Press, Ltd., the British organisers.

Important Points

If the tests are to be fully successful, the following points will require careful consideration :—

(1) Atmospheric conditions must be favourable. This means, of course, that, first, interference from atmospheric noises must not be so loud as to overpower weak signals; and, secondly, that the conditions must be those which make long-distance communication possible.

(2) Listeners must have a clear idea of the frequencies on which the distant stations will transmit, and the times at which they will transmit.

(3) Listeners' apparatus must be properly calibrated.

(4) There must be a minimum of interference at the receiving end.

Atmospheric Conditions

Condition No. 1 is, of course, beyond human control. On some nights wonderfully good long-distance reception can be effected with the simplest of apparatus, while on others most elaborate instruments in the most skilled hands prove hopelessly inadequate. The times chosen for the test in January are as likely as any to be favourable in this respect.

Transmission Frequencies

Condition No. 2 is much more easily tackled. In conjunction with *Radio Broadcast*, of New York, Radio Press, Ltd., will publish the fullest possible details of the frequencies, individual characteristics of the stations, times of working and other essential details.

Calibration at Receiving Station

Condition No. 3, in regard to the calibration of receiving instruments, is one which is being met by the new Radio Press Wavelength Calibration Scheme, particulars of which are already in the hands of *Wireless Weekly* readers in the present issue.

Jamming

Condition No. 4 merits the most careful consideration of all concerned. Interference from commercial and governmental stations will, we trust, be reduced to the minimum, as the authorities in this country are always anxious to do their best in this regard. The real trouble, if there is any, will come from the misuse of receiving apparatus, resulting in the setting up of continuous oscillations in aerials.

Oscillation

Unfortunately, there are numerous experimenters who invariably search for distant stations by making their sets oscillate, so as to enable them to pick up the carrier waves, which they afterwards attempt to resolve by loosening the coupling once more. There is no disguising the fact that this is by far the easiest way to find a distant station; but it is, at the same time, a most selfish method, and it frequently defeats its own object when a number of experimenters are simultaneously searching.

Non-radiating Receivers

It is, however, possible, to set up receivers in which a portion of the instrument can be made to oscillate without these oscillations getting into the aerial and causing interference. An article on this subject will appear in an early issue of *Wireless Weekly*. In any case we trust that all who attempt to receive America during these tests will remember that the success of these tests will depend upon their sportsmanship as much as on anything else.

Schedule of Transmission

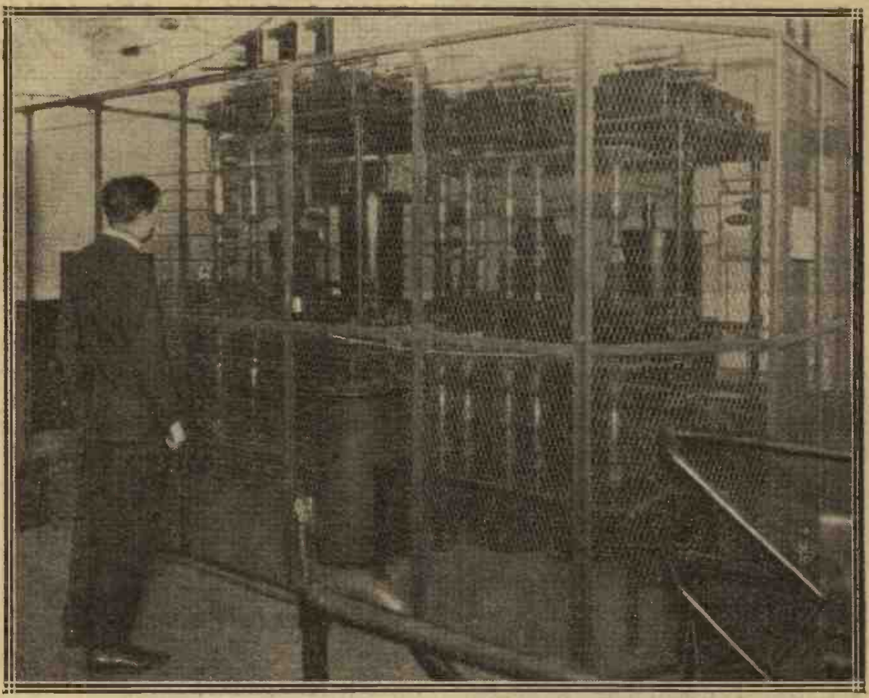
At first an endeavour was made to arrange a schedule something on the following lines. American broadcasting stations were to send out special programmes for European reception between 3 and 4 a.m. Greenwich Mean Time. England was to broadcast on Monday and Tuesday, Continental stations on Monday and Wednesday, England and the Continent on Thursday. On Friday and Saturday it was planned that North and South tests on the American Continent would take place, chiefly for the benefit of American listeners who wished to try for long distance in that country.

Co-operation of American Stations

Naturally the power used for these transmissions would be the same as that for sending to Europe (with one or two possible exceptions), and it should be as easy for English listeners to pick up American stations on those days as on the others of the tests. This provisional scheme is now being modified. American broadcasters are entering into the plans with the utmost co-operation, and on those nights and those hours when attempts will be made to receive from Europe there will be as far as possible complete silence in the American ether.

Records of Observations

This year we are suggesting to experimenters that they keep accurate records of their observations, since from these it should be possible to discover some important data. If the records are all made on the same type of form (this type of form, by the way, will be discussed in a future issue, and will be made available to all listeners before the time of the tests), a comparison of results will be greatly facilitated. For example, it has been found that signals fade considerably during such tests, but the fading is not the same in all districts, and, indeed, it may vary considerably in adjacent areas.



The Kenotron rectifier assembly in station WGY at Schenectady.

The control room at station WAHG, Richmond Hill, New York.

Useful Data

Comparison of results will undoubtedly show that the diminution of signals in certain areas is accompanied by an increase in other areas, so that it is more than likely that a programme which is partially lost at one station may be completed from records of another listener who has missed a different part of the programme. It has also been found that atmospherics are bad in some parts of England when they are practically absent in other districts. All experimenters who collaborate in these tests will thus be able to help in the advancement of the science by collecting important data during the week of the tests.

It must not be overlooked that the more important American broadcasting stations are found at frequencies below 1,000 kilocycles (wavelengths above 300 metres), and some, indeed, go as low as 545 kilocycles (550 metres). The stations of less importance and power are practically all working at the highest frequencies available for broadcasting, excluding, of course, the very high frequencies above 1,500 kilocycles (short waves below 200 metres), which experience has shown to come over very well.

Amplification

Another consideration of which a full account must be taken is the

(*Continued on page* 354.)

Random Technicalities

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

British and American Valves

THERE are many signs that the British radio manufacturer is at last waking up to the importance of good design in his high-frequency equipment, and I am sure that before long British radio apparatus will once more be the best in the world. In view of the comparisons which are always being made between American and British radio apparatus, I would like to draw attention to the fact that much nonsense has been written on the difference between American and British valves. In the United States, as I have previously indicated on a number of occasions, manufacturers of sets have standardised on but two types of valves (there are, of course, exceptions to this rule, but they are very few), namely, the 0.25 ampere small-power valve, and what is known as the dry-cell valve. No one pretends that such good results can be obtained with the dry cell valve as with the storage battery valve, but, of course, there are times when it is very convenient to have a very small filament consumption, and, furthermore, the demand on the high-tension or "B" battery made by the dry cell valve is far smaller.

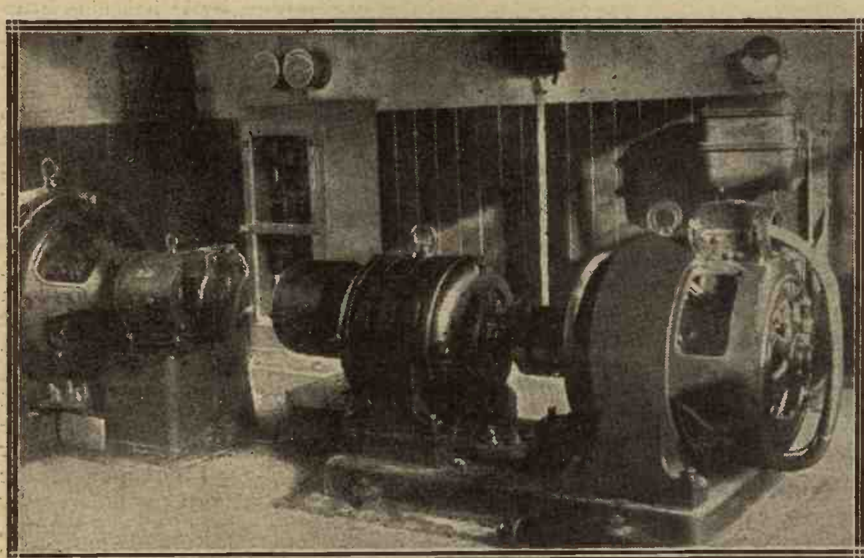
Comparisons

The two leading makes of small-power valves are the Corporation U.V. 201a and the Cunningham C. 301a. Both are made in the same factories, and in their electrical characteristics the two are identical. As this is the type of valve for which most American sets are designed, it occurred to me to make some comparisons between these and the equivalent British valves. I therefore plotted the grid volt-anode current characteristics of a Cunningham C. 301a, and, to take a typical British valve of the class, the B.T.H. B4. As soon as I had finished and compared the curves I found they were almost identical, and, in fact, there was not so much difference between the two curves as one often finds between a pair of valves of the same make and batch.

H.F. Transformers

Now this leads me to another point of considerable importance to the trade, and one which I think has not yet been given sufficiently serious consideration. So long as we have such a big variety of valves available to the user, difficulties are bound to arise in British sets and the design of the high-frequency portion of them. It will be a good idea for manufacturers to experiment with low-loss high-frequency transformers in which the primary winding (which should, of course, have very small capacity couplings with the secondary) is made to be variably coupled to the secondary. This could be done by the primary winding being made of very fine wire on a very small rotating former within the secondary. It would not be necessary to bring out a handle for varying the coupling, and when the transformer is in the set the movable former could be set once and for all to suit the particular valve used. Valves vary very considerably in the degree of coupling that can be used with them between stages of amplification before a point is reached at which self-oscillation occurs.

BROADCASTING IN IRELAND



In the generator room at the new Irish broadcasting station, 2RN, in Dublin.

The Fundamental Principles of Valve Transmission.

By the Staff of the Radio Press Laboratories.

This article, the first of a series to appear in "Wireless Weekly" on the subject of Radio Transmission, deals with some theoretical and practical considerations connected with the use of thermionic valves as generators of high-frequency oscillations.

THE subject of radio transmission is a very large one, and the problems that have to be dealt with are probably as numerous and as interesting as those met with in broadcast reception. In a short series of articles, therefore, it will only be possible to touch on some of the more important general principles of the subject.

High-Frequency Generators

The thermionic valve is probably the only source of high-frequency oscillations now considered by the wireless experimenter, so in the following articles we shall only consider problems in connection with valve transmission. The arc and the high-frequency alternator as sources of radio oscillations are by no means dead, especially with regard to long-distance commercial telegraphic communication. They still have many points in their favour.

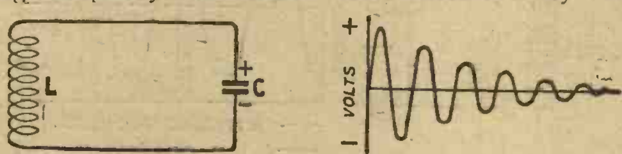
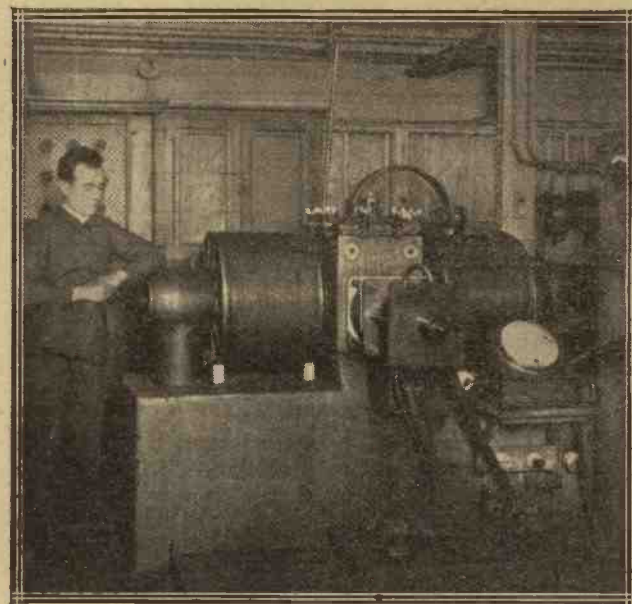


Fig. 1.—The curve shows the nature of the oscillatory discharge of a condenser C through an inductance L.



The arc as a generator of radio-frequency oscillations is still used for long-distance telegraphic communication.

Thermionic Valves Predominant

The thermionic valve, however, has made possible the high degree of perfection that has now been reached in radio telephony, and the remarkable results obtained at high frequencies have opened up a new field of possibilities in connection with long-distance communication, with frequencies which were previously considered to be quite useless for practical purposes.

In future issues of "Wireless Weekly" a series of articles will be published on the subject of Transmission. This article, dealing with the fundamental principles involved in the use of thermionic valves as generators of high-frequency oscillations, is intended to be in the nature of an introduction to the series.

For the generation of very high frequencies, and also possibly for telephony, the arc and the H.F. alternator are at present of no value, and unless there are some very remarkable and unforeseen discoveries made in connection with these, it does not seem possible that they will ever compete with the thermionic valve for these purposes.

Difference between Receiving and Transmitting Valves

There is nothing fundamentally different between receiving and transmitting valves. The latter are simply large editions of the former, constructed to withstand higher voltages, and to deal with larger powers. Anyone who has used valves knows of the ease with which they will maintain oscillations in any suitable circuits. In valve receiver design the chief trouble is to prevent the set from oscillating, either at high or low frequency, and any number of circuits have been devised with this object in view. Thus there is no difficulty in getting a valve circuit to oscillate at practically any desired frequency. The problems in connection with radio transmission with the aid of valves are how to deal with large powers, get good efficiency, obtain radiation free from harmonics, the maintenance of constant frequency, high-speed signalling, and modulation to give pure reproduction of speech and music.

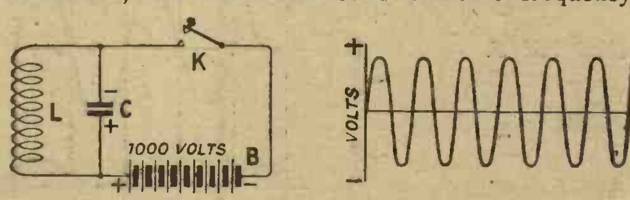


Fig. 2.—Oscillations may be sustained in the circuit LC by properly timed impulses from the battery B.

Oscillatory Circuits: An Analogy

An oscillatory circuit, consisting of an inductance across which is a condenser, can be compared with the pendulum of a clock or the balance wheel of a watch. Pendulums and balance wheels can be sustained in vibration by properly timed impulses transmitted from the mainspring through the escapement, the timing being accomplished by the vibrating member itself. Similarly a vibrating or oscillating electrical system can be sustained in oscillation if properly timed electrical impulses are applied to the system. The three-

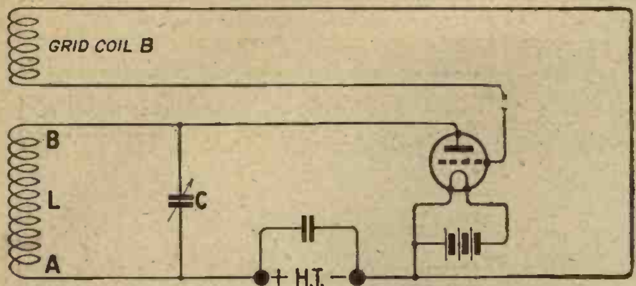


Fig. 3.—Correctly timed voltage variations are applied to the grid by means of coil B.

electrode valve can be arranged so as to act as the escapement in an oscillating electrical system.

Decay of Oscillations

As is well known, a charged condenser, if discharged through an inductance of low resistance, will give rise to oscillations which will gradually decrease in amplitude, the rate of decrease depending upon the resistance in the circuit. Thus, if the condenser was originally charged to 1,000 volts, after one complete oscillation the charge would have fallen to, say, 900 volts; after another complete oscillation it would be still lower, and so on, the rate of decrease of the oscillations following a definite logarithmic law (Fig. 1).

Method of Sustaining Oscillations

If we could arrange to connect a 1,000-volt battery across the condenser by means of a key or

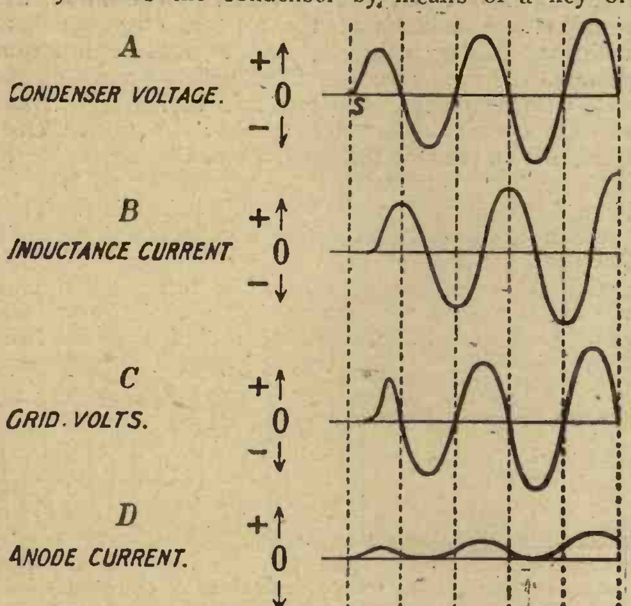


Fig. 4.—Showing the phase relations between the different currents and voltages of the Fig. 3 circuit, starting from the point S, which represents the closing of the high-tension switch.

interrupter, as represented by K in Fig. 2, at every instant at which the oscillating voltage was a maximum, then any decay of voltage amplitude due to damping would be compensated for by a requisite supply of energy from the battery, and the oscillations in the circuit LC would become continuous. If the interrupter or key K were replaced by a resistance which could be varied from, say, infinity to 10,000 ohms in suitable phase relation with the oscillations in the circuit LC, the oscillations could be sustained in the same way as before.

Application of Valves

We can now see how a three-electrode valve can be used as an escapement for sustaining oscillations in the circuit LC. The anode-filament resistance can be used in place of K in Fig. 2, and the resistance can be varied from infinity to, say, 10,000 ohms by variation of the grid potential of the valve. By means of a coil in the grid circuit coupled to the main oscillating circuit LC, properly timed voltage impulses or variations can be applied to the grid of the valve, which will vary the anode-filament resistance in such a way as to maintain the circuit LC in a state of sustained oscillation.

Now that we have got a general idea of the manner in which a thermionic valve is capable of maintaining

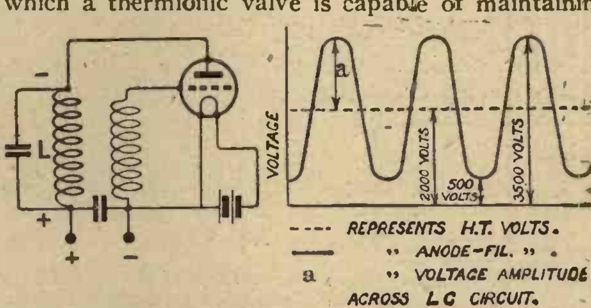


Fig. 5.—The curve shows the anode-filament voltage of the circuit on the left under oscillating conditions.

oscillations, we must consider the circuit a little more closely, in order to understand thoroughly the various functions that a valve performs under actual oscillating conditions.

Starting of the Oscillations

First of all we must consider how the oscillations in the circuit are started. On closing the high-tension switch, the condenser C (Fig. 3) becomes charged through the anode-filament resistance of the valve. The voltage on the condenser at this instant opposes that of the H.T. battery or generator. The condenser discharges through the inductance L, and the voltage across its plates becomes reversed. The current flowing through the inductance L from A to B causes at first a positive potential to be induced on the grid, which rapidly becomes less as the current in the coil reaches its maximum or peak value. As the charge on the condenser approaches its maximum negative value, so this induced grid potential approaches its maximum negative value.

The anode-filament resistance of the valve under these conditions becomes very high, so that the current flowing through the valve is practically nil. The condenser now discharges through the inductance in the reverse direction, causing the grid of the valve to become more positive. It reaches its maximum positive value when the current through the coil is zero, and the condenser has again reached its maximum positive value. The valve under these conditions becomes conducting and the situation is equivalent to the case illustrated in Fig. 2, when the contact K is made.

Phase Relationships

The various phase relations between the different currents and voltages in the circuit are best seen from Fig. 4. Curve A represents the variation of voltage across the condenser C. The point S is the starting of the oscillation when the high-tension switch is closed. Curve B represents the current in the *inductance*, and due to charge and discharge of the condenser C.

Grid Voltage and Anode Current

Curve C shows the variation of the grid voltage, due to coupling between the anode and grid circuits. The voltage variation on the grid is in phase with the voltage variation across the condenser.

Curve D shows the current flowing through the valve at any particular instant of the cycle. The grid voltage is the chief controlling factor of the anode current, so that this becomes maximum when the grid voltage is maximum positive with respect to the filament.

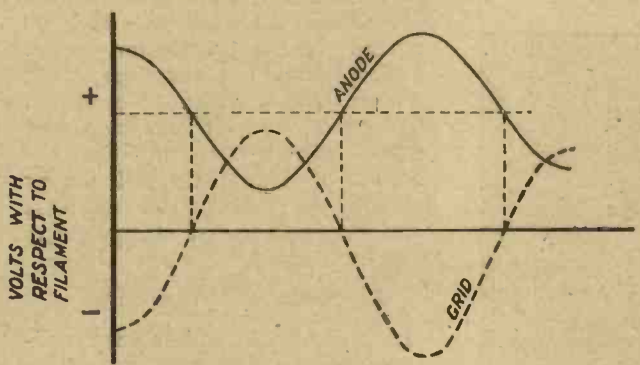


Fig. 6.—Illustrating the phase relationship between grid and anode voltages under oscillating conditions.

When the grid voltage is negative, the anode current should become very small.

Chief Factor which Controls the Oscillation

At first sight it might appear that the anode current is the main controlling factor of the oscillation. This, however, is not the case, as the anode current simply supplies energy to the circuit at the right moment in order to make up losses owing to resistance in the circuit. It is true that the oscillations would gradually cease if there were no anode current, but it does not exercise any control in the actual functioning of the valve. It has no direct effect on the grid voltage variation or on the anode voltage.

The anode current is comparatively small compared with the large oscillating current in the LC circuit. For example, an anode current of 100 milliamps is sufficient to maintain an oscillating current as high as 20 amps under suitable conditions. The oscillating current can therefore take complete control of the grid and anode voltages, the anode current being negligible in comparison.

Voltage Between Anode and Filament

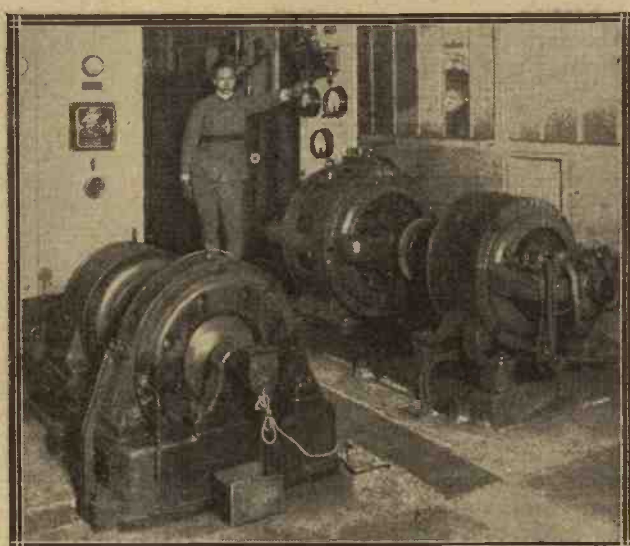
Up to the present we have not taken into consideration the effective voltage across the anode and filament of the valve. It is fairly obvious from what has been said before that the anode filament voltage at any particular instant is the sum of the high-tension voltage and the voltage across the condenser circuit. Thus the condenser voltage and the anode-filament voltage are opposite in phase.

A Practical Example

If, for example, the H.T. or generator voltage is 2,000 volts, the oscillating voltage across the oscillating circuit LC may be 1,500. The voltage between the anode and filament may thus vary between 500 volts and 3,500 volts, as shown in Fig. 5. The phase relationship between the anode-filament volts on the valve and the grid voltage is shown in Fig. 6. The anode filament resistance of the valve is at its lowest when the grid is maximum positive and the anode-filament voltage is at a minimum. During this part of the cycle the anode current is at a maximum. When the voltage across the valve is at its highest, the grid is necessarily so negative that practically no current can pass through the valve.

Necessity for Good Insulation

An intere ·ing point to remember in connection with anode and grid voltages under oscillating conditions is that as these are opposite in phase, there will necessarily be a very high voltage difference between the anode and grid during part of the cycle. In some cases it may reach many times that of the applied D.C. voltage, as it not only consists of the high-frequency voltages, but also, in addition, the applied generator volts, and also any necessary negative grid bias, which may be many hundreds of volts. In large valve transmitters the insulation question is therefore of very great importance.



High-frequency alternators, of which an example is to be seen in the centre of this photograph, are useless for generating oscillations at very high frequencies.

Negative Grid Bias

In order to operate a transmitting valve on the correct part of the characteristic, a negative bias has usually to be applied to the grid. Although this negative bias could be obtained by means of batteries or a generator, it is much more convenient to obtain it by means of a condenser and leak in series with the grid circuit. The operation of this grid condenser and leak is exactly the same as when it is used for cumulative grid rectification.

In the next article in this series the question of efficiency, output, and harmonics of a valve oscillator will be considered.

THE "WIRELESS WEEKLY" CALIBRATION SCHEME

Detailed Arrangements.

In the last issue of "Wireless Weekly" particulars were given of how to calibrate your receiver and wavemeter in connection with the Radio Press Laboratories Calibration Scheme. In this article the first Time Schedule is given.

THE first series of frequency measurements in connection with the Radio Press Laboratories Calibration Scheme has now been definitely fixed for Thursday evening, December 10. The stations which will be measured on that night and the times are as follows:—

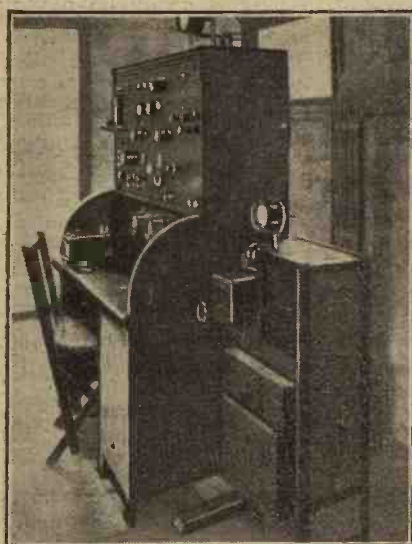
Station.	Time. p.m.
Aberdeen	7.45
Birmingham	7.55
Belfast	8. 5
Glasgow	8.15
Newcastle	8.25
Bournemouth	8.35
Manchester	8.45
London	8.55
Cardiff	9. 5

Ensuring Accurate Readings

So that readers may make their adjustments with accuracy, ten minutes will be given to each station. In order to eliminate the human element as far as possible, we suggest that several experimenters collaborate in all cases where accurate instruments are being calibrated, for if readings are taken in succession by several different people, none of whom knows at the time the figure obtained by the others, a far higher degree of accuracy is likely to be obtained when results are finally compared. This method is particularly recommended to radio societies, and it will undoubtedly increase the skill of members.

Variations in Frequency

It should be remembered that the British Broadcasting Company have already announced that they vary the wavelengths of their stations from time to time, in order to avoid interference between stations in this country and abroad. Whatever view may be taken of the wisdom of this policy, this fact must be clearly borne in mind in any calibration work, or quite misleading results may be obtained when using the wavemeter in future. For example, after the Radio Press Calibrations have been utilised, it may be found that on a certain evening Newcastle comes in at, say, 78 degrees on a particular scale. Readers should not, therefore, mark their wavemeter scales "Newcastle, 78 degrees," for it may be found on the following evening that the position of Newcastle will be 77 degrees, or perhaps 80 degrees, depending upon what changes may have been made.



The compact transmitting panel of the Spanish broadcasting station EAJ 11 at Bilbao.

Frequency and Wavelength

In order that readers may calibrate their instruments in wavelengths, as well as frequencies, the results of Radio Press measurements will be published in both forms. The results of the first set of calibrations will be published in *Wireless Weekly* for December 16.

Your Suggestions

We are very anxious to receive expressions of readers' views on this Calibration Scheme, as we are anxious to develop it in many directions. All suggestions sent in will be very carefully considered, and, if practicable, will be incorporated in subsequent tests.

The Transatlantic Broadcasting Tests

(Continued from page 349)

ratio of signal strength to interference. In most cases it will be found that if conditions are sufficiently good for the reception of distant signals, they will come over quite well with high-frequency stages preceding the detector, and will not be improved by the addition of stages of note magnification, save in the few instances where they are good enough to be put through a loud-speaker. If telephones are used, we would recommend the use of not more than one stage of audio-frequency amplification, as the distressing crashes of atmospherics are brought up to such a strength with audio-frequency amplification that they temporarily deafen the listener.

Further Details

When writing last week, we had hoped to present to our readers in this issue some of the programme details arranged on both sides of the water, but certain changes have had to be made, and we are not yet in a position to give the full American arrangements. On this side of the water the B.B.C. has so far promised one night only to be reserved for the transmission of a special programme for the United States. In our opinion, this is not adequate, and we trust they will see their way to transmit on several evenings programmes of an importance commensurate with that of the tests. On this we shall have more to say later.

The Significance of Decrement in Tuning Circuits

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

In this article, which continues his series in "Wireless Weekly" on the subject of tuning circuits, Mr. Reyner discusses the important question of decrement in oscillatory circuits and shows how appreciation of this quantity provides valuable information in the design of tuning circuits.

IN the early days of wireless there was a quantity which entered to a considerable extent into the calculations and measurements made in connection with tuning circuits. This quantity was the *decrement* of the circuit, which was a measure of the damping existing therein.

With the development of continuous waves, the science of radio engineering became merely a specialised branch of alternating currents, the only difference between the ordinary alternating current theory and wireless theory being one of frequency.

Disuse of "Decrement"

This led to the gradual use of the actual resistance in calculations on tuning circuits, and the old term

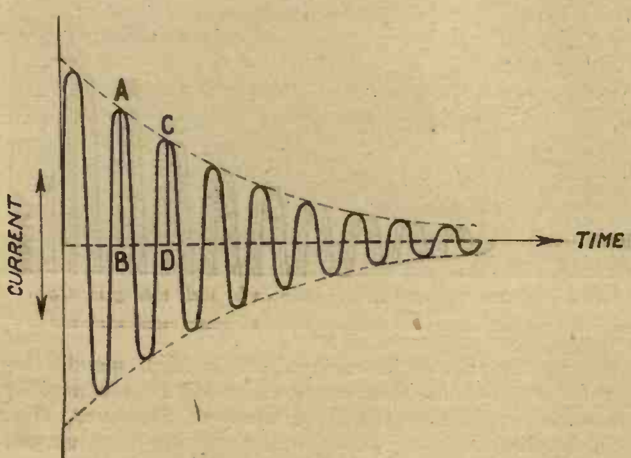


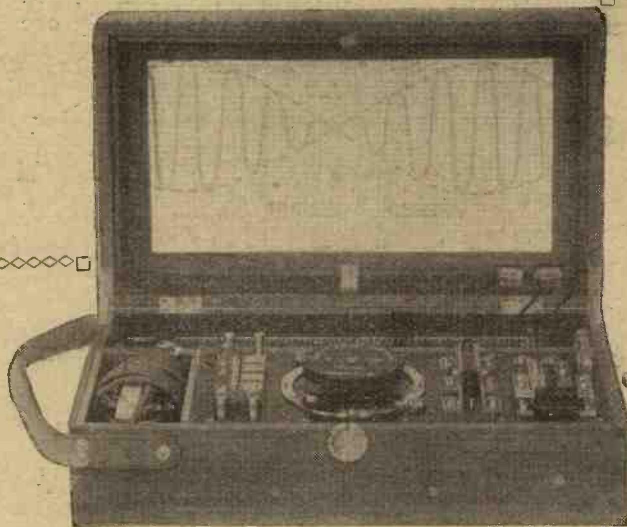
Fig. 1.—The decrement of a damped wave is the ratio of one peak to the preceding one in the same direction.

"decrement," which involved other quantities besides the resistance, as we shall see shortly, gradually lapsed into disuse. In fact, there are engineers who consider that the term "decrement" is meaningless in modern radio-engineering.

This, however, is an overstatement, because the decrement of a circuit is of considerable assistance in judging the selectivity and filtering properties of a particular circuit, and consequently it enables one to obtain the correct perspective.

Simple Oscillatory Circuits

Let us consider exactly what the decrement is. If a current is started in a simple oscillatory circuit, consisting of an inductance in series with a capacity, the whole circuit having a certain resistance, then this



A Marconi decremeter, an instrument which is used for measuring the decrement of tuning circuits.

current will gradually die away in an oscillatory fashion, owing to the losses in the circuit. The actual form of the current when plotted to a time basis is as shown in Fig. 1, which represents the ordinary damped sine wave. This was the type of discharge which was produced and utilised in the first experiments with wireless telegraphy, frequently recurring groups of such waves being produced by means of a spark transmitter. Such a wave, of course, cannot be treated by simple alternating current laws, and involves the more complex methods of treatment.

Nature of Decrement

Arising out of the mathematical treatment of such trains of waves, and their effect on tuning circuits, one of the most important factors to be ascertained was

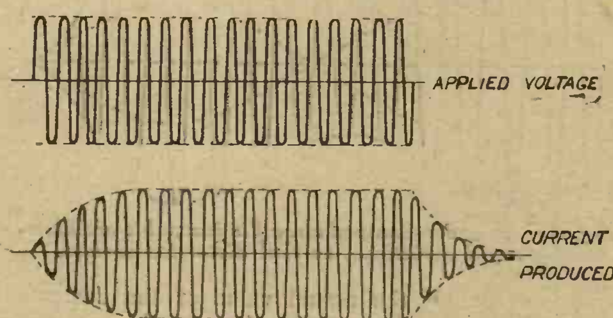


Fig. 2.—Due to the damping in the circuit the current does not build up or die away instantaneously when an alternating voltage is applied or removed.

the rate of decay of the current. This factor was measured in terms of the ratio of the amplitude of the oscillation at a given maximum, to the amplitude of the preceding maximum in the same direction. For example, we may consider the two ordinates AB and CD in Fig. 1. The ratio in question would then be $\frac{CD}{AB}$. This ratio was known as the decrement of the circuit.

Logarithmic Decrement

Owing to the form in which the majority of the calculations were obtained, it was found more convenient to work with the logarithm of this quantity, which was known as the logarithmic decrement. In practice this logarithmic decrement was the only one which was used to any considerable extent, and so the term decrement came to mean the logarithmic decrement.

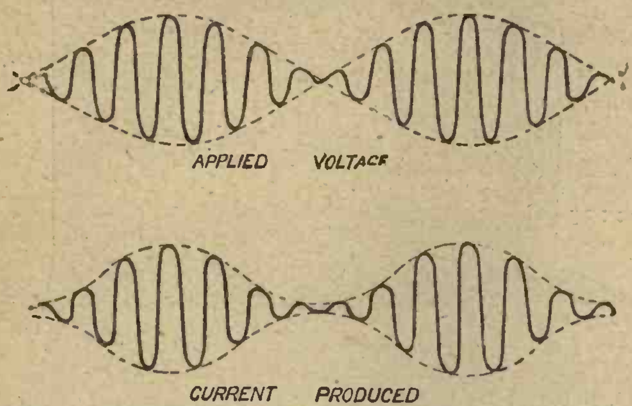


Fig. 3.—With too much damping the current is slow in building up and decays too rapidly.

This explanation has been given in order that the reader may appreciate exactly what decrement is. A clear understanding of its physical meaning will enable the reader to appreciate the significance of the term in mathematical expressions.

Factors Controlling the Decrement

It will be obvious that the greater the resistance in the circuit, the heavier will be the losses, and consequently the more rapidly will the current die away. It can also be shown that the ratio of the inductance to the capacity in the circuit has an effect on the decrement, and if the actual value of the decrement is worked out, it is found to be given by the expression

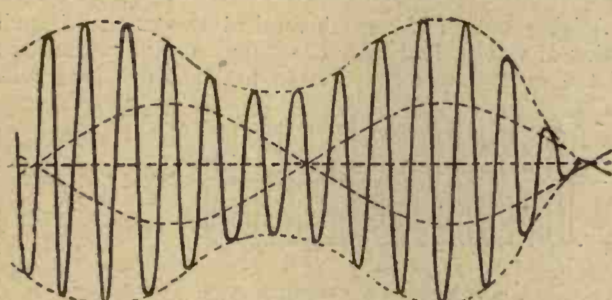


Fig. 4.—An under-damped circuit is incapable of following rapid variations, so that distortion results.

$$\delta = \pi R \sqrt{\frac{C}{L}}$$

where δ = logarithmic decrement.
R = resistance in ohms.
C = capacity in farads.
L = inductance in henries.

The actual frequency of the oscillations in the circuit, moreover, is also dependent upon the inductance and capacity in the circuit, and is given by the expression

$$f = \frac{1}{2\pi\sqrt{LC}}$$

This enables us to re-write the expression for the decrement as follows :—

$$\delta = \frac{R}{2fL}$$

where f = frequency in cycles per second.

Application to Radio Telegraphy

Let us consider now how the decrement affects radio telegraphy. We have seen that if a current is flowing in a tuned circuit, and the source of supply is suddenly removed, the current will die away, somewhat in the manner shown in Fig. 1. Now the converse of this must obviously apply also. If we apply an alternating voltage to a tuned circuit, then the current produced will not immediately attain its full value, but will gradually rise to its maximum value as indicated in Fig. 2.

Time Lag

That is to say, there is a time lag in the growth of the current in a circuit, similar to the decay of the current when the applied voltage is removed. This time lag has a considerable effect in high-speed telegraphy, but we are not concerned with that aspect of the problem here. It will be obvious, however, that if the applied voltage is continually varying in strength, as occurs in the case of radio telephony, then a very peculiar state of affairs will arise.

The 6 kw. transmitter at the Dublin broadcasting station.

Heavy Damping

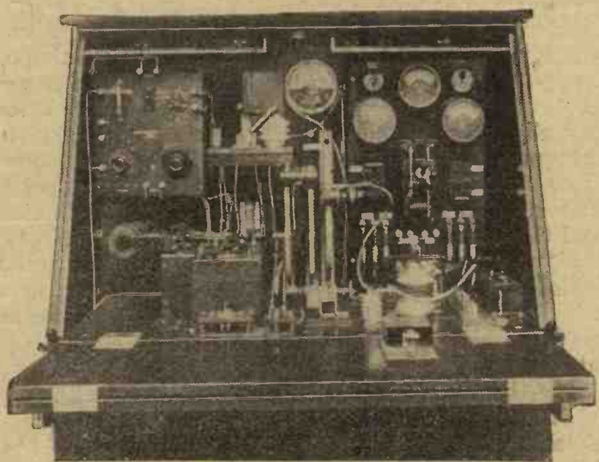
There are three possible cases which we will consider in detail. We may have, first of all, a circuit which is over-damped. In this case, the growth of the current as the applied voltage increases will be somewhat sluggish in following the increase in the applied voltage, and if the applied voltage decreases the current will die away rather more rapidly than the voltage.

Effect on Voltage and Current

This condition of affairs is shown in Fig. 3, where we have represented a voltage modulated in a simple sinusoidal manner. The form of the current set up in the circuit will be somewhat as shown in the lower line. It will be seen that the difference between the two oscillations is comparatively slight, and, moreover, that the current passes through its maxima and minima at approximately the same time as that of the applied voltage. Consequently, if this state of affairs was occurring in a receiving circuit, the distortion would not be heavy.

Correct Damping

The second position which may be obtained is that of correct damping. In this case the damping would



A complete ½ kw. transmitter for ships, shown by Messrs. Siemens Bros. at the Shipping and Engineering Exhibition, Olympia.

be such that at the particular modulation frequency and the particular carrier wave frequency, the growth and decay of the current exactly followed the variations of voltage without any deviation whatever. This condition of affairs, needless to say, is never obtained in practice.

Too Little Damping

The third condition is that of under-damping. In this case the growth of the current exceeds the bounds of the applied voltage, and so likewise does the decay. If we have a voltage which is dying away at a certain given rate, and if we apply this to a circuit in which the natural decay of the current takes place at a slower rate, then the current in the circuit will obviously die away at its own natural rate, and will not follow the variation of the voltage. The same applies to the growth of the current when the voltage increases.

Thus with a continually varying voltage there will be a considerable time lag between the current and the voltage, and it will also be obvious that there will be considerable distortion. The state of affairs will be somewhat as indicated in Fig. 4, which illustrates both these effects.

Practical Needs

This is what happens in a circuit in which the decrement or rate of growth and decay of the current is too small. Such a condition of affairs is obtained by having too low a resistance or by adjusting the reaction too near the oscillation point, which produces the same effect. It will be obvious that since correct damping is impracticable (owing to the fact that the carrier wave is modulated at rapidly varying frequencies, so that the exactly correct decrement required varies with every fraction of a second), the only alternative left is that of over-damping.

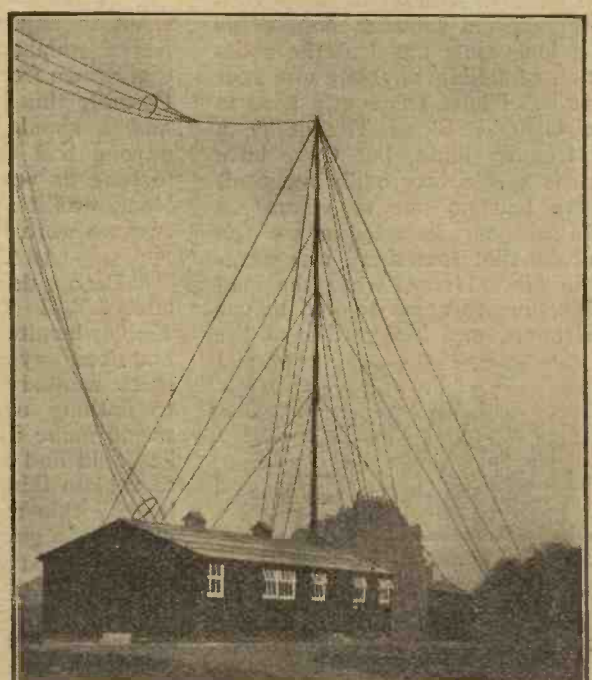
High Decrement for Good Reproduction

We saw that in this case there was no time lag and very little distortion, this distortion becoming less and less as the actual decrement approached its critical value. On the other hand, no satisfactory reproduction can possibly be obtained if under-damping is present, so that particular care must be taken in designing tuning circuits to ensure that the circuit has a sufficiently high decrement.

Requirements for Telephony

Let us now consider a few facts and figures. I discussed this question of the effect of damping in a slightly different form some weeks ago (*Wireless Weekly*, Vol. 7, No. 5). There, by viewing the question of radio telephony from a slightly different point of view, I showed that it was necessary for the resonance curve of the tuning circuits employed to have a flat top, in order that not only the carrier wave but also the various side bands might be suitably amplified.

In that article it was also shown that there was a certain definite minimum resistance required in any given tuning circuit, in order that the reproduction should be satisfactory. It will thus be seen that this result is exactly the same as the one we have just deduced, namely, that there must be a certain definite amount of damping (produced by resistance), in order that there shall be no distortion. The two methods of viewing the problem thus produce the same practical results.

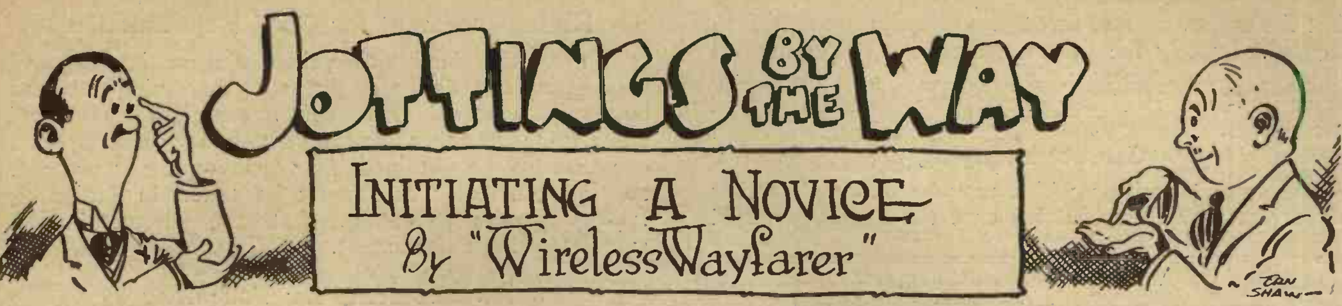


The aerial of the Irish Free State's first broadcasting station, 2RN.

Selectivity and Distortion

In that particular article referred to, I mentioned some calculations made by Professor G. W. O. Howe, who had worked out the necessary resistance in circuit

(*Continued on page* 364.)



WE are all very happy just now at the Little Puddleton Wireless Club, and the source of our joy is that we have a new member. What gladdens our hearts is not so much the fact that he has joined the club, though this is very gratifying, as that he is a complete, utter, absolute and entire beginner at wireless. As you have doubtless observed, no wireless man is ever really happy unless he is explaining things to somebody who knows rather less about it than he does and who admits the fact. The rest of the club know much less than I do about the great science, though each of them is conceited enough to imagine that his own knowledge of the subject is superior to that possessed by all the rest.

As we have all more or less grown up together in wireless, none of us for a long time has had the satisfaction of telling anybody else how to do it. I have frequently tried to give General Blood Thunderby a few friendly hints, but these have been as a rule very badly received. As we had no one to whom we could air our knowledge we felt naturally that something was wanting in life. Hence, when the man Tibblesthwaite came to live in our little town, and his garden at the

. . . "Excuse me, but you dropped this . . ."

end of a fortnight had failed to sprout an aerial, we all hoped for the best. I was one of the first to meet him. It is sometimes a little difficult to find a way of scraping an acquaintance with a man; you cannot just walk up to him, slap him on the back and say "You're Tibblesthwaite, aren't you? I'm Wayfarer." The English are proverbially a rude, blunt nation, but even in this rugged isle of ours there are certain things that are not done. My own effort was, I think, rather neat.

How to Do It

Observing him one day alighting from the Bilgewater Magna 'bus in the High Street, I saw that as he descended he let fall a small object. I hastily retrieved this, and running after him said, "Excuse me, but you dropped this as you got out of the 'bus." Until I opened my hand to give it to him I had not noticed what the small object was, but then I saw that it was a 'bus ticket from Bilgewater Magna to Little Puddleton, for which in all likelihood he had no further use. Some men would have got all hot and flustered in such circumstances, but I did not. "You may have read," I remarked, "that the *Gazette* is offering a prize this week to anyone whose 'bus ticket has a number corresponding with that drawn from a hat by the Editor. Possibly this is the winning ticket, and I should hate to think that anyone had thrown away a small fortune as you might have done." Neat, was it not? In a moment or two we were like brothers.

An Utter Novice

"Been doing much wireless lately?" I asked a little later. Tibblesthwaite replied that he never had done any wireless, that he very much wanted to, that he knew next to nothing about it, and that he would make a start at once if only he could find someone kind enough to explain things to him. My heart leapt within my bosom. It seemed almost too good to be true. "If," I said, "you will accept so humble a person as myself as your instructor, I shall be only too delighted to initiate you into the elements." Tibblesthwaite overflowed with gratitude. I then thought it best to consolidate my position. Little Puddleton, I told him, was a town of wireless enthusiasts; the fame of its club was world wide. Unfortunately, the club contained a great many members who knew little about the subject and were far too fond of giving utterly erroneous explanations to novices. I warned him explicitly against mentioning the fact that he was a novice to any such people as General Blood Thunderby, Admiral Whiskerton Cuttle, Poddleby, Bumpleby Brown, Snaggsby, Gubbsworthy, Dippleswade, Professor Goop, Winklesworth, Breadsnapp and others. He thanked me warmly for my timely warning and promised to have nothing whatever to do with them.

A Demonstration

The next morning I suggested that he should come for a stroll

. . . flung violently upon my back . . .

before luncheon, so that I might begin his education. Desiring to start with a practical illustration, I led him towards the little pond upon which Mr. Bugsnipp's ducks are in the habit of disporting themselves. "Let me show you first of all," I said, "how a wave is propagated." So saying, I picked up half a brick which happened to be handy and hurled it with unerring aim into the midst of the placid though muddy surface of the pond. What I thought first of all was an earthquake followed. I was flung violently upon my back, and there was a terrific splash in the pond, followed by a water-spout, most of which descended upon my prostrate form. I then gathered that Ponto, Tibblesthwaite's water spaniel, who was standing behind me at the moment of hurling, had dashed in in a misguided effort to retrieve the half-brick. Realising that he had been sold, the engaging dog was out of the water almost as soon as he was in it, and had shaken himself all over me before I could say "knife" or any of the other things that I felt much more like saying. It was at this moment that Mr. Bugsnipp arrived carrying a dead duck, which he swore roundly had

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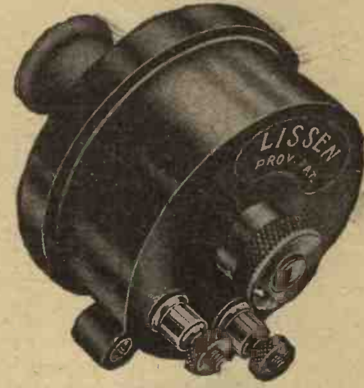

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been done in by my half-brick, and demanding a considerable indemnity in satisfaction for the outrage. The way of the teacher is sometimes a hard one.

Explanations

Tibblesthwaite was a little puzzled over my first practical illustration, but I told him that it was not half a bad representation of what happened in the ether when 2LO's waves were striving to elbow their way through Northolt's mush, whilst being heterodyned by a French station and jammed by a strong spark signal. I said that he would understand all about this kind of thing a little later, but in the meantime he would realise that wireless was not all plain sailing. Tibblesthwaite agreed. He also said that he would wear his oldest clothes during future lessons and that he would leave Ponto at home. He added that learning wireless looked like being rather an expensive process; this, no doubt, referred to the five bob that I had borrowed from him in order to square Mr. Bugsnipp. Tibblesthwaite made rapid progress, and had he remained entirely in my hands I have no hesitation in saying that he would soon have become a really first-rate wireless man.

Evil Influences

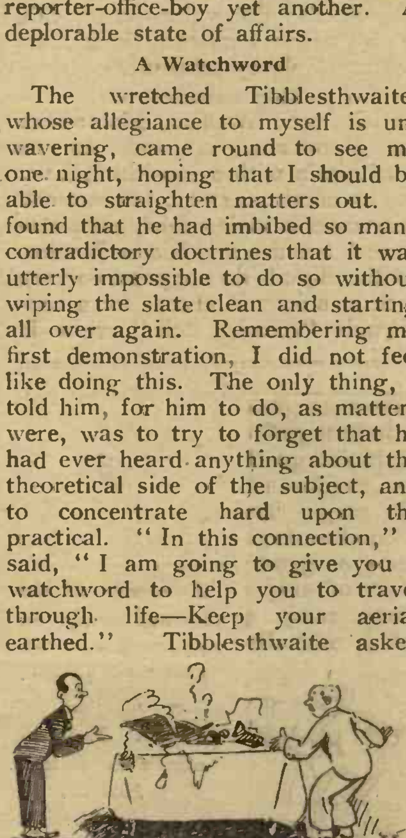
Unfortunately, in a rash moment I consented to propose him for the Little Puddleton Wireless Club. And then the fat was in the fire. He promised me that he would not listen to what other members had to tell him. The poor man simply could not help himself. They fairly fell upon Tibblesthwaite and ate him up. A great deal of my good work was undone almost immediately. Tibblesthwaite was the recipient of such an amount of conflicting advice that he simply did not know where he was. The General urged him to make low-loss coils; Poddleby told him that the word "low-loss" was one of the most overworked in wireless. Snaggsby proved to him that the only possible rectifier, even in a big set, was a crystal, whilst Admiral Whiskerton Cuttle showed that grid-condenser and leak rectification was the one and only method, and Gubbsworthy proved conclusively that if you want pure reception you must put both the crystal and the grid-condenser and leak altogether out of your thoughts, and must use nothing but the valve working upon the lower bend of its characteristic curve. Winklesworth impressed upon him that transformers were the only decent coupling for low-frequency valves, whilst Bumpleby Brown showed that resistance-capacity coupling was the thing, and Breadsnapp demonstrated convincingly that no other method could hold a candle to choke-capacity coupling. Professor Goop

. . . fairly fell upon him . . .

taught him one thing, the Editor of the *Gazette* another, the sub-editor-reporter-office-boy yet another. A deplorable state of affairs.

A Watchword

The wretched Tibblesthwaite, whose allegiance to myself is unwavering, came round to see me one night, hoping that I should be able to straighten matters out. I found that he had imbibed so many contradictory doctrines that it was utterly impossible to do so without wiping the slate clean and starting all over again. Remembering my first demonstration, I did not feel like doing this. The only thing, I told him, for him to do, as matters were, was to try to forget that he had ever heard anything about the theoretical side of the subject, and to concentrate hard upon the practical. "In this connection," I said, "I am going to give you a watchword to help you to travel through life—Keep your aerial earthed." Tibblesthwaite asked



. . . no doubt about the damage . . .

why. I told him at some length. We had a little bother about it all at first, in spite of the beautiful diagrams that I drew for him to demonstrate what happened when a thunderstorm was immediately overhead. Eventually I got into his head the idea that earth was to be regarded as at zero potential, and then I told him quite a lot about positive and negative, explaining in the best manner that these were purely relative terms. Tibblesthwaite has all the makings of a first-rate learner. He simply drank in my words of wisdom.

Earthed!

Readers of *Wireless Weekly* dwell in all parts of the world, but the majority of them will understand something about the vagaries of the British climate. They will not therefore be surprised to hear that even though the month was December, a thunderstorm of no mean proportions actually occurred at Little Puddleton upon the next day. Hardly had it passed away to give way to spells of burning sunshine, bitter cold, fog, frost, rain, hail, snow and sleet, when there was a violent ring at my front-door bell. Thinking possibly that the butcher had called with the idea of talking about the weather and then bringing the conversation round to his little account, I hastily retired to the garden. There my handmaiden found me and told me that Mr. Tibblesthwaite had come round to see me very urgently. Much relieved, I returned to the warmth of my study, where I found Tibblesthwaite in a terrible state of agitation. "My set," he exclaimed, "has been struck by lightning." "Aha!" I said, "you forgot to earth your aerial, and now you have a practical demonstration of what happens when you fail to follow the good advice of your more experienced friend." Tibblesthwaite assured me that he had earthed the aerial. He begged me to repair forthwith to his house to inspect the damage for myself. I went.

There was no doubt about the damage. The high-tension battery had simply burst. There were bits of wax everywhere, and there would have been, I think, a smell of salammoniac if it had not been drowned by that of H_2SO_4, for the accumulator had also come unstuck. Its plates were bent into all sorts of funny shapes, whilst the case reminded me somehow of a tall hat that has been sat upon. "Are you quite sure," I cried, "that you *did* earth the aerial?" "Absolutely," replied Tibblesthwaite. "Remembering what you told me I earthed everything when the thunderstorm approached. I connected the aerial direct to the earth lead, H.T.+ direct to H.T.−, and L.T.+ right through to L.T.−. I am quite sure that everything was at earth potential."

That just shows you, I think, what happens when idiots like some that I could name butt in and give gratuitous advice to a novice who is already in perfectly capable hands.

WIRELESS WAYFARER.

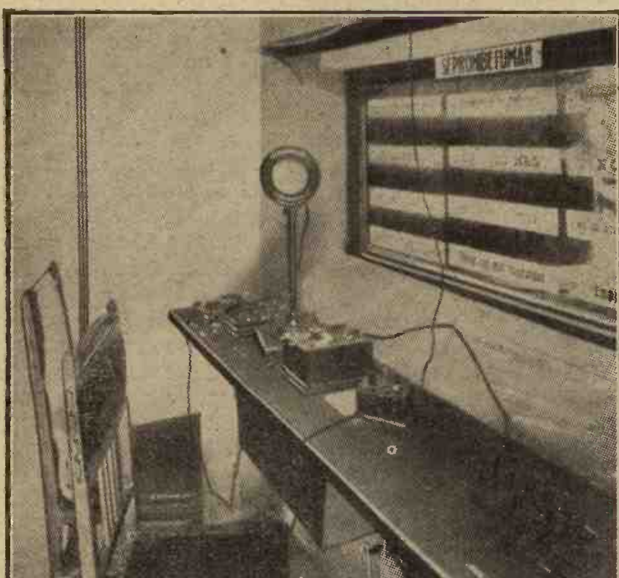
SHORT-WAVE
Notes & News

The North

THE "big noises" of Newcastle have been much more active during the past few weeks, probably on account of the great achievements of 2LZ, 2NM, and other "southerners." 2CC, 5KO, 5MO, and 6FG are among the chief stations in the North, and, of these, 2CC and 5MO both do fairly regular "round the world" work, using the "Hertz" aerial system. 2CC has worked Tasmanian 7JB, being the first British station to do so. 5MO has logged PNP (Pekin), PI-1HR (mentioned in these notes last week), and Australia, all at 2.30 p.m. 5KO suffers from lack of space and cannot erect a Hertz aerial, but still he does excellent work, although he is not using exceptionally large power. 6FG is the operator who can light a neon tube from the stair-rods in his house! 6YV (late 2BDY), of Whitley Bay, is doing excellent "local" (European) work with about 5 watts on 6,667 kc. (45 metres). He has worked Finland and Italy, and is quite strong in London during the hours of daylight. 6OH, of Lichfield, is also doing low-power DX (he only uses 1.2 watts at times), and runs a telephony schedule.

Ship Stations

SGC, the Swedish Motor-liner *San Francisco,* is now to be heard again with a musical I.C.W. note on about 7,143 kc. (42 metres). This vessel is plying fairly regularly between Sweden and Rio de Janeiro, and the signals do not seem to vary much in strength, except for a considerable "dead patch" while in the English Channel. Swedish SMZS is carrying out tests with SGC. KFUH, an American private yacht in the Pacific, is doing long-distance work on quite low powers. He has been heard in Great Britain on several occasions, the best time to listen being about 3.30 p.m. Several other American ships, notably NISM, NISP, and NEDJ, are also to be heard.



A corner of the control room in the Spanish broadcasting station situated at Bilbao. The call sign of this station is EAJ 11.

Ireland

G-6MU, of Belfast, Northern Ireland, worked Australia and New Zealand in less than a month after obtaining his licence. He has also been working European DX during the past week or so. 5NJ, the station of Mr. F. R. Neill, of telephony reception fame, is also active. His signals sometimes reach the stage when it is necessary either to cut out a stage of audio-frequency or to remove the 'phones. He is running a small motor-generator, but has not yet succeeded in obtaining a pure note. 11B, of the Irish Free State, was to be heard on 3,333 kc. (90 metres) for a few weeks, but has disappeared again. 7OK, 7HJG, and 7IV were also heard occasionally, but seem to have closed down for the present.

The United States

As the winter progresses the North American stations continue to come in until 10.30 a.m. We have heard U-2ZV at this time.

The following stations may now all be heard after 10.30 p.m. almost any night. They are mostly commercial, and therefore are not likely to change in frequency to any appreciable extent. The readings given were taken between 11 p.m. and midnight on November 23:—.

NKF ...	7,500 kc.	40 metres.
FW	7,246 ,,	41.4 ,,
WGY ..	7,212 ,,	41.6 ,,
WIZ ...	6,897 ,,	43.5 ,,
WQO ..	6,772 ,,	44.3 ,,
5DH ...	6,250 ,,	48 ,,
	6,000 ,,	50 ,,

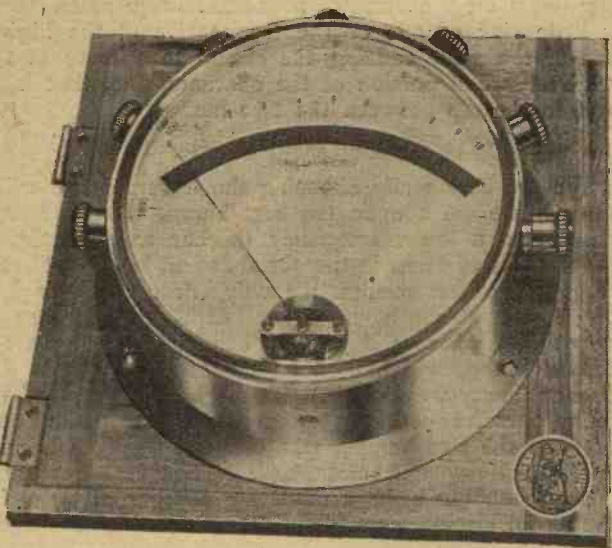
A good enough calibration curve can usually be obtained from the other stations to enable one to determine whether 5DH is working on 6,250 or 6,000 kc. There are, unfortunately, not very many reliable stations above 7,500 kc. (below 40 metres), and this is where a receiver needs calibrating most carefully. A good absorption wavemeter is probably the simplest solution.

Selectivity and the Tight-Coupled Aerial

Continued.

By G. P. KENDALL, B.Sc.

Continuing his investigations of the "Aperiodic" aerial circuit, Mr. Kendall here discusses further the problems introduced in his article in last week's issue, and also deals with the inclusion of a series condenser in "tight-coupled" aerial circuits.



The multi-range meter shown here was used by the author in his experiments. It is to be recommended that a large instrument be used for accurate work of this kind, owing to the advantage gained from the provision of an open scale. (The halfpenny gives an indication of the size of this instrument.)

THE curve reproduced last week showing the relation between the signal strength across the secondary and the number of turns upon the primary winding in what is called the "aperiodic aerial" arrangement, will, I think, have shown the reader that there is considerable justification for assuming that this arrangement is simply the ordinary tuned primary and secondary, with so tight a degree of coupling that the primary becomes very flatly tuned.

Problems to be Investigated

The resonance curve for the primary winding hence becomes a double-humped one, the hump corresponding to the smaller number of turns being commonly employed in actual practice. If it is concluded that the tight-coupled aerial circuit actually functions in this way, a number of interesting problems immediately arise regarding its functioning and its arrangement to obtain the best results, such as the actual degree of coupling necessary between primary and secondary, the relative effects of electro-static and electro-magnetic coupling, the actual width of the frequency band which can be covered with reasonably uniform efficiency with a primary of fixed size, and so on.

Working Points on Curves

One of the first points calling for attention is one concerning the relative properties of the two humps which constitute the resonance curve of the primary winding, since it is obviously of interest to decide whether one or other of these humps is to be preferred for practical purposes. To investigate this point I have carried out some experiments on one of the coupling units illustrated last week, using for the purpose a primary winding arranged upon a small ebonite cross former inside the filament end of the secondary.

Aerial Turns and Signal Strength

The primary winding was, of course, tapped in order that the aerial turns might be varied, and the first experiment was to determine the usual relation between the aerial turns and secondary signal strength, the graph obtained being shown in Fig. 1. The useful part of this curve upon a given frequency is, of course, that which lies between A and B, and the curve was only carried as far as would enable one to determine where a similar position would fall upon the second hump, the points X and Y being adopted for comparison, these two being roughly equivalent to each other in position upon the resonance curve.

Slight Difference

It will be observed that the signal strength obtained upon the second hump is not quite so great as that upon the first, this being probably the result of the higher resistance of the aerial coil when the larger number of turns is in use. The difference is extremely slight, however, and it is probably scarcely worth taking into account under practical conditions. It would certainly not be observed by any aural method.

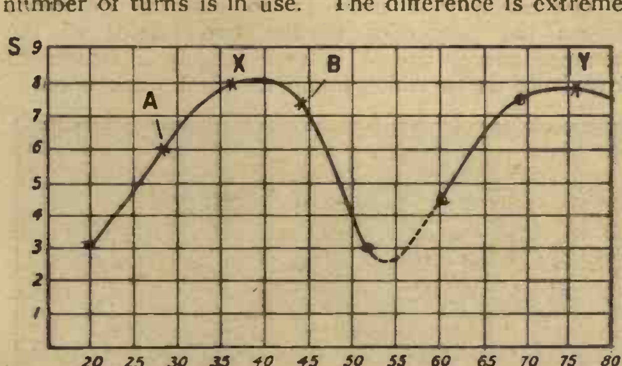


Fig. 1.—A graph showing the relation between turns on the primary (plotted horizontally) and the resulting signal strength in the secondary circuit (vertical scale), when a small internal primary was used (see photograph on page 362).

Selectivity

The most interesting property of the tight-coupled aerial circuit is, of course, its selectivity, and the next step was to plot resonance curves at the two points on the hump in which we are interested, namely, at points X and Y. A very simple method was adopted which will serve for comparative purposes, but whose limitations must be remembered. The value of signal strength was noted at the condenser reading which corresponds to resonance in the secondary circuit, and then this circuit was de-tuned, a degree at a time, the signal strength reading at each point being noted and recorded.

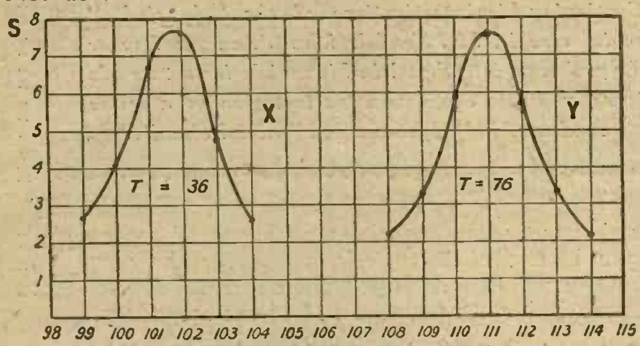
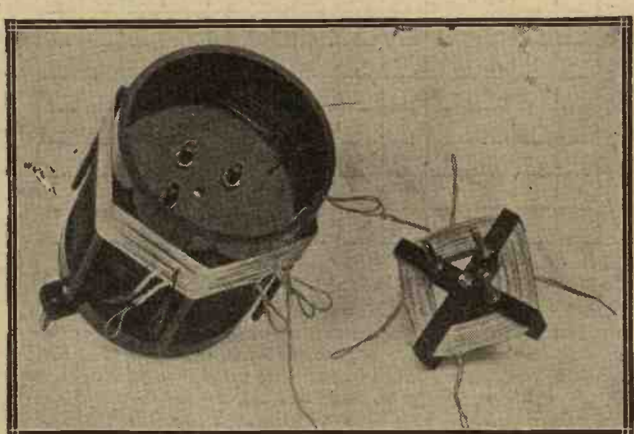


Fig. 2.—Resonance curves obtained in the secondary circuit when the primary turns were 36 and 76 (X and Y respectively), corresponding to the points X and Y of Fig. 1.

Similarity of Curves

If we next proceed to plot these signal strength readings against the dial readings we obtain a form of resonance curve whose degree of sharpness is extremely useful for comparative purposes. This method is, of course, only applicable when the resonance points of the different arrangements fall very close together upon the condenser dial, but in the present case this was easily arranged. The two curves are shown in Fig. 2, being marked X and Y to correspond with the points upon the main characteristic to which they are appropriate. It will be observed that the general form, sharpness of peak, and height of these curves are practically identical, and one is led to the conclusion that there is no material difference between the properties of the two humps of the resonance curve, and it is very largely a matter of convenience as to which hump we shall work upon.



The experiments described this week were all carried out with a primary wound on one of the small cross-formers illustrated, which was placed inside the filament end of the secondary.

Points of Difference

It might at first sight be thought that it is a matter of indifference as to which hump shall be used, but upon consideration it will be seen that there are considerable advantages in the first hump, that is to say, the one appropriate to the smaller number of turns in the aerial circuit. In the first place, this hump is slightly higher than the other, although this difference is not a very serious one.

Next, if the portion A—B is chosen to fall not too low down on the band of broadcast frequencies, there is little risk of one of the frequencies at the higher end of the scale causing the circuit to operate at the relatively dead portion of the characteristic, that is to say, in the dip between the two humps.

Practical Effects

We are here really choosing the lesser of two evils, since if we work upon the first hump, when we tune the set to a lower frequency (higher wavelength), if the number of turns in the aerial circuit is not sufficient to give the best results, the only effect will be a loss of signal strength, together with an increase in selectivity, whereas if we had been working upon the second hump, and had tuned the set to a higher frequency (lower wavelength), we might quite easily have found ourselves working somewhere down in the notch between the two humps, where signal strength is poor and selectivity extremely bad. Thus it is probably wiser to choose quite a moderate number of turns for the aerial circuit, say 15 on a former which is of the same diameter as the secondary, proportionately larger numbers being chosen when the primary winding is arranged upon a smaller diameter former inside the secondary.

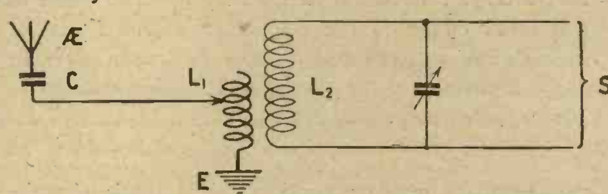


Fig. 3.—The insertion of a small condenser in the aerial circuit is a common practice in America, and produces a number of interesting effects.

Working Point Chosen

A decision being, then, in favour of the first hump in the majority of cases, it will be observed that many of the experiments which follow are confined entirely to this first hump, that is to say, to the portion which has been marked A—B upon the various curves which have been reproduced.

Aerial Series Condenser

It has been the practice in some quarters in America to provide an alternative arrangement of a fixed capacity series condenser in the aerial circuit, this condenser being brought into action when extreme selectivity was desired, and it seems that some interest should attach to an investigation of the effect of this arrangement. Capacities of various values were therefore inserted in series with the aerial lead, as shown in Fig. 3, and the usual curve plotted showing the relation between signal strength across the secondary and aerial turns.

More Inductance Required

One of these is shown in Fig. 4, in which *a* is the curve obtained without a series condenser, while *b* shows the first hump of the curve when the series condenser is in use. It will be observed that the whole characteristic is shifted bodily to the right, so that considerably larger turn numbers are required upon the aerial coil, which is, of course, much what would be expected if it is remembered that we are actually tuning the aerial circuit, and that now a series condenser has been inserted. Further, it will be seen that the actual hump appears to be broader.

Effect of Series Condenser

Whether this broadening is real or apparent is not very easy to say at the present moment, but on the face of it, it would appear that it means that when a series condenser is used the arrangement becomes less critical as to the number of turns upon the primary winding, and that a given number of turns would enable a wider band of frequencies to be covered with substantially uniform efficiency.

Difficulties of Investigation

I hope to carry out further experiments to elucidate this point, since it would appear that the use of a fixed condenser in this way is well worthy of consideration. The difficulty in determining whether the broadening of the hump actually represents a greater capacity to cover a band of frequencies arises from the fact that it is apparently necessary to carry out the experiment upon different lines, that is to say, one must vary the frequency of the testing signal rather than the number

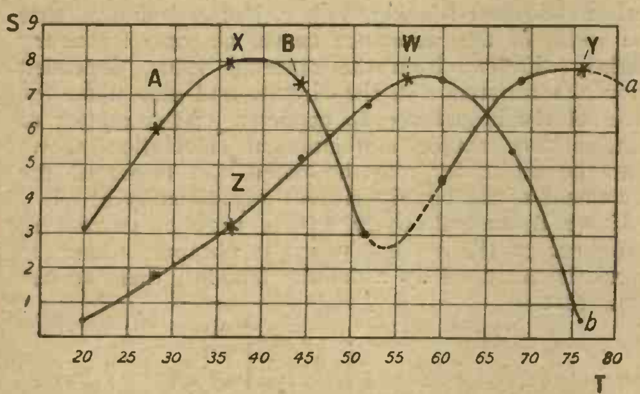


Fig. 4.—Curve a is a repetition for purposes of comparison of that of Fig. 1, while curve b shows the effect of a series condenser of .0003 μF capacity in the primary circuit.

of turns, and to do this one must obtain a source of signals which gives a constant output at all frequencies of the band under consideration, and this is no very easy condition to fulfil.

Particular Advantages of Series Condenser

The fact that the whole curve is shifted bodily to the right when a series condenser is used in the aerial lead means that when such a condenser is in circuit without a corresponding alteration of turn numbers, one simply drops from the curve *a* to the curve *b* of Fig. 4. Thus, if we are working with, say, 36 turns in the aerial circuit without a series condenser, upon the insertion of the series condenser we drop down to the point Z upon the curve B, where it will be seen that we are still a long way from the peak of the first hump, and where we shall therefore obtain a considerable reduction in signal strength but a very marked increase in selectivity. Such a device appears to possess considerable attractions, and it is to be recommended whenever one wishes to receive a station upon a frequency very close to that of the local, with some sacrifice in signal strength, and without the trouble of making a tapping on the aerial winding.

Effect on Selectivity

The normal effect of the insertion of a fixed condenser in the aerial lead is, of course, to throw the operating point back down the slope of the hump, so that we naturally arrive at a position when selectivity is very much higher than at the top of the peak. If, however, the number of turns in the aerial circuit is increased to bring us back to the top of the hump, it is interesting to see whether the selectivity of the arrangement will have been altered by the insertion of the series condenser. On the face of it, it would be expected that, since a very much larger coil is required with a naturally greater high-frequency resistance, there would be, if anything, a loss of selectivity.

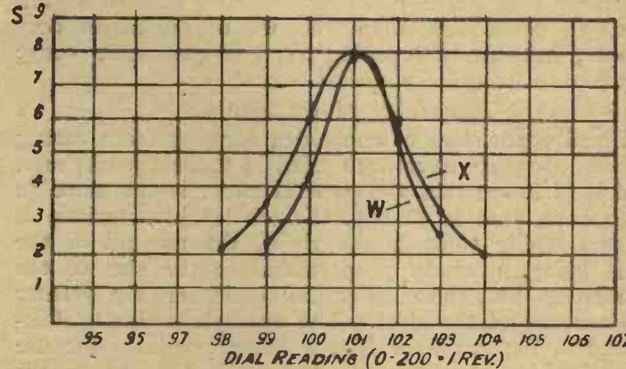
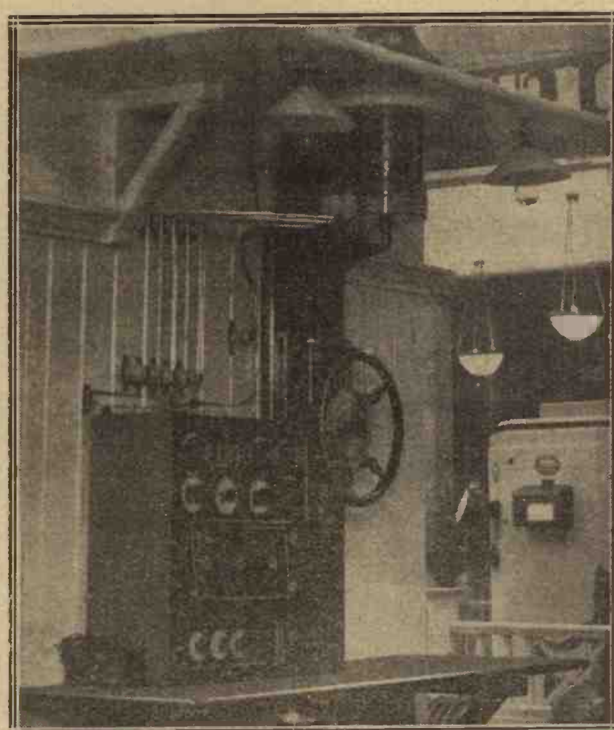


Fig. 5.—If a series condenser is used and the number of primary turns increased correspondingly there appears to be a definite increase in selectivity. Curve X is a resonance curve taken under the conditions indicated by the point X in Fig. 4 (no series condenser) while curve W corresponds to point W of Fig. 4.



The Siemens marine direction finder, exhibited at the Shipping and Engineering Exhibition at Olympia.

Resonance Curves

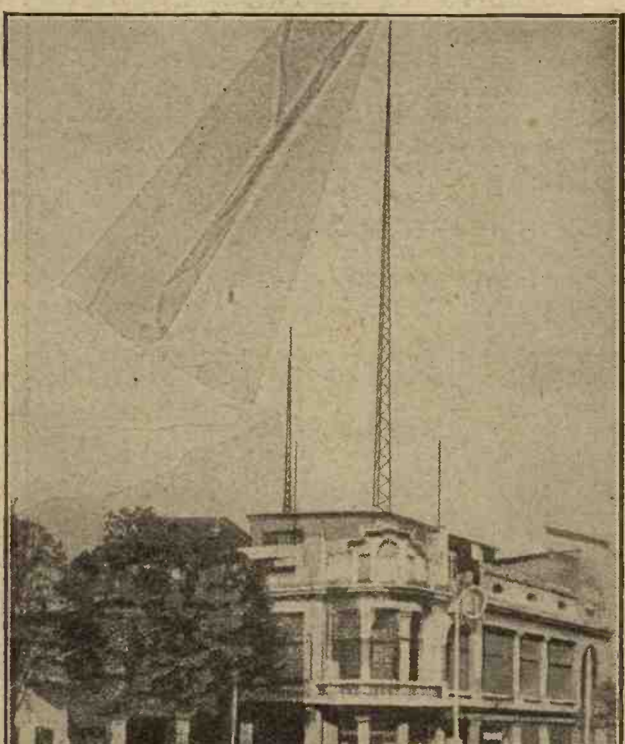
Resonance curves, of the same type as before, were therefore plotted, for corresponding points upon the two arrangements, these points being marked X and W upon the curve of Fig. 4. The two resonance curves are shown in Fig. 5, and it will be observed that the one appropriate to the series condenser and larger number of turns upon the primary winding (curve W) is very markedly sharper than the other which was obtained when no series condenser was used. It is apparent that there is a very minute loss of signal strength consequent upon the use of the series condenser, but the sharpening of the resonance curve appears to be quite a useful effect.

Capacity of Condenser

Fixed condensers of capacities ranging from .00005 μF to .0005 μF have been tried in these experiments, and it is found that the general effect is the same in each case, that is to say, the whole characteristic is shifted bodily towards the right, the amount of the shift being inversely proportional to the size of the condenser, i.e., the smaller the condenser, the greater the amount of the shift. The example which is illustrated in the graph of Fig. 4 corresponds to the use of a series condenser of .0003 μF, this being the maximum capacity of the second variable condenser upon the unit which I employ for most of these tests.

Further Investigations

It was observed in these experiments that with the smaller sizes of series condenser loss of signal strength became somewhat excessive, and probably from .0002 μF to .0003 μF is a suitable size to use in most cases. I hope to investigate these points more closely at a future date, when I have arranged some source of artificial signals giving a constant output over the different frequencies, instead of depending, as at present, upon the carrier wave of the local station with its fixed frequency.



The tall masts which support the aerial of the broadcasting station EAJ11, Bilbao. It is stated that a frequency of 718 kc. (418 metres) is employed.

THE SIGNIFICANCE OF DECREMENT IN TUNING CIRCUITS

Continued from page 357)

at a frequency of 800 kilocycles, using an inductance of 80 microhenries, and a tuning capacity of 500 μμF.

It was further shown that with the value of resistance required to give distortionless reproduction with a single circuit, the selectivity was almost hopeless, and that the only solution to the difficulty lay in the use of at least three tuned circuits, if really good selectivity was to be obtained without the sacrifice of quality.

Now this question of selectivity is one which is of prime importance, and, as we have just seen, it has to be considered in conjunction with that of the quality of reproduction. Since the latter factor depends upon the decrement of the tuning circuit, it would thus be convenient if we could gauge the selectivity in terms of the same quantity.

Selectivity in Terms of Decrement

This, fortunately, is quite possible. In a previous article (*Wireless Weekly*, Vol. 7, No. 4) I showed that the width of the resonance curve, at some frequency slightly different from the resonant value, depended upon the resistance in the circuit, and also upon the ratio of the inductance to capacity. As a matter of fact, a very simple mathematical calculation shows that the selectivity may be defined in terms of the decrement of the circuit without any difficulty at all.

If we define selectivity as the ratio of current at resonance to the current which is obtained when the circuit is mistuned by a definite amount, then we can show that

$$S = \frac{\pi\left[\beta - \frac{1}{\beta}\right]}{\delta}$$

where S=ratio of current at resonant frequency f_o to current at frequency βf_o.
δ=decrement.

Conditions for Good Selectivity

The selectivity is considered good if the ratio S equals 10,000 or more, when β is equal to 1.1. This means to say that at a frequency 10 per cent. different from the resonant value the current is reduced to 1/10,000th of the maximum value.

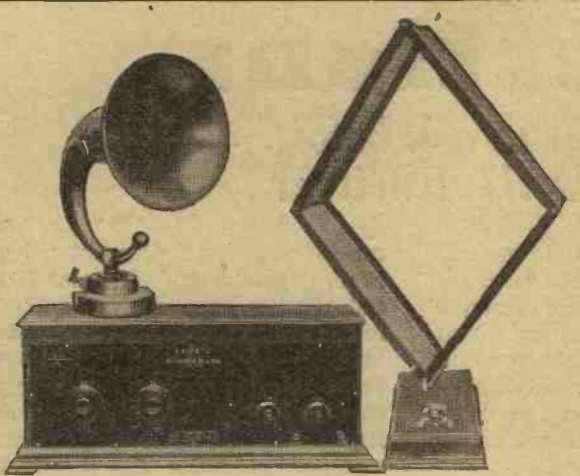
Thus we see that the decrement is a very important quantity. Suitably employed, it enables us to gauge both the selectivity of the circuit and its suitability for reproducing telephony. I propose next week to follow this up with some practical applications of these results, giving values of the decrement for some of our present-day tuning coils.

Inductance Value

There is also the question of the appropriate value of inductance employed. The calculations worked out by Professor Howe were all for a value of 80 μH. In our ordinary circuit of to-day, of course, we use inductances rather higher than this, the value being more in the neighbourhood of 150 μH.

Our results, therefore, require to be interpreted in a more practical light, and this will be done in subsequent articles.

BRITISH MADE, Using Only BRITISH MATERIALS



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SUPERSONIC
HETERODYNE RECEIVER
(*British Patent No.* 143583).

NOTE.—TWO CONTROLS ONLY.

RECEIVES any BRITISH, CONTINENTAL and Principal AMERICAN STATIONS at will, not by accident.

250 to 3,000 metres.

With each set is supplied a chart showing complete settings of all controls for any wavelengths, and all receivers are calibrated to receive such stations by these settings, on a frame aerial using British Standard Dull Emitter Valves, at loud-speaker strength, and guaranteed to cut out any unwanted station *entirely*.

5 VALVE SET Price £27 Plus Royalties.

DEMONSTRATIONS WILLINGLY GIVEN AT ANY TIME

8 VALVE SET Price £32 Plus Royalties.

LIBERTY
SUPERSONIC UNITS
(Provisionally patented).

Comprising four intermediate matched transformers, filter, long and short wave oscillators and balancing device, enabling all stations from 250/3000 metres to be received.

Each transformer matched to half a turn, also secondary windings of the filter.

Full description and illustrated leaflet on request.

Ensures ultra selectivity.
Delivers maximum signal strength to detector valve.
Air cored transformers and filter, no iron being used, thus the sharpest uniform peak at supersonic frequency is obtained.

¶ NOTE.—Knobs controlling mechanical balancing device which enables the constructor to select his supersonic frequency peak and to match each individual stage to a frequency not merely a number of inductive turns. Any variations of valve capacities can be accurately rectified.

PRICE: 4 matched intermediate transformers, 1 filter, 1 long wave oscillator, 750/3000 metres, 1 short wave oscillator, 250/800 meters, including mechanical balancing devices. Also blue print, and wiring diagram showing all other accessories required and their positions. £5 Set Complete.

Sole Manufacturers:—
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A genuine LONG SERVICE BATTERY

THE "PYANEER" H.T. BATTERY is not only popular by reason of its long and economical service, but because in actual use, working is positively silent. The latter feature is absolutely necessary in operating any valve sets from which clear and good results are desired.

Ask your local Wireless man for "Pyaneer." He stocks them, or if he doesn't he will get them for you upon your mentioning our name.

List No.:
RB 12/14 60 volts, each 9/-
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"TUNE-IN" to DAVENTRY and get maximum signal strength

The Igranic B.L. type Variometer will ensure it in any crystal set. Its "wound-on-air" construction eliminates signal-reducing insulation and gives you remarkably selective tuning combined with maximum signal strength. If you are building a set or want to improve your present one, ask your dealer for the Igranic B.L. type Variometer. Its wavelength range is 700 to 2,400 metres and its price is 18/-. For wavelengths of 280 to 650 metres use the B. type which is built on the same principle and costs 12/6.

Write for the new booklet Y 75 which describes IGRANIC RADIO DEVICES. They include:—Honeycomb Duolateral Coils, Variable Condensers, Fixed Condensers, Filament Rheostats, Intervalve Transformers, Variable Grid Leaks, Variometers, Vario-couplers, Coil Holders, Potentiometers, Combined Instruments, Vernier Tuning Devices, Switches, Valve Holders, etc., and also the Igranic Super-Heterodyne Outfit. *All carry the IGRANIC Guarantee.*

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Five Questions

every valve user ought to ask before buying his next Dull Emitter

Is it truly economical?

MERELY because a valve is described as a dull emitter does not necessarily mean that it is cheap to run. Its current consumption may increase as the Valve becomes older. Or, as is often the case, its emission may fall off and the valve will get less sensitive. The fundamental principle underlying every dull emitter calls for some method of increasing the electron emission of the filament. The old way was to use thoriated tungsten. The new way, discovered and patented by Cossor, is to deposit on the filament wire a triple coating of a special electron-producing material. This coating—built up layer upon layer upon a metallic base—can never lose its productivity. Thoriated tungsten, on the other hand, can be easily ruined by the use of an excessive voltage, with the result that the valve becomes practically useless.

Has it long life?

YOU don't want to buy a valve which will only last a few months. Long life is just as important as current economy. The length of time a valve will last depends entirely upon its filament—the only consumable part. Some valves obtain low current consumption at the risk of fragility. Not so the Wuncell which has a comparatively stout filament consuming only .3 amp. at 1.8 volts. In the Wuncell long life is coupled with true economy. Its filament temperature never exceeds 800°C.— whereas all bright emitters and some so-called dull emitters function at 2000°C. Heat has a most destructive influence on filaments. The lower the working temperature, the longer the valve will last. A "cold" valve for example would be almost everlasting. You will hardly be able to see the dull red glow of a Wuncell in daylight—even in the dark it can only be compared to the luminous dial of a watch.

Is it efficient for long distance work?

EVEN a long life, economical valve wouldn't be much use if inefficient. So your new dull emitter must be at least as efficient as a bright emitter. Almost every wireless enthusiast wants to pick up long distance Broadcasting. For this reason the special Wuncell W2 (with an identifying red top) has been developed. This valve has exactly the characteristics which will enable it to respond to weak oscillations and amplify them to a strength which will permit effective rectification.

The standard Cossor electron-retaining principles of construction — in which an arched filament is almost entirely enclosed by a hood-shaped Grid and Anode—are responsible for wonderfully high standard of performance. Wuncell users are everywhere testifying to the efficiency of their valves. The old idea that to obtain current economy meant a sacrifice in sensitiveness or volume is being rapidly dispelled by these superb new Cossor Dull Emitters.

Will it give pure tone?

MORE than 80% of the valve sets in operation to-day are used for Loud Speaker work. It is important, therefore, to choose a dull emitter capable of giving a generous volume of really good tone. The new Wuncell W3 has been evolved specially for Loud Speaker use. Although utilising the same unique Cossor principles of construction—the electron-retaining hood-shaped Grid and Anode—its characteristics have been modified in order to permit an immense volume without distortion. Its Grid—always a vital feature in a power valve—is tremendously rigid. Each turn of the wire is securely anchored in two distinct positions—36 in all. The filament is triple mounted for extra strength. As a result microphonic noises have been completely abolished and a grand mellowness of tone is the result.

And finally—who makes it?

NOT the least important of these five questions is the experience of the manufacturer. Valves are not like electric lamps. They are far more intricate. They cannot merely be made to specification. Each step must be watched with eagle eyes. Every process of manufacture must be carefully checked for possible imperfections. The most delicate tests must be used to safeguard the predetermined standards of performance. Cossor Valves have acquired a world-wide reputation. There is hardly an experimenter of note who has not chosen them above all others for their outstanding qualities. Their super-sensitiveness—their freedom from microphonic noises—their sheer dependability under all circumstances—their long life—their high standard of uniformity—all these features have made the name Cossor synonymous with all that is finest in valve design.

Prices:

W1. For Detector and L.F. 14/-
W2. For H.F. use 14/-
Voltage 1·8 Consumption ·3 amp.
W3. For Loud Speaker use 18/6
Voltage 1·8 Consumption ·5 amp.

Cossor

Prices:

WR1. For Detector & L.F. 16/-
WR2. For H.F. use 16/-
For use with 2-, 4- or 6-volt accumulator.

Issued by A. C. COSSOR LTD., Highbury, London, N.5

Gilbert Ad. 4062.

Wireless News in Brief.

Forthcoming B.B.C. Items. The following are some of the items to be broadcast from the London station in the near future :—

December 6.—The Growth of Military Band Music, illustrated by the Band of H.M. Royal Air Force.

December 8.—Musical comedy—Radio Radiance Orchestra and the Wireless Orchestra.

December 10.—Halle Orchestra, conducted by Sir Hamilton Harty, relayed from Free Trade Hall, Manchester.

December 11.—"Lionel and Clarissa," from the Lyric Theatre.

* * *

December 5 and 12 will be "Gather Round Nights," in which men famous in the world of science, music, art, and literature will take part. This feature takes the form of a kind of party, and the programme is quite informal.

* * *

Broadcasting School Songs. Arrangements are being made by the B.B.C. to relay concerts and other functions from a number of English Public schools. The first of these is due to take place on December 21, when a concert will be relayed from Marlborough College, probably S.B. to all stations.

* * *

An Oxford Studio. The recent opening of a broadcasting studio at Oxford marks the first step in the direction of providing broadcasting facilities at our Universities. It would appear that the opening of such studios should provide possibilities for further educational broadcasting.

* * *

Frequency Change. As a result of recent jamming experienced by certain B.B.C. stations, we understand that the following frequency alterations have been advised by the Geneva Conference :—

Leeds : 867 to 933 kc. (346 to 321.5 metres).

Edinburgh : 915 to 924 kc. (328 to 324.5 metres).

Nottingham : 920 to 916 kc. (326 to 327.5 metres).

* * *

Beam Stations. A beam wireless agreement has been signed by representatives of the British Post Office and the South African Wireless Company, as a result of the work of the Imperial Wireless Committee, which has been in session since June. It is understood that a complete understanding has been reached about the handling of traffic and the division of revenues.

* * *

Beam stations for communication with South Africa are fast approaching completion at Bodmin and Bridgwater, while a corresponding station is in course of erection near Cape Town. The stations will be under the independent control of the British and South African Governments, and it is expected that they will commence operation next spring.

An interesting fact is that the rates to be charged are one-third less than ordinary cable rates.

* * *

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

* * *

Direction Finding Vagaries. The Radio Research Board has now published the second part of its report upon an investigation into the variations of apparent bearings of radio transmitting stations under the direction of Dr. R. L. Smith-Rose, of the National Physical Laboratory. The report is obtainable from H.M. Stationery Office.

* * *

A Cheaper Licence? A suggestion that one of the results of the broadcasting inquiry might be a recommendation to reduce the licence fee for a crystal receiver to five shillings instead of the present sum of ten shillings, receives no support in official circles. The attitude of the B.B.C. is that the cost of transmitting is not affected by the receivers employed by the public.

In any case, the Post Office authorities state that there would be great difficulty in making sure that the cheaper licences were being used for crystal sets only.

* * *

The Dublin Station. The first broadcasting station in the Irish Free State, situated on the outskirts of Dublin, commenced transmitting last week with preliminary tests at a frequency of 769 kc. (390 metres), using the call sign 2RN. A feature of the transmissions was an appeal for licence fees between the items, and a reminder that no licences meant no programmes.

The Design of Intermediate Frequen
Rece

By McMURDO SI

Mr. Silver's arguments a
iron-core type of trans
necessarily agree with his
able value to the exp
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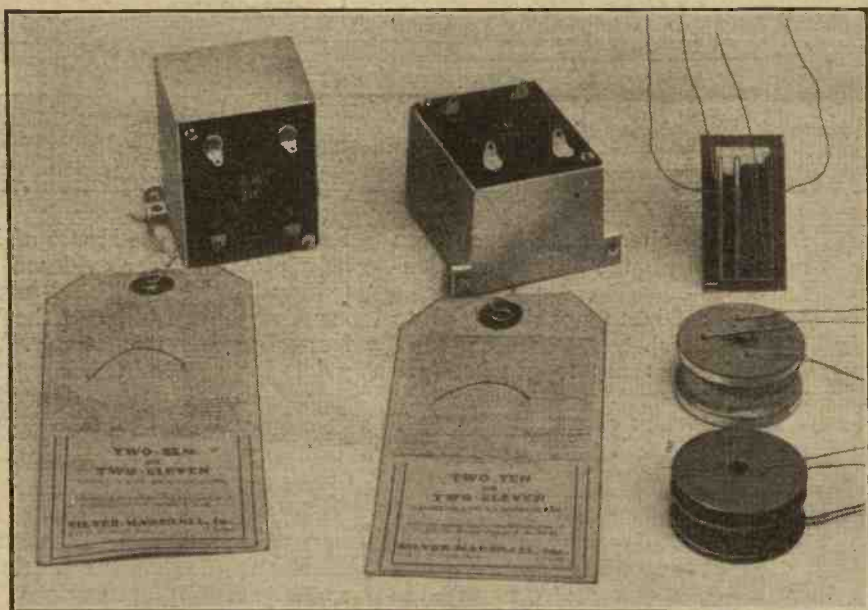


Constructional details of the Silver-Marshall intermediate frequency transformers. This photograph may be studied in conjunction with the diagrams given below.

IT is not the purpose of this paper, nor is it possible in the space available, to enter into a theoretical consideration of the ideal characteristics of intermediate frequency inter-stage transformers suitable for use in superheterodyne receiving systems, but rather to explain the desirable characteristics of such transformers briefly, and to present some designs which have been found to be most satisfactory, yet that are simple enough to be constructed by the experimentally inclined radio enthusiast.

Frequency Changing

As is well known, a signal received upon a superheterodyne system at a high frequency (short wavelength) is converted by means of an oscillator and first detector to some lower frequency (longer wavelength), then fed to a sharply-tuned amplifier, amplified, and again detected, after which the audio frequency signal may be further amplified. The reason for this change in frequency is twofold: direct radio-frequency amplification at high frequencies (short wavelengths) is not at all efficient, whereas it may be made extremely so at lower frequencies (longer waves) between 30 and 150 kilocycles (2,000 and 10,000 metres).

Tuned Stages.

The second reason is that an efficient radio-frequency amplifier operating at broadcasting frequencies must have each stage tuned, which would involve from three to six adjustments for a really sensitive receiver (inter-stage coupling in the amplifier prevents practically building such a really sensitive system) each time it was desired to tune to a different signal. In the super, the amplifier, consisting of several stages, is permanently tuned to one frequency, and the signal frequency changed to that of the amplifier by means of but two adjustments—the oscillator and loop circuit controls, regardless of the amount of amplification obtained.

The Ideal Transformer

Obviously, the ideal interstage transformer must operate at a frequency low enough to get away from the drawbacks of amplification at the higher frequencies, but not so low that the amplifier will approach the audio-frequency range and be non-selective. The transformer must give the greatest possible gain (amplification) so that a minimum number of stages may be used, it must be entirely stable, and it should preferably operate with a negative grid potential so as to be economical of anode current. In its ideal state, the transformer would give uniform amplification over a frequency range of 10,000 cycles (necessary for undistorted speech and music reproduction), yet no amplification of any frequencies outside this range. It must not be so

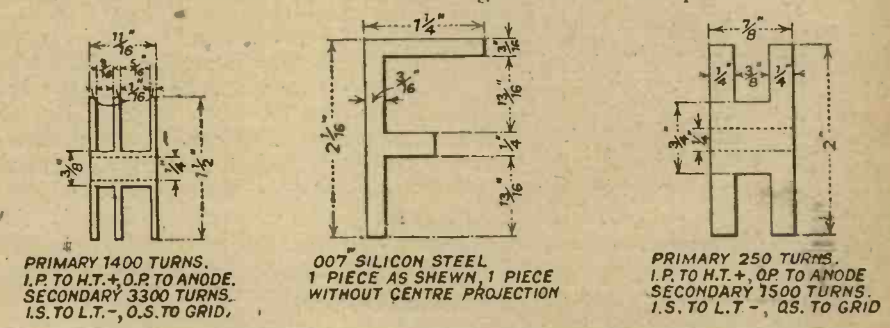


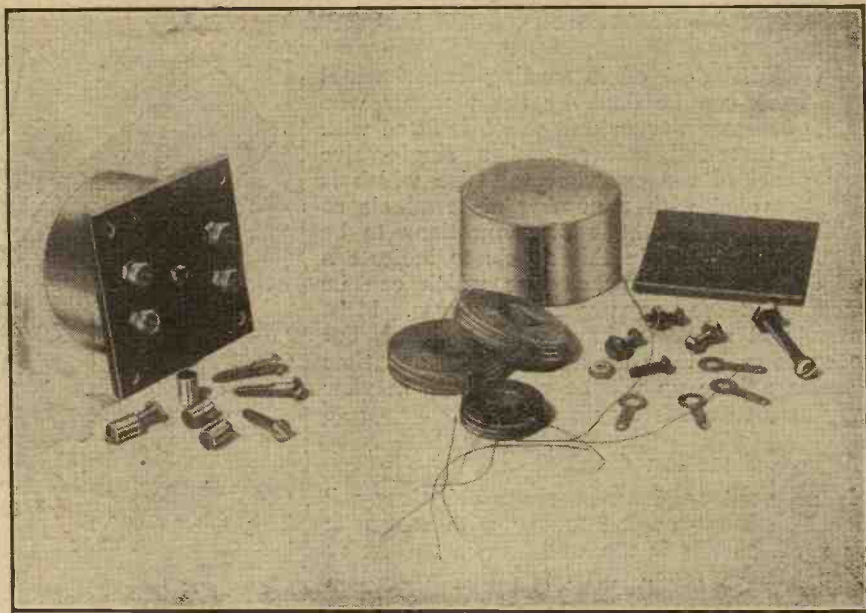
Fig. 1.—Showing the dimensions of (left) the wooden bobbin for the intermediate transformers (centre) the iron stampings for the core, and (right) the wooden spool for the filter.

ıcy Transformers for Superheterodyne
ɜivers

LVER, Assoc. I.R.E.

re distinctly in favour of the former. While we do not views, they are of consider- erimenter, since he gives cal data.

selective as to cut frequencies within this range, and it should be so shielded either by a metal case or an iron core that it will not be affected by strays in the nature of low frequency (long wave) telegraph transmissions, etc. This latter consideration necessitates the use of a frequency not commonly used for telegraph transmission.



An air-core Silver-Marshall input or output filter designed to be used with standard iron-core intermediate transformers. It is tuned by an external fixed condenser of .002 μF for 50 kc. (6,000 metres), .004 μF for 40 kc. (7,500 metres), or .006 μF for 30 kc. (10,000 metres).

Air-Core and Iron-Core Transformers

It is commonly accepted that a frequency in the neighbourhood of 43 to 60 kilocycles (5,000 to 7,000 metres) is most satisfactory, preference being given to 60 kilocycles (5,000 metres), since transformers may be made more selective at this frequency than at the lower ones. Obviously, a transformer wound with large low-loss air-core coils, tuned by a low-loss condenser would give maximum gain. Actually, its tuning would be so sharp as to cut side-bands, and it would have a terrific field, resulting in instability and the impossibility of using more than one or two such coils. The next step is an air-core transformer with smaller coils of higher resistance. However, the same troubles prevail in a lesser degree, until we resort to an iron-core, which limits the transformer field, broadens the curve to the desired width, and reduces amplification. If we go further, and use a large iron core, we get a nice flat curve, wonderful reproduction, no selectivity, and no gain. It is obvious again that we must resort to a compromise, and if this paper has brought out this single point, the writer feels amply repaid, for it may be said that the necessity for compromise between desirable theoretical extremes is an axiom of radio equipment engineers.

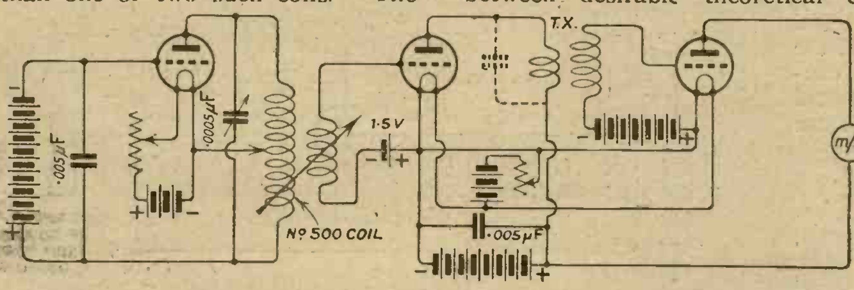


Fig. 2.—In this circuit, used for matching completed transformers, the transformer for test is inserted at TX.

Comparison of Transformers

Looking at the curves of Fig. 3 we see A, B, C and D. A represents the ideal transformer, giving infinite amplification over a 10,000 cycle band, but at no other frequencies. B is an air-core transformer giving the highest possible amplification. It is useless, since it will not pass music and speech, and is subject to the physical limitations previously set forth. C is the practical ideal transformer, passing the desired frequency band with a gain variation insufficient to cause distortion, yet with a limited field and good stability. D is the extreme for perfect reproduction—but gives no selectivity and no amplification to speak of.

Construction

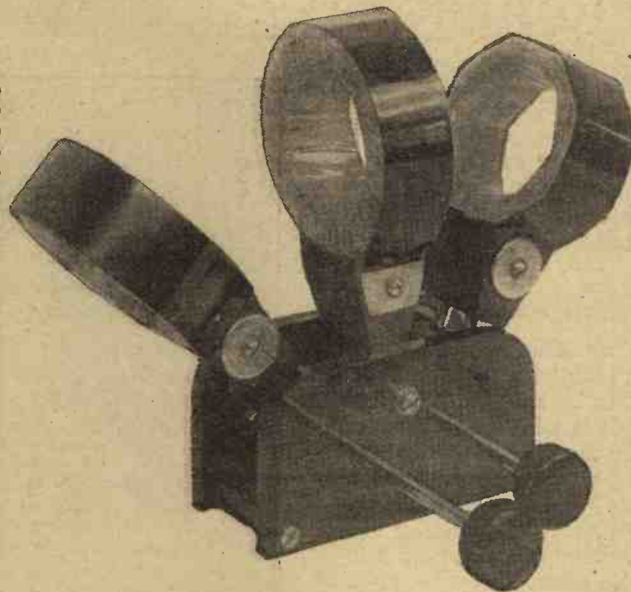
Suppose we wish to construct the type giving the curve C, which is the best transformer we can build practically. We shall require a bobbin turned out of wood or built up of fibre, together with two pieces of core-iron, as shown in Fig. 1. The bobbin is wound with 1,400 turns of No. 36 gauge s.s.c. and enamelled wire in the smaller slot for the primary, and 3,300 turns of

(*Continued on page 377.*)

WHAT TO DO WITH THREE COILS

By C. P. ALLINSON (6YF).

A considerable number of circuit arrangements may be tried out with the aid of a three-coil holder, and some of the most useful and interesting circuits are discussed in this article.



A GREAT deal of interesting experimental work can be done by the amateur who possesses a tuner unit which is fitted with a three-coil holder, and a single-valve panel of the experimental type which is provided with a number of terminals so as to enable different methods of connections to be employed. It is intended in this article to indicate a number of different receiving circuits which can be tried by means of these two simple instruments. Most experimenters will no doubt have these to hand, but where the contrary is the case a little work and time spent in making these up will be well repaid in view of the many uses to which they can be put.

Reaction Control

There is no need to describe the usual three-coil circuit in which loose-coupled tuning with magnetic reaction is used, as this is too well known to require more than a passing note. An interesting variation, however, can be made with this circuit by employing a different way of controlling reaction. If this method is employed, the reaction coil can be left fixed, and the actual control obtained by means of a variable condenser. This gives a very fine and positive control of reaction, which can be made entirely free from backlash.

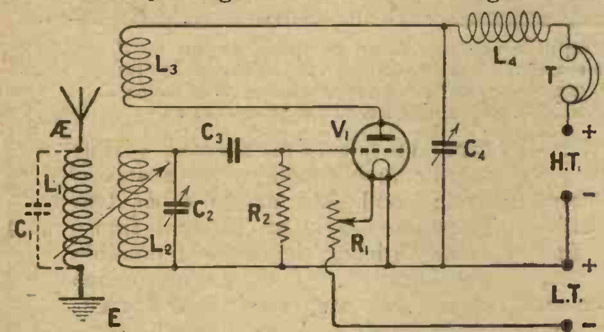


Fig. 1.—A single-valve circuit in which fine control of reaction is obtained by means of the variable condenser C4.

Fixed Coupling

The circuit diagram of this is shown in Fig. 1. L1, the aerial coil, may be tuned or untuned as desired, while L2 will be tuned by the usual condenser C2. The coupling between these two coils may be varied in the usual manner. The reaction coil L3 is coupled fairly tightly to L2 and left fixed. A choke coil L4, of about 250 turns, is connected in series with the reaction coil and the telephones. A by-pass variable condenser C4 is connected across this choke and L.T. positive, as shown in the diagram, and acts as a by-pass oscillation control. When the value of C4 is at its minimum, the choke L4 prevents oscillations from being generated. As, however, the value of C4 is increased, a certain point will be reached at which oscillations will commence, and a smooth and delicate control is thus obtained. A suitable value for C4 is .0003 μF or .0005 μF.

The Tuned Plate Method

Another means of obtaining reaction with a single-valve receiver is shown in Fig. 2. This is what is usually known as the "tuned plate" method. The plate coil L3 is of the same size as L2, and is tuned by means of a variable condenser C3. When the circuit L3 C3 is brought into tune with L2 C1, the electro-static coupling due to the inter-electrode capacity of the valve is sufficient to pass back enough energy into the grid circuit to bring the receiver into the oscillating condition. This gives a very smooth control of reaction, and there is no necessity for the two coils L2 and L3 to be deliberately coupled in any way.

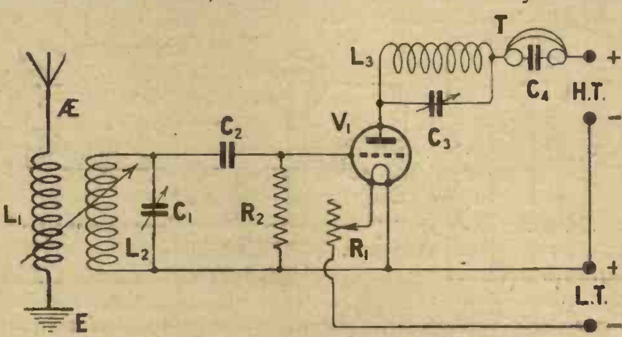


Fig. 2.—In this circuit oscillations are produced by tuning the anode circuit to the frequency of the grid circuit.

A Selective Circuit

Fig. 3 shows a selective circuit employing Trap tuning as evolved by John Scott-Taggart, F.Inst.P., A.M.I.E.E., and described by him in the February, 1925, issue of *Modern Wireless*. In this circuit L1, which is the aerial and grid coil, consists of a small coil, say, of 25 turns, to which L2 is tightly coupled.

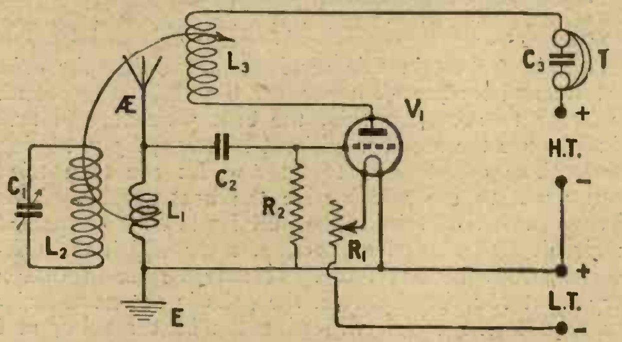


Fig. 3.—A selective single-valve circuit employing Trap tuning in place of the usual method.

L2 is a 50- or 75-turn coil, according to the frequency it is desired to receive, and is tuned by C1, a variable condenser of .0005 μF capacity. L3, the reaction coil, may be coupled either to L1 or to L2 as desired, and is of the usual size. Although this scheme of connections may result in a slight reduction of signal strength, it gives a very appreciable increase in selectivity, which is of great value when the experimenter is working close to one of the B.B.C. stations.

The Ultra-audion

A circuit which is well known, but very little used over here, is the Ultra-audion. A receiver employing

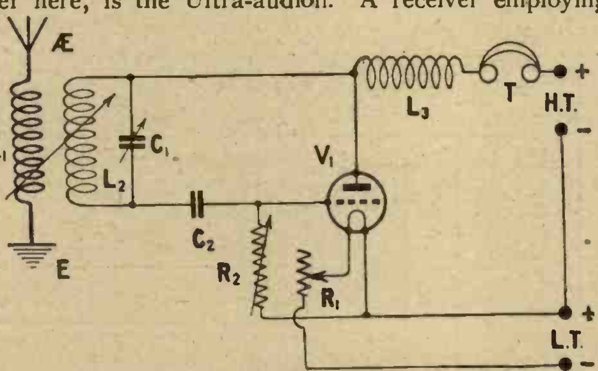


Fig. 4.—The Ultra-audion circuit, a feature of which is the extreme sharpness of tuning.

this principle was described by Percy W. Harris, M.I.R.E., in the November, 1925, issue of *The Wireless Constructor*.

Fig. 4 shows the scheme of connections using a loose-coupled aerial. L1 may be tuned or not as desired, while L2 is connected between grid and anode, and it should be noted that it is particularly important in this case that the grid-leak R2 be connected between the grid and filament. L3 is a choke coil of 250 turns connected in the anode circuit, as shown, and should preferably be kept at right angles to L1 and L2. The effect of coupling this coil to the others may be tried of course, but it is doubtful whether any advantage will be observed. The grid-leak R2 should preferably be variable, and the filament resistance R1 should be capable of fine adjustment, as this circuit is extremely critical to operate, reaction being controlled by the filament temperature. Great care should be taken when working a receiver of this description, on account of its very great liability to radiate, and further, some experience may be necessary before the best results are obtained.

The Flewelling Circuit

A super-regenerative type of receiver is shown in Fig. 5, which is a diagram of the simplified Flewelling circuit. It has been the writer's experience that this particular circuit works best with a very small frame aerial, consisting of at most two turns about 18 in. in diameter. A loading coil L1 is connected in series with it in order to bring the grid circuit into resonance with the band of frequencies over which it is desired to receive. It will be found that the value of the reaction coil L2, which is variably coupled to L1, is inclined to be critical if the best results are to be obtained with this receiver. The fixed condenser C3 is from .005 μF to .01 μF capacity, and here again a little experimenting is required to find which is the

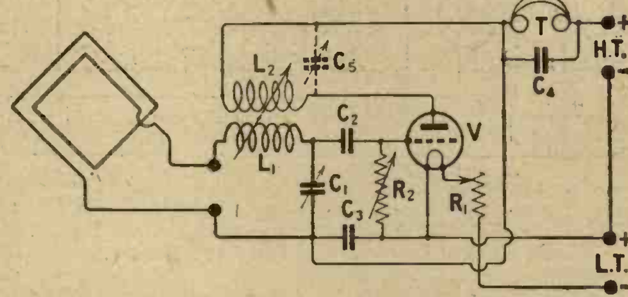


Fig. 5.—A modified form of the Flewelling circuit, which, used in conjunction with a frame aerial, is capable of giving good results.

most suitable value. The variable grid-leak R2 must be of good make if positive control is to be obtained.

Type of Aerial

The writer has tried this circuit loose-coupled to an aerial, with a large frame aerial, and with a very small frame aerial of one or two turns, and the best results were obtained with this last arrangement. The amateur transmitter 7EC of Denmark was received at a good strength in the headphones on 1,500 kc. (200 metres), and numerous British and Continental amateurs were also received at varying strengths without any other pick-up system than the small frame.

Double Reaction

An interesting circuit is shown in Fig. 6, in which two valves are used, one as an H.F. amplifier and

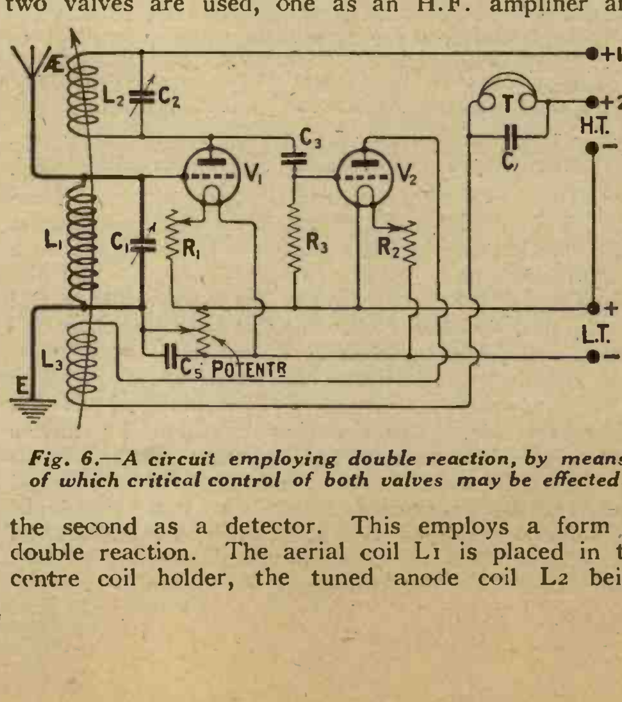


Fig. 6.—A circuit employing double reaction, by means of which critical control of both valves may be effected.

the second as a detector. This employs a form of double reaction. The aerial coil L1 is placed in the centre coil holder, the tuned anode coil L2 being coupled with it on one side, and a reaction coil L3 on the other. It will be evident, of course, that the three coils can be arranged in many different ways, such as placing the tuned anode coil in the middle, with the aerial coil on one side and the reaction coil on the other; or alternatively the reaction coil may be

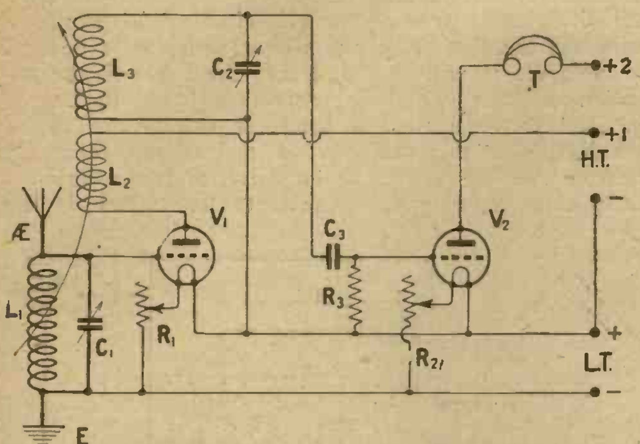


Fig. 7.—In the Tri-coil circuit reaction effects are obtainable by coupling either L2 to L1 or L3 to L2.

placed between the aerial and anode coil. It will be found that these arrangements give very sensitive and selective circuits.

The Tri-coil Circuit

One of the many circuits developed by the Editor is the Tri-coil circuit shown in Fig. 7. In this circuit L1 is the aerial coil and L2 the untuned anode coil, which is equivalent to the primary of an H.F. transformer. L3, the grid coil of the detector valve, is tuned by the variable condenser C2, of .0003 μF or .0005 μF capacity. Reaction effects are obtainable in two ways; one method is by coupling L2 more tightly to L1, and the second by coupling L3 more tightly to L2. When the coupling between L3 and L2 is tight, L2 begins to approximate to a tuned anode coil, and the valve therefore has in effect a tuned anode and a tuned grid circuit, and tends to oscillate freely. As the coupling between L2 and L3 is reduced, L2 returns to its status as an untuned coil, so that the coupling between these two coils gives a control of oscillation.

The "Reinartz" Circuit

A circuit that has achieved well-deserved popularity is the "Reinartz." One of the disadvantages, however, which has in many cases discouraged people from using it is the fact that specially wound inductances ordinarily have to be used. Fig. 8, however, shows a method by which ordinary plug-in coils can be employed in this receiver. L1, the aerial coil, should be inserted in the centre socket of the three-coil holder. L2, the grid coil, is of the usual size, and is plugged in on one side of the aerial coil. L3, the reaction coil, is plugged in on the other side. Reaction is controlled by means of a variable condenser, C3, and different sizes for L3 will have to be tried until smooth and even reaction is obtained with C3 over the whole of the tuning range of C1. L1 will, of course, be untuned, and where maximum selectivity is required, owing to interference problems, it should be as small as possible consistent with good signal strength. L4, the choke in the plate circuit of the valve, should be approximately a 250-turn coil, and should not be coupled to any of the other coils.

Preliminary Adjustments

It is important in this receiver to see that the coils L1, L2 and L3 are all connected the right way round. In order to ascertain this, the best procedure is first of all to use the receiver without reaction, L3 not being used. The connections to L1 and L2 are then tried both ways to see which give the best results. This having been determined, the coil L3 is now connected in circuit so as to give reaction, after which the connections may be left fixed. It may be found that a very tight coupling between the coils is not necessarily the adjustment which will give the best results, and therefore small variations in coupling should be made to ascertain which position is the best.

Coil Sizes

For those of our readers who are in any way doubtful as to the correct value of coils to use with the above circuits, the following indications may be of help. In loose-coupled circuits the aerial coil will be a No. 35 or 50, the grid coil No. 50 or 75, and the reaction coil any size between Nos. 35 and 75. The smaller size coils will be used for the higher B.B.C. frequencies, the larger ones for those below, say, Newcastle. In all circumstances it will, however, be a matter for experiment to determine the best coil sizes for varying conditions. Where plain aerial tuning is

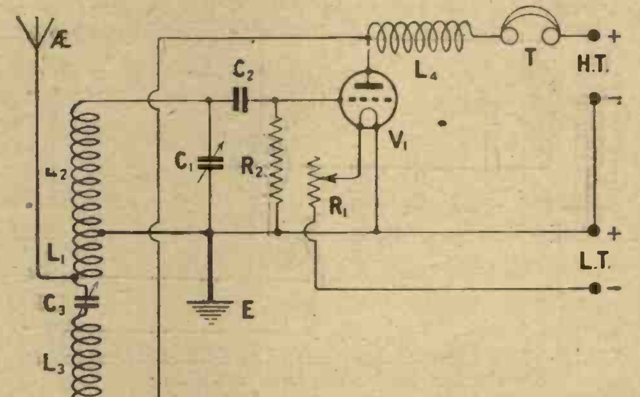


Fig. 8.—One form of the various circuits generally classified as "Reinartz" circuits.

used, the aerial coil will be a No. 35 or No. 50, again according to which frequency band it is desired to receive. Tuned anode coils will be No. 50 or No. 75, with the same proviso, and in all cases where reaction is being used it is preferable to work with the smallest size reaction coil that is capable of giving oscillation over the full band of frequencies covered by the tuning condenser.

Practical Operation

It should be remembered that in all these circuits, where there are three coils which give two variable couplings and perhaps two, or even three, variable condensers, one cannot expect to obtain the best results at the first trial. A certain amount of experience is required in order to get the maximum signal strength in some cases, and the experimenter should not therefore be discouraged if the first trial does not give him the anticipated results.

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Filament Current ..	·06 *amps*
Anode Volts	20-80
Impedance ..	22,000 *ohms*
Amplification Factor ..	7

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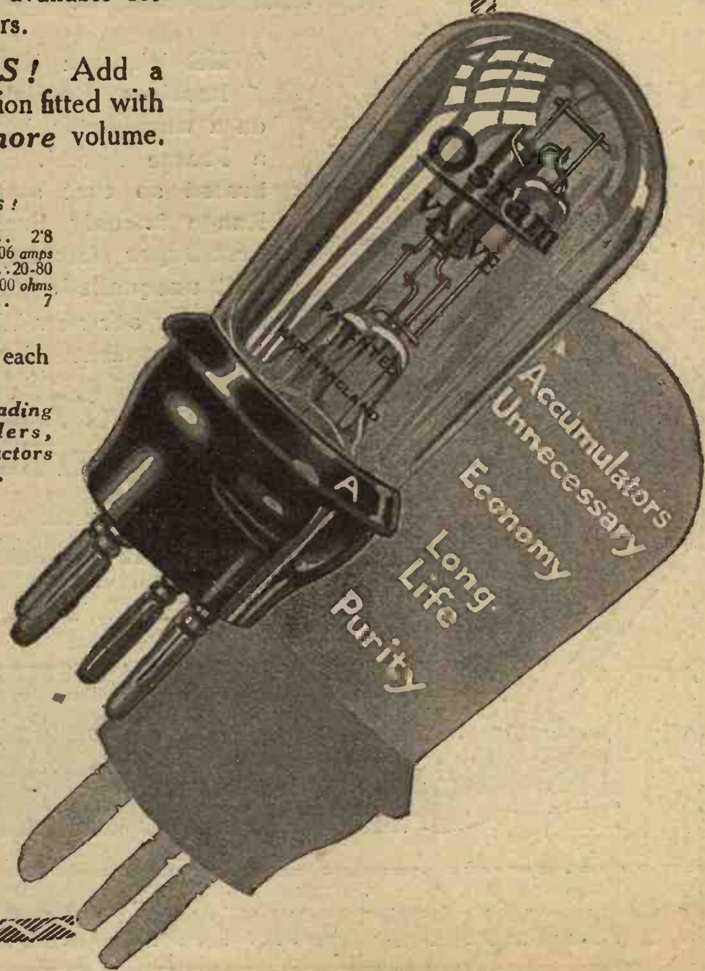

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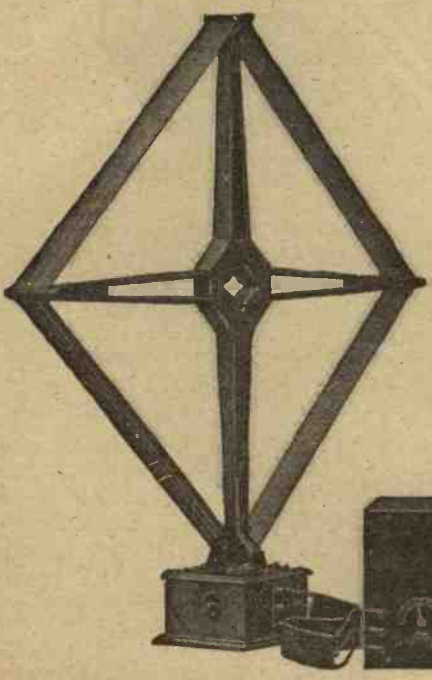

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A Crystal Circuit Modification

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

At times it would seem as if all possible lines of research in crystal circuits had been explored, although there is still much to be done. The circuit described by Mr. Harris is brought about by an ingenious simplification of wiring, and can be very easily tried by our readers.

LOOSE - COUPLED crystal sets, while they were quite popular in pre-broadcasting days, are now very little used either in commercial or home-made receivers. The reason is probably that the additional complication of control is not compensated for by any increase in efficiency, while selectivity (the great virtue asso-

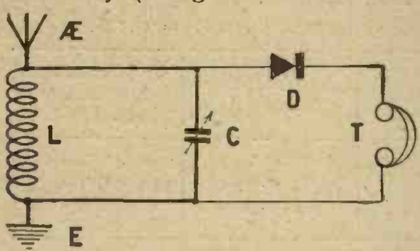


Fig. 1. — This conventional type of circuit gives very flat tuning.

ciated with loose-coupled receivers) is rarely desired in crystal sets, as, even if one could cut out the local station, the set is not sufficiently sensitive to receive anything else.

Direct Coupling

Fig. 1 shows the conventional directly-coupled crystal receiver in which the aerial and earth are connected across the whole tuning inductance, while the crystal detector and telephones are shunted across the variable condenser. Such

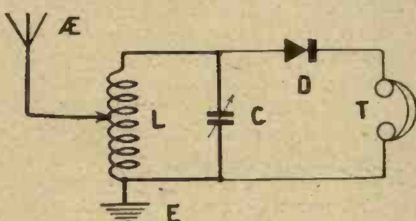


Fig. 2.—An improvement in sensitivity and selectivity may be affected in the manner shown here.

receivers are very flat in their tuning, and, with large aerials, the size of the coil is such that it is not possible to develop a high potential difference across it.

Variable Tapping

In many cases an improvement is found in selectivity and sensitivity by joining aerial and earth across only a portion of this inductance, as is shown in Fig. 2. The best position for the tap differs considerably with different aerials, and for most efficient working it is usually desirable to have a number of tapping points for trial. Some writers have suggested that this is an auto-transformer arrangement, in which a greatly increased potential difference is built up across the coil, and that greatly improved signal strength results. Practical experiments show, however, that there is not a great deal of difference between this arrangement and that of Fig. 1 so far as signal strength is concerned, unless we are dealing with very large aerials.

Selectivity

A considerable improvement in selectivity and generally in signal

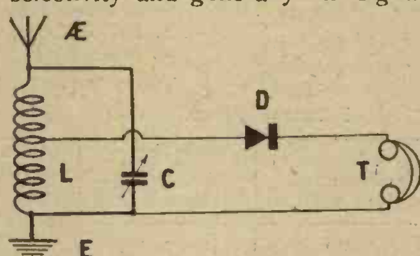
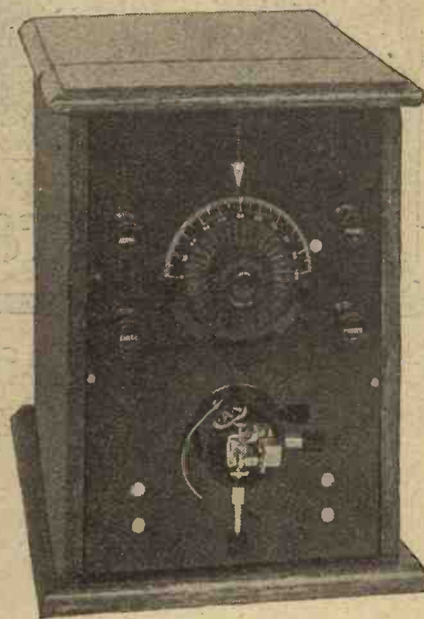


Fig. 3.—Shunting the crystal across only a portion of the tuning inductance will reduce the damping caused by the crystal.

strength is obtainable by shunting the crystal across only a portion of the coil, as shown in Fig. 3. In this arrangement the damping introduced by the crystal is far less marked in its effect, and, indeed, if such a circuit is loosely coupled to an aerial the selectivity becomes so high that stations can easily be missed, although when tuned in they are quite strong. A circuit of this nature was used by the writer in *The Wireless Constructor* recently, when describing a set consisting of a crystal detector followed by three stages of resistance-coupled note magnification. When tested at the Elstree Laboratories, the set in question proved to be so



A crystal receiver made up with the circuit described. Any single-layer coil set can be quickly modified on the same lines:

selective that, although it gave full loud-speaker strength when tuned to London, not a sound could be heard on the loud-speaker when it was detuned to 769 kilocycles (390 metres).

A Simplified Circuit

Some experimenters have built up sets in which the aerial tap has been variable, and in which the crystal tap has been variable also. It occurred to me recently that many of the advantages of aerial tap variation and crystal tap variation could be obtained in a greatly simplified circuit which I am now

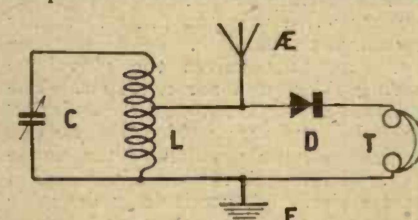
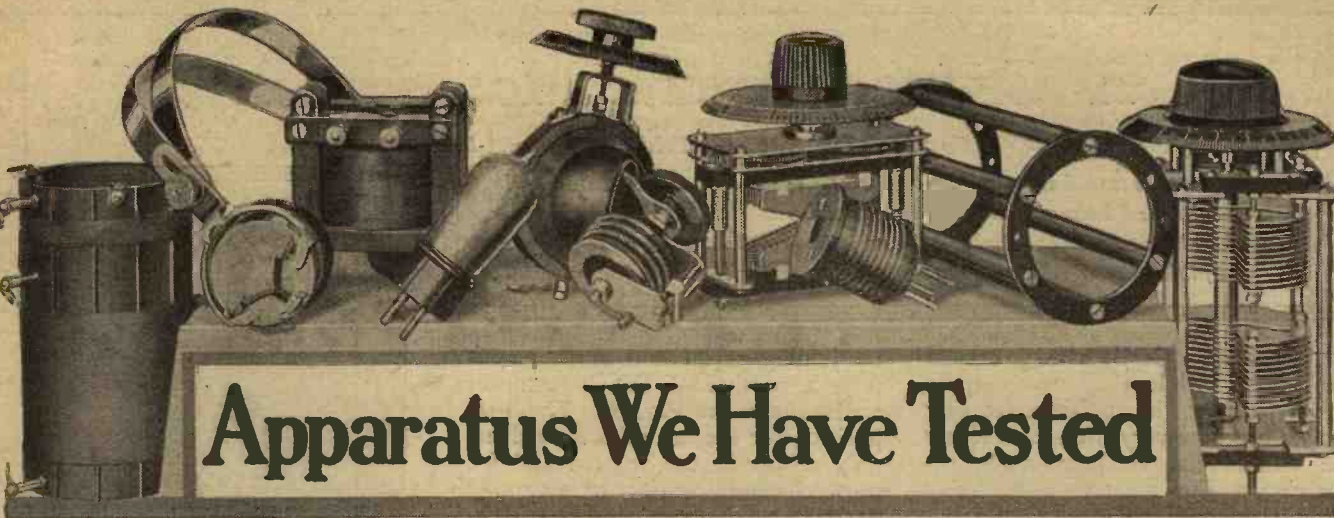


Fig. 4.—The circuit used in the receiver illustrated on this page.

showing in Fig. 4. It will be seen that an inductance shunted by a variable condenser is tapped as shown, the earth being joined to the

(Continued on page 377)



Conducted by Radio Press Laboratories, Elstree.

Marconi Valves for High and Low-Frequency Working

Readers who have used Marconi valves of the DE5, DER and other types, will be pleased to learn that there are now available some Marconi dull emitter valves of the 120 milliampere class.

Description of Valves.

In all, four valves have been submitted to us for test, i.e., one each of the four types—DE8LF, DE8HF, DE2LF, and DE2HF. The former pair of these require a 6-volt battery, while the latter pair can be worked with 2 volts. The DE8 valves are large, and have pips on the bulbs. They are completely transparent on one side, while the other side is of the silver appearance characteristic of the getter employed. The plate and grid are of a flat rectangular shape, while the filament is in the form of an inverted V, the two ends being secured at the base, while the centre of the filament is hung over a support at the top of the valve.

The DE2 valves are smaller in size than the DE8 valves, and are pipless, while the getter renders them almost opaque. In the case of the low-frequency valve, it was observed that a cylindrical anode is employed, but the silvery deposit on the high-frequency valve was too thick to render examination possible.

In all four valves the pins have spring sides, and are not split. The caps are of hard, black insulating material, and are provided with a ridge to indicate the position of the anode pin. A letter A renders identification still easier. A particularly desirable feature is that the caps are hollow inside, and as thin as is consistent with mechanical strength. This is useful in reducing the self-capacity of the high-frequency valves. The marking of the valves is on the glass, and in one case was somewhat indistinct.

Laboratory Tests.

It will be seen from the tables that in the case of the DE2HF the

Valve Type DE2HF Dull Emitter.

Filament Potential = 1.6 V. Filament Current = 0.12 A.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio (μ).	Internal Impedance in ohms (R_o).
30	5.0	1.21	9.2	41,700
50	4.0	1.41	8.4	40,000
80	1.0	1.38	12.7	45,500
100	0	1.52	13.7	45,500

Manufacturer's Rating.

Filament Potential = 1.8 V.
Filament Current = 0.12 A.
Anode Potential = 20—120 V.
Amplification Ratio = 12.
Internal Impedance = 45,000 ohms.

Valve Type DE2LF Dull Emitter.

Filament Potential = 1.7 V. Filament Current = 0.12 A.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio (μ).	Internal Impedance in ohms (R_o).
40	1.0	1.23	6.3	25,700
80	—4.0	1.60	6.3	25,000
100	—6.0	1.95	5.1	23,300

Manufacturer's Rating.

Filament Potential = 1.8 V.
Filament Current = 0.12 A.
Anode Potential = 20—120 V.
Amplification Ratio = 7.
Internal Impedance = 22,000 ohms.

Valve Type DE8HF Dull Emitter.

Filament Potential = 5.8 V. Filament Current = 0.11 A.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio (μ).	Internal Impedance in ohms (R_o).
40	3.0	1.40	14.3	28,600
80	1.0	1.73	16.1	27,700
100	—1.0	1.32	14.9	28,600

Manufacturer's Rating.

Filament Potential = 5.6 to 6 V.
Filament Current = 0.12 A.
Anode Potential = 20—120 V.
Amplification Ratio = 16.
Internal Impedance = 25,000 ohms.

amplification ratio varies with the high-tension used, this quantity being greatest with a high anode potential. In the case of the DE8LF there is a smaller relative variation of impedance with anode voltage. For the other two valves both the amplification ratio and impedance seems to be independent of anode voltage within wide limits. In our tests a somewhat lower filament current was used than the makers specify. This was done because the valve constants were not found to vary appreciably with filament current under the conditions employed, and it is desirable to under-run rather than over-run a filament. Further, although the filament current was lower than the manufacturer's rating, the filament potential was well up to the rating. These slight inconsistencies are generally found in valve filaments, but in the valves tested they were all on the right side.

Valve Type DE8LF Dull Emitter.

Filament Potential = 5.8 V. Filament Current = 0.11 A.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in milliamps.	Amplification Ratio (μ).	Internal Impedance in ohms (R_o).
40	0.0	1.30	6.9	15,400
60	—2.0	1.85	6.6	13,300
80	—4.0	2.50	6.7	11,800

Manufacturer's Rating.

Filament Potential	= 5.6 V.
Filament Current	= 0.12 A.
Anode Potential	= 20—120 V.
Amplification Ratio	= 7.
Internal Impedance	= 8,000 ohms.

On testing in Radio Press receiving sets the valves were found to function satisfactorily in their various capacities. They were also a good fit for a number of valve sockets, and only slight traces of microphone noises were present.

Vernier Dial

Messrs. A. F. Bulgin & Co. have submitted to us for test their Combine Vernier Dial. It is claimed that the vernier adjustment is very smooth, and that a desirable feature is the low gearing ratio of 180 to 1.

Description of Component.—This consists of two parts, *i.e.*, the dial and the vernier movement within the knob. The dial consists of a black disc 3 in. in diameter bevelled on its rim and graduated from 0 to 180 degrees. Opposite this graduated scale there are some more graduations extending through a small angle of 10 degrees. These are not on the bevelled edge, but are on the flat part of the dial, and are intended for the vernier pointer. The main knob, which is milled and rather long, is apparently composed of the same black insulating material as the dial. It is fixed to the latter by means of two screws which are invisible when the dial is in position. The knob is hollow and contains the vernier mechanism. On the inside of the main knob there are two vertical grooves at opposite ends of a diameter. A brass bush screws on to a spindle in the centre of the knob, and from it two short brass rods project, so as to engage with the screws mentioned above. The spindle can be rotated by a small milled vernier knob which is secured to the spindle by a brass pin. Thus, as the knob is rotated, the brass bush moves up and down the spindle, while the short rods fixed to it slide up and down in the grooves in the main knob. These rods also engage with curved slots in a short hollow brass cylinder which fits loosely into the main knob. A hollow, screwed brass lug projects from the brass cylinder and is designed to screw on to the main spindle of the condenser. Thus, as the main knob of the dial is rotated, the dial rotates at the same rate, carrying with it the moving vanes of the condenser. When the vernier knob is rotated, however, the short brass rods slide up and down the curved slots in the brass cylinder and thus cause the latter to revolve slowly. The moving vanes revolve with it, but the dial itself remains stationary. A short pointer attached to the brass cylinder indicates the amount of the vernier movement on the 10-degree scale. The dial submitted screws on to a 2B.A. condenser shaft, but the makers state that the dials can also be supplied for 3/16-in. or ¼-in. shafts.

Laboratory Tests.—The movement was found to be quite smooth in operation, although there was a slight amount of backlash on the vernier. There was no appreciable wobble on the dial. The reduction ratio was found to be as stated, *i.e.*, 180 to 1. This dial is a very interesting article, and should be especially useful to amateurs who desire to fit a vernier on to an ordinary condenser. The vernier provides an exceptionally fine motion.

Combined Filament Resistance and Valve Holder

A Garnett's combined filament resistance and valve holder has been submitted to us for test.

Description of Component.

This component is designed for back-of-panel mounting, and incorporates the filament resistance and valve holder in one unit. One-hole fixing is employed, and the rheostat knob is the only portion visible above the panel surface. This knob is of fluted black moulded material, a curved white arrow on the top of the knob indicating the direction of rotation for increasing the filament current. A brass nut is embedded in the knob, and enables it to be screwed on to the spindle. A circular lock-nut of almost the same diameter as the knob is provided, while one-hole fixing is secured through the agency of a screwed sleeve concentric with the spindle. Two nuts screw on to this, one to fix the sleeve to the panel and the other to secure a metal plate to the sleeve. This metal plate serves to support the rheostat.

The Resistance Element.

The resistance element of the rheostat consists of resistance wire wound tightly on a cylinder of insulating material. The rheostat arm is of curved section, so that as it sweeps from end to end over the resistance it makes smooth contact, and does not scrape. It is fixed to the spindle by two nuts, and a spring washer causes it to be pressed firmly against the resistance winding. A stop is provided at the "On" position, and at the other end the contact arm is free to move clear of the resistance winding, so that the valve can be switched off by means of the rheostat knob. The resistance element and rheostat arm are supported by the metal plate beneath the spindle.

Insulating Panel.

The part of the metal plate above the spindle carries a small right-angled insulating panel, which is fixed to it by two screws. This panel is about 2¼ in. long, and at its distant end four brass valve sockets are inserted. These are tapped at their lower ends, and screws are inserted, and when screwed up these hold soldering tags in place against the base of the sockets. These tags are of sufficient length, but there is no adequate provision for fixing connections without the aid of soldering. Sufficiently large terminals are, however, provided for the rheostat.

Laboratory Tests.

The resistance of this rheostat was found to be 28 ohms, which is sufficient for controlling valves of the .06 ampere class with a 4-volt battery. On test the rheostat was found to work smoothly, and to be practically silent in operation. Rotation through 90 degrees was sufficient to turn the rheostat arm from the "On" to the "Off" position. The insulation resistance of the valve sockets was found to be infinite, and it was impossible to insert a valve in the wrong position so as to damage the filament by contact with the anode socket. The fit for several types of valves was found to be satisfactory.

This is quite a useful component, and the provision of valve holder and rheostat in one unit is of considerable assistance in mounting.

ITALIAN AMATEUR TRANSMISSION

SIR,—We think your readers will be interested to know that the following Italian amateurs have entered the Radio Transmitting Contest organised by *Il Radiogiornale*, official organ of the National Radio Club of Italy :—

1NO—Marietti Franco, Corso Dante 8, Torino.

1AS—Pozzi Silvio, Corso Torino 1, Novara.

1JR—Jerace N. Ottone, Via Melchiorre Gioia, Torino.

1LP—Ponzio Luigi, Via Venti Settembre 50, Torino.

1AP—Sella Giuseppe, Via Ospedale 51, Torino.

1AU—Strada Federico, Via Ospedale 14, Torino.

1FD—Deregibus Francesco; Via del Carmine 6, Torino.

1CO—Gian Luigi Colonnetti, Via Maria Vittoria 24, Torino.

1AY—Fontana Giuseppe, Corso Garibaldi 34, Piacenza.

1GW—Bruno Brunacci, Via Evangelista Torricelli 1, Roma.

1GS—Giovanni Serra, Via S. Secondo, Pinerolo (Torino).

1RM—Associazione Radio Montatori, Viale Angelico 19, Roma.

1BS—Luise Fausto, Piazza Manzi 10, Piacenza.

The points awarded in the contest will be for :—

Greatest distance.

Greatest number of two-way communications.

Best report about the whole question of short-wave transmission.

The National Radio Club of Italy requests the amateurs of the whole world, and specially the American, Australian, African, and Asiatic operators, to be kind enough to send QSL's promptly to their Italian friends.

During the month of October last the following Italian short-wave transmitters were QSO with New Zealand: 1RM, 1AU, 1AS, 1BS, 1CO. 1AS was QSO with Australian 3BQ. 1GW was QSO with Argentine AA8. 1AU was QSO with Australian 2YH. 1RG ('phone, 100-watt input) has been QSO with many European amateurs, and his modulated signals are generally received R7 over all Europe.—Yours faithfully,

RADIO CLUB NAZIONALE ITALIANO,
E. M. MONTI,
Il Secretario Generale.
Milano, Italy.

AMATEUR TELEPHONY TRANSMISSION

SIR,—I note with interest your remarks about my station G6OH in your very excellent paper, *Wireless Weekly*, of November 11. My station is situated at Lichfield, but I am in Stafford during the week.

I should be very much obliged if you could bring to the notice of your readers the fact that I have, every Sunday, a low-power telephony transmission at 10.00 G.M.T. and 18.00 G.M.T. These usually last 10-15 minutes, and after that I stand by for reports by radio. I should also, of course, be very glad of any reports by letter or card. The wavelength is 44-46 metres. I have been received in Glasgow at good L.S. strength on a 0-Det.-2. My input here is about 3 watts. I have only had reports on schedule, and I should be very glad of any further reports.—Yours faithfully,

G. S. SAMWAYS (G6OH).

8, Rowley Avenue,
Stafford.

This Marconi alarm device, shown at the Olympia Shipping and Engineering Exhibition, automatically rings a bell when a distress call is received.

AMATEUR CALL SIGN

SIR,—I should be grateful if you would bring to the notice of your readers that the call sign 6VZ has been allotted to me.

I am using 10 watts rectified A.C., and my transmissions take place on 150-200 metres (2,000-1,500 kc.), C.W., I.C.W., and telephony.—Yours faithfully,

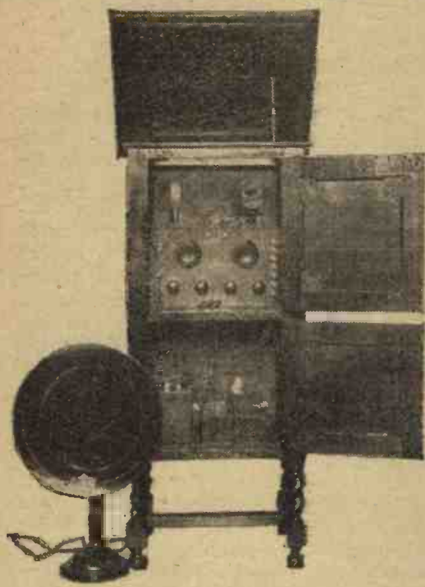
A. E. STEPHENS (G6VZ).

West View,
Chewton Road,
Keynsham, Bristol.

ELIMINATION OF "ATMOSPHERICS"

SIR,—I have been much interested as a wireless experimenter in your issue of November 11, the article on "Atmospheric Elimination" especially; I have conducted very many experiments in this connection. Perhaps you will be interested to know that at a distance of nine miles from the Belfast Station I am able to receive on a straight, one-valve set that station (*a*) without aerial, and on the earth lead alone, (*b*) without earth, and on the aerial alone. Under (*a*) I have received 2BE during a thunderstorm without a trace of static or other interference. I did not care to risk the aerial alone during the storm. But, under normal conditions, the signals come in loudest when the aerial alone is used — approaching loud-speaker strength. On the earth alone very good volume, but not quite as loud as on the aerial alone. The Glasgow station has also been picked up, using only the aerial or earth, and without trace of atmospherics. It has been noted that with aerial alone the volume is greater than with aerial and earth. The latter volume is about the same as with earth alone. The system of coils and arrangement are of my own design. With my arrangement I am of the opinion that for a local station, at least, perfect and voluminous reception can be had at any place within 20 miles radius of a broadcasting station without an aerial, or conversely without an earth. In a short time I expect to be able to carry my experiments further.

Your article on "Are Long Coils Doomed?" was of immense interest to me, as I have been experimenting for some years in this direction. Within limits, in my opinion, it does not matter what gauge of wire is used. I am able to receive as efficiently on a coil of 42 gauge wire as on one of 18 gauge, but the former must be narrow in width. The ratio of width to diameter should run about 2 : 5, but modifications can be made within limits where space has to be considered. That shown, 2 :5 seems to be right for our B.B.C. waves. The former should be of as thin a material as possible, and



Mr. F. H. Sheward's "All-Concert" Receiver is built into a handsome cabinet, the batteries being placed in the lower compartment.

perforated throughout where the strength of the former will allow it. If the ratio I quote is adhered to, efficient reception can be had with any gauge of wire. With this ratio, resistance will be at its lowest, so far as solenoid coils are concerned. On a straight one-valve circuit with reaction, in August last, within half a mile of the Glasgow station, on an indoor aerial, I cut out with ease the Glasgow station and brought in two French and four German stations, Belfast, London, Newcastle, Edinburgh, Liverpool and Manchester. The test was made in the presence of an electrical engineer. I was given to understand that I had done the impossible with an ordinary set of minimum power!

Wishing *Wireless Weekly* continued success.—Yours faithfully,

RICHARD E. BARBOUR.

Lisburn, Co. Antrim.

RECEPTION OF AUSTRALIA

SIR,—I should like to inform you *re* publication in *Wireless Weekly* regarding Australian 6AG that I received him, R37, here (on o-Det.-1 with indoor aerial) as far back as October 18, which, I believe, was before your previous report. Wishing the best amateur's journal all success.—Yours faithfully,

Derby. E. D. DUNN.

SHORT-WAVE RECEPTION IN INDIA

SIR,—A short time ago I decided to make my first attempt at constructing an ultra short-wave receiver. I selected the two-valve circuit as described by Mr. A. D. Cowper, M.Sc., in *Wireless Weekly* of May 27. With very little difficulty I soon had the set wired up and ready for work, and I must say that I was really surprised at the results obtained. Using a single-strand aerial 15ft. long and 20ft. high, and Marconi D.E.R. valves, the following stations have been heard: ANE, FW, 6AG, G2NM, GB1, 8SSC, NTT, NIJR, NPU, NPO, G2LZ, G6DA, PCLL, POF, G2XY, A3E and F8TK. I would be very glad if any of your readers could inform me as to the identity and wavelength of the following stations: PCLL, F8TK, 8SSC, A3E, NTT, GB1 (GB one), ANE and FW.

Trusting that this letter may be of some interest to you, I will close, wishing you every success.—Yours faithfully,

J. M. DRUDGE.

Razmak, N.W.F., India.

[We are able to supply the following information about the stations quoted: F8TK, Chauny, Aisne, France; 8SSC, Belgian Army of Occupation; A3E, South Africa; NTT, U.S.S. *Scorpion*, Black Sea; GB1, North Africa; ANE, Dutch Government Laboratory, Bandoeng, Java; FW, French Commercial Station.—ED.]

ENVELOPE No. 4

SIR,—I enclose photograph of my three-valve "All-Concert de Luxe" Receiver described by Percy W. Harris, M.I.R.E., in Radio Press Envelope No. 4.

I have added another stage of L.F., using a power valve, each valve having separate H.T. control.

Excellent results are obtained from both British and Continental stations.

Wishing Mr. Harris and all the Radio Press publications every success, —Yours faithfully,

F. H. SHEWARD.

Stoke-on-Trent.

SIR,—I am using the "All-Concert de Luxe" Receiver, described by Percy W. Harris, M.I.R.E., in Radio Press Envelope No. 4, which certainly deserves praise. Using 35, 50, and 75 coils respectively for aerial, anode and reaction, most B.B.C. stations are brought in with ease, while with a 50, 75, and 100 coil I have picked up no less than six foreign stations in twenty minutes. Using 60 volts H.T. I have inserted 1.5 volts grid bias, and I am using a variable grid-leak, both of which have increased the efficiency of the set. You may consider it worth while publishing a tip, which, had I previously known it, would have saved me the cost of three dull-emitter valves.

On the right-hand side of my set were the battery and earth terminals, the earth being next to H.T.+. When taking off the H.T.+ lead I accidentally touched the earth terminal with it, and, to my astonishment—a white flash. H.T.— and L.T.+ being a common terminal, it only requires, of course, H.T.+ on the earth terminal to complete the H.T. circuit across the filaments. Needless to say, my earth terminal has since been transferred.—Yours faithfully,

Driffield. T. H. COLWILL.

"THE HARMONY FOUR"

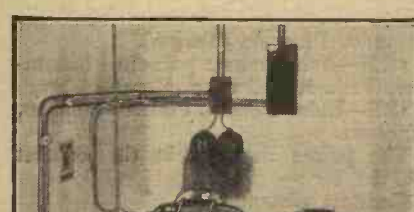
SIR,—In spite of my "unhandiness" with the quill, one of your circuits has driven me to send you my appreciation of it. For the last eighteen months I have been following *Modern Wireless*, and with the more complicated lay-outs I have always had good success when trying those of Mr. Percy W. Harris, M.I.R.E. I have, amongst many others, made the "Transatlantic V," the "Anglo-American Six," and now at last he brings out the ideal circuit—the "Harmony Four." It is excellent—pure and powerful and sensitive! My aerial is but a 15-ft. length of wire across the room, and I get Daventry, Manchester, Liverpool, Stoke-on-Trent, and Birmingham at full loud-speaker strength. —Yours faithfully,

Wrexham. A. E. RAYNER.

ENVELOPE No. 6 IN CANADA

SIR,—It will interest you to know that my wave-trap constructed from Envelope No. 6 is proving a great success.

As I am writing our local station within 2½ miles is broadcasting; the wave-trap has "cut him out," and



A view of the power plant which supplies the power of 2 kilowatts to the Bilbao broadcasting station (EAJ 11).

Omaha, Nebraska, 1,300 miles away, is coming in at full loud-speaker strength.

My aerial and lead-in are 180 ft. long. The set is a 4-valve radio-frequency one, with a 2-valve amplifier. At present all six valves are working. There is no loss in volume, and I am of the opinion that the trap clears the music to a great extent.

Congratulating you on your No. 6 Envelope.—Yours faithfully,

LEONARD H. COOPER.

Calgary, Canada.

The Design of Intermediate Frequency Transformers for Superheterodyne Receivers

(Continued from page 367)

the same wire in the larger slot for the secondary. The core is put in so that the air-gap comes under the larger or secondary coil, and the ends of the laminations are bent over each other to hold them together. This transformer may be placed in a small metal can, with leads brought out as desired. It should first be boiled in a resin-beeswax compound, with which the can should be filled.

The "Filter"

This transformer, while selective, may best be used in conjunction with another type, which would be a compromise between B and C. This latter transformer may be built by turning out a wood spool, as shown in Fig. 1. In the bottom of the slot are wound 250 turns of No. 30 gauge d.s.c. wire. On top are wound 1,500 turns of No. 36 gauge d.s.c. wire, forming the secondary. This coil has an air core, and cuts side bands slightly. Using but one, this is not noticeable, but the use of two or three would be out of the question for the reasons outlined above, in addition to this latter one.

Matching the Transformers

Now that we have these transformers we cannot use them unless they are properly matched. Therefore, we may arrange the simple circuit shown in Fig. 2. The transformer for test is shown at TX. The oscillator coupling is reduced until, with the condenser adjusted for best reading on the plate milliammeter, a small deflection is just barely discernible. The reading of the condenser is then noted. Transformers reading not over a degree apart are excellent and should be used together. Those reading four degrees apart will work together, but not very satisfactorily. The air-core transformer is measured by setting the condenser at the reading for the other transformers, and adding condensers in small steps up to .01 across its primary until it gives maximum deflection of the plate milliammeter at the given setting of the oscillator condenser. This measurement method is crude, but will be found satisfactory for one or two sets of transformers.

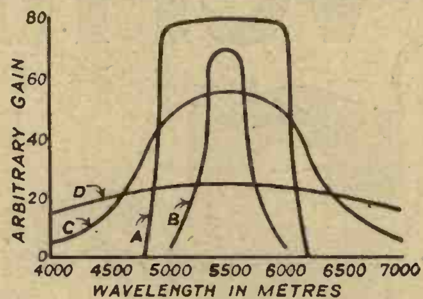


Fig. 3.—Curves of different types of transformers, plotted on a scale of wavelength against amplification.

A Crystal Circuit Modification

(Continued from page 371)

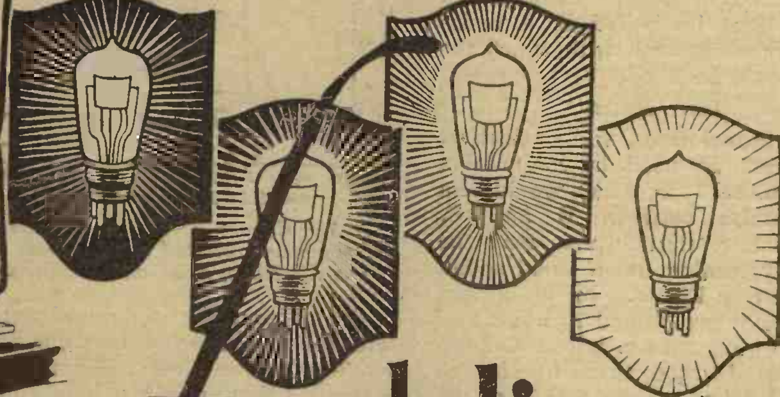
lower end of the inductance, and the aerial to the central tap. The crystal detector is also joined to the central tap, and the telephones are connected to the earth as usual.

Simple Wiring

Obviously a circuit of great simplicity such as this has not all the advantages of one in which there are a number of tappings, both for aerial and crystal; but the great simplicity of wiring is a point in its favour.

EFESCA

Efesca Vernistat



for delicate Filament Control

The Efesca Vernistat (Patent) is the most delicate filament control yet invented, and should be used wherever a separate rheostat is employed for H.F. and detector valves. The Vernistat is smooth and silent in operation, and absolutely safeguards the valves from an accidental burn-out through too rapid switching on. Three complete turns of the knob are required to bring in or out the whole resistance.
The Vernistat is made for both dull and bright emitter filament control, resistance 5 ohms or 30 ohms.

Price complete, 6/- each.

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

Ask your Wireless Dealer for:—

EFESCA
COMPONENTS

Wholesale Only:— **FALK, STADELMANN & CO., Ltd.**
Efesca Electrical Works,
83-93, FARRINGDON ROAD, LONDON, E.C.1
and at Glasgow, Manchester and Birmingham.

EFESCA Popularity Competition £200 IN CASH PRIZES
Ask your dealer for entry form or write direct to
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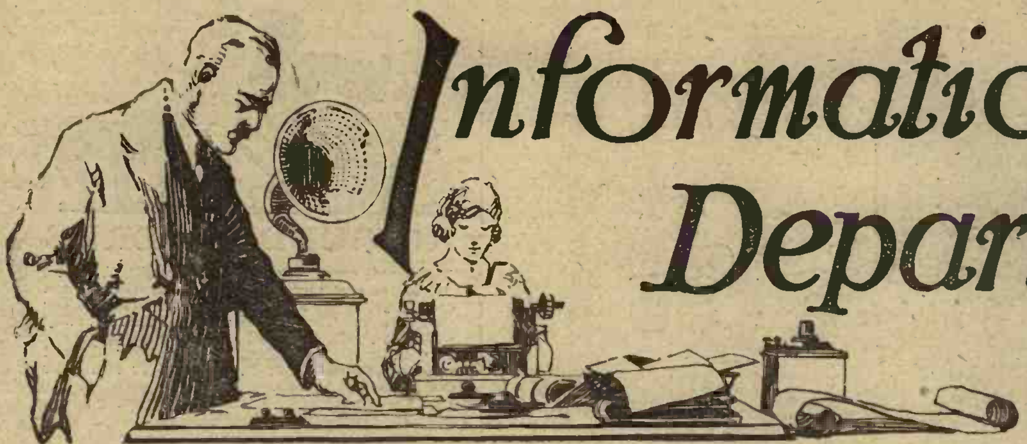
83-93 FARRINGDON ROAD, LONDON, E.C.1



Information Department.

R. P. (LLANELLY) asks us to tell him the frequency range a certain coil in his receiver will cover. The set is a short-wave receiver described by Mr. Rattee for the reception of KDKA, which station our reader tunes in between 40 and 50 degrees on his condenser.

From the particulars given above we are afraid any calculation made to obtain the frequency range of the coil in the receiver would be practically useless, since it would be necessary to know definitely the capacity of the condenser at the exact setting for KDKA, and also the particular frequency at which this station was transmitting at the time. Even if these two figures could be given, it is doubtful whether sufficiently reliable results could be obtained by calculation, and we are afraid therefore that we can only advise our correspondent to obtain a wavemeter and measure the range of the coil in question.

G. F. S. (SOUTHPORT) has a receiver employing a valve detector, with reaction, and two stages of transformer - coupled low-frequency amplification. Until recently the set worked well, but now the tuning alters from night to night for a given station, and sometimes has to be changed during a transmission. Occasionally a low-pitched howl commences in the loud - speaker, finally drowning all signals.

From the symptoms given we are at once inclined to suspect the earth connection, and would advise that alternative earths be tried; or, if this is difficult to accomplish, that a temporary counterpoise arrangement be erected. This latter may consist of a length of insulated wire connected in place of the normal earth, and taken to the full length of the aerial, preferably underneath the latter, 6 ft. or so up and well insulated. If with an alternative earth connection, or a counterpoise, whichever is tried, the trouble disappears, it will show that the earth connection was responsible. In certain cases a break in the earth lead can be seen, but in others where the break has occurred where it is soldered to a

buried earth plate, the fault must be located as described above, or by digging up the earth plate.

H. T. C. (CHISWICK) is employing a direct-coupled straight 3-valve receiver and experiences great difficulty in cutting out the London station. He has tried the usual types of wave-trap with but little success. He asks our advice.

Although fortunately not particularly common, there are aerial and earth systems on which ordinary wave-traps do not function satisfactorily. In such cases a very useful arrangement to try is that given in Fig. 1. Here we show the high-frequency and detector portion of a common type of receiver, slightly modified to accommodate an acceptor wave-trap arrangement. For the normal aerial coil an auto-coupling arrangement has been substituted, and across the so-called "aperiodic turns" a series-acceptor circuit has been placed. In practice this arrangement often proves efficacious where other types fail. L_T is a low-loss coil, wound, for example, on a standard Collinson type low-loss former 7 in. long with 70 to 90 turns of No. 20 gauge enamelled wire. The trap condenser C_T may be of .0003 μF or .0005 μF capacity. For fuller particulars and constructional details of a trap of this type we would refer the reader to *Modern Wireless* for October, 1925, in which a unit of this type is described by Mr. G. P. Kendall, B.Sc.

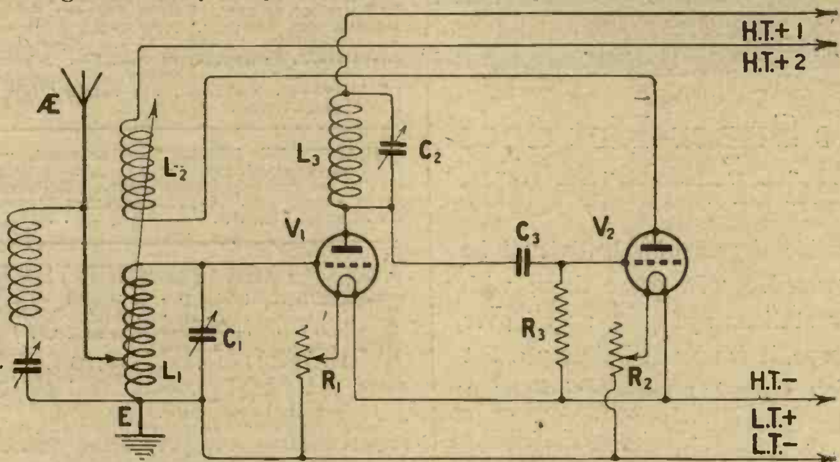


Fig. 1.—The series-acceptor form of wave-trap proves effective on most aerial systems, and is shown in the above diagram as L_T. C_T. (H.T.C. Chiswick).

A. B. (EARLSFIELD) possesses a rather small outside aerial which he is unable to improve, and asks us to recommend a receiver to suit him, explaining that he requires as many British and Continental stations as possible, on the loud-speaker.

Since our correspondent's locality is not a good one, and he is further handicapped by a small aerial, we think two high-frequency valves will be needed. A highly selective receiver will also be necessary, owing to the proximity of the London station. We advise that the "Special Five" receiver described in the November issue of *Modern Wireless* be constructed, since this is an ideal instrument for long-distance reception on the loud-speaker, and is highly selective.

No, Sir! The Keystone Super-Het does not limit you to one band of wavelengths

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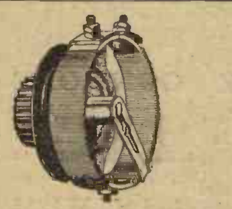

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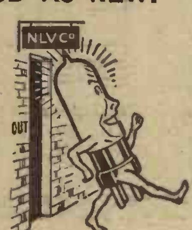

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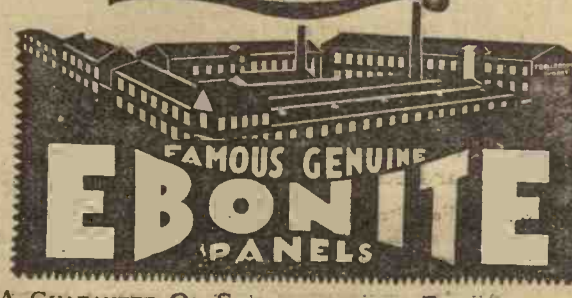

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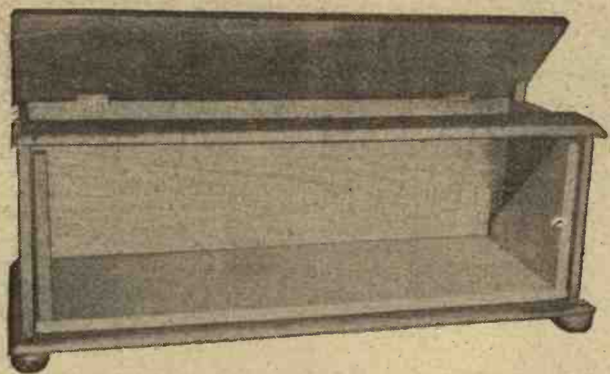

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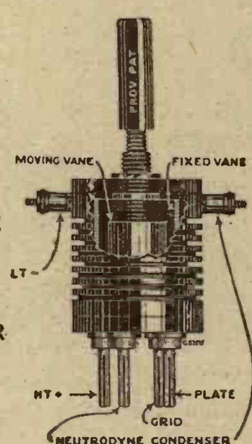

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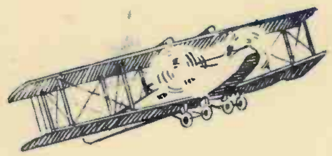

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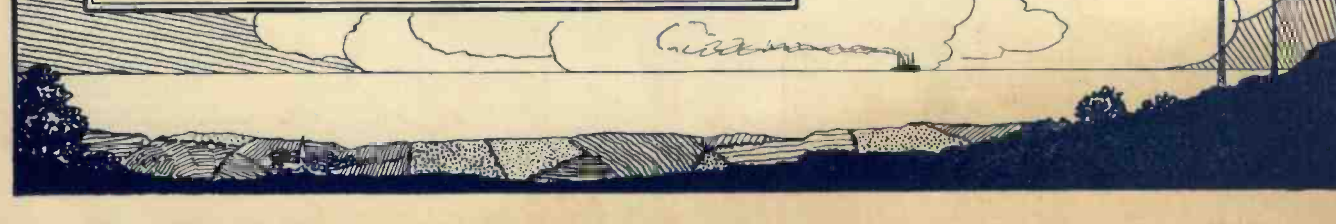

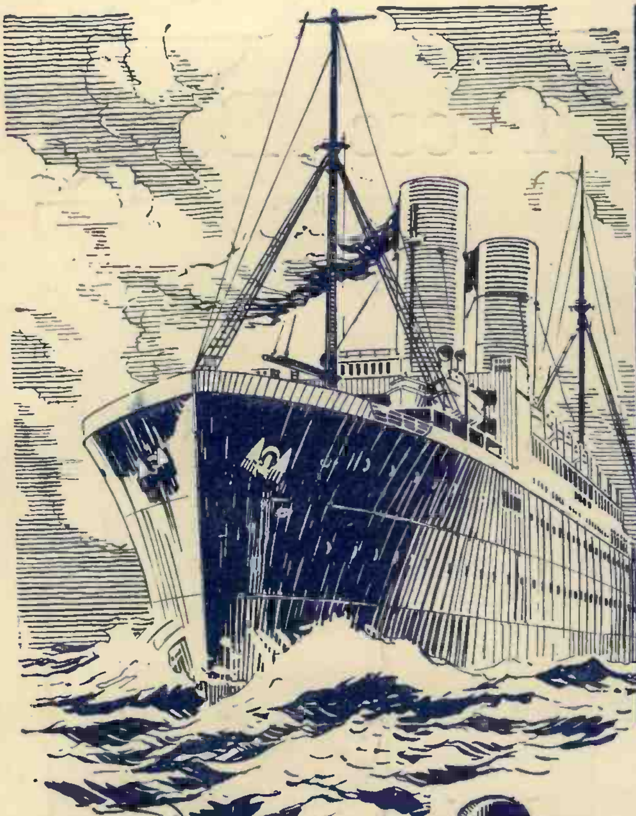

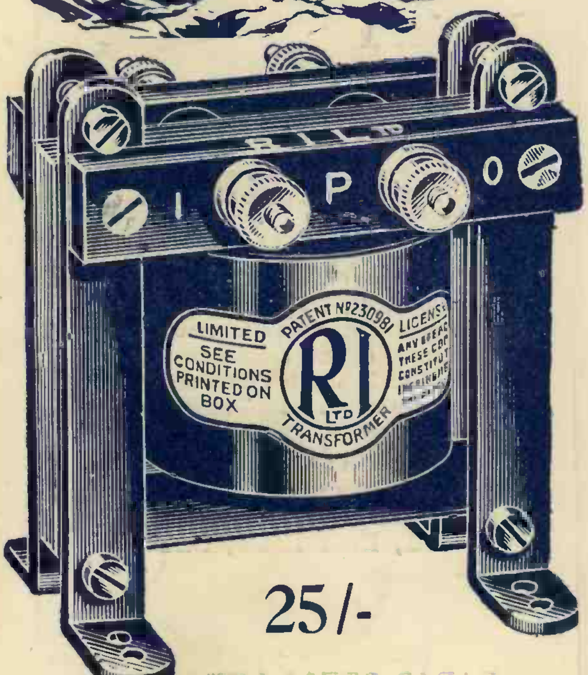

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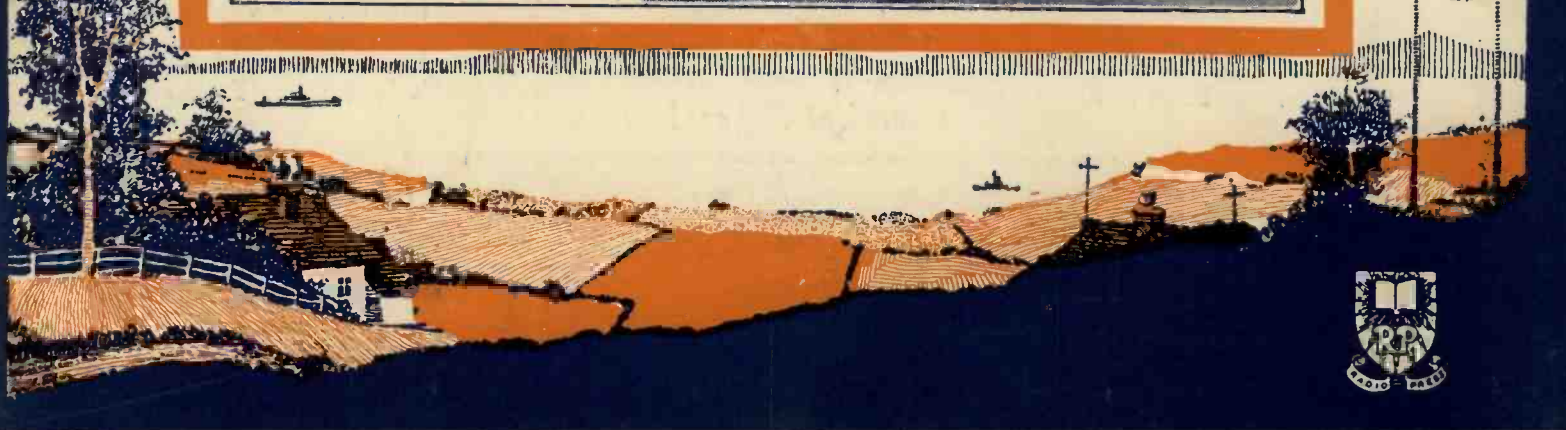
Wireless Weekly, 6d. Net. Wednesday December 9th, 1925

Wireless Weekly

Vol. 7. No. 12.

Are "LOW-LOSS" COILS NECESSARY?

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



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What is Wrong with the Radio Societies?

THIS is the question that is being asked in all parts of the country, and it is one which merits consideration for the start of the year, when such societies should be most active. There is no disguising the fact that while a few Societies are really flourishing, and helping forward the art, the great majority are lacking in vitality, or else are, to all intents and purposes, dead. Why is this so at a time when the interest in radio by the general public is greater than ever in the history of the art?

Careful examination of the position shows that most of the societies have been formed by a few enthusiasts, with a common interest in the art, but without any clear idea of the hard work necessary to make such a society strong and vigorous. Radio Societies are so very easy to start, and so very difficult to keep alive. The preliminary steps are always the same, beginning with the choice of a local "Big Wig" as chairman (he rarely, if ever, attends the meetings!) and the original band of enthusiasts as the committee. There is always enough local talent to provide a few interesting lectures for a start, and publicity through the usual channels will always bring a good attendance the first few weeks.

The real trouble, of course, comes from the difficulty of obtaining good lecturers from a distance. Only those who have experience of such matters can realise the difficulty of going from one suburb to another at night and the long waits on cold and draughty platforms, necessitated by infrequent trains.

There will always be good attendances at radio societies when the members know that they will learn something new by attending. A number of the big wireless concerns will willingly send a lecturer free of expense to demonstrate their own particular goods before a society, provided a good attendance is promised, and such lectures are often of absorbing interest. It is true that the firm in question gets an excellent advertisement; on the other hand, the society gains a great deal by listening to a lecturer in his own particular line, and from the questions which are invited and willingly answered.

Then, again, the practical side of the art is too frequently ignored. How many radio societies have a really good wavemeter properly calibrated? In many cases it would be an excellent plan for members to get together and either buy or build a really substantially constructed instrument, which could be calibrated and kept on the society's premises. One or two less elaborate instruments could also be built and calibrated from the Society's standard. Another most valuable instrument to be constructed would be a valve-testing board, by which members' valves could be tested on some fixed night, and the characteristics rapidly plotted.

Success in running a radio society can only be gained by making the meetings not only interesting but directly helpful to the members, and the suggestions given above are simply the result of contrasting the methods of successful societies with those which have failed in their object.

CONTENTS.

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Some Non-Radiating Receiver Circuits

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

The success of such tests as the Transatlantic Broadcasting Tests, to be held early next year, depends in large measure on the amount of jamming and interference, and the radiation of oscillations from receivers can completely spoil reception for other listeners. Details are given in this article of some circuits which, with proper handling, will not radiate sufficiently to cause annoyance to one's neighbours.

WE are being constantly advised, and occasionally warned, about allowing our aerials to oscillate. The nuisance of such oscillating aerials is well known, and there are not many people who would deliberately oscillate their aerial if it could be avoided. There are many circumstances where there is absolutely no necessity for anyone to oscillate his receiver or to allow his aerial to radiate. Such circumstances occur when listening to local broadcasting stations when the signals are fairly strong.

Distant Reception

There are, however, occasions when we get advice not to oscillate our aerials, but at the same time we are asked for information, such as during the recent tests of the European broadcasting frequencies. Although we were advised and implored not to oscillate, there was very little information as to how distant stations could be obtained without having to oscillate one's own aerial system. Facts must be faced, and there are not many of us who are innocent of the crime of oscillating when we are searching for distant stations. We all know that the easiest way to intercept a distant station is to pick up the carrier wave, and by doing so we are able to save a considerable amount of time.

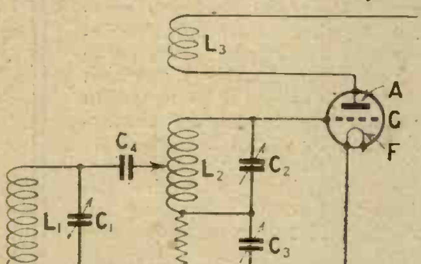


***Fig. 1.**—In this form of the Tropadyne circuit the coil L1 represents a loop aerial, tuned by the condenser C1.*

The Easy Method

Under the present broadcasting conditions, where the transmissions consist of continuous waves which are modulated at speech frequencies, we have the option of either the heterodyne method of reception to pick up the continuous waves which are called the carrier waves, or the ordinary detection without the aid of a local oscillator in order to pick up the damped or modulated wave. The case of heterodyne reception is too well known, and no matter how much we are implored or warned not to oscillate our aerials, most of us will still continue to find the carrier wave first of all in order to pick up distant stations. Again, it is well known that sometimes the carrier wave of a distant broadcasting station can be heard when the telephony is too weak to be heard.

Curing the Trouble

With such an easy method of picking up distant stations as oscillating one's aerial in order to pick up the carrier wave, the only result of advising people not to oscillate will be that very few people will pick up distant stations at all if they carry out the instructions. This will tend to prevent progress in wireless, and we must inquire whether there is not some way of obtaining the sensitiveness of the present method for picking up the carrier wave with the ideal condition where one's aerial does not oscillate.

Supersonic Receivers

This problem has been solved in a number of different supersonic receivers. These receivers operate on the principle of oscillating the whole time, and in such cases the nuisance of oscillating aerials was so bad that it was essential to take steps to prevent radiation. Various devices have been introduced into supersonic receivers which have resulted in preventing the aerial from radiating. In such cases the oscillations are kept to the oscillating valve, and cannot reach the aerial.

The Tropadyne

One of the best known devices is called the Tropadyne, which has been described on various occasions. In such a Tropadyne circuit it is possible by careful balancing to prevent the oscillations in the oscillating circuit from getting to the aerial. In Fig. 1 the loop aerial is shown as a coil L_1 with a tuning condenser C_1 across it. The oscillating circuit consists of a grid circuit L_2

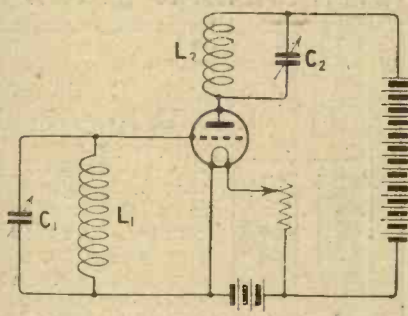


***Fig. 2.**—In this arrangement oscillations will be generated when the circuits L1 C1 and L2 C2 are brought into resonance.*

C_2, with a reaction coil L_3 in the anode circuit. The coil L_2 is tapped at its centre point, and this acts as one of the leads to the loop aerial.

Neutralising Condenser

The oscillations in this circuit L_2 C_2 would normally go through the loop in order to complete the circuit of the valve from filament to grid, but instead of this the condenser C_3 is provided from the lower end of the inductance L_2 to the filament.

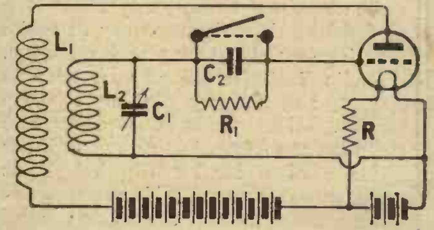


***Fig. 3.**—The circuit of the oscillating valve wavemeter used in the experiments described. The grid-leak, which has a high resistance value, may be left in circuit to provide damped oscillations, or short-circuited to produce continuous waves.*

By means of this small variable condenser it is possible to neutralise the high - frequency oscillations which would otherwise pass through the loop circuit L_1 C_1 by means of passing through the valve.

Other Methods

Another method for preventing an oscillating circuit from radiating from the aerial was described in *Modern Wireless* for December, and is called the rejector circuit.

A further device which is used in

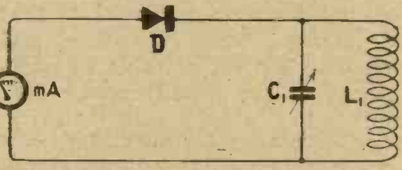


***Fig. 4.**—The detecting device used in conjunction with the oscillating wavemeter (Fig. 3) included a crystal detector and a microammeter.*

supersonic circuits is to have a high-frequency stage of amplification before the oscillator and detector valve. More will be said about this device later when dealing with other forms of circuits. There are other devices in supersonic circuits which, although they do not exist primarily for preventing the aerial from oscillating, assist towards this end.

Receivers with H.F. Amplification

We shall now consider the case of receivers employing high-frequency amplification. The problem we have to attack is whether it is possible with this type of receiver to oscillate one of the valves without making the aerial radiate. It is, of course, obvious that the valve which is to oscillate should not be directly coupled to the aerial, but that it should be the second or third valve in the series, the first or second valves being ordinary high-frequency amplifiers. The problem

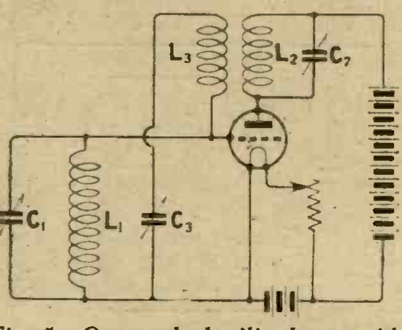


***Fig. 5.**—One method utilised to provide a neutrodyne effect in the circuits of a high-frequency valve.*

resolves itself into the possibility of a high-frequency valve allowing oscillations to pass one way through the valve and not the other way.

A Practical Circuit

Referring to Fig. 2, which is a diagram of a high-frequency valve circuit, we know that if oscillations are impressed upon the grid coil, by coupling an oscillating circuit to it, the oscillations will pass through the high-frequency valve and be amplified. Now if we repeat the process in the reverse direction by feeding in oscillations to the anode coil L_2, it would appear that very little energy should be transferred to the grid coil. The effect of the impressed oscillation on the anode coil is to increase the anode volts slightly, and this should have very little influence on the grid volts.

Results Anticipated

There is, however, another effect, which is that we have high-frequency oscillations in the coil L_2 which are impressed on the valve, and there is a capacity between the anode and grid of the valve, so that this capacity offers a path for the high-frequency oscillations to pass to the grid circuit. There is very little chance here of amplification, and we should expect to have only an exceedingly small portion of the oscillating currents getting through to the grid circuit.

Testing for Radiation

Experiments were made to investigate whether any such oscillating currents really did get through the valve in this way. The apparatus employed for this purpose consists of an oscillating wavemeter shown in Fig. 3. This has no unusual feature about it, except the fact that a switch is used across the grid condenser and leak, and that the grid-leak has a very high value, so that when the grid-leak was used the wavemeter acted as a transmitter of damped oscillations, a note being produced. Thus we could use the wavemeter either as a source of continuous waves or of damped waves. The detecting device is shown in Fig. 4. This consists of an oscillating circuit with an inductance L_1 and a condenser C_1, with a crystal and a microammeter across the circuit.

Result of Tests

The oscillator was first of all coupled loosely to the grid coil, and the detecting circuit coupled to the anode coil. The oscillating circuit had a high-frequency oscillating current of 5 milliamperes. In the detecting circuit, a current of 70 microamperes was obtained. On reversing the conditions and using the oscillator coupled loosely to the anode coil L_2 and the detector circuit coupled to the grid coil L_1, the current obtained in the microammeter was only 5 microamperes. Thus a simple high-frequency valve circuit, of the type shown in Fig. 2, allows oscillations to pass much more easily through the valve from grid to anode than in the reverse direction. Thus such a circuit would prevent oscillations in one of the later valves of a receiver from being violently communicated to the aerial.

Neutrodyning

The next experiment was to neutrodyne the high-frequency valve circuit, and to make similar tests. The neutrodyne effect was introduced in two different ways, as shown in Fig. 5 and Fig. 6. In Fig. 5 the method is shown of connecting an inductance L_3 and condenser C_3 in series between the grid and the filament, and coupling the inductance to the anode inductance L_2. In Fig. 6 the neutrodyne device employed was to join the anode battery to the mid-point of

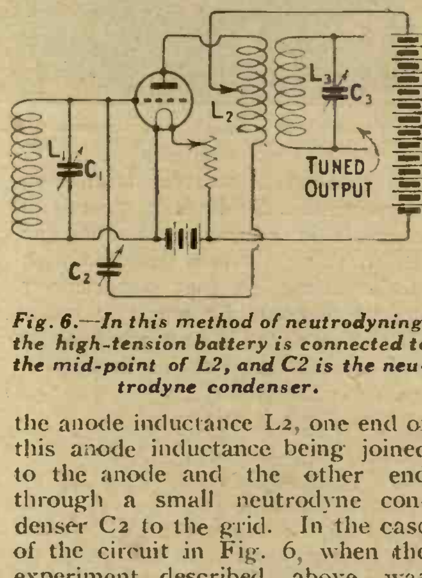


***Fig. 6.**—In this method of neutrodyning, the high-tension battery is connected to the mid-point of L2, and C2 is the neutrodyne condenser.*

the anode inductance L_2, one end of this anode inductance being joined to the anode and the other end through a small neutrodyne condenser C_2 to the grid. In the case of the circuit in Fig. 6, when the experiment described above was repeated no current at all was obtained in the grid coil.

Unwanted Effects

It is to be expected that this would occur in such a case, since the high-frequency current is now fed to the grid circuit through two capacities, that of C_2 and that of the capacity of the valve from anode to grid. The very principle of neutrodyning is to adjust this capacity C_2 to be equal to that of the anode-grid capacity of the valve, and thus the high-frequency oscillations cannot get through to the grid. It is very important in such a case that other reaction effects in the circuit should be avoided, such as the direct influence of the anode coil on the grid coil, and again the effect of capacity between various wires.

Tests Between Aerials

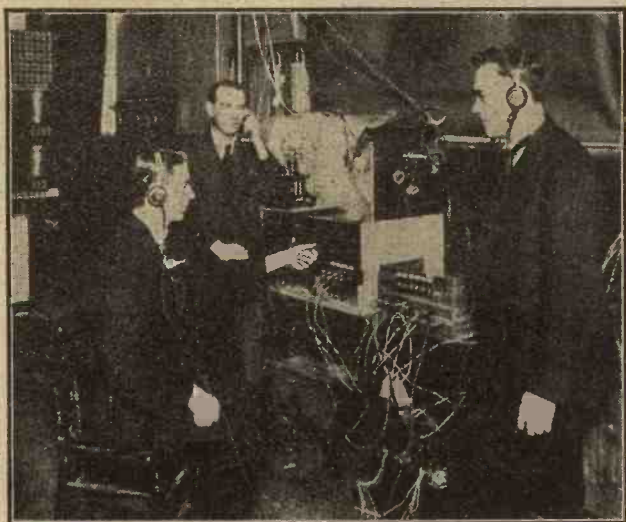
The next experiment was to investigate whether in fact there was any actual radiation from an aerial which could be detected by a neighbouring aerial. A two-valve receiver was fixed up, employing the neutrodyne principle in one of the valves, as shown in Fig. 6. This two-valve receiver is shown diagrammatically in Fig. 7. The valve V1 is neutrodyned, and the second valve V2 is a detector with anode tuning, so that if necessary this valve could be made to oscillate. The aerial is connected to the grid coil of the valve V1 through a tuning condenser C.

Parallel Aerial Systems.

The high-frequency valve V1 was neutrodyned and a very stringent condition of test was employed, to use an aerial which was almost parallel to the aerial of the receiver, these two aerials being at an average distance of about 10 ft. apart, varying from about 20 ft. to about 3 ft. This second aerial employed a crystal detector.

Successful Tests

Both aerials with their respective circuits were tuned to the London broadcasting station. The crystal circuit picked up the London signals without interference when the valve V1 was neutrodyned and when the valve V2 was acting as a detector. Even when the valve V2 was made to oscillate no sign of the oscillation was heard in the crystal receiver. The tuning of the valve circuit V2 was varied, in order to give some opportunity of hearing the heterodyne beats with the carrier wave of London, but no trace of these could be obtained. On cutting out the neutrodyne condenser in valve V1, oscillations were of course violent, and the crystal circuit was jammed. The high-frequency transformer used in this case was that employed in Mr. Percy W. Harris' "Special Five" receiver (*Modern Wireless*, November, 1925). This experiment was repeated, using the neutrodyne principle shown in Fig. 5, with the same results. Great care must be taken in wiring receivers of this type, so as to avoid direct influence from the oscillating valve on the aerial.



In the control room at 3LO, Melbourne, during the first simultaneous broadcasting experiments carried out in Australia.

Single-valve Circuits

Thus in using high-frequency amplification it is possible to prevent one's aerial from radiating, and at the same time to have the advantages of oscillating one of the valves of one's receiver, and thus be able to search for distant stations. Some attention should now be given to the case of receivers which have no high-frequency stages, but which are using reaction. In such a case it is, of course, impossible at present to oscillate this valve without causing radiation. In this case it is possible to cause a minimum of radiation by arranging that as soon as the valve commences to oscillate it oscillates feebly. This, however, does not satisfy the conditions that we imposed upon ourselves, and even with the most feeble of oscillations it is not to be recommended.

Wavemeter for Searching

To those who do not wish to use the neutrodyne principle, the use of a wavemeter is recommended for searching purposes. This wavemeter should be of the transmitting type, and it should be set to the frequency of the transmitting station which is being searched for. The receiver should then be tuned to its most sensitive condition on the actual frequency, and very little adjustment should be required afterwards in order to find the distant station. This type of transmitting wavemeter is assumed to be of the non-heterodyne type.

Heterodyning with Wavemeter

Such wavemeters are not so accurate as the heterodyne type, and using a heterodyne type of wavemeter it is possible to find a distant station by using the wavemeter very loosely coupled to the receiver, tuning the wavemeter to the frequency desired, and then adjusting one's receiver to the most sensitive condition so that the local wavemeter produces heterodyne beats with the distant station. By keeping the wavemeter as loosely coupled as possible to the receiver it is possible to prevent the radiation from being a nuisance to one's neighbours.

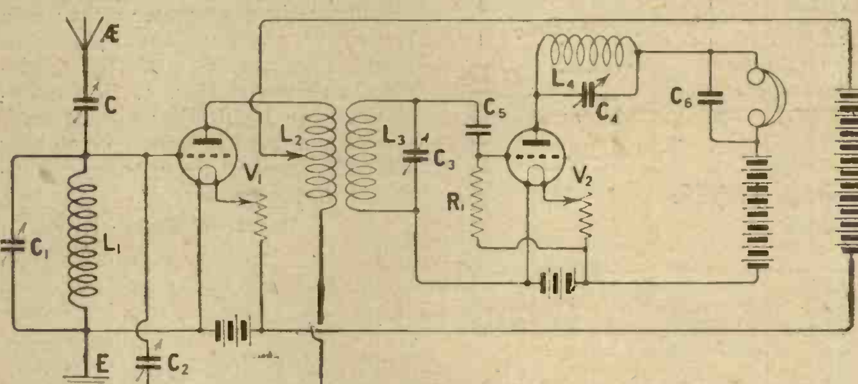


Fig. 7.—The theoretical circuit of the two-valve receiver, comprising a neutrodyned high-frequency stage and a detector valve, which was tested for radiation as described.

An Efficient Transmitting Inductance

A transmitting inductance of low-loss type may be constructed quickly and easily on the lines indicated in this article.

THE amateur transmitter may occasionally find himself, as the writer did, at a loss because of the lack of a particular transmitting inductance. In the writer's case it was desired to change a direct-coupled transmitter over to loose-coupled, and, in view of the small transmitting aerial employed, it was necessary to provide a large loading inductance in order to bring its frequency down to the desired value.

Speedy Construction

This loading inductance was required rather in a hurry, which put

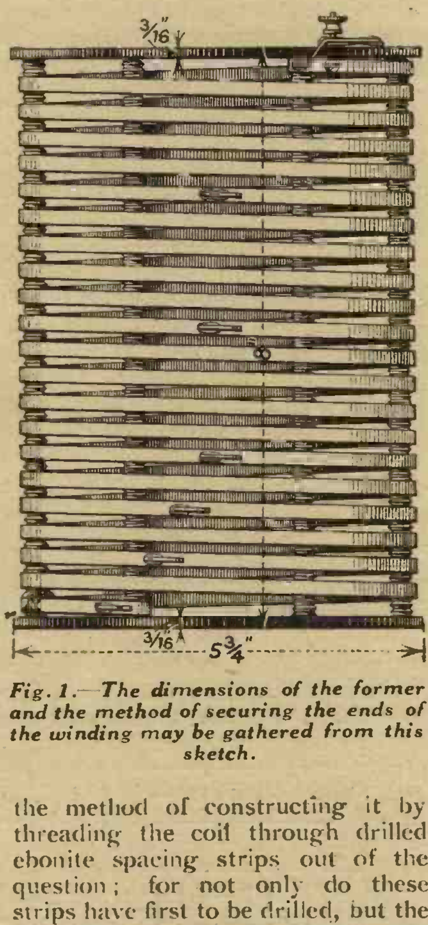


Fig. 1.—The dimensions of the former and the method of securing the ends of the winding may be gathered from this sketch.

the method of constructing it by threading the coil through drilled ebonite spacing strips out of the question; for not only do these strips have first to be drilled, but the threading of the coil through the holes is a tedious process. Also, the coil has to be mounted rigidly in some fashion before it is ready for use.

The coil to be described here took just over twenty minutes to construct, and although it may not, perhaps, be actually a "no-loss" coil, it is certainly a low-loss coil.

Materials

The only materials required for the construction of this coil are one Collinson low-loss former, 6 in. in diameter, three $\frac{1}{4}$ in. by $\frac{1}{2}$ in. strips of ebonite, 6 in. long, and about $1\frac{1}{2}$ lbs. of $\frac{1}{4}$ in. by 24 gauge bronze strip. The ebonite strips are used to strengthen the former at the centre, as otherwise the rods comprising the former would bend as the winding was put on, and would probably finally break.

Winding the Coil

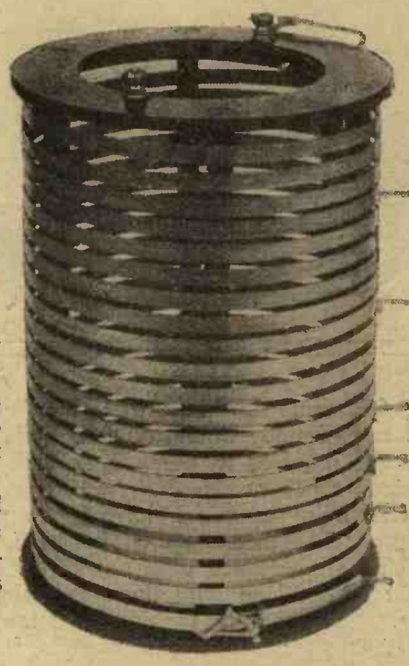
The one end of the winding was fixed by bending the strip round one of the rods of the former, and drilling a small hole right through the strip and fixing it with a screw and nut, as shown in the drawing. The task of winding the coil itself is one that certainly requires two persons, owing to the springy nature of the bronze strip. One person should take the coil of strip and pay it out slowly to the other, who winds it on to the former. The turns should be spaced about 1/16th of an inch, and it will be found that the standard former employed takes about 20 turns with ease.

Securing the End

The end of the winding was secured round one of the supporting rods in a similar manner to that used at the beginning, only as it was found somewhat difficult to drill through the springy strip when in position on the former, the end, which was bent back round the rod, was secured in position with a piece of wire, which was also fixed round one of the rods, thus firmly fastening the end of the winding.

Tapping Points

The top end of the winding was connected to a terminal, and pieces of square tinned wire were soldered on at regular intervals to give tapping points, by means of which various numbers of turns of the coil could be put in circuit with a flexible lead and a spring clip. As this



Short lengths of wire for tapping points are soldered to the bronze strip, external connections being made by means of spring clips.

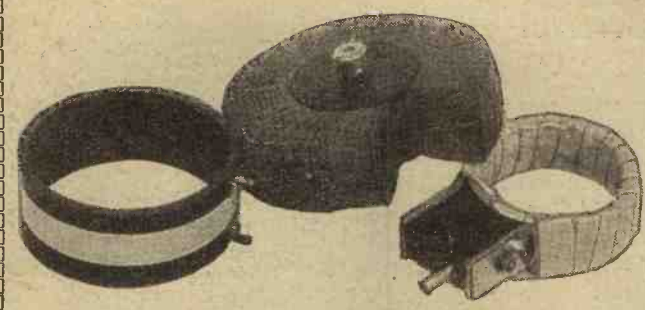
coil was used for loading the aerial, only a small number of tappings was required, but if it is intended to be used as a main transmitting inductance in, say, a Hartley or

Ebonite cross-pieces are fitted inside the former to prevent it from buckling when the strip is wound on.

Reinartz circuit, every turn should be tapped. For convenience the taps may be staggered in three rows.

When completed, the coil presents a serviceable appearance, and as the bronze strip does not easily oxidise it will keep its polish for some time.

THE DESIGN OF TUNING CIRCUITS



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

In this article the subject of the design of tuning circuits is treated exhaustively, and the decrement required under various conditions is worked out. These theoretical results are compared with practical values, and thus the reader is able to see at a glance just where low-loss coils are desirable.

FOR some time past there has been a tendency to use specially wound types of coils in circuits which are required to possess specially sharp tuning. Various types of low-loss windings have been employed, many of which have given particularly good results. The fact remains, however, that the results which were obtained were not surprisingly better than could be obtained with quite ordinary types of windings. This led to the investigation of the actual resistances of various types of coils, these results being remarkable in that the actual values of the resistances were very much higher than one would anticipate at first sight.

A Standard for Comparison

Some of the results obtained on various types of tuning coils have been published from time to time in these columns, and it is interesting at this stage to co-ordinate these results, and also to obtain some sort of standard with which any future results may be compared, by considering exactly what the requirements are in any particular tuning circuit.

In my article last week I showed that the decrement of a circuit enabled us to gauge its particular properties very simply. In order to see how this may be done it will be advantageous to consider the matter from first principles. The current in a circuit produced by the application of an alternating voltage E is given by $\frac{E}{Z}$, where Z is the property known as the impedance of the circuit.

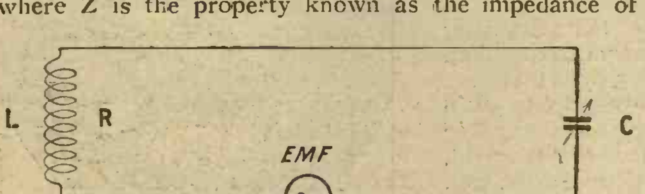


Fig. 1.—A simple resonant circuit.

For a circuit such as that shown in Fig. 1 the impedance is given by

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

where R, L and C are the resistance, inductance and capacity and $\omega = 2\pi \times$ frequency.

Reactance

The expression inside the bracket is termed the reactance of the circuit, and is made up of a component due to the inductance, equal to $L\omega$, and another component due to the capacity, which is $\frac{1}{C\omega}$. It will be seen that these two components act in the opposite direction, and the condition of resonance is that which obtains when the two are equal, when the total reactance in the circuit reduces to zero. In this case the impedance of the circuit Z_0 becomes simply R, this being the resistance in the circuit.

Determining the Degree of Selectivity

Consider now the impedance Z_1 at a frequency slightly different from the resonance frequency. Let the new frequency f_1 be β times f_0, the resonant frequency. Then $\omega_1 = \beta\omega_0$. In this case the expression for the impedance reduces to

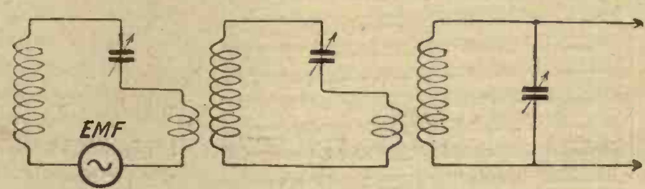


Fig. 2.—Selectivity is improved by using a chain of filters.

$$Z_1 = \sqrt{R^2 + \left(L\omega_1 - \frac{1}{C\omega_1}\right)^2}$$

$$= \sqrt{R^2 + \left(\beta L\omega_0 - \frac{1}{\beta C\omega_0}\right)^2}$$

This expression can be simplified, remembering that $LC\omega_0^2 = 1$, to

$$Z_1 = \sqrt{R^2 + \left[L\omega_0\left(\beta - \frac{1}{\beta}\right)\right]^2}$$

The current in the circuit is obtained by dividing the applied voltage by the impedance, so that if we have a constant applied voltage E, then the current is inversely proportional to the impedance.

$$\text{Hence } \frac{I_0}{I_1} = \frac{\sqrt{R^2 + \left[L\omega_0\left(\beta - \frac{1}{\beta}\right)\right]^2}}{R}$$

$$= \sqrt{1 + \left[\frac{\pi\left(\beta - \frac{1}{\beta}\right)}{\delta}\right]^2}$$

This ratio $\frac{I_0}{I}$ is a measure of the selectivity of the circuit.

Use of Coupled Circuits

A single circuit, however, is seldom used when selectivity is required, so that we have to consider next the case of a chain of tuned circuits, such as is shown in Fig. 2. In the majority of receivers a simple cascade filter of this type is replaced by one employing valves to couple the successive stages, or else a combination of the two methods. Where transformer coupling is employed, however, as is usually

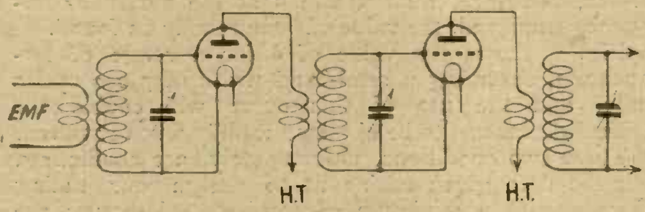


Fig. 3.—A valve-coupled filter such as this is electrically similar to the circuit shown in Fig. 2.

the case, the electrical conditions are similar. With the tuned anode arrangement certain secondary effects are introduced, and this method will be neglected for the present.

Chain of Circuits

In the case of a chain of circuits, therefore, we have two factors to consider. In the first place, the current produced by the interfering signal is successively reduced at each stage. Secondly, a point which is often overlooked, the e.m.f. induced in each succeeding circuit is dependent on the frequency. If both these effects are taken into account, the selectivity ratio becomes

$$S = \left(\frac{1}{\beta}\right)^{n-1} \left\{1 - \left(\frac{\pi\left(\beta - \frac{1}{\beta}\right)}{\delta}\right)^2\right\}^{\frac{n}{2}}$$

where n = number of circuits.

S = ratio of current at resonant frequency f_o to that at a frequency βf_o.

δ = decrement $= \frac{R}{2f_oL}$ where R is in ohms, and L in henries.

This expression, unfortunately, is not simple, but I have obtained from it a series of curves which enable the necessary results to be deduced without much trouble.

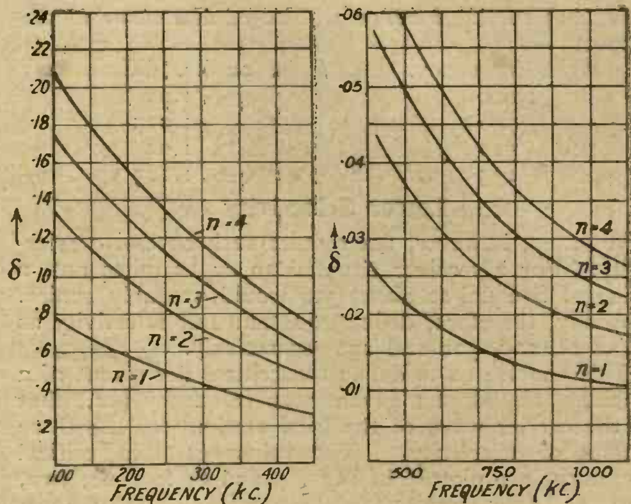


Fig. 4.—In order not to cut off the side bands unduly and so produce distortion, the decrement of each circuit must be greater than the critical values given above.

Definition of Selectivity

Before proceeding, however, it will be as well to obtain a definition of good selectivity. It will be agreed that a receiver situated within two miles of the local station, which will receive satisfactorily a similar station 500 miles away operating at a frequency only 20 kilocycles different, would be considered very good. The detector current is proportional to the square of the voltage applied across it, *i.e.*, to the square of the current in the last circuit. If we assume the current ratio to be $\frac{1}{5}$, this gives a signal strength ratio of $\frac{1}{25}$, which would be very good. Since, however, the e.m.f. set up in the aerial by the local station is at least 250 times as great as that produced by a station 500 miles away (and probably even more), this requires the ratio S to be at least 1,250, for the given frequency difference of 20 kilocycles.

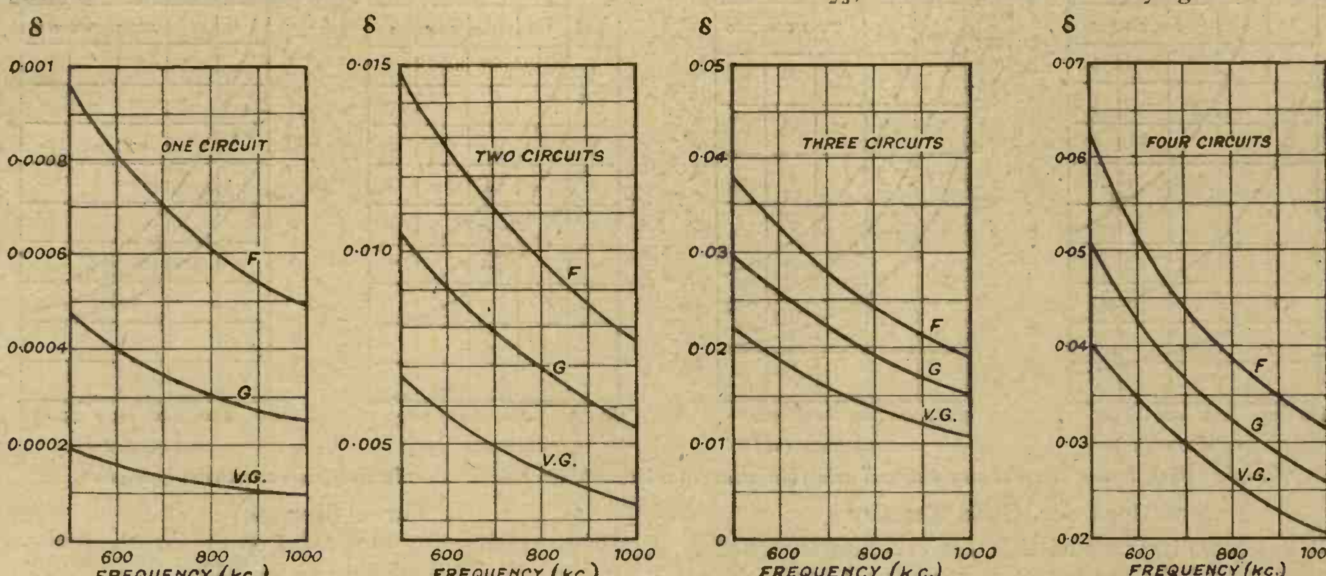


Fig. 5.—To obtain adequate selectivity the decrement of the tuning circuits must be less than the values shown above. The three grades of selectivity (V.G., G. and F.) are defined in the text.

The value of β depends upon the frequency; 20 kc. at a mean frequency of 1,000 kc. is a greater percentage than at a mean frequency of 500 kc. The value can readily be determined in any particular case, and the table below will be of assistance in this respect :—

Mean frequency.	β for 20 kc. difference.
1,000	1.02
750	1.027
500	1.04
175	1,115

Lower Selectivity

We may, however, not require such excessive selectivity. For a receiver situated 10 or 12 miles out, a value of S equal to about 500 would probably suffice. We may, therefore, define good and fair selectivity as ratios of, say, 500 and 250 respectively.

This enables us to define the critical decrement of a receiving circuit at a given mean frequency (*i.e.*, that of the carrier wave of the local station) for the three classes of selectivity. The values of this critical decrement are plotted in Figs. 5 and 6, for one, two, three and four circuits.

Distortionless Tuning

Having chosen which class of receiver is required, it is then possible to work out the critical decrement, for one, two, three or more tuned circuits, by referring to the curves just given. The question as to the number of tuned circuits to be employed is controlled by the conditions for adequate reception. As I showed last week, if the resistance in the circuit is reduced below a certain value, the quality of reproduction suffers. The question thus arises as to what is the limiting value of this resistance in any particular case.

In such circumstances, it is unscientific to make calculations based on mathematical ideals, and it is probable that little alteration would be noticed in the quality if the semi-band width of the resonance curve was reduced to 3,000 instead of 4,000 cycles.

Value of Critical Decrement

The actual value of the critical decrement of the circuit may be readily obtained from the formula previously given. In this case the term S has the value 2. If, therefore, we evaluate β at the particular frequency employed, the value of δ can readily be found.

Fig. 4 shows the value of δ for a range of frequencies, assuming a semi-band width of 3,000 cycles only, and the use of this curve will enable the critical decrement to be obtained rapidly when required.

These two conditions, unfortunately, are conflicting, but the data given enable us to design our tuning circuits with a minimum of trouble. Although the mathematical working has been given in a fairly detailed manner, the actual results are obtained in a simple form, and a few practical examples will serve to show the usefulness of this method of designing tuning circuits.

An Example

Assume a mean frequency of 750 kc. (corresponding to a wavelength of 400 metres). For good quality the decrement should be *greater* than

.015 for 1 circuit;
.025 for 2 circuits;
.033 for 3 circuits;
.039 for 4 circuits.

With a single circuit the decrement, even for fair selectivity, must not exceed .0007 at this frequency, so that one circuit is inadequate. With two circuits the decrement permissible for fair selectivity is .01, whereas for good quality we require .025.

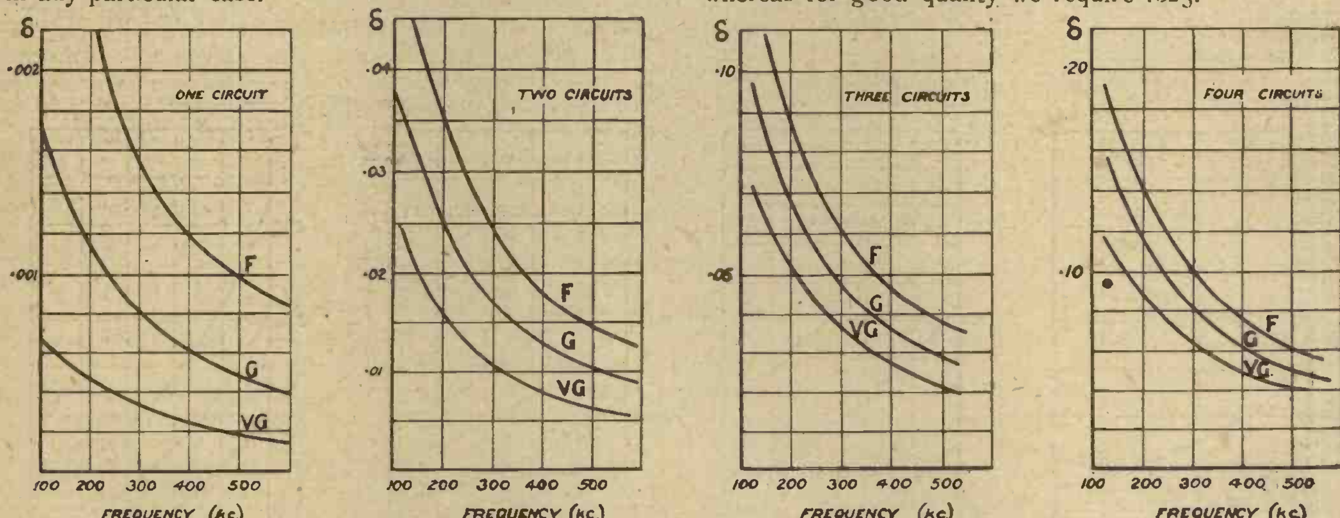


Fig. 6.—With lower frequencies the permissible decrement to obtain adequate selectivity is considerably higher.

Conditions for Good Quality

It is generally accepted that the criterion for good quality is that the current at a frequency 4,000 cycles difference from the resonance value shall not be less than one-half the maximum. This appears to be a reasonable value. Even so the higher harmonics are going to suffer somewhat, but it must be remembered that in the reception of distant stations the reproduction is usually marred by atmospherics and other parasitic noises which tend to detract from the general quality of reproduction.

Three Circuits

Better results are obtainable with three circuits. Here the decrement should exceed .033.

Fair selectivity requires a decrement of .026 and good selectivity with .02. These values are approaching the ideal, and a compromise is obtainable by using a tight-coupled aerial which enables us to increase the decrement slightly and still to obtain the necessary selectivity.

With four circuits both fair and good selectivity are practicable, but very good selectivity requires even

(*Continued on page* 413)

Super-Regeneration at the Higher Frequencies

By A. V. D. HORT, B.A.

It is well known that the efficiency of super-regenerative circuits of the "Armstrong" type increases with an increase in the frequency of reception. In this article details are given of a super-regenerative unit which can readily be attached to an existing single-valve short-wave receiver.

SUPER-REGENERATIVE circuits, whether of the "Armstrong" or Flewelling type, would appear to have gone more or less out of fashion at the present time. At one time, it will be remembered, such circuits had a considerable vogue. A description of a successful circuit of the "Armstrong" type, devised by A. D. Cowper, M.Sc., was published in *Modern Wireless* for May, 1923. More recently, however, the development of the superheterodyne has pushed into the background these simpler arrangements—simpler from the constructional point of view, that is to say.

The "Armstrong" Circuit

One of the main disadvantages of the super-regenerative receivers, especially in their simpler forms, is the sustained whistle which is audible continuously when the circuit is functioning correctly. This feature has probably deterred many experimenters from using the circuits to any considerable extent. There is no intention here to go deeply into the theoretical aspects of the circuits. It will suffice to remind readers, taking the single-valve "Armstrong" super-regenerative circuit, which is the subject of this article, that on the ordinary high-frequency oscillations of a detector valve are superimposed other oscillations at a comparatively low frequency.

High and Low Frequencies

Now the amplification obtainable with the circuit depends mainly on the frequency of the low or "quenching" frequency oscillations relative to that of the high-frequency oscillations. For instance, in a receiver designed for the 600- to 1,000-kilocycle (300 to 500 metre) band, if the quenching oscillations are of a frequency above audibility, the amplification obtained will not be high. With an audible frequency considerable amplification will be obtainable, the amplification increasing as this frequency is lowered; a constant setting of the high-frequency tuning circuits is assumed for purposes of comparison.

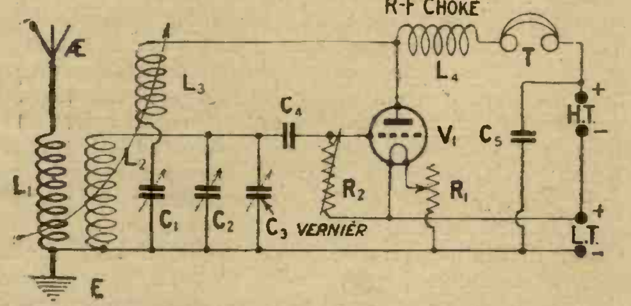
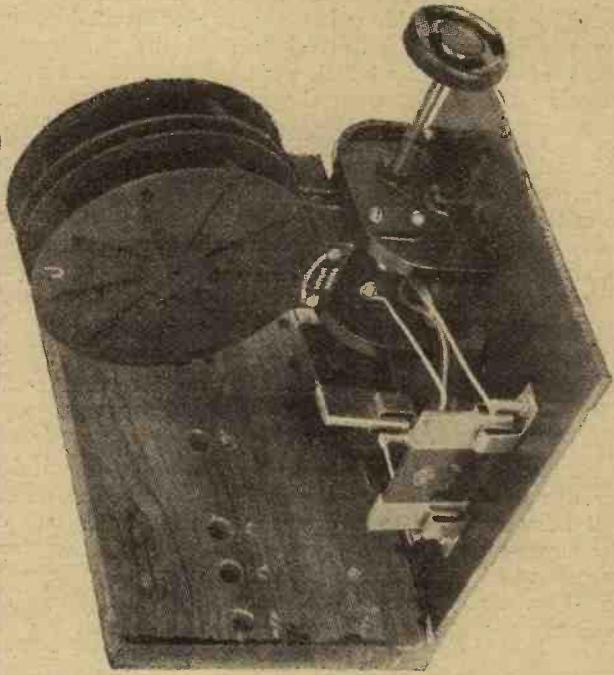


Fig. 1.—The modified "Reinartz" form of circuit used in the short-wave receiver before adaptation.



The simple construction of the super-regenerative unit will be obvious from this photograph.

Limits of Amplification

It might be supposed from this that it is only necessary to use a very low frequency relative to the normal high frequency of the tuning circuits to get very great amplification. Unfortunately, as the quenching frequency is lowered, so distortion increases. On the band of frequencies quoted, spark notes become extremely "hoarse," C.W. loses its character and is not at all easy to read, while telephony, of course, is rendered utterly unintelligible.

Higher Frequencies

So far the 600- to 1,000-kilocycle (300 to 500 metre) band or thereabouts has been discussed. Since, however, a wide *difference* between the tuning and quenching frequencies will give good amplification, it would appear that good results should be obtainable at higher tuning frequencies. This is borne out in practice; in fact, in his first discussions of super-regenerative circuits, Major Armstrong emphasised the point that such circuits will function better the higher the signal frequency.

Elimination of Whistle

Incidentally, another gain in the use of the super-regenerative circuit for very high-frequency reception is that the whistle of the quenching frequency can be almost, if not altogether, eliminated. There is no longer any need to devise filters consisting of chokes and condensers to by-pass the low-frequency oscillations of this particular frequency across the telephones, while audio-frequency impulses, distinct from the quenching frequency, alone affect them. When one is working on the shorter waves, frequencies increase so rapidly with decreases in wavelength that there is no need to work with quenching oscillations of an audible frequency at all. Quenching oscillations of a super-audible frequency give excellent amplification around 8,571 kilocycles (35 metres), for instance.

In order to secure greater amplification the quenching frequency can readily be lowered, if desired. The provision of a suitable value of capacity shunted across the telephones will effectively reduce the penetrating effect of the high-pitched whistle, without seriously affecting the efficiency of the receiver.

A Super-Regenerative Unit

Turning now to practical matters, it is proposed to describe a super-regenerative unit, which is very simple to construct and which can be attached to most single-valve receivers with reaction, little modification of the existing circuit arrangement being necessary. The writer has used this unit in conjunction with the short-wave receiver described by him in *Wireless Weekly*, Vol. 6, No. 23. The circuit of that receiver is reproduced here (Fig. 1), and it will be seen that a modified "Reinartz" type of circuit was employed.

Circuit

Now this type of circuit is, as it stands, unsuitable for use with the super-regenerative unit. The choke coil L4 was found to interfere with the functioning of the super-regenerative arrangement. It was therefore necessary to convert the circuit to the form shown in Fig. 2, which is practically that of an ordinary "straight" single-valve circuit with reaction. At high frequencies, however, movements of the reaction coil cause inconvenient changes in the tuning frequency; the condenser C1, therefore, is connected between the anode of the valve and earth, to provide the requisite final control of

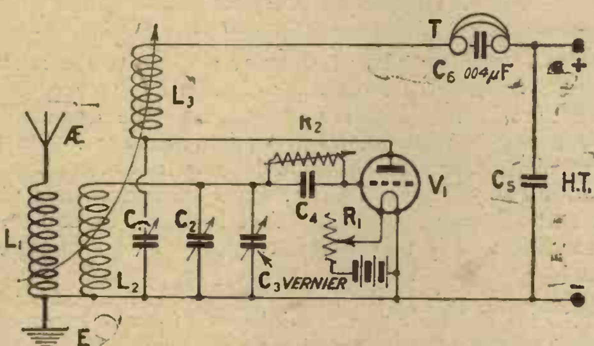


Fig. 2.—The circuit of the short-wave receiver as modified for use with the super-regenerative unit. This circuit may be compared with that given in Fig. 1.

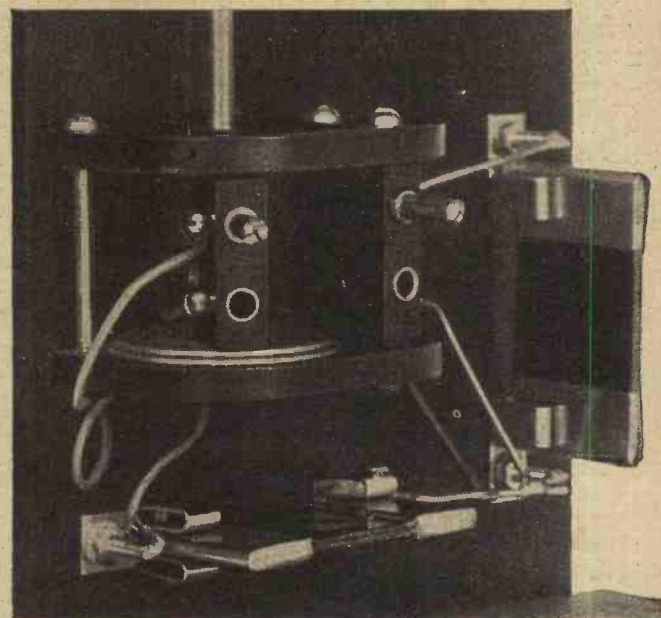
reaction. Also the grid leak is connected direct across the grid condenser, and not direct to filament positive.

Components

The super-regenerative unit consists of two coils in a two-coil holder, with a fixed condenser in parallel with each coil. A No. 1,500 and a No. 1,000 plug-in coil will be required, and clip-in condensers are very convenient, owing to the ease with which various values may be tried in circuit. In the unit shown in the photograph the coil-holder is mounted on a small ebonite panel, itself attached to a baseboard, one Gambrel J and one Gambrel I coil being used. Clips for the shunting condensers are attached to the panel by means of terminals, so that the connections can readily be attached on the front of the panel.

Connecting Up

The complete circuit of the receiver and the unit is shown in Fig. 3. One end of the No. 1,500 coil is connected to the "earth" lead, the common connection of the two coils to low-tension positive of the battery, and the remaining end of the No. 1,000 coil to high-tension negative. It is essential to shunt both the high-tension battery and the telephones with fixed condensers. A capacity of .004 μF across the tele-



The wiring of the unit may be seen in this photograph.

phones was found adequate to provide a free path for the quenching oscillations, and to reduce any whistle to a minimum. Care should be taken to see that the quenching coils are connected relatively the right way round. If the "earth" connection is taken to one pin of the coil-holder, H.T. negative will go to the other pin, and the two sockets will be connected to the filament.

Testing

Before the unit is brought into use, the receiver should be tested to see that it oscillates properly itself. This test can be carried out at any time by shorting across the quenching coils. After connecting up the unit, the reaction coil of the receiver and the movable coil of the unit should be swung right away. A .003 μF condenser may be connected across the No. 1,000 coil, and a .002 μF across the No. 1,500 coil. On switching on the valve filament, and applying ample H.T. (not less than 80 volts, and preferably more, depending on the valve used), a high-pitched whistle should be heard. With the unit described, on tightening the coupling of the quenching coils the note of the whistle fell slowly, changed pitch sharply with a shriek at about 45 degrees, became a loud rushing sound, and finally changed to a clear whistle again when the position of tightest coupling was reached. These phenomena may vary somewhat with different H.T. values and so on. The important sound to listen for is the rushing sound just before the tightest coupling.

Searching for Signals

If the unit is functioning correctly, it will be as well, till practice has been acquired in handling the set, to proceed as follows:—With the unit short-circuited, tune in a fairly strong signal on the receiver. Then remove the short-circuiting wire, and, with the quenching coils tight-coupled, readjust the receiver

Terminals are mounted on the vertical panel for convenience in connecting the unit to the receiver.

slightly till the same signal is heard. Now slowly loosen the coupling between the quenching coils, when the signals should increase in strength, accompanied by an increasing rushing noise. A point will be reached when the signals are of maximum audibility relative to this rushing sound. Looser coupling will give still greater amplification, but atmospheric and parasitic noises will be amplified also to such an extent that the signals will be practically swamped.

Optimum Working Frequency

The receiver and super-regenerative unit were found to function most satisfactorily above 6,000 kilocycles (below 50 metres). At frequencies below this the quenching frequency had to be lowered also to give stable working and efficient amplification, and a larger reaction coil in the receiver than that normally used was required.

Actual Reception

The main reception tests were therefore carried out between about 6,000 and 8,571 kilocycles (35 and 50 metres). On this band signals from distant C.W. stations, about R3 or R4 on the receiver only, could be amplified to the limits permitted by atmospheric interference. Selectivity was decreased to a certain extent by the addition of the unit, but by tightening the reaction coupling and sacrificing a certain amount of the "super" amplification, no serious disadvantage was noticeable in this respect. Strong signals originating from stations fairly close to the receiver, such as those of the G.P.O. station 5DH at Dollis Hill, could not be amplified much more than weaker signals without increasing the H.T. voltage on the anode of the valve. Normally about 110 volts were applied to the anode of a small power-valve, a Mullard D.F.A.4 being the actual valve in use. A short indoor aerial was used, and earthing the set in the ordinary way was found to minimise body-capacity effects. The use of a 2-ft. frame aerial was less satisfactory with the circuit employed.

Telephony

Telephony from WGY, Schenectady, New York, at a frequency of about 7,500 kilocycles (40 metres) was observed for a considerable period. Various fixed condensers were tried in parallel with the quenching coils. It was found necessary always to have C7 of a smaller value than C8, in order to avoid instability of the circuit. With values of .001 μF and .002 μF for C7 and C8 respectively, no low-frequency whistle was audible, and speech from WGY was clear, though no great amplification could be obtained. It may be noted here that on the receiver alone WGY was audible with careful tuning, but portions of the programme were periodically inaudible owing to fading.

Lower Quenching Frequency

The substitution of capacities of .002 μF for C7 and .003 μF for C8 made the whistle audible, though it was not strong enough to be very noticeable. In fact, when WGY's transmission was correctly tuned in, no trace of a whistle could be detected at all. Amplification was greatly increased, and the best telephone strength obtainable, without pushing amplification so far that atmospheric and other interference predominated, was about equivalent to that experienced on an average receiver with a detector and one low-frequency stage at a distance of 20 miles or so from a main broadcasting station.

Speech and Music

Speech was plainly audible, even during the periods of fading. The only distortion observed was a slightly unnatural lowering of the pitch of the voice; there were no signs of the "quacking" or "clucking"

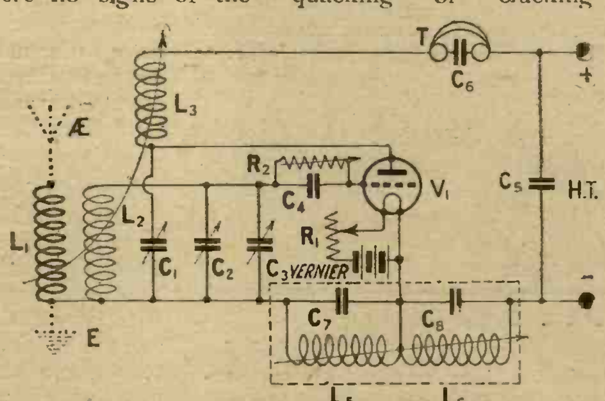


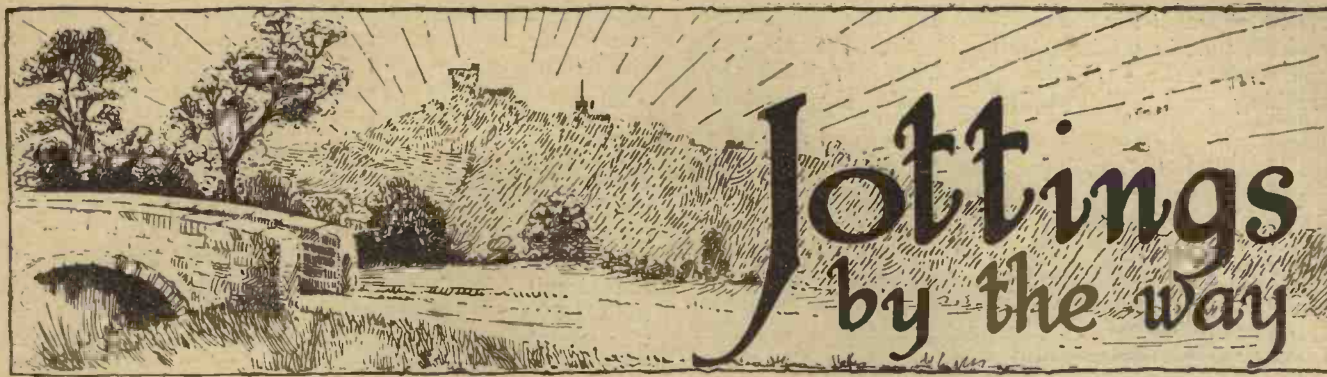
Fig. 3.—The complete circuit of the receiver and super-regenerative unit combined, the components included in the latter being enclosed in the dotted lines.

sounds sometimes associated with speech as heard on receivers of this type. A piano solo sounded rather "wooden" in tone, but harp solos were much better. Vocal solos, both soprano and tenor, came through excellently, and the words of the songs could be clearly heard.

Selectivity

No difficulty was experienced in tuning in this transmission. It was audible over about 5 degrees of a .0003 μF tuning condenser; normally a fraction of a turn on the vernier is sufficient to lose all trace of the station. Because of this flat tuning, a certain

(*Concluded on page* 415)



"IF," I said to Professor Goop, as we sat chatting the other night, "if a place like Oxford can have a studio of its own, then why on earth should we not have one in Little Puddleton? We have a message to give to the world, or rather to that part of it which is interested in the one and only hobby, whilst Oxford, I should imagine, had probably never even heard of wireless until that studio came along. And even when they had got their studio, they proceeded straightaway to miss their opportunities. It is needless for me to tell you that the topical talk on the opening night should have been 'Fashions for Men' by the Originator of Oxford Bags; for if it had not been for the style of its nether garments, Oxford could never have hoped to leap to its present fame."

. . . By the originator of Oxford bags . . .

Professor Goop received my suggestion with the utmost enthusiasm. He had always felt, he told me, a longing to tell the world something of his great discoveries in wireless. After a little discussion of the matter we decided to bring the suggestion before the wireless club at their meeting that very night, and this we duly proceeded to do.

Private Business

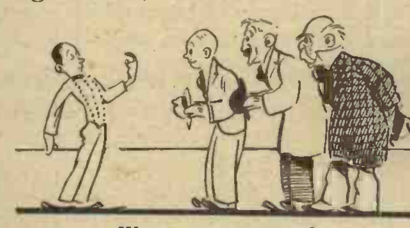
When General Blood Thunderby asked if any member had any private business to bring before the meeting, the Professor produced several sheets of paper from his coat pocket and began to read rapidly from the first of them. "Dear Sir," he read out. "We beg to bring to your notice that the enclosed account is very much overdue. . . ." He hastily turned to the second and proceeded, "Why be bothered by financial difficulties? I shall be only too glad to advance you from £5 to £50,000 on note of hand alone, without any unpleasant . . ." Seeing that he was again on the wrong tack, he turned to the third sheet, which was a communication to remind him that his telephone would be disconnected if he failed to pay last quarter's amount within three days. "Dear me, dear me," said the Professor, looking rather puzzled. "I am quite sure that I *had* some private business to bring before the meeting, and that I placed my notes in my coat pocket. I am equally sure that the private business was not of the kind that I have so far mentioned." Meantime, at the further end of the room, I was engaged in making frantic signals to him to try the other tail pocket.

First Aid

It was, of course, unfortunate that in the course of one of my gestures I should have dug my finger into Poddleby's ear, but I cannot see that there was any reason why he should then have called in the assistance of a great hulking fellow like Snaggsby to put me under the table. However, once I was under the table an idea came to me, as ideas generally do. I ran rapidly along on my hands and knees until I came to a pair of boots that I recognised as the Professor's from the fact that one was black and the other brown. Then, making my way out into the open, I neatly picked the Professor's pocket and passed the right bundle of papers up to him. I then made my way back to my own place, giving a growl when I was opposite Poddleby and biting him sharply in the leg. Poddleby leapt into the air with a scream and danced round the room on one foot. Several members had heard the growl and, knowing how dangerous a dog bite may be, took the necessary precautions. The protesting Poddleby was held down upon the table, whilst the wound was properly treated with a red-hot poker. Several people were quite sure that Poddleby had developed instantaneous hydrophobia, owing to the way in which he was foaming at the mouth. Mr. Hercy Parris discovered some time ago that similar behaviour on the part of accumulators was easily cured by the insertion of a pinch of Hudson's soap. Remembering this I dashed out at lightning speed to Mr. Muggs, the grocer's, and on my return gave Poddleby a whole packet. This, however, only seemed to make matters worse.

The Proposal

When Poddleby had at length escaped from those who were rendering first aid, order was restored with



. . . We were apparently expected . . .

some difficulty, and the meeting went on once more. By this time Professor Goop had once more mislaid his notes, and the only thing was for me to address the meeting in his stead. This I proceeded to do in my usual felicitous style. Naturally, I said, none of my hearers would have any great experience of what was known as broadcasting. All of us were serious experimenters, who, of course, made no use of broadcast transmissions—except when we were conducting experiments in the reception of wireless telephony. My own custom, I explained, was to confine experiments of this nature strictly to the evening hours between seven and eleven, and I had no doubt that

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other members did much the same kind of thing. At the same time we must not close our eyes to the fact that there were in the country thousands, nay, millions of people who used their receiving sets primarily as a means of entertainment. It was not an uncommon thing, I assured them, in the households of broadcatchers for the whole family to sit for a couple of hours or more each evening round the loud-speaker, listening with the utmost pleasure to the speech and music that it brought in for their benefit.

The Deputation

"And though they are not experimenters, as we are," I continued, "the majority of these people are dying to learn more and more about wireless. And who is most fitted to give them the information that they require? Is it not the Little Puddleton Wireless Club? And how can we give our message to the world, unless the B.B.C. provides us with a broadcasting studio?" Deafening applause greeted my remarks. Member after member rose to congratulate the Professor and myself upon the inspiration that had come to us, and before the end of the meeting it was decided unanimously that the B.B.C. must be shown its obvious duty. It was agreed that a deputation consisting of General Blood Thunderby, Bumpleby Brown and myself should visit Savoy Hill to lay our views before the Company. The Professor, though invited to do so, was too modest to join the deputation. He explained that it would hardly be seemly for him to go to the office of the Company and to blow his own trumpet. That, he felt, could be done much better on his behalf by somebody else if he were not there. The journey to London passed without incident. Arrived in London, we made our way promptly to Savoy Hill, and came to the palatial office of the Company. On entering we found that we were apparently expected, for a small boy, resplendent with many buttons, took charge of us before we could utter a word, and whirled us skywards in the lift. We supposed that other members of the club must have sent a telegram announcing our arrival.

Our Reception

The lift stopped, the lad flung open the gates and conducted us to a very pleasant room furnished mainly with armchairs and a grand piano. We had not been there many moments when there entered a young man with an exceedingly efficient look about him. Again no words of ours seemed to be required; in fact, we did not get a chance to utter a sound. "Just come and stand here in a row," said he, seating himself at the piano. We arranged ourselves, wondering what was coming next. "We will start," he said, "with John Peel. Let yourselves go and see if you cannot raise the roof." He struck a crashing chord, and, supposing that it was one of the customs of the place, we obliged with a splendid rendering of that fine old song. At least, Bumpleby Brown and I did our bit, though the General was growing more and more purple in the face, and it was plain that he was fighting for words. Just as the music ceased he let out one of his well-known roars. "I think that 'Hoiloa!' at the end sounds rather well," said the young man, "but you were just a *leetle* bit flat." He banged a note. "Now try again." This time the General produced a perfect neigh of rage. "No," said the young man, "it is a hunting song, but I don't think that we want any farmyard noises." At this moment the power of speech returned to the General. Who the blue blazes did the young man take

. . . *Bumpleby Brown and I did our bit* . . .

him for, and what in the thunder did he mean by this infernal tomfoolery? The young man looked blanker and blanker as the General proceeded. "But aren't you the Whitechapel Singers?" he asked. I will draw a kindly veil over the ensuing scene between him and our worthy president.

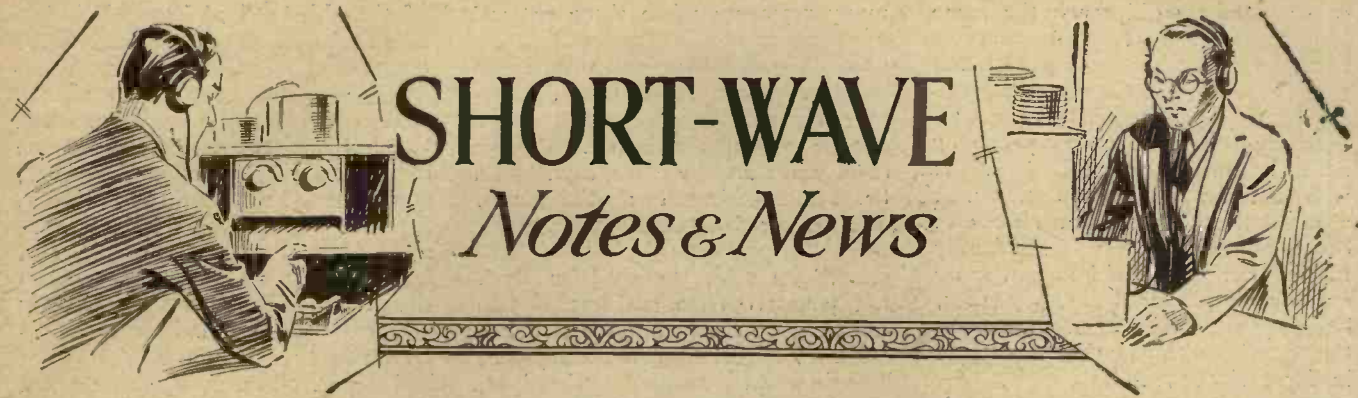
Soothed

I may say, however, that between us we made it perfectly plain to the young man that we were *not* the Whitechapel Singers. He began to say that he had suspected something of the kind when he heard us sing, but the General damped out any facetiousness with one awful look. We told him that we were members of the Little Puddleton Wireless Club. He said that he had never heard of the Little Puddleton Wireless Club. We very soon remedied that defect in his education. The General insisted upon seeing one of the Big Guns instanter, so that he might lay the facts of the outrage before him, and demand a full, frank and free apology. Our interview with the Great Man was exceedingly pleasant. He listened most sympathetically to our account of what had taken place, and then poured the most healing of oils upon the troubled waters. Having soothed the General, and having rendered first aid to the wounded pride of Bumpleby Brown and myself, the Great Man said that, as we were there, he had no doubt that we would like to see just how broadcasting was done. We spent the next hour most pleasantly in examining the transmitting gear, the studios, the noises off, and all the gadgets, bits, pieces, jims and doohickies that go to make up a broadcasting station. At the end of our tour round the building the Great Man and ourselves were like brothers.

An Oversight

"That's what I call a jolly pleasant afternoon," said the General, as we walked down the Strand. "It is a long time since I enjoyed myself so much. We shall have a lot to tell the other fellows when we get back to the club, shall we not?" "We shall, indeed," I agreed. "I should be looking forward whole-heartedly to to-night's meeting if it were not for one thing." "What's that?" asked the General and Bumpleby Brown with one voice. "Why," I said, "we entirely forgot to mention anything about the Little Puddleton studio." "Great Scott!" bellowed the General, "so we did. But I'll tell you what. We will send the rest of the club up next week as a deputation, and we will wire the B.B.C. on the morning of their departure to say that they *are* the Whitechapel Singers."

WIRELESS WAYFARER.



SHORT-WAVE *Notes & News*

DURING the past week the volume of amateur traffic audible has increased to a very great extent. The 6,667-kc. (45-metre) band is now quite as crowded as the 3,333-kc. (90-metre) band was during the corresponding period of last winter. European stations continue to fade out at about 17.00 G.M.T., but the Americans are now audible much later in the morning and much earlier in the evening. 5LF has worked a United States station at 10.00 G.M.T. and has heard a 6th district station at 10.45. He was also working a Canadian on Sunday, November 29, at 18.00 G.M.T.

A Good Day's Work

This extension of the time when it is possible to work real " DX " led 2KF to conduct what might be termed an " international daylight test." He started at 06.00 G.M.T. on November 29, and worked fairly continuously for twelve hours—till 18.00. During that time he worked the 1st, 2nd, 3rd, 6th, 8th and 9th U.S.A. districts, as well as Z-4AS and A-3YX, the latter station being worked at 18.00.

After these real " DX " stations had faded out, he worked Finland, Holland, France and Italy, thus showing Europe that we do not yet despise distances of 300 miles or so! During the previous week he was in communication with GFUP, a British ship in Hong Kong harbour, and BER of Bermuda.

Quartz Frequency Control

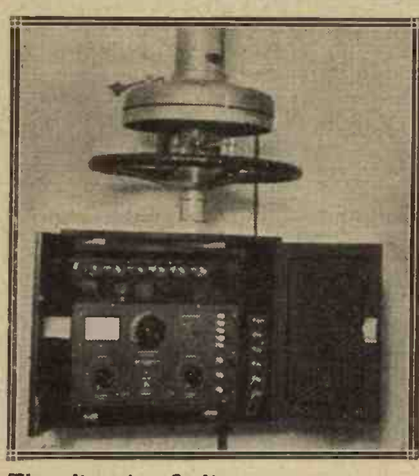
5LF, who has also worked these stations, informs us that he is now using a crystal-controlled transmitter. To the best of our knowledge, he is the first European amateur transmitter to do so.

5LS, of Blackheath, formerly one of the " big noises " of the South, and famous for the enormous variety of his sources of H.T. supply, has just started up properly with rectified A.C., having had the mains installed at last. He has worked 6YV of Whitley Bay, and Canadian 1AR.

Further North

Probably all this news from the London district will incite our Northern friends to do great things during the next week or so. They have already made a name for themselves, rather for consistency than record-breaking.

6YU, of Coventry, for no accountable reason, came in at strength R99 instead of his usual R25, on the morning of November 29. He has not increased power or altered any adjustments. He received 6QB's speech at R5 and C.W. at "R9+," when the latter was using an input of only 4.5 watts. Another northern station which has suddenly become painful to listen to is 6RW of West Derby, Liverpool. All these stations are working between 6,818 and 6,667 kc. (44 and 46 metres).



The direction-finding apparatus exhibited by the Radio Communication Company at the Olympia Shipping and Engineering Exhibition.

Higher Frequencies

With regard to the higher frequencies, the 20,000-kc. (15-metre) band seems to have lost all its popularity. We have listened there for an hour, the only station audible being a very strong harmonic of 5DH, the G.P.O. station working on 6,250 kc. (48 metres), who, incidentally, seems to spread very badly near his fundamental. This is probably due to the rough A.C. note employed. On about 10,000 kc. (30 metres) evidence of life is first heard, the majority of stations employing this frequency being of South American origin. We have no information from any official source, but Brazil seems to have been divided into districts in a manner similar to that employed in the United States, as, in addition to the usual " 1's " we have heard BZ-5AB, 5AF and 4AI. A station signing Y-FX1 has also started up in Uruguay, though the significance of the intermediate " Y " is difficult to follow.

The Antipodes

On about 8,330 kc. (36 metres) stations in the Antipodes can be heard almost any morning between 06.00 and 09.30, G.M.T. Conditions seem to have been reversed again, and these stations are better in the early mornings than in the evenings. A-3BD has, however, been heard at about 18.00 G.M.T., working a station with the call-sign E-1BH, the latter station also having been received at good strength. We have at present no information about his QRA.

European Notes

Danish 7EC has worked Brazil on several occasions, and has had reports on his signals from Siberia and South Africa. He also ran a nightly schedule with Porto Rico for several weeks.

Luxembourg 1JW has appeared on the ether again, using a frequency of 6,667 kc. He worked U1CH almost the first night he was on. L-0AA has not been heard for some time.

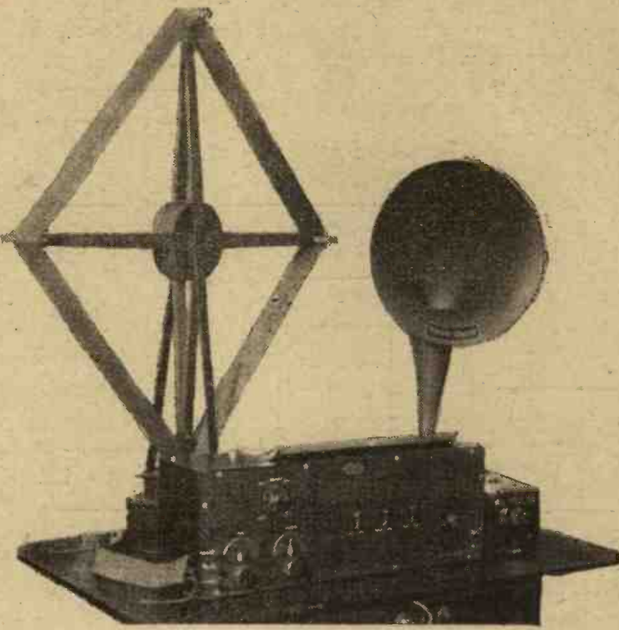
The Autodyne System in Supersonic Reception

By C. P. ALLINSON (6YF).

There are various methods in supersonic heterodyne receivers by which the functions of first detector and oscillator can be combined in one valve. In this article some of these methods are discussed, and practical values of components and operating data are given.

APART from the intermediate-frequency amplifier transformers, what is probably one of the principal causes of high cost in building a supersonic receiver is that a large number of valves have to be purchased or employed with it. If, then, a six-valve super-heterodyne receiver can be made to give results equal to those obtained with seven valves, not only is the cost of one valve saved, but also that of its attendant valve-holder and filament resistance.

One method that may be employed for making this saving is to use the same valve to act in the capacity of first detector and oscillator.



A commercial 7-valve supersonic receiving set.

The Tropadyne

One of the first circuits to appear in this country, by means of which this could be done, was the American circuit known as the Tropadyne. A circuit which had been used previously, but unsuccessfully, is shown in Fig. 1, in which a tuned circuit L2 C2 was placed in the grid lead between the grid and the circuit L1 C1. L1 may be the frame aerial that is so frequently employed with a supersonic receiver, or it may be a coil very loosely coupled to the aerial. The reaction coil L3 is coupled to coil L2 (tuned by a variable condenser C2), so as to generate oscillations of the correct frequency to superimpose on the incoming signals to give the beat frequency to which the circuit L4 C4 is tuned.

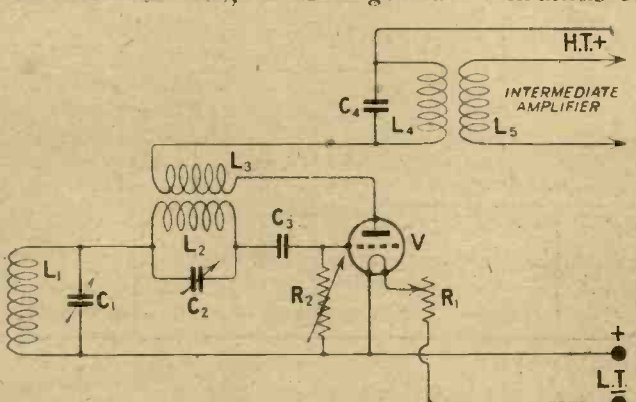


Fig. 1.—In this form of Autodyne circuit the operation is rendered extremely difficult by the interaction between the tuning controls.

Interaction Between Tuning Circuits

It was found, however, that interaction between the two tuning controls was so great as to make the handling of this type of circuit an impracticable proposition. One solution to this problem is the circuit shown in Fig. 2. In this case the tuning circuit L1 C1 is connected to the mid point of the inductance L2, which, with its tuning condenser C2, forms the oscillatory circuit. L3, the reaction coil, is coupled to L2 as before. Provided that the point of the inductance L2, to which the grid condenser C3 is connected, is the electrical centre of the coil, the tuning of the circuit L2 C2 will in no way upset the circuit L1 C1.

Centre Tapping on Grid Coil

It will be found in practice that the centre of the wire composing the winding of the grid coil L2 is not necessarily its electrical centre, as this may be displaced owing to the effect of various parts of the receiver which may be located near the coil; different types of coils will also vary in this respect. It is therefore advisable to take several tappings at about the centre point, and find out which of these allows the receiver to be handled with the minimum amount of interaction between the two tuning controls. An easy method of determining this is to bring the intermediate-frequency amplifier just on the oscillation point, and tune in a carrier by means of the oscillator condenser C2. The rotation of the tuning condenser C1 should now merely have the effect of weakening or strengthening the beat note heard in the telephones, but should not appreciably affect its pitch. If it does alter the pitch, the electrical centre of the coil L2 has not been found, and another tap should be tried.

Hand-Capacity

This circuit may be found somewhat difficult to handle as regards the tuning of the circuit L2 C2, unless some type of condenser is used in which the dial spindle is entirely insulated from the condenser itself, and some form of shield is interposed between the condenser and the dial. If this is not done, hand-capacity effects will be very noticeable, since the circuit is more or less "up in the air," one end being connected to the grid and the other to one side of the grid leak, of which the other end is earthed. This means that both sets of vanes of the variable condenser C2 will be at high-frequency potential to earth, and special means must therefore be taken to avoid hand-capacity effects.

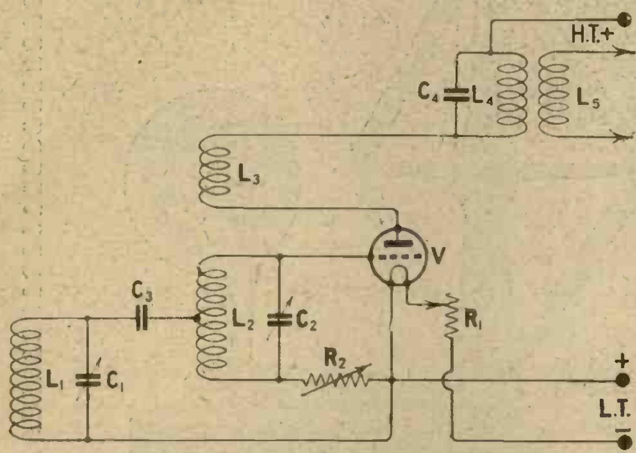


Fig. 2.—An improvement on the Fig. 1 circuit, known as the Tropadyne. Here the coil L2 is tapped at its electrical centre, thereby preventing interaction between the tuning of the circuits L1 C1 and L2 C2.

Second Harmonic Method

Another solution to the problem of interaction between the two circuits is that of the second harmonic. The circuit is the same as that shown in Fig. 1, but the values of the components used are different. Instead of the circuit L2 C2 being tuned to the frequency necessary to give the required beat with the incoming signals, it is tuned to exactly half the frequency. Now, owing to the naturally large difference in frequency between the two circuits, the tuning of the one will hardly, if at all, affect the tuning of the other. The oscillations generated in the circuit L2 C2, however, will not only have their fundamental frequency, but also will have present a number of harmonics. The second harmonic has a frequency exactly twice the fundamental, and by choosing our fundamental frequency suitably, this second harmonic can be given the desired frequency to produce beats with the incoming signals, so as to give us our desired intermediate frequency to which the circuit L4 C4 is tuned.

Disposition of Components

Although it is a fairly simple matter to get this circuit to operate after a fashion, in order to get the full measure of results of which it is capable, a considerable amount of experimenting is necessary. Not only is this needed in respect of the constants of the circuit L2 C2 with relation to any particular valve which is used in the combined function of detector and oscillator, but also with regard to the disposition of the components themselves, which, if unsuitable, may seriously affect the results.

The Super-Autodyne

The latest circuit which has been evolved by means of which the same valve can be made to act as detector and oscillator is that known as the Super-autodyne. This circuit is shown in Fig. 3, and one of the chief advantages of the circuit is that the oscillating grid coil may actually consist of two plug-in inductances of (nominally) the same size. These will be L2 and L3. It will be seen that these two inductances, together with the two variable condensers C4 and C5, which are of a very small value, form a bridge, and it is therefore an easy matter to balance out any inequality in the coils by means of the two small variable condensers. The actual values of these may be in the region of 80 to 100 $\mu\mu$F, and the writer has actually used ordinary neutrodyne condensers of a lower value quite successfully.

In this case, again, the condenser C3 is preferably of the special design previously mentioned, owing to the fact that the circuit L3 L2 C3 is rather "up in the air."

Balancing Adjustments

The procedure for balancing up is not very difficult, and can be done as follows :—Set the tuning condenser C1 at about the centre of its scale, and swing C3 backwards and forwards, when it will be noted that clicks will be heard at certain points. Now set the small condenser C4 at its maximum value, and gradually alter C5 from maximum to minimum, swinging the condenser C3 at the same time. It may be found that at a particular point in the adjustment of the condenser C5 the clicks will no longer be heard, and as this point is somewhat critical, the condenser C5 should be revolved very slowly.

Readjustment for Frequency Change

Should the clicks not disappear, however, with any adjustment of C5, the procedure should be repeated by leaving C5 fixed at its maximum value and gradually reducing the value of C4. This process of balancing up should not occupy a very long time, and a point

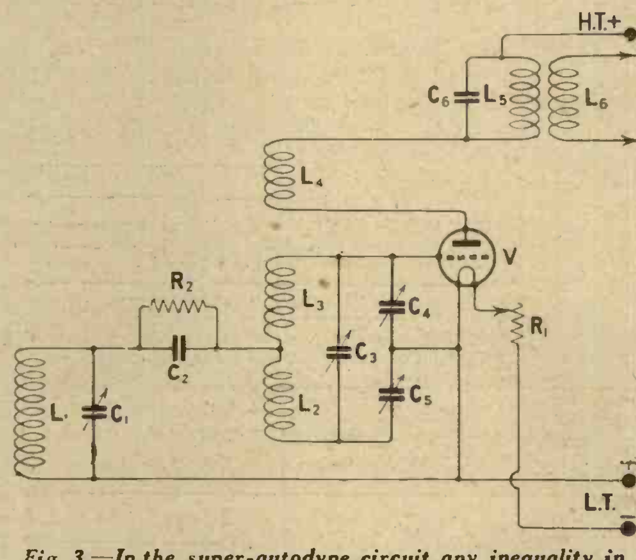


Fig. 3.—In the super-autodyne circuit any inequality in the two coils L2 and L3 is balanced out by suitable adjustments of the small variable condensers C5 and C4.

to be noted is that, although the balance may appear correct on the lower readings of the two variable condensers C1 and C3, on working on the higher portions of the scale of these two condensers, a slight readjustment of the balancing condensers may be required. A point may, however, be found in which balance is obtained for all readings of the two condensers C1 and C3.

A Possible Experiment

It is claimed by the designer of this circuit that actually better results will be obtained if one of the condensers C4, C5 is adjusted so as to throw the circuit slightly out of balance, as, under these conditions, it is stated, a small proportion of the reaction effect from the coil L4 will be transferred to the coil L1, thus producing an increase in signal strength. It is obvious, of course, that when the grid circuit is perfectly balanced, no energy introduced by the coil L4 into the circuit L3 L2 C3 will be transferred to any other portion of the circuit involved in reception. In fact, it is this very property that eliminates interaction effects between the two tuning controls.

Audio-Frequency Howling

One of the chief difficulties in using the circuit shown in Fig. 2 is the fact that, when using a ·0003 μF variable condenser for the grid oscillatory circuit tuning condenser C2 with a coil which will cover the frequencies between 500 and 1,500 kilocycles (200 and 600 metres), as the condenser approaches the lower end of the scale, the valve will set up an audio-frequency squeal. Reducing the value of the variable grid leak R2 is one means of stopping it, as long as the condenser C2 is not reduced further. It thus presents only a temporary measure of relief. The only way to stop this squealing is to reduce the reaction coupling.

There would seem to be, therefore, a considerable field for experiment in this line to obtain suitable values for the coil and condenser in the oscillatory circuit, so that the same value of reaction coupling may be retained throughout the frequency range covering the broadcast stations. It may be noted here that if the coupling between L3 and L2 is made sufficiently loose to enable the condenser C2 to be reduced to its minimum value without squealing being produced, the stations for which the condenser C2 has to be practically all-in will not come in at full strength.

Best Signal Strength

With the super-autodyne circuit shown in Fig. 3 it will generally be found that the greatest signal strength

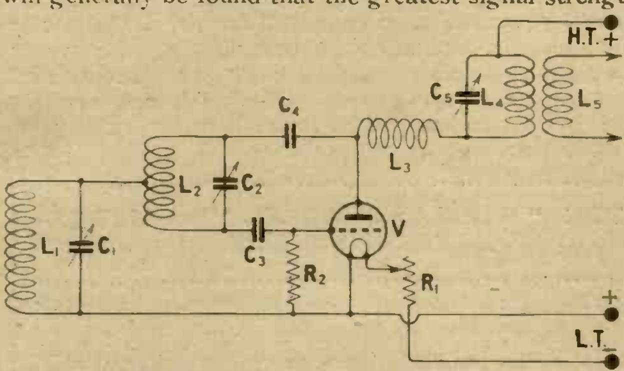
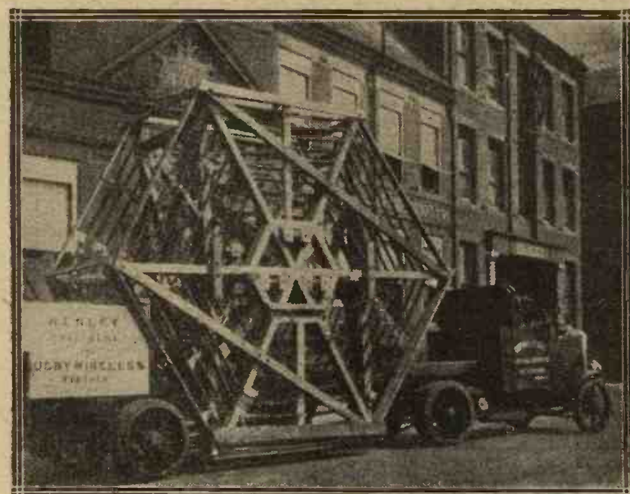


Fig. 4.—A Hartley type of circuit used by the author with some success. The radio-frequency choke coil L3 may not always be essential to the correct functioning of the circuit.

is not necessarily obtained when the two small variable condensers are set so as to give the exact state of balance as described when no clicks are heard

A Further Circuit

A circuit that was evolved and used by the writer some twelve months ago may here prove of interest, though it was employed with very varying degrees of success. This is shown in Fig. 4. In this case the oscillator circuit, L2 C2, will be seen to be the well-known Hartley oscillator, in which the two ends of the coil L2 are connected to plate and grid and a centre tap is taken to L.T. In this case oscillation has to be controlled by altering the filament temperature



The giant inductances for the Rugby Wireless Station were conveyed from the works on a special type of motor truck.

of the valve, and this circuit, like the others, is somewhat liable to squeal at the lower readings of C2. The choke coil L3 is not always required, and in some cases it may cause the valve to squeal at all settings of the oscillatory circuit L2 C2, but this depends to a certain extent on the type of coupling used for the intermediate frequency amplifier, the values of H.T., etc.

Harmonics

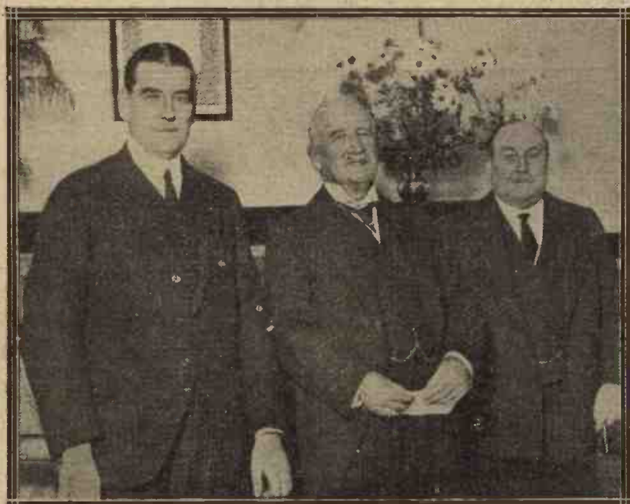
Another difficulty experienced with this circuit is the fact that it appears to be extraordinarily rich in harmonics, so that stations may be found to come in at four or more settings of the oscillator condenser, instead of the more customary two. Here again it will probably be found that the electrical centre of the coil L2 is not necessarily the centre of the winding, and it will be necessary to take various taps in order to ascertain which is the best.

Faults Peculiar to Super-Heterodynes

One of the most puzzling faults to trace in the super-heterodyne is that of the faulty valve-holder. Valve-holders which have been used in a straight set and have not shown themselves to be faulty in any way may, when used with a super-heterodyne receiver, introduce into it some very puzzling symptoms. This applies specially to non-microphonic valve-holders. The actual vibration of the valve in the holder causes the springs to expand and contract, and may be sufficient to produce a slight variation in the contact resistance of the springs and the lugs, or the springs and the valve legs, if these are not soldered. If this occurs in the intermediate-frequency amplifier, it may show itself by intermittent oscillation and swinging of signals.

Disconnections

Another puzzling fault is a complete disconnection owing to a break somewhere in either the grid or plate circuits. It is impossible to classify the symptoms, but the writer would certainly recommend as a preliminary test, when any trouble is experienced with a super-heterodyne receiver, to go round it with a flashlamp tester and make sure that continuity exists between every lead and the valve-leg to which it is connected.



The Postmaster-General, Sir William Mitchell-Thomson (left), with Mr. Prideaux (centre), Chairman of St. Mary's Hospital, and Sir Arthur Stanley (right), President of the Wireless Fund, on the occasion of the handing over of the wireless installation at the Hospital.

Badly Matched Valves

Another annoying trouble which occurs occasionally with a "super-het," especially when unmatched valves are being used, is that one stage of the intermediate-frequency amplifier will go into oscillation before the others, when the potentiometer is moved over to the negative end. The distortion introduced is so small as to be hardly noticeable, the chief difference being the number of heterodyne whistles which are heard when the oscillator condenser is turned. Low-frequency (long-wave) signals also come through and cause interference, and cannot be eliminated without also elimination of the station which it is desired to receive. Under these circumstances the best thing to do is to try changing over the valves in the receiver, so as to obtain three valves which, in a given order, will pull together satisfactorily in the intermediate-frequency amplifier.

Transformers not Balanced

Another disturbing symptom is that experienced when the local station is found to come in at, not two, but perhaps half a dozen or more points on the dial. This is in many cases due to the intermediate-frequency amplifier transformers not being correctly balanced up, and the writer is of the opinion that it is desirable that some form of tuning controls be provided on these. His own experience has shown that merely changing over the valves in the intermediate-frequency amplifier will throw the various stages out of tune, and they will have to be re-balanced before full selectivity and signal strength are obtained. At the same time, if the intermediate-frequency amplifier is tunable, it gives the operator an opportunity of shifting his intermediate frequency, should he experience interference from low-frequency commercial stations at any time. It is certainly very annoying to have a good programme spoilt by interference from stations such as Leafield, which has to be endured because it cannot be cured.

Frame Aerial

A few pointers as to the values of components in these circuits for use on the broadcast frequencies may be of use. In cases where L1 is a frame aerial, a suitable size for this is 14 to 16 turns on a 2-foot square frame, or 10 to 12 turns on a 4-foot frame. The actual number of turns will depend to a certain extent on the spacing. C1 may be a variable condenser of .0005 μF capacity. In the Fig. 1 circuit, where the second harmonic system is being employed, L2 may be a 100-turn coil and C2 a .0005 μF variable condenser. The size of the reaction coil L3 may be determined experimentally, but should be in the region of about 50 turns.

Coils and Condensers

In the Fig. 2 and Fig. 4 circuits, the coil L2 may consist of about 60 turns on a 3½-in. former, or a 50-turn plug-in coil with a centre tap. The grid oscillatory circuit tuning condenser C2 may be .0003 μF, and it should preferably be provided with some form of vernier control, as its adjustment is likely to be extremely critical. In the Fig. 3 circuit, the two coils L3 and L2 may each be 35-turn plug-in coils, and in some cases may even possibly have as many as 50 turns.

Valves

It is understood, of course, that these circuits do not in any way affect the functioning of the intermediate-frequency amplifier or the rest of the receiver, this being the same as that used when a separate oscillator system is employed.

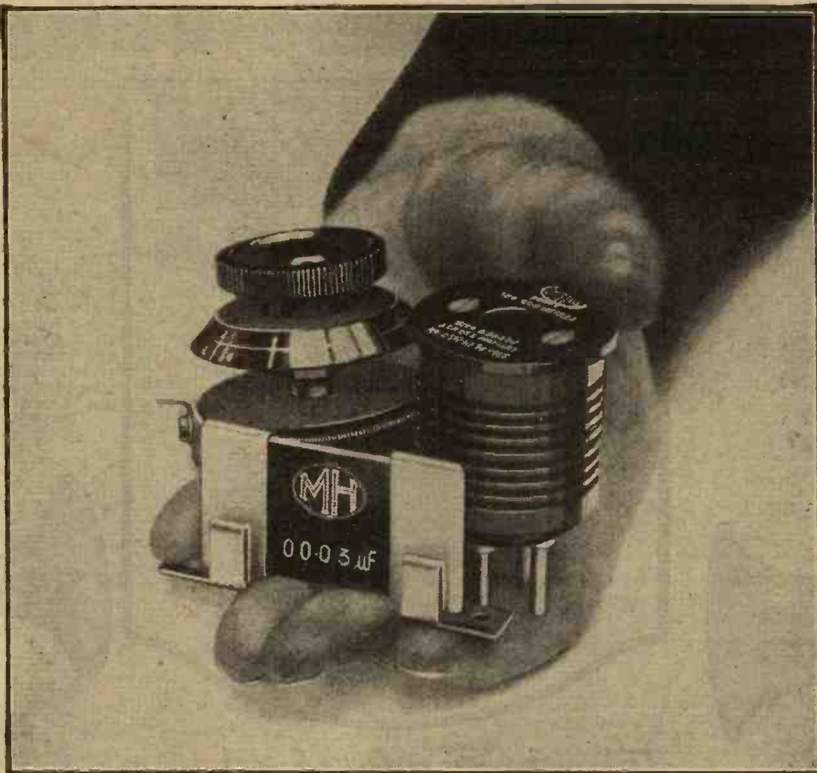
It is recommended, when using these circuits, that a small power-valve be employed for the first detector and oscillator, and although the .06 type of valve or general-purpose valve may be used quite successfully, it is the writer's experience that small power-valves give greater signal strength and better quality of reproduction.

THE "WIRELESS WEEKLY" CALIBRATION SCHEME.

We would remind our readers that the first series of frequency measurements in connection with the Radio Press Laboratories Calibration Scheme will be taken on Thursday, December 10. The results of this set of calibrations will be published in *Wireless Weekly* for December 16. Readers are invited to send in their views and suggestions relative to this Calibration Scheme, as we are anxious to develop it in many directions.

We reprint below the stations whose frequency will be measured on December 10, and the times :—

Station.	Time. p.m.	Station.	Time. p.m.
Aberdeen	7.45	Bournemouth	8.35
Birmingham	7.55	Manchester	8.45
Belfast	8.5	London	8.55
Glasgow	8.15	Cardiff	9.5
Newcastle	8.25		



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Barclays Ad.

Wireless News in Brief.

Forthcoming B.B.C. Items. Below we give some of the interesting items to be broadcast from the London Station during the week commencing Sunday, December 13:—

December 13.—Light Symphony Programme, conducted by Maurice Besly.

December 14.—"The Belle of New York."

December 16.—Beethoven Commemoration Programme, Sir Landon Ronald conducting.

December 17.—The Hallé Chorus and Hallé Orchestra.

* * *

Radio Revels. On December 15 Radio Revels, arranged by the B.B.C., will be held all over this country. Simultaneously wireless enthusiasts all over Europe, and possibly also in America, will be dancing to music received by wireless. In addition to dance bands in London, bands in other European countries will play for the Revels which will be held in London. An attempt will be made to pick up the London broadcast music in the U.S.A. and to relay it over America.

* * *

Future of Broadcasting. We understand that it will be some time before any decision is reached as to the future of broadcasting after the expiration of the B.B.C.'s licence next year. A large amount of evidence is to be given, and no recommendations are likely to be put forward by the Broadcasting Committee for some months.

* * *

A question was recently asked in Parliament regarding the broadcasting of debates. An answer was given to the effect that no decision would be taken until after the report of the Broadcasting Committee.

* * *

During the month of October 45,020 wireless licences were issued by the Postmaster-General, bringing the total of current licences up to the end of that month to 1,509,520.

* * *

In less than three days the B.B.C. have received more than 60 complaints of oscillation spoiling broadcast reception of a large number of listeners.

In a further attempt to stop this trouble the B.B.C. have issued a pamphlet giving full particulars of how to avoid oscillation, and copies can be obtained on application to the B.B.C. headquarters at 2, Savoy Hill, W.C.2.

* * *

European Broadcast Frequencies. We learn that a second meeting of broadcast representatives from various countries will be held this month at the International Wireless Bureau, Geneva, and that a further attempt will be made to abolish interference between British and Continental broadcasting stations.

As there are more than 100 stations now working in Europe on frequencies between 500 and 1,500 kc. (200 and 600 metres), it will be seen that to fit all stations into this band of frequencies satisfactorily is no mean problem. It is hoped, however, that a mutual "give and take" policy will be pursued and thus a solution arrived at.

* * *

British Industries Fair. Exhibits of wireless apparatus are to be included in the London Section of the British Industries Fair, to be held at the White City in February, 1926. The opportunity of exhibiting their goods at this Fair is to be open to all British manufacturers of wireless apparatus.

* * *

U.S.A. Broadcast Test. It appears that the first test transmission carried out by the American station at Boundbrook, New Jersey, with a power of 35 kilowatts, was not so successful as had been hoped. Reception in this country was, on the whole, poor. The tests will be continued at 1.30 a.m. every Thursday morning.

* * *

The exhibitors at the National Wireless Exhibition, held in Chicago, were able to listen to a violinist playing whilst accompanied by a piano three miles away. We may, perhaps, look forward to a day in the future when we shall be able to listen to a world orchestra broadcast, composed of various instruments, each of which might be in various countries throughout the world.

* * *

Broadcasting in India. We understand that the delay in the settlement of terms with the Indian Government has checked somewhat the hopes of an early organisation of broadcasting in that country. The hope is expressed that terms will soon be agreed upon.

* * *

At the time of writing, the strike of the seagoing wireless operators appears to be extending, and although the Board of Trade has temporarily relaxed the regulation which compels ships above a certain tonnage to carry wireless operators, in some cases, we understand that the crews have refused to sail without an operator.

This refusal, we are told, is quite within the articles which the crews sign on joining a vessel.

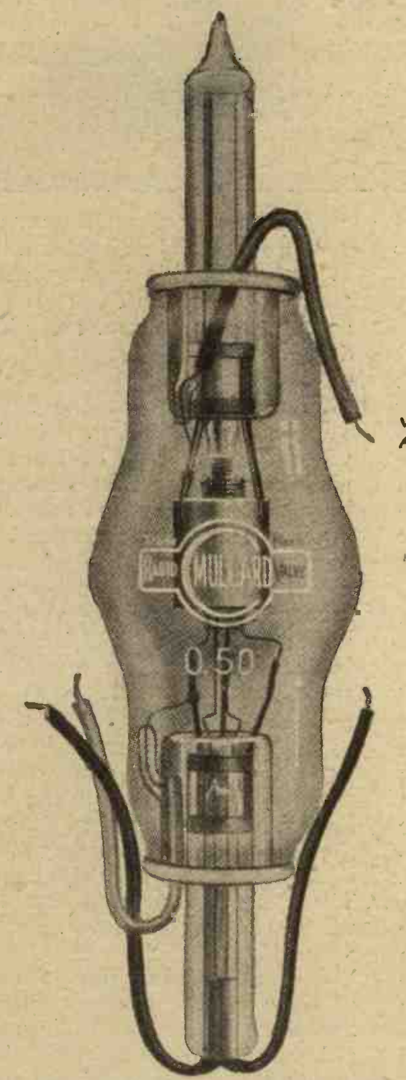
* * *

Coastal Wireless Stations. The opening of a new D.F. wireless station on Belle Isle, at the northern entrance to the Gulf of St. Lawrence, is announced by the Radiotelegraph branch of the Canadian Department of Fisheries. This station will operate at 375 kilocycles (800 metres), and has been allotted the call sign VCM.

OUTPUT EFFICIENCY IN

By the Staff of the Ra

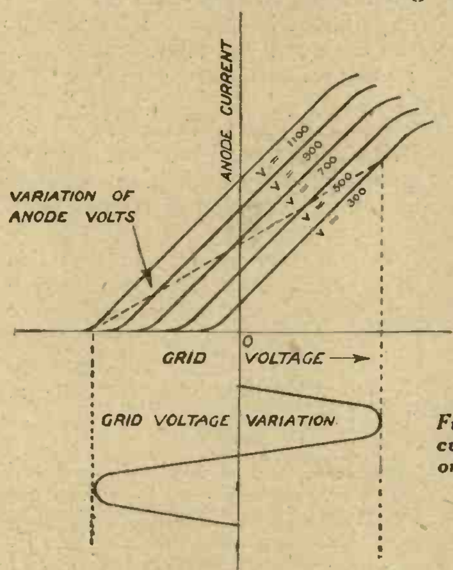
In last week's issue of "Wi an introductory article to a s Transmission. In this article connected with efficiency countered when using therm circ



A Mullard 0.50 transmitting valve of the renewable filament type.

IN the issue of *Wireless Weekly* for December 2 we showed how a three-electrode valve could act as an escapement in starting and maintaining oscillations in an oscillatory circuit. We also considered some of the fundamental relationships existing between the various currents and voltages in the circuit when under oscillating conditions. For instance, we showed that the current through the valve was a maximum when the voltage across it was approximately at a minimum value.

In the following article it is proposed to consider some further problems in connection with simple oscillatory valve circuits, particularly with regard to the efficiency of such circuits for converting D.C.



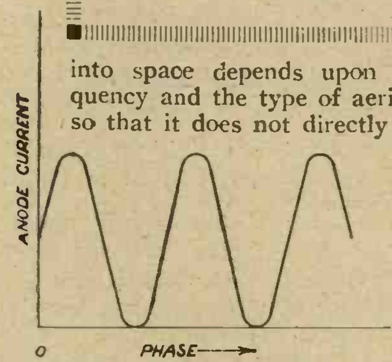


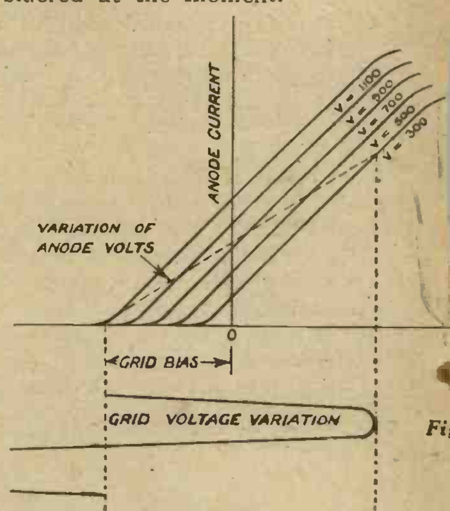
Fig. 1.—Showing the shape of the anode current impulse (right) when working on the straight portion of a valve characteristic.

energy into radio frequency energy and the conditions under which the maximum output can be obtained from a valve.

The Efficiency of a Valve Circuit

The efficiency of an oscillating valve circuit can be considered in different ways. First of all it can be taken as the ratio of the total high-frequency energy lost in the circuit to the output from the high-tension generator. It might also be taken as the ratio of the energy put into an aerial to the input from the D.C. supply. If we consider a stage further, the actual energy radiated into space could be compared with the D.C. energy put into the circuit. It is usual when considering a valve circuit to define efficiency as the ratio of $\frac{\text{Total H.F. output}}{\text{H.T. input to valve}}$. The wattage consumed by the filament is not generally taken into consideration.

The relative amount of the high-frequency energy which is radiated into space depends upon the frequency and the type of aerial used, so that it does not directly concern the valve and its circuits. The question of actual radiation efficiency will therefore not be considered at the moment.



Fig

Valve Rating

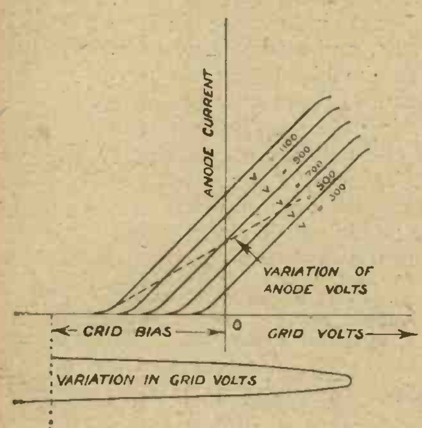
The power of a transmitting valve is practically limited by the amount of energy that can be dissipated at

VALVE TRANSMISSION

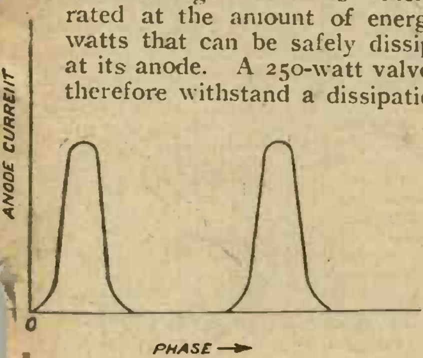
dio Press Laboratories.

reless Weekly" we published series on the subject of Radio are discussed some problems and output which are en- ionic valves in transmitting uits.

its anode. No matter how big the filament or how large the glass bulb, the maximum energy that can



be dealt with is entirely dependent on the size of the anode and the material of which it is made. A transmitting valve is therefore rated at the amount of energy in watts that can be safely dissipated at its anode. A 250-watt valve will therefore withstand a dissipation of



. 3.—The anode current impulse with high negative grid bias.

250 watts at its anode, without overheating.

Circuit Efficiency

In order to determine the high-frequency energy that can be obtained from a valve of any given rating, it is essential to know the approximate efficiency of the circuit in which it will be used. The conditions under which the valve is used may be such that efficiencies varying from 10 per cent. to 90 per cent. may actually be met with in practice.

Practical Efficiency

For practical purposes it can be assumed that, of the energy put into a circuit, that which is not converted into high-frequency energy is dissipated as heat at the anode of the valve. Thus a 100-watt valve working under conditions of 80 per cent. efficiency would be capable of delivering 400 watts of

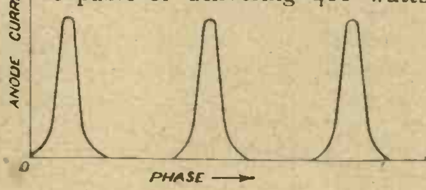


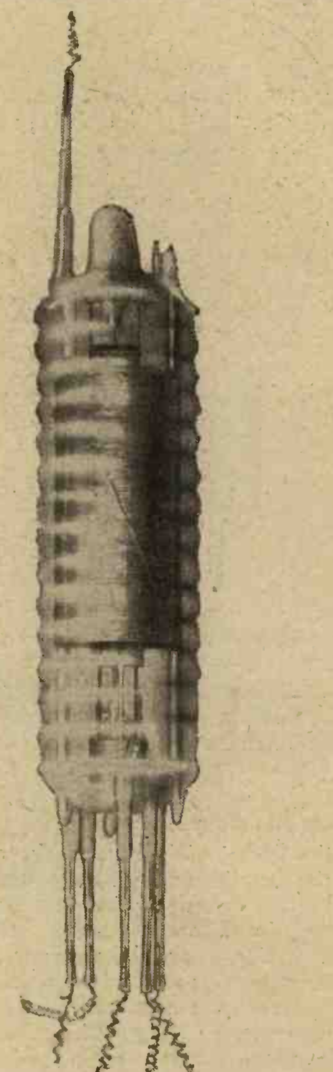
Fig. 2.—When negative grid bias is applied, the anode current impulse takes the form shown here.

high-frequency energy. The H.T. input to the circuit in this case would be 500 watts. The following table shows the maximum output that can be expected from a 100-watt valve worked at different efficiencies :—

Rating of Valves.	Efficiency.	H.T. Input.	H.F. Energy.
	Per cent.	Watts.	Watts.
	10	111	11.1
	20	125	25
100-watt.	33⅓	150	50
	50	200	100
	75	400	300
	80	500	400

Anode Circuit Impedance

The importance of the value of the impedance in the anode circuit of valve amplifiers, both high-frequency and low-frequency, is well known, and has often been dealt with in Radio Press publications. The same also applies to transmitting valve circuits. The value of the impedance in the anode circuit in relation to the valve has a very



One of the high-power silica valves made by the Mullard Wireless Service Company, Ltd., to the design of H.M. Signal School, Portsmouth.

large controlling influence on the efficiency and output that can be obtained from any valve. Conditions for high efficiency do not necessarily coincide with conditions for maximum output, but this question will be considered later.

Conditions for Efficiency

As with amplifying circuits, probably the best general conditions are met in practice when the effective impedance in the anode circuit is about equal to that of the valve.

Under these conditions good output can be obtained with high efficiency. Of course, the value of the impedance in the anode circuit is not the only factor controlling the efficiency and output of a valve oscillating

The Osram T15 type low-power transmitting valve.

circuit. The reaction coupling, grid bias, emission and high-tension volts all have important bearing on the efficiency and output of the circuit.

Anode Current Impulse

In the first article it was shown how the anode current was controlled almost entirely by voltages occurring in different parts of the circuit. The shape of the anode current impulse is dependent on the voltage amplitude across the anode and grid coils, on the grid bias, and on the value of the high-tension voltage supply, and also, of course, on the valve characteristics themselves. The shape of the anode current impulse has a vital controlling influence on the efficiency of the circuit, and consequently on the maximum energy that can be obtained from the valve. If one is given the working data for the voltage amplitude across the grid and anode coils, the grid bias and the H.T. voltage, the shape of the anode current impulse can be determined from the characteristics of the valve.

Variation of Anode Current Impulse

Let us first of all consider to what extent it is possible to vary the shape of anode current impulse. By working only on the straight parts of the anode current/grid voltage characteristics it would be possible to obtain practically a sine-wave current through the valve, as shown in Fig. 1. Under these conditions the maximum theoretical efficiency of the circuit is only 50 per cent.

Negative Grid Bias

By giving the grid a negative bias, so that one is working at the bottom of the characteristic curves, it is possible to stop completely any current flowing through the valve, during the negative half-cycle of grid swing, as shown in Fig. 2. In this case the current through the valve is in the form of a half-sine-wave. Under these conditions the efficiency of the circuit is very much higher and may be of the order of 75 per cent.

Increased Grid Bias

If the grid bias is still further increased, it is possible to obtain a condition when current passes through the valve during only a fraction of the positive half of the grid swing, as shown in Fig. 3. Under these conditions it is possible to obtain very high efficiencies, which may be over 90 per cent. if the anode current is allowed to pass through the valve for only a small fraction of the time of a complete cycle. These very high efficiencies can only be obtained at the expense of output, as the energy put into an oscillating circuit is the product of the anode current and the voltage across the anode coil, taken over the whole cycle. No energy is therefore being put into the circuit during the greater part of the cycle, when high efficiencies are being obtained.

Anode Inductance Voltage and Anode Current

As was shown in the previous article, the effective voltage across the anode and filament of the valve at any particular instant is the sum of the voltage of the H.T. supply and the voltage across the anode coil. During the working half of the cycle, *i.e.*, when energy is being transferred to the oscillating circuit, the voltage across the anode inductance opposes that of the H.T. supply. Under working conditions the amplitude of the oscillating voltage across the anode inductance may approach, and in some cases exceed, that of the H.T. supply. Thus the minimum voltage across the valve is usually only a small fraction of that of the H.T. supply, and in some cases it may actually be negative. This low voltage across the valve causes a flattening of the anode current impulse.

Variation of Anode Tapping

If the anode voltage actually falls to zero or becomes negative, then the anode current also falls to zero, and one obtains a double-humped curve for the anode impulse. Fig. 4 shows the various shapes of the anode current impulse that have actually been obtained under working conditions by simply varying the position of the anode tapping on the inductance. Variation of the anode tapping alters the voltage across the anode inductance, and this has a very large influence on the output and efficiency of the circuit.

Curves

Curve A of Fig. 4 was obtained with the lowest anode tapping, *i.e.*, with the least inductance in the anode circuit, and curve D was obtained with the highest anode tapping. Curve D represents the case where the voltage amplitude across the anode coil actually exceeds that of the D.C. supply.

In curve C the voltage amplitude across the anode coil is slightly less than that of the D.C. supply.

Curves A and B represent cases in which the voltage across the valve does not fall below three or four hundred volts positive.

Good Output and High Efficiency

It has been mentioned above that the best output is not always obtained under conditions of the highest efficiency. In practice it is

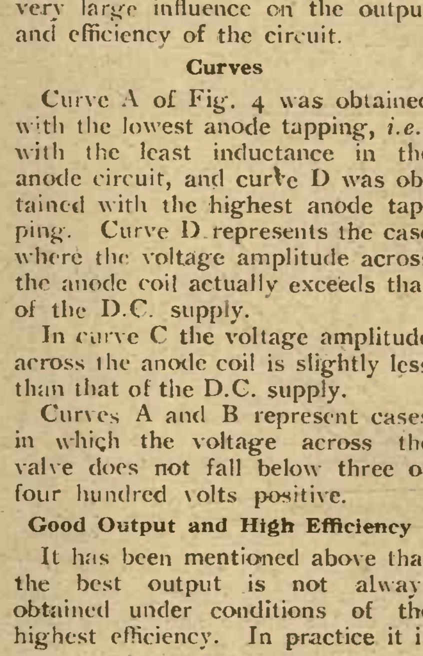


Fig. 4.—These curves show the effect of different anode tappings on the shape of the anode current impulse.

found that most generally satisfactory results are obtained when the anode current impulse has the form of approximately a half sine-wave, which may or may not be flattened at the top. Under these conditions maximum output can be obtained with efficiencies of the order of 60 to 70 per cent.

Selectivity and the Tight-Coupled Aerial

The Effect of the Position of the Primary Winding.

By G. P. KENDALL, B.Sc.

In this week's article in this series Mr. Kendall describes the effect on selectivity of placing the untuned aerial winding in various positions relative to the secondary coil.

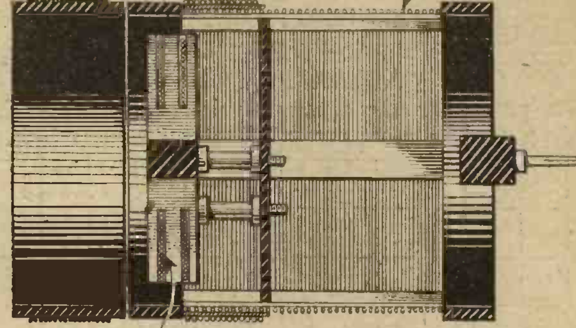


Fig. 1.—This sketch shows on the right the secondary coil used by the author. The primary winding was coupled to this in three different positions roughly as indicated.

IT has been suggested by some writers that the position of a tight-coupled primary coil in relation to the secondary has a considerable bearing upon the tuning properties of the whole arrangement. For example, the use of a primary of the basket type, arranged inside the filament end of the secondary coil, this latter being a cylindrical inductance, has been thought to give improved results in selectivity, and it seemed desirable to investigate this aspect of this useful circuit in a quantitative manner.

Earth or Aerial End?

It should first be mentioned that one point will be accepted as being fairly definitely established, and that is that it is best to place the primary coil at the earth or filament end of the secondary, a variety of undesirable effects being produced if it is arranged at the grid end. The experiments were therefore confined to primaries arranged in different ways inside, against or over the filament end of the secondary.

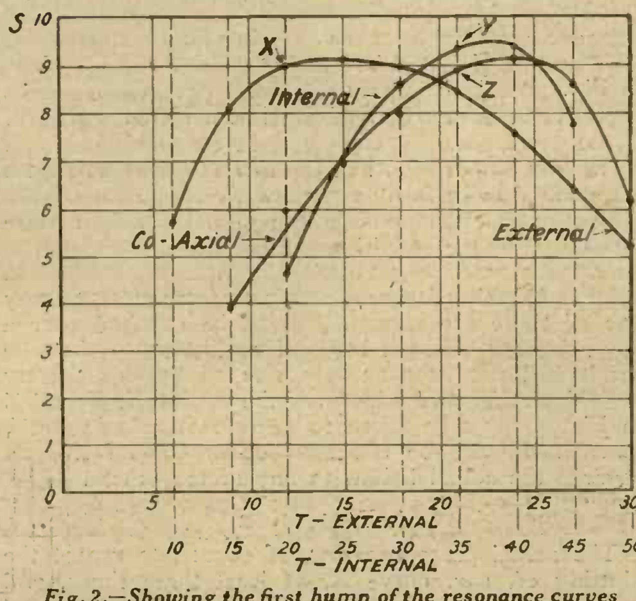


Fig. 2.—Showing the first hump of the resonance curves of three primaries, arranged as shown in Fig. 1. The turns scale for the internal winding differs from that employed in plotting the other two curves.

The Primaries Used

For purposes of the investigation three primaries were arranged to work with the secondary unit which has been used in all the experiments described in recent articles. The first primary was of the usual internal type, wound upon a small ebonite cross former (this was illustrated last week). The windings were arranged in slots upon the cross former, so that they were edgewise to the cylindrical secondary.

The second primary was a single-layer winding, placed on the top of the secondary, at the filament end, a space of about ⅛ in. being arranged between them by means of small ebonite spacers. The third winding was again a single-layer coil, on a piece of cardboard tube approximately the same diameter as the secondary, arranged end to end with it, and with the two windings placed as close as possible. A sectional drawing indicating the relative positions of these three windings appears in the heading of this article, and the respective coils are marked "internal primary," "over-wound primary," and "co-axial primary" respectively.

The Windings

All the primaries were wound with No. 26 d.c.c. wire, and tappings were taken at every five turns on the small internal primary, and every three turns on the other two primaries. This arrangement of tappings was chosen because it was found that approximately the same tuning variation was produced by an alteration of five turns upon the internal primary, as by an alteration of three turns on the two larger primaries. This point will be returned to in considering one of the graphs illustrating the results of the experiments.

Scales Used

In accordance with the decision given in one of the earlier articles of this series, only the first hump of the resonance curve for each primary was determined, and the three resulting graphs are given in Fig. 2. They are marked "Internal," "Co-axial," and "External" to indicate to which primaries they are appropriate, and a word of explanation as to the horizontal scale is necessary. This scale, of course, gives the turn numbers in use for the corresponding value of signal strength, which is plotted vertically, but it will be observed that two scales are marked. This was necessary because the variation of turn numbers upon the internal primary was found to produce a different alteration of tuning, consequent upon the smaller size of the coil, than that produced in the case of the two larger primaries.

The scale marked "T—External" is the scale upon which the graphs for the "Co-axial" and "External" primaries are plotted, the other being the scale used in plotting the graph for the "Internal" primary. As a matter of fact, it is to be noted that the arrangement of these scales is decidedly approximate, but it will serve our purpose sufficiently well. It will be seen that the curves for the "Internal" and the "Co-axial" primaries are very similar, that of the internal coil being slightly more sharply peaked.

A Doubtful Point

The curve for the external primary, on the other hand, possesses a very much flatter hump, which, it

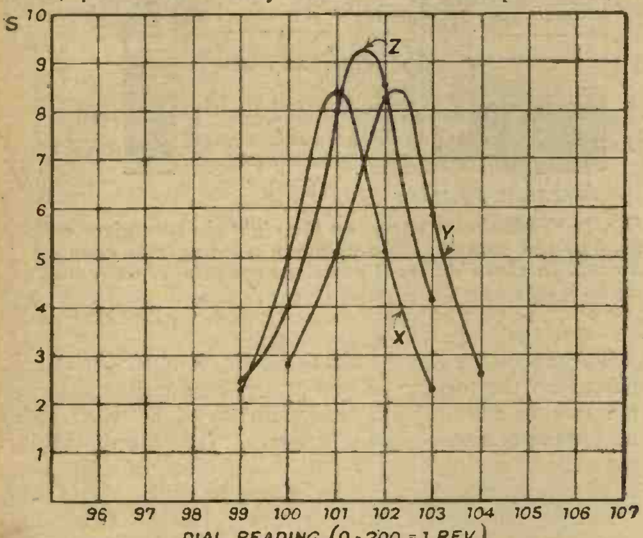


Fig. 3.—The three resonance curves obtained at the points X, Y, and Z on the graph shown in Fig. 2.

would seem, may indicate that this arrangement is capable of covering a broader band of frequencies with comparatively uniform efficiency. The consideration of the question of whether this assumption is justified or not must be deferred until I have succeeded in setting up a satisfactory apparatus for determining the actual width of the frequency band which a given primary coil will cover.

The object of plotting these three characteristics was in order that a similar point might be located upon each, as regards position upon the resonance curve, in order that the selectivity of the secondary circuit might be investigated when this definite number of turns was in use upon the primary in question. It will be seen that the points X, Y and Z correspond fairly closely upon the three curves, and, accordingly, the sharpness of tuning of the secondary was investigated when numbers of turns appropriate to these points were included in the aerial circuit with each of the three primaries in turn.

Resonance Curve Determination

First, a resonance curve in the secondary was plotted when the external primary was in use, with 12 turns included in the aerial circuit, these being the conditions appropriate to the point X on the characteristic curve for this particular primary. The resonance curve was obtained in the manner described in preceding articles, that is, by the simple expedient of varying the tuning of the secondary a degree of the condenser dial at a time, recording the signal strength upon each adjustment. The result is shown in Fig. 2, the curve being marked X. The same procedure was then repeated for the points Y and Z on the other two primaries, 21 and 35 turns being required respectively.

The results are indicated in the curves Y and Z in Fig. 3, and a careful examination of these will show that there is extremely little difference in the degree of selectivity obtained with the three arrangements. Such slight difference as there may be between the relative sharpnesses of the peaks of these three curves are not sufficiently great to be worth taking into account, when it is remembered that variations such as this might readily be introduced by the fact that the points X, Y and Z were not exactly located upon equivalent points upon the three characteristics in question.

Conclusions

The conclusion to be drawn from these three curves would appear to be that amongst the three primaries employed there is extremely little choice as regards selectivity or signal strength in the secondary circuit, provided that similar points be chosen upon the resonance curves of the primaries. It is obvious, then, that we should do well to devote our attention to the question of the width of the frequency band which can be covered upon a primary of fixed size, and this point must be left for consideration at a later date.

I have, as a matter of fact, carried out this type of test upon a great variety of primaries arranged in a number of different ways, and this result appears to be general. The three primaries which I have chosen for the purpose of illustration are merely intended as typical examples, and it will be realised that the majority of possible arrangements of two windings are capable of being put into one of the three classes considered.

A Point of Comparison

It should, perhaps, be explained that the relative heights of the points X, Y and Z as regards signal strength must not be taken as being fully comparative. As a matter of fact, I believe the relative heights given in Fig. 2 do truly represent the relative efficiencies as regards the production of maximum signal strength. These were specially compared in an additional test, as rapidly as possible, and the figures shown in Fig. 2 were found to be fairly representative.

In Fig. 3, variations in the signal strength were introduced by the activities of a neighbour of mine who operates a reaction set perilously near the oscillation point, and makes frequent readjustments, so that every one of these experiments had to be checked over a large number of times before I could be sure that the result had not been entirely vitiated by this fidgety individual. Thus, each one of the curves X, Y and Z in Fig. 3 must be taken to be correct only in itself, and should not be taken as being comparative as regards the actual height to any of the others.

A Precaution

The actual procedure was, of course, to repeat the plotting of, say, curve X, at least three times, and when three separate sets of readings had been obtained which agreed with each other, it was concluded that a constant strength of signal was being received. Attention was then turned to curve Z, and readings taken in sets of three again here, until reasonable uniformity was the result. It would have complicated the experiment too much, however, to endeavour to obtain truly comparative curves for, say, X and Z, and it will be observed that the divergencies between the correct maximum heights of these curves is not sufficient to affect one's appreciation of their relative steepness, this latter being the property in which we are at the moment interested.

Inventions and Developments

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

The Use of Dull Emitter Filaments for Transmitting Valves

THE thoriated type of filament has long been employed for receiving valves, but has only recently come into use for transmitting valves. There are, however, many very valuable advantages to be gained from the use of these filaments for power purposes. In a paper by J. C. Warner and O. W. Pike in the October issue of the Proceedings of the Institution of Radio Engineers, some of these advantages are enumerated.

Residual Gas

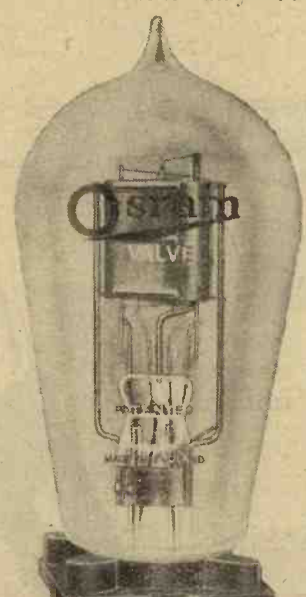
The principal feature of this type of valve would appear to lie in the design of the anode. It is well known that even the smallest amount of gas inside the bulb of a valve provided with a thoriated filament almost immediately destroys the emission. In the case of receiving valves, the ordinary method of producing a vacuum suffices throughout the usage to which the valve is put in practice. A transmitting valve, however, is nearly always run up to somewhere near the limit of dissipation of energy by the anode, and this causes the anode to warm up. Consequent upon this heating a certain amount of occluded gas would be liberated, and this would render the valve useless.

Molybdenum Anode

By the use of a molybdenum anode, however, it is possible during the process of manufacture to raise the electrodes to a very high temperature without any danger, so that when the valve is in use it is capable of dissipating all the energy that is required without ever reaching such high temperatures as these. Consequently, little or no occluded gas is given off in actual use.

Long Filament Life

Another advantage which accrues from the use of a thoriated filament lies in the fact that a longer actual length of filament may be employed. This is valuable in the design of the valve, for it may be shown that in order to reduce losses in operation due to the space charge effect, it is desirable to have long electrodes with a consequent long filament.



The Osram D.E.T.1 is one example of the dull emitter type of transmitting valve.

Multiple Filaments

Arising out of this point it is interesting to note that for a given power consumption the total length of filament is greater if two or more branches are used, and this has led to the adoption of valves having two or more filaments permanently connected in parallel. Each of these filaments carries a share of the filament current, but, as has just been explained, the overall length of the combination is longer than that of a single equivalent filament, so that once again the anode and grid may be proportionately lengthened.

Less Wastage of Filament

Wastage of the actual filament is again negligible with a thoriated filament. In the case of a bright emitter, the filament itself actually grows thinner, due to the constant emission of electrons, whereas in the case of a thoriated filament, the emission takes place from a thin layer of thorium on the outside only, and this is replaced by fresh thorium which finds its way to the surface from the inside of the filament. It appears that as long as there is any thorium left in the filament this process of replacement will continue without any appreciable reduction in the diameter of the filament, a factor which naturally makes for a longer life.

British Valves

Descriptions are given in the paper referred to of several types of American dull emitter transmitting valves, but it is interesting to note that there are already British valves which are provided with this type of filament. As examples, we may quote two such types that are manufactured by the Marconiphone Co., Ltd., and the General Electric Co., Ltd. One of these is the L.S.5, which is a large power-valve suitable for low-power transmitting, and the other is the D.E.T.1, which is definitely classed as a transmitting valve.

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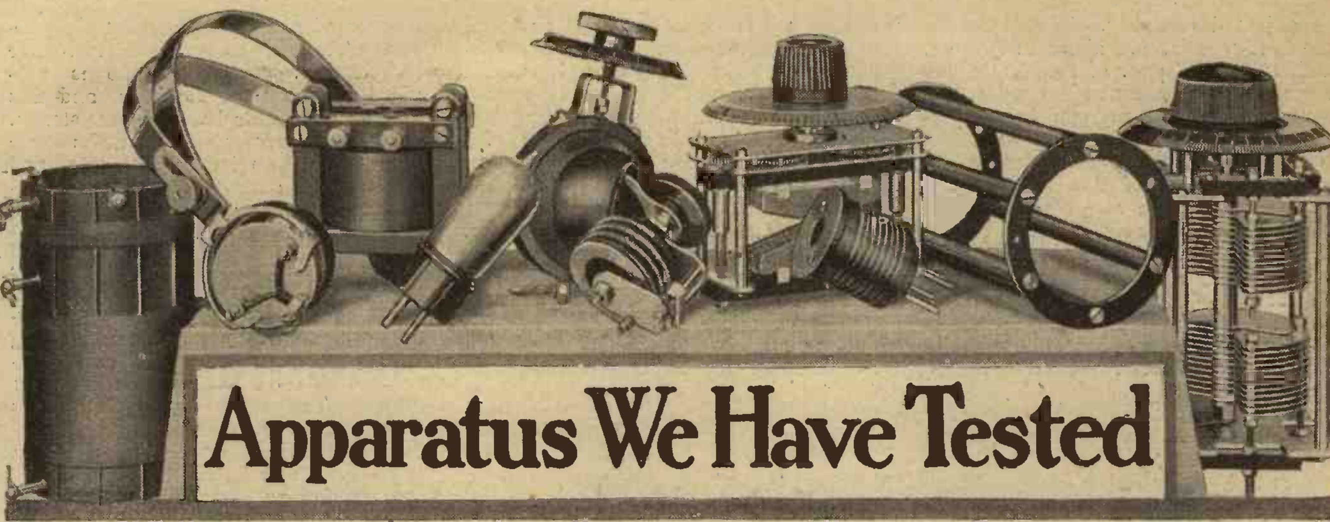

Apparatus We Have Tested

Conducted by Radio Press Laboratories, Elstree.

Pelican Receiving Set

A novel portable four-valve receiving set has been sent to us for test by Cahill & Co., Ltd. This set has been primarily designed to provide an instrument for receiving at least two stations in all parts of England, viz., the local station and Daventry. Provision is made for outside aerial and earth connections, while panel controls have been reduced to a bare minimum.

Description of Set.

The set, complete with batteries, frame aerial, and loud-speaker, is contained in a well-finished wooden cabinet about 17 in. by 16 in. by 9 in., with a leather handle at the top for carrying purposes. Double doors are opened for access to the control panel, which has mounted on it a vernier dial tuning condenser (Pelican Univernier type), a filament rheostat control, a push-pull valve switch, and a long and short wave change-over switch. Beneath this panel is the loud-speaker opening. On closing the doors, the valve switch is automatically brought into operation, cutting off the accumulator supply to the valves. A side door can be opened for viewing all the components. The loud-speaker, which is of the high resistance portable type, manufactured by A. Graham & Co., is situated in the bottom half of the cabinet with the H.T. and L.T. batteries. A horizontal shelf is employed to support all the other accessories in the top half of the cabinet.

The set itself consists of 1 H.F., 1 detector and 2 L.F. valves. The 8-pole, double-throw switch is used in one position to put three aerial loop circuits in parallel, and a low wavelength transformer between the first and second valves, and in the other position the three aerial loop circuits are in series and a high wavelength transformer is connected between the first and second valves. The aerial is located in one of the cabinet sides and consists of a number of spiral turns of three parallel wires wound on a length of insulating strip, each turn being well spaced. Dull emitter valves are employed in anti-microphonic holders, and a 30-ampere hour accumulator of the non-spillable type is used for the L.T. source.

Laboratory Tests.

The set was tried at our Laboratories 13 miles from 2LO and about 60 miles from 5XX. Both stations were received at full loud-speaker strength, and the sharpness of the tuning made the vernier dial of the condenser a necessity. Capacity reaction is accomplished with the aid of a small adjustable condenser inside the cabinet.

The "Sferavox" loud-speaker, submitted for test by Messrs. Goodchild and Partners.

The frame aerial was very efficient, and good directional effects were obtained by rotating the whole cabinet.

Oscillation is also controlled by adjusting the filament rheostat, but when tried on an outside aerial this control was found to make the set difficult to handle. Birmingham, Newcastle and Radio-Paris were, however, heard on the loud-speaker in this case.

General Remarks.

The set fully justifies the makers' claims, inasmuch as it is an efficient two-station portable receiver. It is rather heavy to carry, as the complete weight is about 30 lbs. The oscillation control from the filament rheostat may be improved by using a fine vernier to prevent it being so critical. Other combinations of valves were tried, but it was found that the best is that recommended by the makers, i.e., two D.E.2 (Marconi or Osram) valves for the first two stages and two S.P.18 (Cosmos) valves in the L.F. amplifying stages.

The convenience of having every accessory contained in one cabinet is a feature which will commend itself to many people. The quality of the reproduction in the loud-speaker was not considered good, but it is difficult to expect a complete self-contained receiving set of this type and size to be absolutely efficient from every standpoint.

Loud-speaker

Messrs. Goodchild & Partners have submitted to us for test their Sferavox loud-speaker. It is claimed that this loud-speaker is capable of taking the output of large sets without buzzing or distortion, and will, at the same time, operate satisfactorily from the smallest set capable of working a loud-speaker. Its sensitivity is remarkable, while the roundness of tone, and its response to high and low notes, is remarkable.

Description.

The loud-speaker is of the disc type, and consists of a cone of stout paper 11½ in. in diameter and 3 in. deep. The edge of the cone is gripped between two plated annular rings riveted together. The loud-speaker mechanism is enclosed in a cylindrical case supported centrally by two pieces of metal of V-shaped section along the vertical diameter. The base of the loud-speaker is circular, and 4½ in. in diameter. The mechanism is of the reed type, and a thin steel rod connects this reed with the centre of the diaphragm, where it is secured by two set screws. These set screws are placed on opposite sides of the rod and enable it to be adjusted centrally. The leads for the loud-speaker are about 12 ft. long, and, to within 4 in. of their ends, are enclosed in a common brown cotton covering, spade terminals being provided.

Laboratory Tests.

The resistance of this loud-speaker was found to be about 1,600 ohms, which is a satisfactory value, especially when used in conjunction with a low impedance power valve. It must be recognised, however, that the resistance is only a guide to the probable impedance, and is not necessarily proportional thereto. On testing, in conjunction with a number of different Radio Press receiving sets, the quality was found to be particularly good, and the loud-speaker handled quite a large amount of power satisfactorily. There was, however, a point of resonance at a rather high frequency, and the piccolo in an orchestra occasionally came out louder than was natural. The volume compared very favourably with that given by a number of other loud-speakers.

This loud-speaker can be recommended for general use, and will probably be found to give every satisfaction. It is unfortunate, however, that the rod connecting the reed to the diaphragm is of steel, since, in the specimen examined, it had rusted slightly.

Permanent Crystal Detector

Messrs. The Sclerine Crystal Co. have submitted to us for test their "Harmo" permanent detector. It is claimed that this detector is not a perikon or an ordinary crystal fixed in wax, but is a specially treated material, absolutely permanent and anchored so as to be quite shock proof.

Description of Component.

This detector is totally enclosed in a nickel-plated case 1¼ in. in diameter and ¾ in. deep, with a base of black insulating material. Two split pins serve as legs and project from this base, making contact inside with the two elements of the detector. Their spacing and diameter are the same as that of the two filament pins of a valve, so that they will fit into sockets intended for valve legs.

On taking the component to pieces it was found that the actual detector was mounted on the underside of the insulating base. Contact was made between two pieces of foil. One of these was pointed, and had the appearance of tin foil, and this point made light contact with the other piece of foil which was extremely thin and fragile, and had a blue black sheen. A piece of copper foil was used to support this, the blue black foil lying flat on the copper. Both of these pieces of foil were secured beneath the nut and washer used to hold the corresponding detector leg in place. The double foil was bent down to provide a surface for the contact of the point of the foil forming the other element of the detector.

Laboratory Tests.

The detector was tested at our Elstree Laboratories in conjunction with a plug-in coil and condenser, on an aerial of average efficiency. About 16 microamps were obtained from 2LO, while a galena detector of ordinary type gave 30 microamps on a corresponding setting. Corresponding currents for Daventry were 2 and 4 microamps respectively. In order to test for stability the detector was dropped on the floor several times from a height of about 3 ft. No alteration in rectified current was found to have taken place when the detector was placed in the circuit again.

The sensitivity of the detector is below that of the average catswhisker detector using a galena crystal. It has, however, considerable stability, and this compensates to some extent for its lack of sensitiveness. The finish is decidedly good, and it is possible by pressing the detector well home into flush-fitting sockets to bring its base almost flush with the panel.

The Philips rectifier, intended for the charging of accumulators from A.C. mains. A perforated cylindrical shield, removed for the above photograph, protects the instrument when in use.

Philips Rectifier

Messrs. Philips Lamps, Ltd., have submitted for test at our Laboratories an interesting product, i.e., a rectifier suitable for use on 200 volt A.C. mains.

Maker's Claim.

The rectifier, which is capable of charging one to six cells (2-volt) with a charging current of 1.3 amperes, is a full-wave rectifier. Having regard to its smooth action it shows a high efficiency, since it utilises both directions of the wave of the A.C. supply. It is absolutely silent in action.

Description of Component.

The rectifier has as its main operating part a rectifying valve with the usual four-pin base. This contains a filament, whose yellow incandescence can be viewed through a clear spot in the bulb, which is covered internally with a silver coating. The bulb is further provided with two plates connected to the secondary windings of a transformer, and these act as separate sources of alternating current of opposite direction, to produce full-wave rectification. Another bulb is provided with a three-pin base, and this acts as a variable balancing resistance. The transformer and bulbs are mounted on an insulating plate, and an external casing of perforated aluminium covers all the components.

Laboratory Tests.

The rectifier was employed to charge various accumulators, and with one 2-volt unit on charge, the output current was about 1.4 amps. Increasing the 2-volt units from one to six decreased this current to just over 1.1 amps. The ammeter reading was quite steady, but with a large capacity accumulator the time required for a full charge was on the high side.

A further test was carried out by using the accumulator in conjunction with a three-valve receiving set with the rectifying unit still charging the accumulator. Under these circumstances it was possible to hear a hum in the loud-speaker, but with strong signals this did not produce an unpleasant effect.

The rectifier thus wholly fulfils the maker's claims, being simple to use, and the only real wearing part is the rectifying valve, which is stated to have a normal working life of at least 1,000 hours. The rectifiers are supplied for various voltages, the frequency range on each instrument being 40 to 100 cycles.

Insulex

The Danum Trading Co. have sent us a bottle of their "Insulex" for examination and subsequent report. The liquid is claimed to remove fingermarks, stains, etc., from panels, giving perfect panel insulation, preventing surface leakage, and to increase the range of a crystal set and improve a valve set.

Laboratory Tests.

A film of this liquid was formed on a piece of ebonite of good quality, and the insulation resistance was found to be infinite. After a week's exposure to dust and damp air the insulation resistance was not affected in any way. This result was obtained with good quality untreated ebonite. For cleaning panels with bad leakages this liquid was found particularly satisfactory, and an improvement in signal reception was consequently found. It has been in use for a long period in our Laboratories for panel-cleaning purposes with marked success. This chemical preparation should be found very useful for panel-cleaning.

Ribbons of steel

—the same century-old principles of construction are employed in every Cossor Grid.

FROM bank to bank across a girder bridge a train speeds on its way. A hundred tons or more of living freight suspended in mid-air on a few ribbons of steel. Such is the skill of man. Rigidity is the Alpha and Omega of bridge construction. Without rigidity no bridge can withstand the devastating forces of Nature.

Rigidity, too, is the very essence of successful Valve construction. Without rigidity there must be distortion and microphonic noises. Compare the Cossor Grid with the ordinary spiral Grid and you'll instantly appreciate why the Cossor Valve has won such a unique reputation for purity of tone.

The Cossor Grid is a wonderful piece of miniature engineering. It is built up on a stout metal Grid band, and each turn of the wire is secured in three positions—35 places in all. Was there ever such rigidity?

Combine that with the Cossor electron-retaining system of design and you'll readily recognise why the Cossor is by far the most popular British Valve.

Everywhere it is earning golden laurels for a mellowness of tone hitherto considered impossible.

Before choosing your next Valve ask your Dealer to show you the Wuncell — the Cossor Dull Emitter. Functioning at a dull red glow (almost invisible in daylight) it is, indeed, a super-economy valve with an abnormally long life. For the first time it is possible to obtain a low temperature valve in every way as sensitive as the best bright emitter. The secret of Wuncell success is to be found in its wonderful filament. Instead of a wire, whittled down to the point of fragility, the filament used in the Wuncell is built up layer upon layer under the Cossor patent process. Instead of weakness there is strength.

The Wuncell Dull Emitter

Voltage 1·8 volts. Consumption ·3 amp.
•W1 for Detector and L.F. **14/-**
•W2 for H.F. amplification **14/-**

The Cossor Loud Speaker Valve W3

Voltage 1·8 volts. Consumption ·5 amp.
Price **18/6**

•Also in WR Series, with special switch and resistance in base to enable Valve being used with 2- 4- or 6-volt Accumulator:
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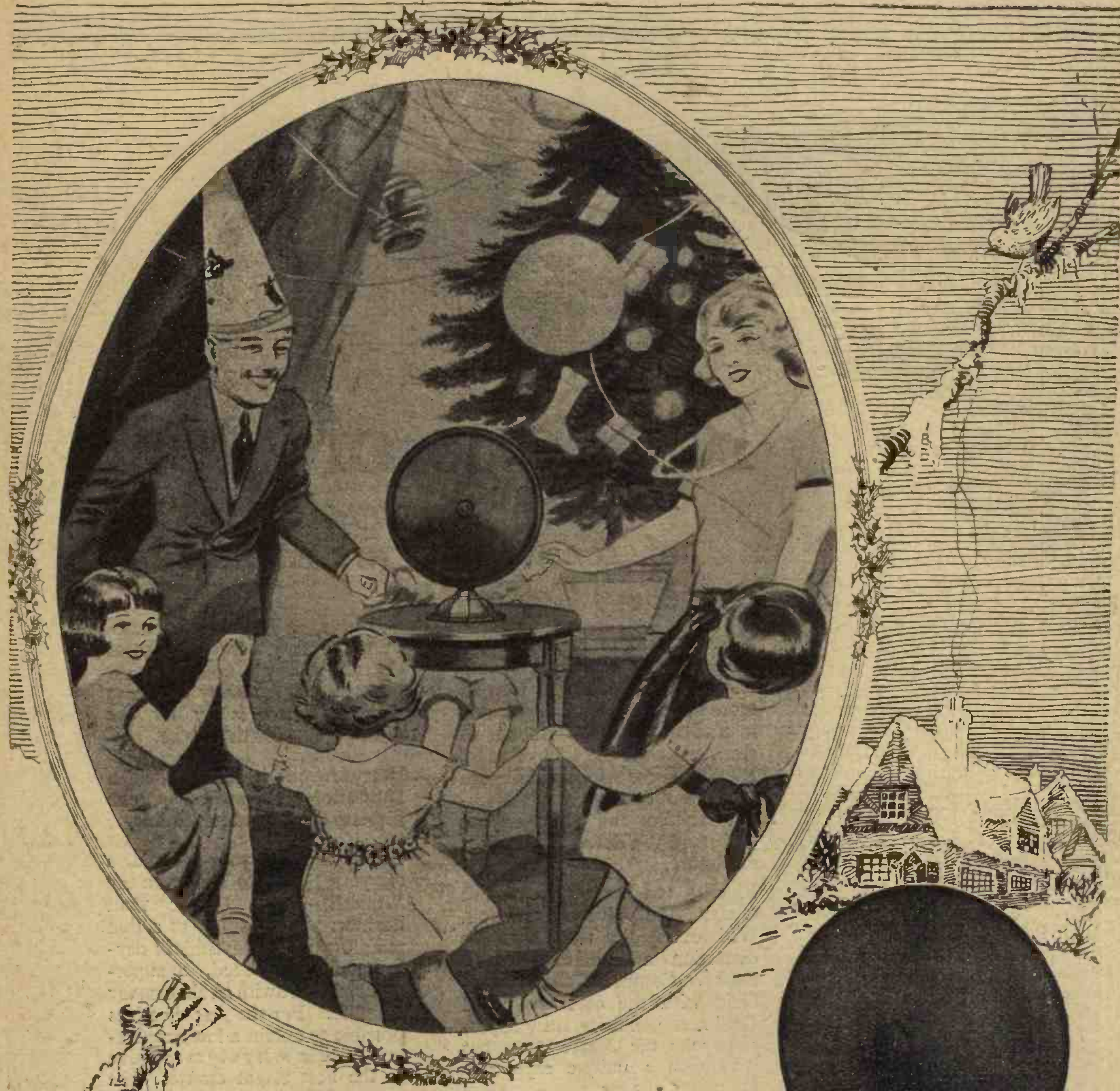

Make your Christmas one of the happiest on record by inviting a really welcome visitor to entertain you all and to keep the festivities going without a dull moment.

The "Kone" Loud Speaker, the most perfect instrument yet placed upon the market, will prove a source of endless delight. It will operate successfully on any amplifier having an output impedance of 2,000 to 5,000 ohms. The ideal output impedance is 2,000 ohms as in the "Kone" amplifier. *Order it now.*

Price £6 : 6 : 0

PATENT APPLIED FOR

The KONE Speaker

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ADVT. of **Standard Telephones and Cables Limited** (formerly Western Electric), Connaught House, Aldwych, W.C.2

CORRESPONDENCE

ILLEGAL USE OF RADIO CALL LETTERS

Sir,—From reports received by me it has been definitely established that the call letters 5NJ allotted to my station are being employed by some other person or persons unknown for the purposes of radio transmission, and I should be obliged if you would announce to all interested the existence of this irregularity.

I need hardly emphasise the unfairness of such an illegal procedure. Transmitting licences are only granted under the strictest conditions as to times of transmission, wavelengths, etc., and this in itself makes it sufficiently difficult to be answerable for one's own conduct without being held responsible for that of some unknown and probably irresponsible pirate.

I would therefore be very grateful for any help your readers can give me in order that I may trace the offender and so put a stop to this nuisance.

All the available details are already in the hands of the Post Office authorities.—Yours faithfully,

F. R. Neill.

Chesterfield, Whitehead,
Co. Antrim.

AMATEUR CALL SIGNS.

Sir,—I beg to inform you that I have received a permit to carry out experiments in transmission on an "artificial aerial." My call sign is 2BFQ and my address is given below.—Yours faithfully,

W. D. Oliphant.

4, Widmar Avenue, Edinburgh.

Sir,—Will you please note that my station 2OZ (two oh zed) has been transferred from Exmouth to 20, Perryn Road, Acton, W.3.

Perhaps you would be kind enough to give publicity to this alteration.—Yours faithfully,

John W. Norton.

Acton, W.3.

THE "TWIN-VALVE" RECEIVER

Sir,—Six months ago I had a plain one Det., one L.F. valve set, and felt fed-up because I could not get anything like good results. I could at times get Birmingham, Bournemouth and Cardiff, but at no great strength. Then reading the January, 1925, issue of *The Wireless Constructor* I noted the "Twin-Valve" Receiver, described by John Scott-Taggart, F.Inst.P., A.M.I.E.E., comprised all my components except two fixed condensers. So I "re-wired" my set to your circuit, and although I have not adhered to the design in detail, results have really been excellent.

I can get all the B.B.C. stations at good 'phone strength (I have a very poor aerial and a worse earth), Le Petit Parisien, PTT, Hamburg, Madrid (RI), Radio-Sud-Est, Brussels, Munich, Radio Toulouse, Radio-Paris, Hilversum, Stockholm, Dresden and WGY (U.S.A.) (twice).

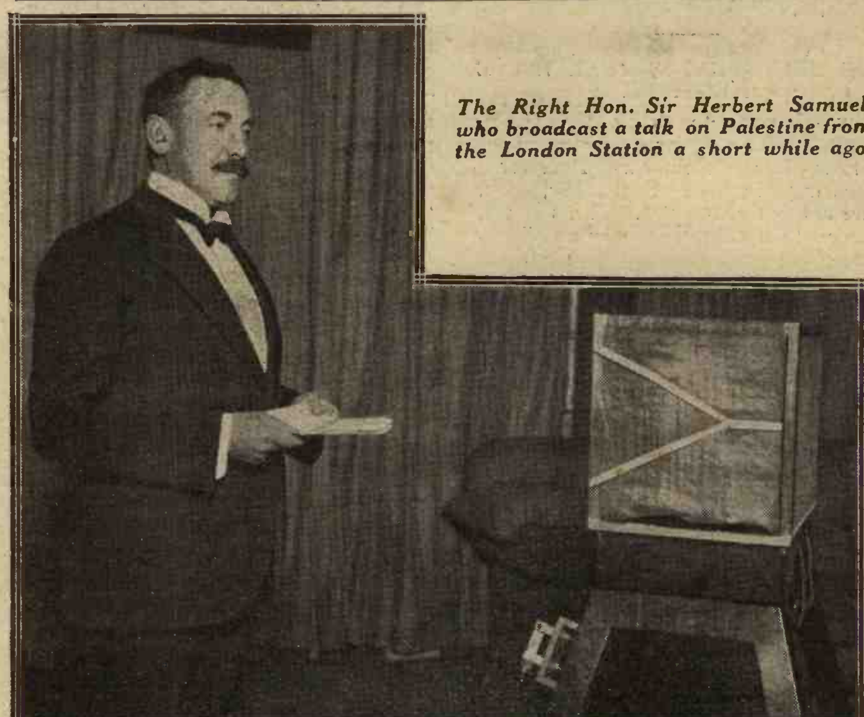
Every station is clear, and I think that, given a better aerial and earth, the majority would work a loud-speaker (small type).

Later I intend to add the "Two-stage Choke Amplifier," by John W. Barber, described in the September, 1925, issue of *The Wireless Constructor*.

Many thanks for the circuit.—Yours faithfully,

J. Shann.

West Kensington.



The Right Hon. Sir Herbert Samuel, who broadcast a talk on Palestine from the London Station a short while ago.

Sir,—I made up the "Twin-Valve" set as described by John Scott-Taggart, F.Inst.P., A.M.I.E.E., in the January, 1925, issue of *The Wireless Constructor* about six months ago, and am very pleased with results.

I have had all the main stations and several relays and Continentals. Being situated about 25 miles from the nearest station (Cardiff), this comes in after dark rather too loud for 'phones (five pairs), while Daventry, much louder still, has worked a loud-speaker.

I do not, however, want to work a loud-speaker, but prefer the more distant stations, such as Bournemouth, Birmingham, Newcastle, etc., at excellent 'phone strength to accommodate the whole five pairs of 'phones.

Perhaps the following would be of interest. My aerial is of the "bird-cage" type, 5 ft. across and 4 ft. above the roof (no room for any other type), and was erected by the trade, and seems quite efficient for Cardiff and Daventry.

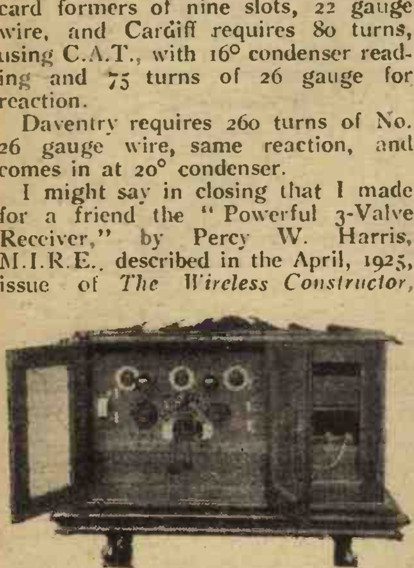
My earth is a copper tube with a

15-ft. lead of five strands of No. 20 and 7/22 twisted together.

My coils are home-made baskets on card formers of nine slots, 22 gauge wire, and Cardiff requires 80 turns, using C.A.T., with 16° condenser reading and 75 turns of 26 gauge for reaction.

Daventry requires 260 turns of No. 26 gauge wire, same reaction, and comes in at 20° condenser.

I might say in closing that I made for a friend the "Powerful 3-Valve Receiver," by Percy W. Harris, M.I.R.E., described in the April, 1925, issue of *The Wireless Constructor*,



A handsome cabinet "All-Concert de Luxe" receiver (Radio Press Envelope No. 4), constructed by Mr. P. M. Weir of Gourock, Renfrewshire.

and he was delighted, Cardiff 25 miles, Bournemouth 65, and Daventry coming in on an Amplion loud-speaker at full strength.—Yours faithfully,

A. L. MARTIN.

Bristol.

THE SELECTIVE SINGLE-VALVE RECEIVER

SIR,—I wish to thank Mr. G. P. Kendall, B.Sc., for the excellent "Low-loss Reinartz Receiver" appearing in the September, 1925, *Wireless Constructor*. This set, coupled to a stage of power amplification, gives me all three South African stations on telephones; in fact, too loud to be comfortable. Durban and Johannesburg, respectively 300 and 140 miles away, at night come in clearly at fairly good loud-speaker strength. Cape Town, 1,000 miles, at night also on loud-speaker. This is not all. On the night of September 29 I held a Spanish station for half an hour from 11.25 p.m. African time, and a British station, presumably Bournemouth, from 12 to 12.50 a.m. Musical items were clearly heard. I am struck with the purity and wonderful selectivity. Tuning in my case is very sharp, and the reaction control is delightful. I also operate a five-valve tuned anode circuit and a special Reinartz type short-wave circuit. I have a very fine aerial system, the height at the lead-in end being 85 ft., with a stretch of 40 ft. across to a pole 95 ft. high. Earth—water pipe running immediately under the aerial. The set described by Mr. Kendall is certainly one of the best one-valvers I have yet come across.

I found the best valve to use with this set, in my case, was a B.T.H. Type B4 power valve—an excellent valve indeed. I use this type of valve for my short-wave receiver with the greatest success. Many thanks again.—Yours faithfully,

G. W. SMITS.

P.S.—After nightfall all African stations excellent signal strength on one valve only.—G. W. S.

East Transvaal, South Africa.

THE "TRANSATLANTIC V" AND "ANGLO-AMERICAN SIX" RECEIVERS IN JAPAN.

SIR,—In view of your request for reports from subscribers to your papers who have constructed the various receiving sets described from time to time in your columns, I have pleasure in forwarding a photograph of my "Transatlantic V" (described by Percy W. Harris, M.I.R.E., in *Modern Wireless* for June, 1924) and "Anglo-American Six" (described by Percy W. Harris, M.I.R.E., in *The Wireless Constructor* for January, 1925) receivers. These sets have been a most interesting spare time occupation, and have given perfect results.

We are not favoured in Japan with so many broadcasting stations as in Europe; our fish pond only contains five stations, viz., Tokyo, Nagoya and Osaka in Japan proper, Dairen in South Manchuria, and Shanghai in China. My residence is in Yokohama, about 12 miles from Tokyo; the Nagoya station is about 150 miles away and Osaka something like 250 miles, while Dairen is about 1,000 miles and Shanghai 1,200 miles. I am able to bring in all these stations on my "Anglo-American Six" at loud-speaker strength. The wavelengths of these stations are 375, 365, 385, 390 and 356 metres respectively; but, even with the wave-trap, I have a little difficulty in totally cutting out Tokyo when listening to the Nagoya station. Owing to the difference in time, the Shanghai and Dairen stations do not interfere at all, as they do not commence broadcasting in the evening until all the Japanese stations have shut down.

I have found the D.E.5 valve an excellent valve to use in all stages of the "Anglo-American Six," but it is, of course, essential to use a storage battery for the H.T. supply, as the drain is something like 35 milliamps, with 75-50-120-150 volts on the respective valves. I have now mounted a D.E.5 in the resistance-coupled amplifier, and with 120 volts H.T. this gives excellent strength and reproduction.

I should be very pleased to hear from any reader who has managed to make the "Anglo-American Six" a little more selective when operating near a local station, as I find its selectivity cannot be compared with that of the majority of the standard American Neutrodyne receivers. However, the power is superior to any set, even a superheterodyne.

Radio appeals greatly to the Japanese, but, due to the poor programmes we have from the broadcasting stations, many are disappointed. Business is fairly brisk, and my firm is having great success with a well-known make of British loud-speaker; but the English receiving sets must improve in selectivity before a market can be found for them here.

With all good wishes for your future success.—Yours faithfully,

H. C. LEPPER.

Tokyo, Japan.

"AN EFFICIENT SINGLE-VALVE RECEIVER"

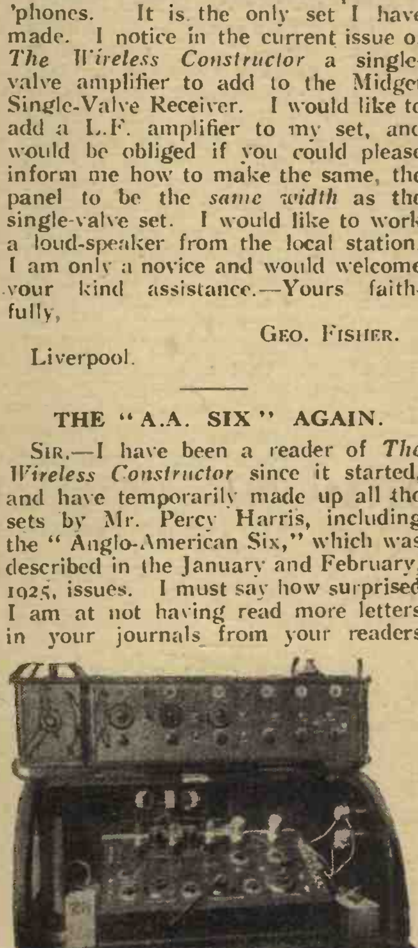
SIR,—I constructed the single-valve set by Herbert K. Simpson (June, 1924, issue *Modern Wireless*). It has given me great satisfaction. I get Liverpool and Manchester easily, using an indoor aerial. I use three pairs of 'phones. It is the only set I have made. I notice in the current issue of *The Wireless Constructor* a single-valve amplifier to add to the Midget Single-Valve Receiver. I would like to add a L.F. amplifier to my set, and would be obliged if you could please inform me how to make the same, the panel to be the *same width* as the single-valve set. I would like to work a loud-speaker from the local station. I am only a novice and would welcome your kind assistance.—Yours faithfully,

GEO. FISHER.

Liverpool.

THE "A.A. SIX" AGAIN.

SIR,—I have been a reader of *The Wireless Constructor* since it started, and have temporarily made up all the sets by Mr. Percy Harris, including the "Anglo-American Six," which was described in the January and February, 1925, issues. I must say how surprised I am at not having read more letters in your journals from your readers



The "Anglo-American Six" and "Transatlantic V" receivers built by Mr. H. C. Lepper and used with success in Japan.

regarding this set. This is the best set of all I have made, has given me more pleasure than any set I have worked, and is quite fascinating to use.—Yours faithfully,

F. HAYWARD.

Ipswich.

THE DESIGN OF TUNING CIRCUITS

(Continued from page 390)

more. It should be remembered, however, that the standard laid down for very good selectivity is very high indeed, and the need for it seldom arises.

Capt. Round, moreover, has suggested that with a valve-coupled filter a form of saturation in the valve tends to give flat-topped resonance curves, which means that distortionless reproduction is obtainable with lower decrements than those given in Fig. 4.

Actual Values of Decrement

Let us consider now how these theoretical values of decrement compare with those which are obtainable in practice.

A two-circuit receiver requires a decrement of .025, while for three circuits the figure is .033. This latter value is a fairly practical figure. I have recently measured the decrements of a large number of coils, and the following results will indicate the order of this quantity. The results are not by any means complete, and I hope to give more data on the subject in future articles. Having discussed the exact requirements of a good coil, it will be a simple matter in future to gauge the suitability of any particular sample.

Practical Results

For a simple unspaced winding on a 3-in. former, wound with any wire between 28 S.W.G. and 36 S.W.G. (double silk covered), the decrement rises from about .04 with a coil $\frac{1}{4}$ in. long to about .08 with a coil 1 in. long.

Thus, provided the coil is kept short, the decrement with a plain winding is of the order required for a three-circuit tuner. It is not always possible to obtain the requisite inductance, however, with such a short coil, and in this case a spaced winding pays.

The "Three-step" Coil

With a "three-step" coil, for example, having an inductance of 130 μH, the decrement was .044, whereas a plain winding of equal inductance gave a decrement of .048. There is thus a slight advantage in using a spaced winding. It should be remembered that this coil has a large ratio of l/D which is inefficient, and better results may be expected from low-loss coils having only a short length of winding. Experiments with this type of coil are now in progress.

I have not yet found any coil, low-loss or otherwise, wound with ordinary wire in a reasonably compact form which reaches the limit. The best coil so far tested had a decrement of .035.

In a filter comprising a series of loose-coupled tuned circuits, therefore, ordinary coils are satisfactory with three circuits, but something better is required with only two circuits. Our present methods of low-loss construction, however, are not good enough, and better methods will have to be devised for this type of coil.

Valve-Coupled Filters

In the more usual case of valve-coupled filters there are secondary effects introduced. In the first place, the valves themselves may introduce additional damp-

(Concluded on page 415)

THE DESIGN OF TUNING CIRCUITS

(Concluded from page 413)

ing. This is particularly the case with a detector valve, when the effective resistance may be increased by as much as 40 ohms.

On the other hand, reaction effects are possible here, which allows the decrement to be reduced again. Practical experience seems to indicate that simple types of coil, with suitable reaction, are quite satisfactory, and that the reaction control is not critical.

Further Research Necessary

The ideal type of circuit, however, is one in which reaction can be dispensed with, so that research in the direction of reduction of losses is still desirable, and we have not yet reached the desired limit.

SUPER-REGENERATION AT THE HIGHER FREQUENCIES

(Continued from page 393)

amount of interference from amateur C.W. stations working at neighbouring frequencies was noticed. If, however, the receiver was tuned carefully to the exact frequency of the required transmission, the interfering signals became merely a faint background to the telephony.

Distortion

With values of .003 μF and .004 μF for C7 and C8, a much more disturbing whistle was obtained, and telephony was much distorted, speech being barely intelligible. The most satisfactory values of shunt capacity for the particular coils used appeared to be the second pair mentioned.

Notes on Operation

In the operation of the receiver it should be noted that C1, the reaction condenser, will need to be set at one particular point for any given point on the tuning condenser C2. Variations of C1 will have a slight effect on the frequency of the quenching coil oscillations, since it is in effect shunted across them. An adequate size of reaction coil must be provided for L3. In the receiver used by the writer the size of reaction coil which, with the normal circuit, was found adequate to cover a range of 3,529 to 8,571 kilocycles (35 to 85 metres), with the super-regenerative unit added was only suitable for the 6,000 to 8,571 kilocycle range (35 to 50 metres).

If the circuit proves unstable in use, an improvement in this direction may be effected by connecting L.T. negative instead of L.T. positive to the common connection of the quenching coils.

L.F. Amplification

The addition of stages of L.F. amplification to a receiver equipped with this super-regenerative unit, owing to the disproportionate amplification of the note of the quenching frequency and of any atmospheric or parasitic noises is not generally advisable. It is admittedly possible to design filter circuits to overcome, or at any rate diminish, this trouble. But in the writer's opinion, ample signal strength for all ordinary purposes is obtainable with the single-valve circuit.

Information Department.

D. I. C. (OMAGH) has just constructed his first receiver, which is a "Transatlantic V," and reports that although he can get all of the British main stations at fair strength in the telephones using three valves, when he switches over to the full five valves only weak signals are heard from the loud-speaker.

Since this is our correspondent's first set, it is quite likely that there is no actual fault in the circuits of the low-frequency valves, but it is more likely that the trouble results from a characteristic of all sets in which resistance-capacity coupling is used on the low-frequency side. In such sets switching in the low-frequency valves involves bringing a resistance of usually 80,000 to 100,000 ohms into the anode circuit of the detector valve, with a consequent drop in the effective anode voltage applied to the plate. This will, of course, upset any critical adjustment of reaction, and cause the set to be less sensitive than it was previously. In practice it is quite possible for a station which, with critically adjusted reaction, was quite strong in the telephones to be only just audible on the loud-speaker, unless the set is readjusted after switching in the low-frequency valves. In the case of the set in point, the receiver should be brought back to its most sensitive state after switching in the L.F. valves, by turning the potentiometer towards the negative end, or by readjusting the position of the reaction coil, at the same time slightly re-tuning if necessary.

Where the accumulator is a small one, it is quite possible that the extra load placed on it when the two low-frequency valves are switched into circuit, will result in dropping the voltage on all valves sufficiently to prevent the set functioning in a satisfactory manner. If this is the case the fault can be located by readjustment of all the filament resistances. As a permanent remedy for this trouble a larger low-tension accumulator should be obtained.

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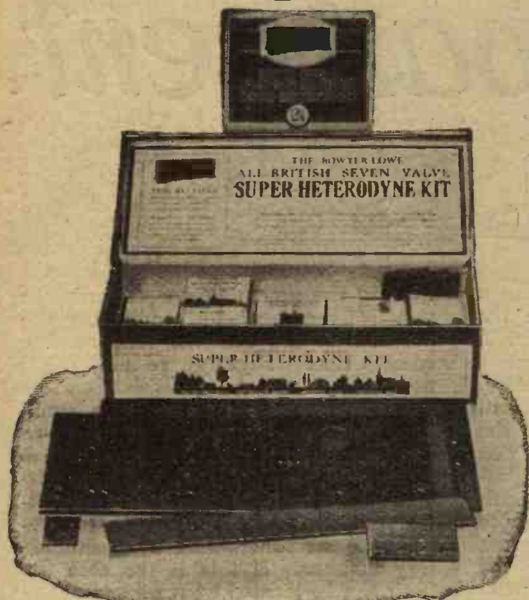

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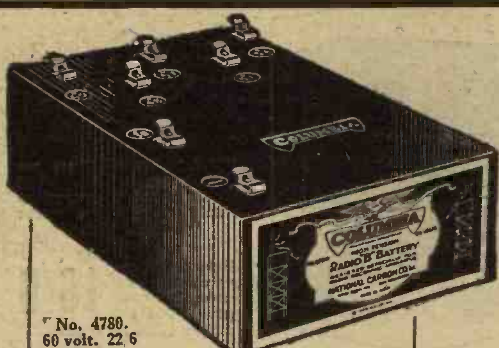

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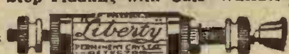

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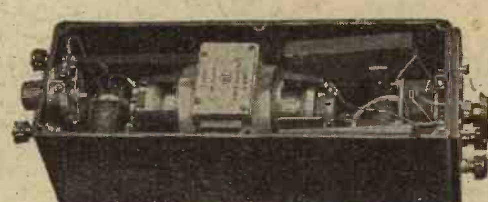

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REGISTERED TRADE MARK

takes first place—why?

BECAUSE IT HAS PROVED ITSELF AND IT IS GUARANTEED FREE FROM SURFACE LEAKAGE.

Matt or Polished. Panels cut accurately to size.
RODS. TUBES. SHEET.

Ask your dealer for ebonite branded "Becol."

THE BRITISH EBONITE CO., LTD.
HANWELL——LONDON, W.7.

"Meet a good pal of mine,"

says CLIXIE

"CLIXIE"

"Name of **CLIX RINGTAGS.** Nothing to wire home about for looks, I'll admit," says CLIXIE, "but still a very useful acquaintance.

"RINGTAGS job is gathering up the loose ends — the sort of neatness that makes for 100% efficiency. Always use RINGTAGS when you're making CLIX terminal-loops, etc., in ordinary wire or RADIO CONDIT—the H.F. Conductor of double efficiency that I've been boosting lately. It's a habit that doesn't cost much in money or time, but it's apt to save you a whale of a lot in time *and* temper.

"The sketch shows you how to attach flexible wire to RINGTAGS. The price? Two-pence buys a packet of a dozen."

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CLIX

The Electro-Link with 159 Uses

Ringtags, like Clix, are obtainable everywhere

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Fits any Condenser.

from your dealer

6/-

EASIER & MORE ACCURATE TUNING!

FOR quick accurate tuning the Pelican Univernier dial is far superior to the old method of moving a pointer around a fixed scale. The dial and its control make it easy for you to direct your attention to a particular degree and to tune in a station with the minimum of trouble. In the Pelican Univernier is found the real embodiment of condenser dial perfection. To begin with it is massively built. It has a good size knob which provides a comfortable grip without allowing your fingers to cover up the scale. The graduations are clearly marked to allow quick easy reading. Smooth in operation the Pelican Univernier is a revelation in accurate tuning. You can at once replace your ordinary dials with the Pelican Univernier—no set alterations are necessary, simply take off the old and put on the new.

Write for descriptive leaflets and details of Pelican 1, 3 and 4 Valve Sets. Self-contained, no aerial, no earth. Simple to operate. Prices from £10.

CAHILL & COMPANY Ltd. 64, NEWMAN ST., LONDON, W.1
Telegrams: Pelcarad, Wesdo, London
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Use Electric Light Mains

Greater Power.
Quieter Background.
Less Cost.

Complete Receiving Sets run from the Mains. H.T., or H.T. & L.T. Units for your Set.

DYNAMERGY MAINS SUPPLY, STAINES.

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Easily fixed in place of your present jerky coil holder, it makes the tuning in of distant stations —sure, easy and definite.

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Let our valve making plant repair your broken or burnt-out valves efficiently and promptly (most makes). Amplification, radiation, and current consumption guaranteed same as new. Bright emitters 5/- "D.E.'s" (2 and 3 v. types) 7/6. *Radions Ltd., Bollington, nr. Macclesfield Ches.* Largest Valve Repairing Firm in the world. List Free.

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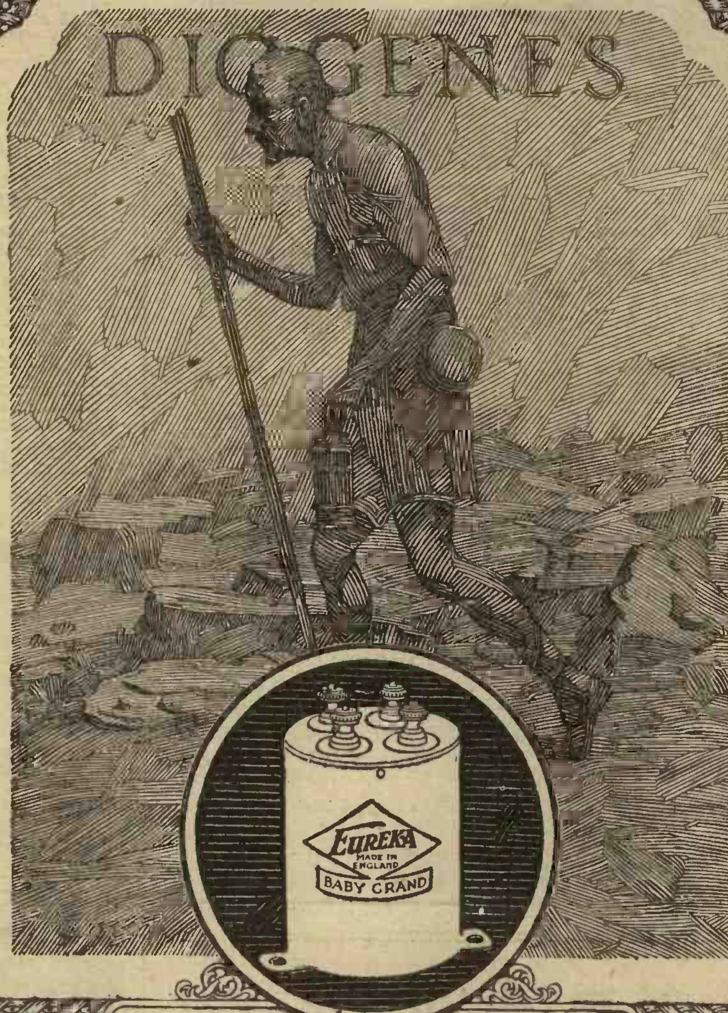

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DIOGENES in his life-long search for an honest man had no greater task than the wireless experimenter setting out to buy his Low Frequency Transformer. Amid such a babel of claims he may well be confused and nonplussed.

Sober presentation of facts has always been the outstanding feature of all Eureka advertisements. More than three miles of wire in every Concert Grand . . . Every Eureka hermetically sealed . . . Interaction positively prevented by the coppered steel case . . . These are but three features which helped to place the Eureka in the very front rank of transformers.

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Price Per Piece 3/-

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stands alone. Unrivalled for any purpose where super-sensitiveness and long range are required.

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and suffer the depreciation and many annoying inconveniences caused by unskilled charging.

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You must therefore fit THE

Dorwood Precision Condensers

which are guaranteed by our work's laboratory test.
The only grid condenser having a three point connection.
The DORWOOD has often been used in sets described in Radio Press publications. This is another guarantee of its efficiency

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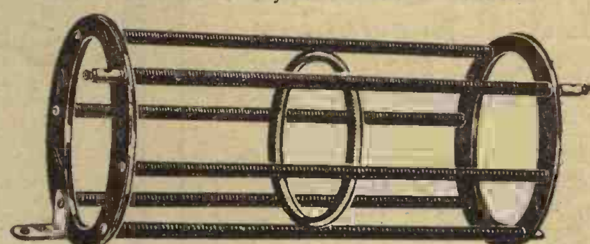
GET A "LOWFORMA."

The most convenient and efficient low loss coil former obtainable.
AN IDEAL PRESENT for anyone interested in Wireless.



Prices: 3½ in. diameter × 5 in. long 4/9, 6 in. long 5/-, 7 in. long 5/6.
Order from your dealer. If unobtainable send to the Makers—
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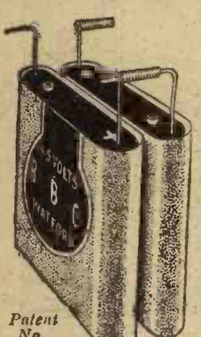
BRITISH BATTERY CO., LTD.



Patent No. 202760.

CLARENDON RD., WATFORD, Herts
(*Telephone: Watford 617*).
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H.T. BATTERIES.

No. 1 W.
Standard Pocket Lamp Size—4½ volt *with* patent spiral wire terminal *and* plug sockets to take Wander Plugs. Note:—1 doz. 54 volts. Used units replaced easily. To connect in Series insert straight Terminal in spiral of next battery. Bend spiral and thus ensure permanent electrical connection without soldering. (*See illustration*).

Price Carriage Paid 7/- per doz., with Plug 3/9 for 6.

All standard voltages supplied with 3 volt. tappings.

Guaranteed British Made at our own Watford Works.

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RADION DE·06 3-volt (H.F. or L.F.) 10/6
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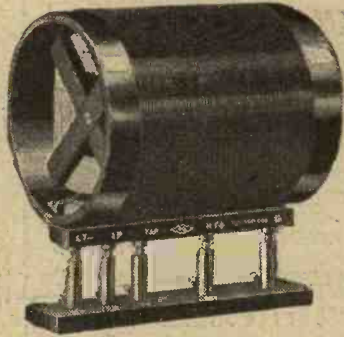
RADIONS LTD., Bollington, Nr. Macclesfield, Cheshire.
Send for our booklet; it describes valves, repair service, and gives useful hints. It's free. Write to-day.

Radio Press Information Dept.

2/6 QUERY COUPON 2/6

WIRELESS WEEKLY. Vol. 7. No. 12. December 9, 1925.

This coupon must be accompanied by a postal order of 2/6 for each question, and a stamped addressed envelope.



Scrap your Barrel-type H.F. Transformer

—this new pattern gives you incredible selectivity.

As used by Mr. P. W. Harris in the "M.W." "Special Five."

This H.F. Transformer (patent applied for) represents an entire departure from all other designs. In selectivity and amplification it is far ahead of the ordinary barrel type of Transformer. Its primary is aperiodic and its exclusive design and shape make it the last word in low-loss and efficiency. The secondary is air spaced on a grooved ebonite former, and each one is made to an exact standard, resulting in the condenser scale reading being practically identical in each successive stage of H.F. amplification. The main feature of this new Peto-Scott production is that the capacity coupling has been reduced to an absolute minimum resulting in an exceptional degree of selectivity.

PRICES

No. 1. 250 to 550 metres, with base .. **15/-**

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Catalogue of Components 3d.

Super-Het. Builders Before building your Super-Het. send 3d. in stamps to cover postage of new Keystone Book of Super-Hets. The largest and most complete book published, with full constructional details and diagrams.

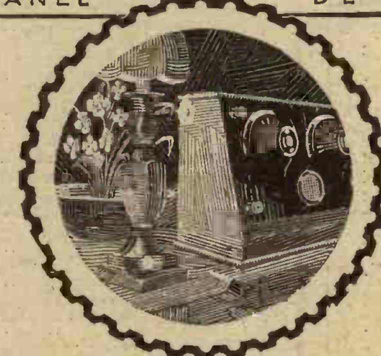
Peto-Scott Co., Ltd.

HEAD OFFICE: 77, CITY RD., LONDON, E.C.1

Branches: LONDON, 62, High Holborn, W.C.1. WALTHAMSTOW, 230, Wood St. PLYMOUTH, 4, Bank of England Place. LIVERPOOL, 4, Manchester St.

P.S. 4115

THE PANEL DE LUXE



IF after you have built up your Set you find that a component is unsatisfactory it can usually be replaced without much difficulty. On the other hand a leaky panel will render useless the work of many hours and necessitate the complete rebuilding of the Set. Be wise, therefore, and refuse to take risks. Don't ask merely for an ebonite Panel—ask for a Radion Panel and see that it bears the trade mark Radion.

¶ *Radion is available in 21 different sizes in black and mahoganite. Radion can also be supplied in any special size. Black 1d. per square inch, mahoganite 1½d. per square inch.*

RADION

American Hard Rubber Company (Britain) Ltd.

Head Office: 13a Fore Street, London, E.C.2 *Depots:* 220 Wellington Street, Glasgow: 116 Snow Hill, Birmingham. *Irish Agents:* 8 Corporation Street, Belfast.

Gilbert Ad. 4122

ELECTRADIX RADIOS

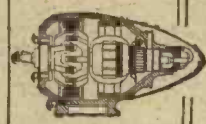
(Leslie Dixon & Co.)

LONDON'S LATEST RADIO EXHIBITION *of* SURPLUS GOVERNMENT BARGAINS

now open at Lambeth Hill and 218, Upper Thames Street, E.C.4.

Great Sale of Surplus Radios at Sacrifice Prices. The wide range of our Huge Stock is World Renowned.

Call early as prices cannot be repeated. Our Showrooms are easy of access—Blackfriars or Mansion House Station on the Underground Railway; Cannon Street or St. Paul's on the Southern Railway are close by. 1d. Bus from the Bank lands you at the top of Lambeth Hill. We are at the bottom corner, nearly opposite Siemens Bros. Colonial Avenue is closed for retail now. 'Phone City 191, and all orders should be sent to 218, UPPER THAMES STREET.

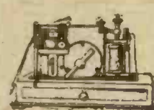


200 WATT, 500 CYCLE ALTERNATOR and EXCITER.

CRYSTAL SETS. Mark III Tuners.

MIDGET M.C. 0·10 m/a. 22/6

H.T. & L.T. POCKET VOLTMETERS.



MORSE RECORDERS.

MIRROR MICRO-AMMETERS.

EDISWAN VALVES, R.A.F. "C" Type.

FRENCH ALL-IN WORLD BEATER SETS.

ELECTRADIX RADIOS

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'Phones: City 191. Avenue 4166.

Address all Post Orders to City Showroom:

218, Upper Thames Street, E.C.4.

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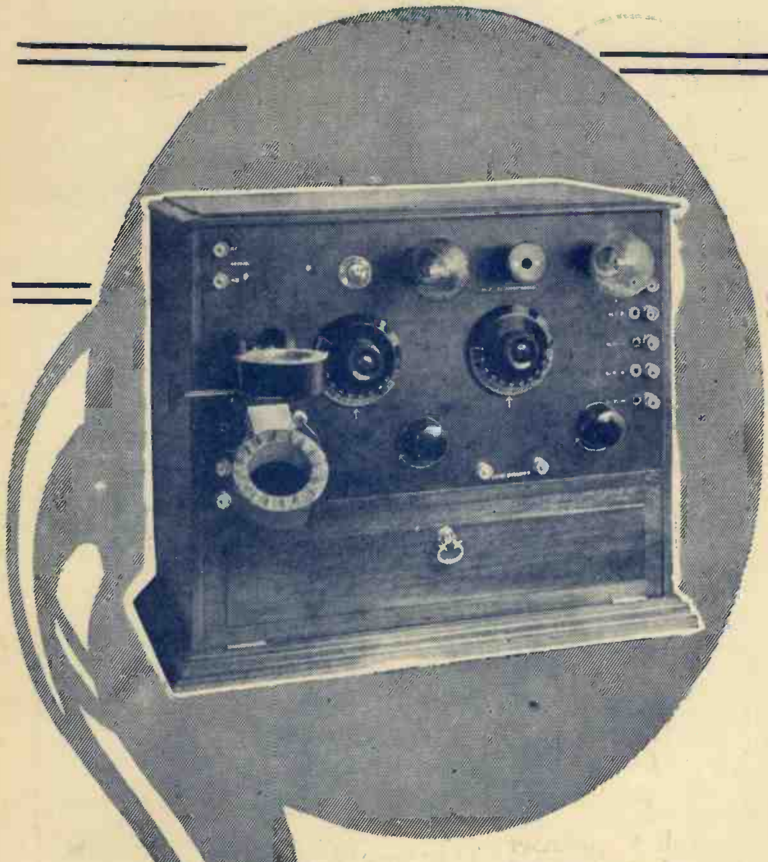


GOOD LOUD-SPEAKER RESULTS WITH TWO VALVES

Volume and Purity

In the "Twin-Valve Loud-Speaker" Receiver, full details of which are included in Radio Press Envelope No. 10, you have a handsome and highly efficient set which gives good loud-speaker results from your local station.

With an average aerial system it operates a loud-speaker up to 25 miles from the local station, yet it employs only two valves. The first valve is a dual high- and low-frequency amplifier, and the second a rectifier. No crystal is used, so that the set is perfectly stable when once adjusted.

Dull or Bright Emitter valves may be used. Ease of control is a special feature, and the set will satisfy and give pleasure to everyone who constructs it.

ASK FOR ENVELOPE No. 10.

BUILDING THIS SET

You are sure to succeed in building this set because, as with all Radio Press Envelopes, the instructions are most clear. Blue prints, reproductions of photos, and working drawings show you exactly how to construct easily and efficiently.

PRICE

2/6

Post Free 2/9

Obtainable at all Newsagents, Bookstalls, your local Wireless Dealer, or direct from Dept. S., Radio Press, Ltd. For prompt and sure delivery when ordering direct please write your name in BLOCK LETTERS.

The Twin-Valve Loud-Speaker Receiver

by John Scott-Taggart, F.Inst.P., A.M.I.E.E.

RADIO PRESS ENVELOPE No. 10.

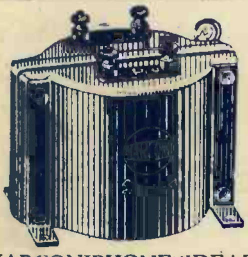
RADIO PRESS, LTD., BUSH HOUSE, STRAND, LONDON, W.C.2.

RADIO PRESS

Barclays Ad.

Marconiphone and STERLING Radio Components

For perfect results build your radio set with the best components. Marconiphone and Sterling Components are easily the best by every test. Absolute satisfaction is assured, for these components are correct in design and made of the finest materials. The test is—results. They stand by that alone.



MARCONIPHONE "IDEAL" RANGE OF TRANSFORMERS.

A type for every specific purpose. With their use very extensive amplification is possible without distortion. "Ideal" Transformers undergo a special impregnating process using *Marconite*, the most perfect insulating material obtainable and non-corrosive. Each Transformer is within 5 % of the guarantee curve.

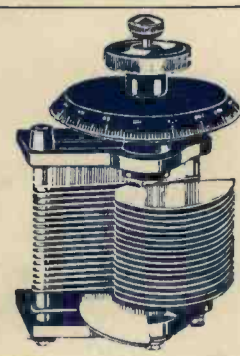
"IDEAL" TRANSFORMERS are supplied as follows:—Type "A," ratio 2·7 to 1; Type "B," ratio 4 to 1; Type "C," ratio 6 to 1; Type "E," ratio 8 to 1. Each complete in metal case (as illustrated) - - **30/-**

"IDEAL JUNIOR" TRANSFORMER. This type has been produced in a ratio of 3 to 1, for it was found possible at this ratio only to successfully retain in a simplified form the standard "Ideal" principles of construction. Supplied at the popular price of **25/-**

MARCONIPHONE AUTO SERIES PARALLEL VARIOMETER.

An entirely new pattern which will tune an aerial from 230—1630 metres with a single revolution of the 360 degs. scale. This extensive wave-range capacity is effected by means of a patent parallel switch. The action of this variometer is remarkably smooth and even. PRICE **16/-**

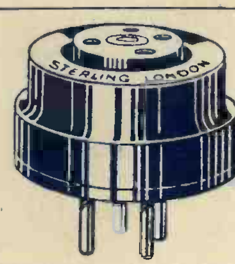
STERLING SQUARE LAW VARIABLE CONDENSERS. With and without vernier adjustment; also geared; double and triple, and balanced types. Full range of prices on application.



MARCONIPHONE BATTERY RESISTANCE. A very compact filament rheostat of novel design. Especially suitable for attaching to an accumulator or dry battery when employing D.E. 3 type valves. PRICE **6/6**

STERLING "NON-PONG" VALVE HOLDERS. Obviate microphonic noises and lengthens the life of valves.

Valve Holder 4/3
Adapter (as illustrated) 5/-



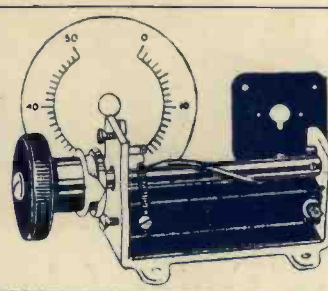
STERLING "LILLIPUT" HEADPHONES **20/-** per Pair

STERLING "LILLIPUT" HEADPHONES

A veritable masterpiece of headphone efficiency. Clear in tone, light in weight and extremely comfortable. Easily adjustable to any head. The most efficient inexpensive 'phone obtainable. PRICE **20/-**

MARCONIPHONE "VELVACT" POTENTIOMETER

Specially designed to ensure perfectly smooth and silent operation. Contact with the resistance wire is made by a spiral of thick wire mounted on a metal rod. Resistance 350 ohms. PRICE **9/-**



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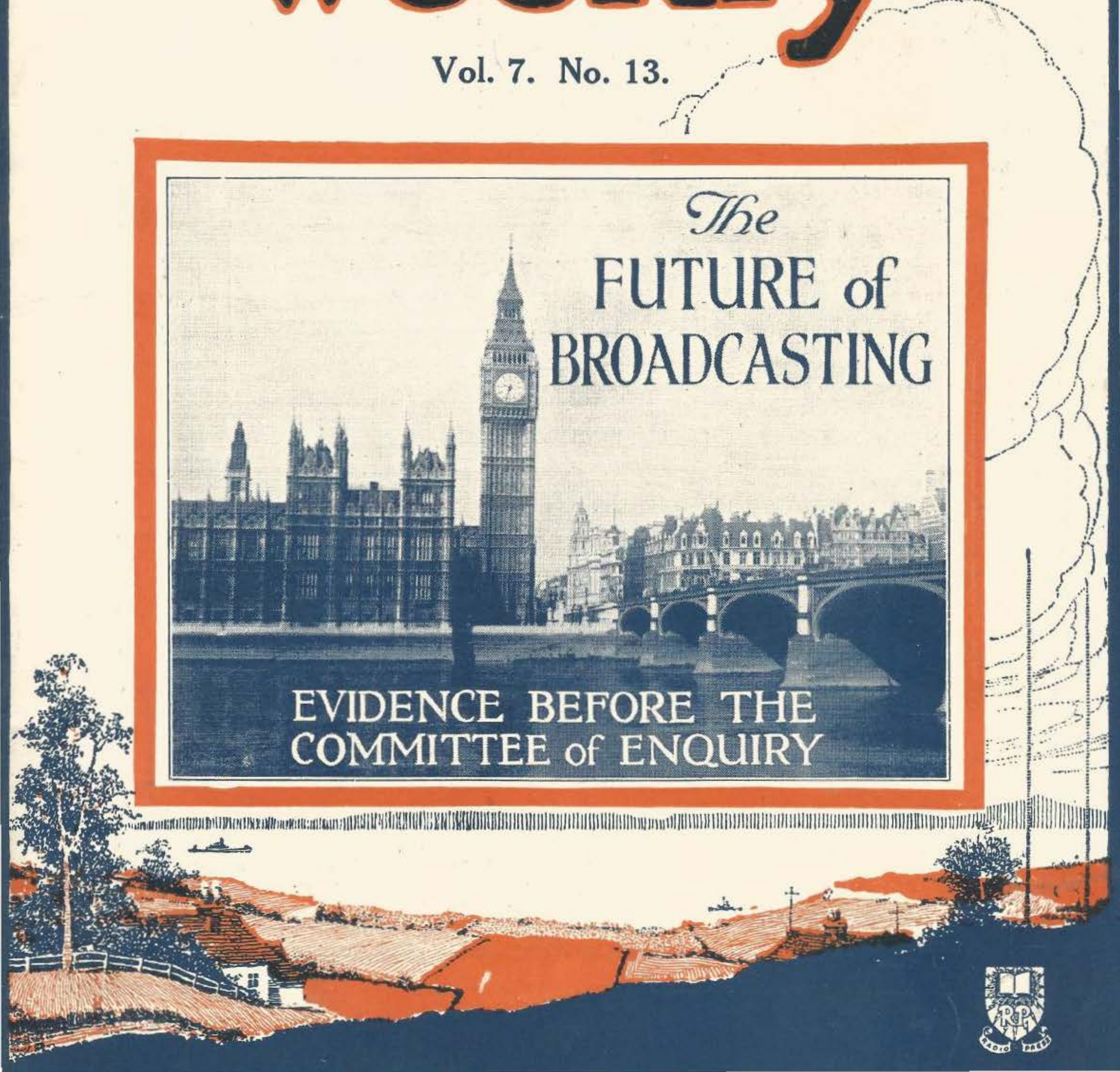
Wireless Weekly, 6d. Net. Wednesday December 16th, 1925

Wireless Weekly

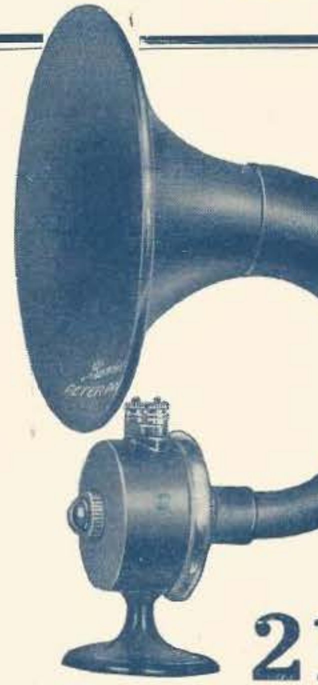
Vol. 7. No. 13.



The "Peter Pan"

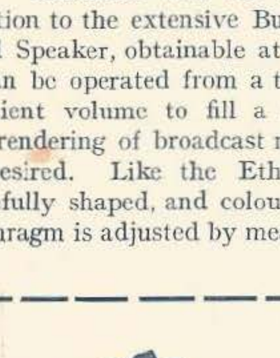
—a Burndept loud speaker for one guinea

A new and inexpensive Burndept loud speaker has appeared at a most opportune moment — when everyone is concerned with the Christmas Present problem. This addition to the extensive Burndept Range is the "Peter Pan" Loud Speaker, obtainable at the moderate price of one guinea. It can be operated from a two-valve receiver, and gives quite sufficient volume to fill a small room while its pure tone and rendering of broadcast music and speech is all that could be desired. Like the Ethovox Models, the Peter Pan is gracefully shaped, and coloured a rich mahogany shade. The diaphragm is adjusted by means of a knurled knob.

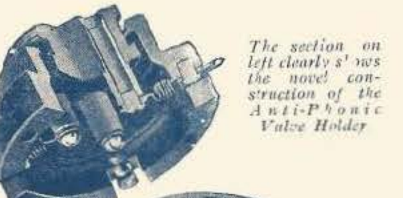


21/-

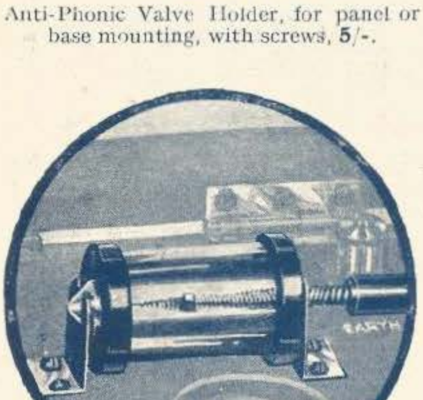
2,000 OHMS RESISTANCE



The section on left clearly shows the novel construction of the Anti-Phonic Valve Holder



Anti-Phonic Valve Holder, for panel or base mounting, with screws, **5/-**.



The Burndept Crystal Detector, complete with metal end plates for panel mounting, and drilling template, **4/-**.

Valve and Crystal users

who desire maximum results from their Wireless Receivers will be wise to consult the Burndept Components Catalogue. Two most interesting components described therein are the Anti-Phonic Valve Holder, and the Burndept Micrometer Crystal Detector. The Anti-Phonic Valve Holder affords complete protection for the filament of any valve, and eliminates the microphonic noises usually associated with dull-emitter valves.

Climatic conditions do not affect the Anti-Phonic Valve Holder, as *there is no rubber to perish.* This holder consists of an inner and an outer portion joined together by four spiral springs which make the electrical connections and also support the valve holder which is made of highly-polished bakelite. The valve sockets are countersunk to obviate the risk of short circuits. Don't leave your valves unprotected—fit Burndept Anti-Phonic Valve Holders.

The most important feature of the Burndept Crystal Detector is the micrometer screw which permits very fine adjustment of the gold catwhisker to be made with ease. The Burndept Synthetic Crystal, which is enclosed with all working parts in a glass tube, gives excellent signal strength. *Fit a Burndept Crystal Detector and obtain clear reception with easy manipulation.*

The Burndept Range includes everything for radio reception from components to complete installations.

BURNDEPT
WIRELESS LIMITED

HEAD OFFICE: Aldine House, Bedford Street, Strand, London, W.C.

Telephone: Gerrard 9072. *Telegrams:* Burndept, Westrand, London.

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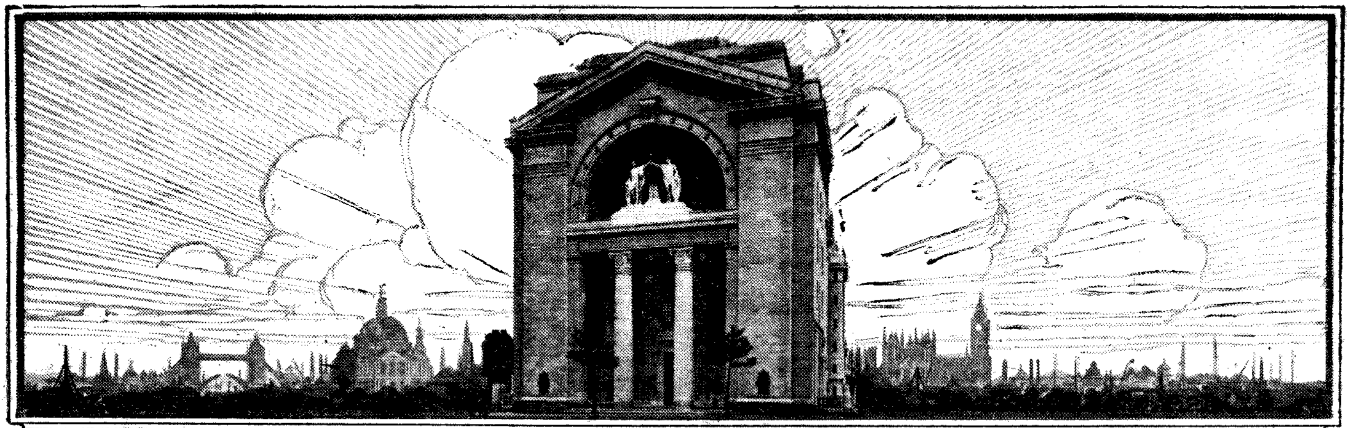
Belfast, Birmingham, Brighton, Bristol, Cardiff, Exeter, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Northampton, Nottingham.



Radio Press LTD — **Wireless Weekly** — Bush House STRAND·W·C2
Phone City, 9911

The N.A.R.M.A.T. Sees Reason

WE are pleased to be able to announce that in 1926 there will be one large combined wireless exhibition, organised by the National Association of Radio Manufacturers and Traders, at which both members and non-members will exhibit their goods side by side. The exhibition will be held at Olympia, and will unquestionably have an immense influence on the trade.

Both last year and this the N.A.R.M.A.T. held an exhibition at which many well-known firms of high standing were unable to show, not being members of the association in question. The public looked in vain for these firms, and immediately saw that the exhibition was not representative. When we consider that a very appreciable proportion of the visitors, both trade and private, to such an exhibition come for the purpose of making their choice among the latest apparatus, it does not take much further thought to understand how in such circumstances trade suffered. In the past the N.A.R.M.A.T. figuratively has shrugged its shoulders, and airily indicated that the cure is, of course, to join the N.A.R.M.A.T.! Although in the inner circle of the Association there have been many who felt that a single exhibition had its advantages, in the past the more violent elements have had their way. Now, fortunately, wiser council has prevailed, and the new attitude will result in a single really representative exhibition at Olympia next year, which will form a landmark in the history of the industry.

The conversion of the N.A.R.M.A.T. to the idea of the unified exhibition is a change of policy which indicates a more tolerant and sympathetic attitude to the trade than they have taken in the past. We have no sympathy with those who object to the N.A.R.M.A.T., and all its works on principle. Such an Association properly conducted can be of immense benefit to the whole industry, but its conduct requires the most careful watching, and immediately it loses a sense of proportion and forgets that first and foremost the policy must be for the benefit of its members, and not for a favoured few, it becomes, not a beneficial but a pernicious organisation.

In October, in a now well-known letter to the wireless trade, we made it perfectly clear that if N.A.R.M.A.T. and non-N.A.R.M.A.T. members did not come together under a single roof of their own accord, Radio Press, Ltd., would itself conduct a single exhibition, as being an impartial organisation with the necessary national influence. The immediate result of the letter was that we received dozens of letters from manufacturers of high standing, promising support for such an exhibition, should it be necessary for us to conduct it, and a special company was duly formed to provide for the emergency.

Now that the N.A.R.M.A.T. has come to a wise decision, the necessity for our own exhibition will not arise. The incident, if it can be so called, is now closed, and it remains for the whole industry to appreciate the broad-minded decision of the Association in the matter. Within the next few months the National Association of Radio Manufacturers and Traders will pass through a very difficult period, but its wisdom in making the latest decision will do more to consolidate it, and gain support for it, than anything else that could have happened.

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Some Heterodyne and Rectification Effects

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

In the following article Captain Round discusses in detail the effects of heterodyne rectification on selectivity, together with some notes on the supersonic heterodyne.

THERE are some phenomena connected with rectification which affect the question of selectivity in a way which I propose to show. Careful consideration of these points led Armstrong to evolve the super-heterodyne in Paris in 1917-1918.

The various questions involved are very difficult to keep in one's mind, and I find it wise to put the arguments down in sketch or writing form step by step.

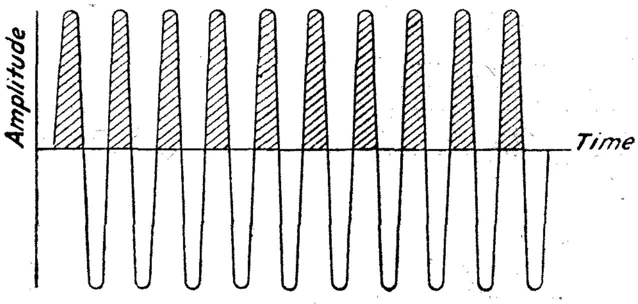


Fig. 1.—In this diagram the shaded portions of the curves represent the current which would flow if a perfect rectifier were applied to the oscillation.

Perfect Rectification

Fig. 1 represents an oscillation frequency n, and the shaded portions represent the current which flows if we apply a perfect rectifier to it and plot the resulting current. A little later I will discuss what happens in certain local cases if the rectifier has the usual bend.

The result through the rectifier will obviously be a current that will move a galvanometer, plus a complex alternating current with a basic frequency the same as n.

Audible Detection

Now if we added a weak oscillation from another source to the first one (Fig. 2), first at the same frequency and phase, and then of opposite phase, we should get the galvanometer increasing its reading and then decreasing its reading (the galvanometer will not respond to the H.F. component); if the change from the same to opposite phase takes place at an audible frequency, we can use a telephone instead of the galvanometer and get an audible note.

Beat Notes

Obviously, we can get just the same note by some method of changing the strength of our original oscillation (this would be called modulation), or we can get it by adding a weak oscillation to the first one, with a frequency such that it first adds and then subtracts from the first oscillation at the same rate as the reversals. This is called producing a beat note. There is a little difference between these methods which it is not necessary to go into at present.

It is very important to note and definitely grasp the reasons why a rectifier is necessary in all these cases to produce an audible note in the telephones or a movement in the galvanometer.

Modulation Frequency

Now even if our modulation is made of too high a frequency to hear, the rectifier is still producing a new alternating current of the modulation frequency; and, likewise, if the beat frequency is raised to this inaudible note, the new alternating current is still being produced. In all considerations here I am taking the case when the modulation produced in any way is weak; matters get very complicated otherwise, and in the beat method of simulating modulation we can assume always that one of the frequencies is much weaker than the other. Suppose that our weaker wave is now modulated by speech, and that we add it to the stronger wave, then it is quite easy to see that if the two waves are of the same frequency and phase the result is just the same as if we modulated the stronger wave, except that the amount will vary depending upon the phases of the two waves.

Inaudible Modulation

But suppose that we alter the weaker modulated wave to such a frequency that the resulting beat note, due to beating and rectifying, becomes inaudible; is the speech modulation of the weaker wave then audible in our telephones? First the weak wave adds and then it subtracts from the strong wave amplitude; the average rectified change over one supersonic beat is obviously nil on a galvanometer or telephone, so that

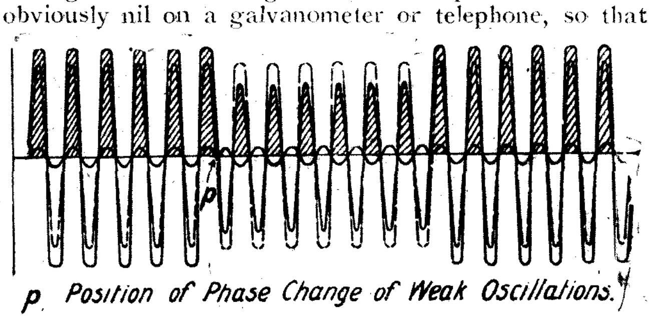


Fig. 2.—Illustrating the effect of adding a weak oscillation to another one of the same frequency and altering the phase.

whether the speech modulation of the weaker wave is weak or strong makes no difference. Therefore the modulation will be inaudible.

Conclusions

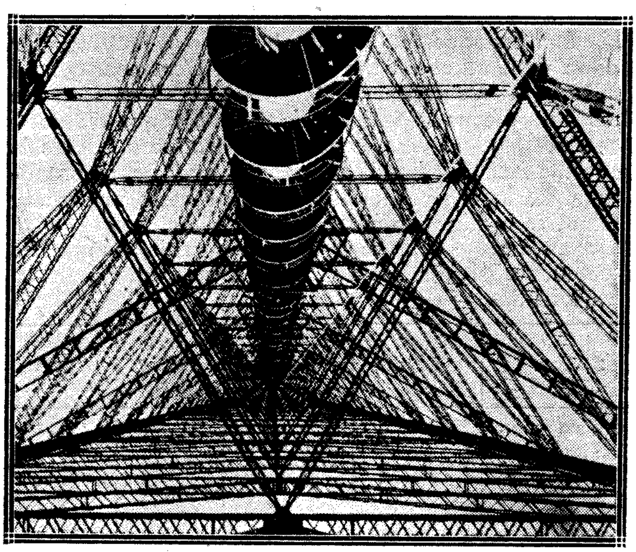
Summing up this point, which is of great importance, *if we are receiving a weak signal on a rectifier and telephones, and if we heterodyne the rectifier with a stronger wave such that the resulting beat note is inaudible, then the modulation of the weak signal will also be inaudible.* Unfortunately, owing to the fact that rectifiers do not have quite straight line characteristics the theoretical result is not quite true, but it is very nearly true.

Homodyning

One important point follows from this. We saw that if we modulate our weaker wave and add it to the stronger wave, and if they are the same frequency and phase, the result is the same as the modulation of the stronger wave; in fact, we shall get our speech if the modulation is a speech modulation. This operation is called "homodyning," but it is not easily realisable in practice. However, it serves to illustrate a point. Suppose, simultaneously, we applied to the rectifier a second weak oscillation, the frequency of which was sufficiently different to give an inaudible beat note with the strong oscillation, and suppose this weak oscillation was also modulated by music, the first speech would be audible, but the music would not be audible, and, in fact, no modulated wave outside the audible beat tone range would be received (except harmonics). Homodyning thus gives a selectivity which is of just exactly the correct width to take in all the frequencies we want to hear, but it cuts out everything else that gives beat tones outside the audible range.

A Practical Test

Now, again, suppose that you are close to 2LO, and that you want to get Birmingham, and that the selectivity of your receiver is only such that there is always a background of London. Tune up to Birmingham and start applying reaction. If the carrier of Birmingham can be brought up to a strength of several times the forced wave from 2LO, then as this carrier produces an inaudible beat with 2LO's wave, it tends to remove the signals from 2LO altogether.



A view upwards inside the lattice structure of the mast of the recently opened wireless station at Königswusterhausen. The height of the mast is about 900 feet.

Perhaps on your receiver London is too strong; then you must weaken your coupling or decrease the size of your aerial, and use reaction more to bring up Birmingham's carrier, which will wipe out the last trace of London.

The Reverse Effect

When one is using a selective receiver of great sensitiveness this effect is very noticeable, and it is sometimes a nuisance, as in certain cases it can work the opposite way; for as long as you keep the carrier of the wanted signal stronger than the jammer it is all right, but if the jammer takes charge then he wipes out your modulation.

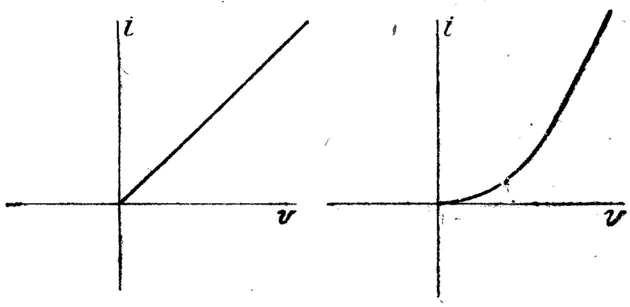


Fig. 3.—Showing (left) the characteristic of a perfect rectifier, and (right) the form of rectifier characteristic obtained in practice.

This point consequently makes it very difficult to estimate the degree of selectivity in tuning, which must be aimed at in the design of receivers, to give certain separations.

Reducing Interference

In general, if the jammer can be reduced by tuning methods to equality with the decided signal, and you then have available reaction to bring up the signal you want, the jammer can be reduced to inaudibility. Obviously, however, the best thing to do is to have a selectivity curve on your tuning circuits, which reduces any possible jammer by pure tuning to very weak signals; the only objection is that this is so difficult to carry to the limit sometimes required that to a great extent the heterodyning effect has to be relied upon.

A Second Rectifier

So far everything has been comparatively simple, so let us introduce a second rectifier and study the effect of it.

We have a strong oscillation and a weak one; they are combined and rectified, and the resulting alternating current is applied in some way by means of a transformer or other coupling circuit to a second rectifier. Let our weaker oscillation be of sufficient difference of frequency to produce an inaudible beat tone.

Strength of Beat Note

Note first that through very wide limits the strength of the beat note is proportional to the strength of the weaker wave, and that alteration of the strength of the stronger wave will make only secondary differences to the strength of the beat tone.

Now if our weak oscillation is constant, and we re-rectify the beat tone, the combination will send a direct current through our telephones, and even if we modulate with speech the strong oscillation we shall hear nothing of the speech through our second rectifier. But if our weak oscillation is modulated with speech the rectification by the second detector will produce speech.

Application to Duplex Telephony

This peculiar phenomena is used by Franklin in his duplex telephony, in which he uses his transmitter to heterodyne to an inaudible frequency the received wave. He then re-rectifies and gets any modulation of the received wave, but no modulation of the transmitter emission (within limits, of course), so that the receiver need never be disconnected when transmitting. Again, of course, if the receiver signals get stronger than the amount of the transmitted wave allowed to get into the receiver, the transmitter modulation will be the only one heard. The signal has taken charge, an unlikely thing to happen in this case.

Utilising Beat Tones

The beat tones are curious pictures at another frequency of the original weak oscillations, as, not only is the original amplitude imitated, but the phase also is imitated.

For instance, it is quite easy to make out that, if the weaker oscillation is altered in phase by 180 deg., the beat tone also shifts through 180 deg. So that if two weak signals are coming in together, and if we beat with a strong oscillation with both at once, the two oscillations will be represented as beat tones in amplitude and phase, and we can treat them as signals to be tuned, rectified and received in the ordinary way; they only suffer from distortion due to rectification once, not twice. There is, however, one very important difference between treating these beat tones as your signals to be received and using the original signals.

When dealing with the original signals, supposing that you are building a selective circuit, if it is tuned to a certain wave it will only get that wave and traces of others of nearly the same frequency. If, however, you beat first and then use the resulting beat frequencies, you are dealing with two possible groups of waves; for it is obvious that if n is the heterodyne frequency, then n+d and n−d will produce exactly the same beat tone. This effect has to be guarded against in the superheterodyne.

Perfect Rectification

If our rectifier is very perfect, and has a curve like that in Fig. 3 (left), it will not be necessary to have a heterodyne very much stronger than the signal, the only condition being that the signal can never reduce the total oscillation to zero. Certainly a little distortion enters, in that the resulting rectifier beat becomes a more and more pure sine wave as the heterodyne wave is strengthened, but this would not matter much in superheterodyne work. The term "optimum heterodyne" has no meaning with a perfect rectifier.

Heterodyne Too Strong

But suppose our rectifier curve is like Fig 3 (right). Then the result will be that for a weak oscillating voltage applied, a certain amplitude of current is produced, but for a stronger oscillation a larger proportional current is produced. Too large a heterodyne may run us into saturation.

The Optimum Heterodyne

In this case, however, the results are nearly the same as the hypothetical results on a perfect rectifier, if the heterodyne carries us well up to the straighter part of the curve, and if the weak signal applied does not shift us up and down from this point very much. The position is called the optimum heterodyne.

In fact, even with the practical imperfect rectifier the resulting beat tones are nearly proportional in strength to the applied signal, so that the only place in which distortion can occur in a superheterodyne is in the second rectifier, where the "square" law still applies.

Results of the Radio Press Calibration Tests

THE first series of measurements in connection with the Radio Press Laboratories' Calibration scheme were taken during the evening of December 10. The list of stations checked, together with the time of measurement and the frequencies, is as follows :—

Station.	*Time p.m.*	*Frequency (kc.)*	*Wave-length (metres).*
Aberdeen	7.45	603.9	496.8
Birmingham	7.55	629.2	476.8
Belfast	8.5	684.1	438.5
Glasgow	8.15	711.9	421.4
Newcastle	8.25	742.7	403.9
Bournemouth	8.35	779.8	384.7
Manchester	8.45	795.8	377.0
London	8.55	823.3	364.3
Cardiff	9.5	854.3	351.2

Further measurements of the frequencies of the above stations were also taken at other times. In this connection readers should take special note of the fact that, in order to ensure accuracy in the calibration of their wavemeters or receivers, the time of taking their own notes of settings on their instruments should coincide with the times given for the Radio Press measurements.

Variations of Frequency

If, for instance, notes of the correct setting for London were taken on the evening of December 9, and the Radio Press measurements of December 10 were taken as a means of indicating the frequency obtained at this setting, an error would be introduced. This is due to the fact that the frequencies of most of the broadcasting stations given above do not remain absolutely constant from night to night.

As examples of the variations which may be expected, we give below a table of measurements taken on various dates :—

Station.	*Date.*	*Time.*	*Frequency (k.c.)*	*Wave-length (metres).*
Aberdeen ..	Dec. 9	6.30 p.m.	603.4	497.1
Birmingham ..	,, 8	4. 0 p.m.	630.8	475.7
	,, 10	5.30 p.m.	630.0	476.2
Belfast	,, 8	4.30 p.m.	685.2	437.8
	,, 10	4.15 p.m.	684.5	438.2
Glasgow ..	Various re	adings	711.9	421.4
Newcastle ..	Dec. 8	p.m.	741.8	404.4
	,, 9	6.15 p.m.	742.5	404.0
Bournemouth ..	Various re	adings	779.9	384.7
Manchester ..	Dec. 8	p.m.	794.7	377.5
	,, 10	p.m.	796.2	376.8
London ..	,, 9	p.m.	824.3	363.9
	,, 10	p.m.	823.7	364.2
Cardiff	,, 9	p.m.	857.9	349.7
	,, 10	p.m.	854.7	351.0
Daventry ..	,, 9	a.m.	187.4	1,600.9
	,, 10	9.30 p.m.	187.3	1,601.6

Continental Broadcasting Stations

In next week's issue of *Wireless Weekly* we shall have an important announcement to make with regard to Continental broadcasting stations.

SHORT-WAVE Notes & News

THE past week has afforded examples of several astonishing "freaks" on the part of the somewhat mysterious conditions that govern long-distance reception. These may be best illustrated by a short account of the stations heard by the writer and the owner of another receiver, both in South London, all reception taking place on Sunday, December 6, starting at 06.00 G.M.T. Cuban 2BY and a Brazilian station were heard, but no East Coast Americans; they were heard, however, at 09.30. Between the latter time and 13.00 strong signals were received from practically every active European country, the northern British stations being, on the whole, the most powerful.

Further Afield

At 2.30 p.m. A-6AG was heard, the signal-strength being about R6, and half an hour later G-2KF heard PI-1HR, PI-NAJD, and U-6CTO, of California. Between 17.00 and 19.30 the following were heard:—A-3BQ, A-3EF, O-A4Z, CRP (Delhi), and HBK (Northern India). By 20.00 not one of these was audible, but several East Coast American stations suddenly appeared. By 22.00 the ether seemed quite dead, but at 23.00 several Brazilians were heard, including 1AC, 1BC, 1BD, 1IA, 1IN, 5AB, and 7AA. Chilian 2LD and 3IJ were also received at good strength.

A Good Effort

G-2KF had another "International field day" on the same date. Starting at 00.00 G.M.T. on Sunday he worked 6ZK, of Palestine. At 03.40 he worked O-A4Z, and U-3AHA, following this up by communicating with Z-4AS. During the day he was in communication with S-2NM, D-7EC, A-6AG, CRP (India), and A-3YX. The average report of his signal strength was R6.

Ireland

We hear that the Irish Free State has been officially allotted the intermediate "GW." There are, however, very few licensed stations in operation. The amateurs in Northern Ireland use "GI" for their prefix. Up to date the only active stations that we have heard are 5NJ, 6MU, and 6TB.

Several readers probably heard a station a few months ago with the amazing call-sign of NW-4XYZ. They will doubtless be relieved to hear that he degenerated into NW-4X, and finally LA-4X. He is situated at Stavanger, Norway.

Special Ship Transmissions

Another Swedish boat is now active on short waves, using the call-sign SDK. As he seems to be audible only at the same times as when the Brazilian stations are coming in, he is probably somewhere in that direction. The *San Francisco* (SGC) was, it will be remembered, in action between Rio de Janeiro and Stockholm.

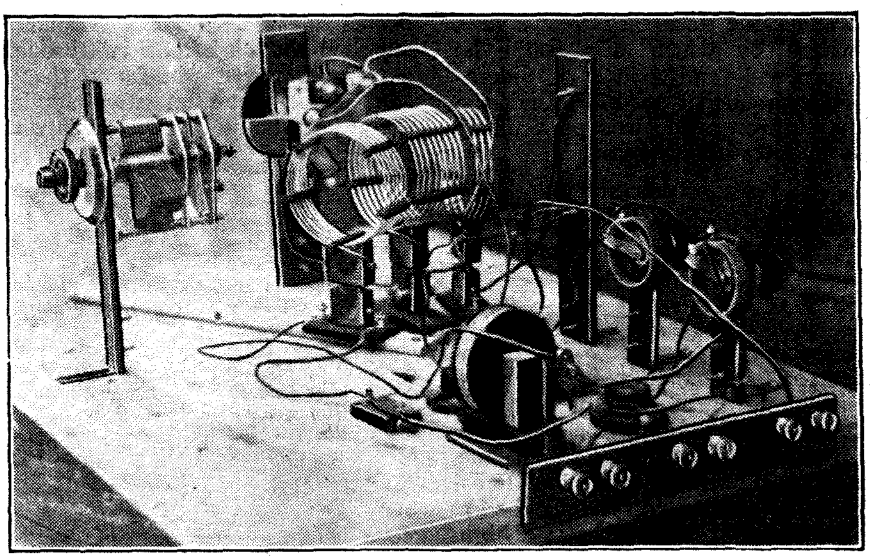
London

There are now more London stations "on the air" than there have been for some time. 2NM is working C.W. and telephony on 9,677 kc. (31 metres), and 2KF, 5LF, 2YQ, and 2WJ are all "big noises" on about 6,670 kc. (45 metres). 6QB has at last forsaken his aged and polarising dry cells, and uses a small motor-generator. 2ZB has built a receiver *instead of* a transmitter! He is conducting "world-wide reception programmes," and has already heard five new countries on it.

The Eastern Counties

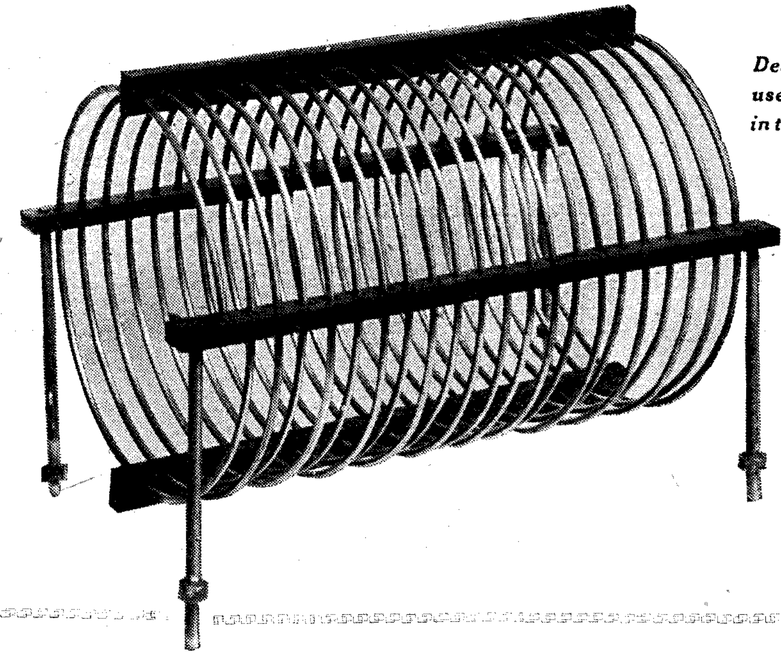
2XV, of Cambridge, may be heard on telephony at very good strength on 6,670 kc. 2LZ is also very strong, but, unfortunately, these seem to be the only stations working telephony consistently at the higher frequencies.

The East of England seems more active than usual, being represented by 2LZ, 5QV (Clacton), 2TO (Ipswich), and 5GS (Grimsby). We have not heard a Welsh or West of England station for some weeks.



The low-loss short-wave two-valve receiver constructed by Mr. J. J. McConochie. A letter from Mr. McConochie, describing this receiver, will be found on page 447.

FINDING THE NODAL POINT



By C. P. ALLINSON (6YF).

Describing how a Moullin voltmeter may be used to determine the voltage distribution in transmitting inductances or aerial circuits.

IN the course of some transmitting experiments it occurred to the writer that it would be very useful indeed if he could know definitely just where the high voltage and nodal points on his transmitting inductance were situated. It therefore became necessary to evolve a method by which this could be determined, and a little consideration showed that our old friend, the Moullin voltmeter, was particularly suitable for the purpose.

Voltage Distribution

A case in which a knowledge of the voltage distribution would be of particular value is in the circuit shown in Fig. 1. In this case the oscillator circuit L2 C2 is coupled to the aerial circuit ÆL1CP by means of a small coupling condenser, shown at C1, and an R.F. feeder. The point on the transmitting inductance A, at which the condenser in series with the R.F. feeder is connected, should be a high potential point (that is a high high-frequency potential point), while B, the point on the aerial tuning inductance to which the R.F. feeder is connected, should be the nodal point of the aerial earth system.

First Readings

It was therefore decided to take a number of readings on a transmitting circuit (dissociated from the aerial-earth circuit) similar to that shown in Fig. 1. The first readings taken were with the circuit shown in Fig. 2b, in which the oscillatory circuit was connected across the grid and plate of the transmitting valve. Curve No. 1 in Fig. 2a was taken with the low-tension filament supply not connected to earth. As the A.C. mains supplied the high tension (through a transformer) it was found that a small A.C. potential was applied thereby to the inductance, even with the valve switched out. This mean potential gave a reading on the Moullin voltmeter of 9 units, and this point was taken as the zero point from which to take the H.F. readings. This, therefore, resulted in the zero point with relation to the curve being shifted, the No. 1 curve being thereby obtained.

Effect of Earth Connection

The readings were taken by connecting a flexible lead from a Moullin voltmeter, the other side of which was connected to earth, to each turn of the inductance in turn, starting from the plate end. The curve No. 1 shows the voltage distribution using a 21-turn coil. The total voltage swing will be seen to be approximately 13 units. Curve No. 2 was taken at the same frequency, but with the L.T. supply connected to earth. The total voltage swing in the No. 2 curve is 10 units, so that the actual difference between the two curves is not so great as it appears to be, and is due to the fact that they are drawn to different scales. Further, with the No. 3 curve, the L.T. supply being connected to earth resulted in the A.C. component, which previously had affected the Moullin voltmeter, not being impressed on the oscillatory circuit. The curves, therefore, show the comparative values of H.F. potential distributed along the tuning coil from turn to turn. These curves further show what would be expected, namely, that the whole of this circuit is at H.F. potential to earth.

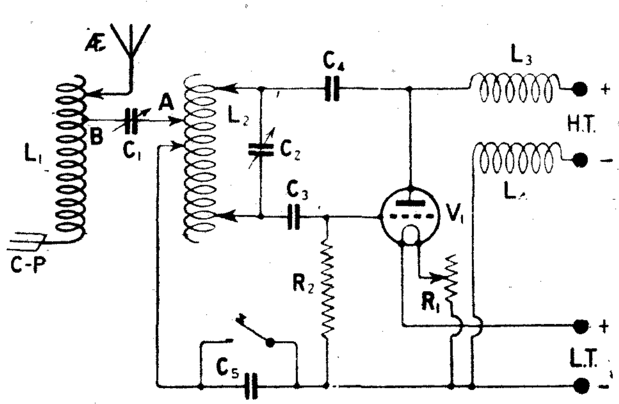


Fig. 1.—A transmitting circuit used by the writer, in which C1 is a small coupling condenser. The correct point for connecting this to the inductance L2 was determined by the method described.

It will be noted that all three curves peak at approximately the same places, namely, at six and fifteen turns.

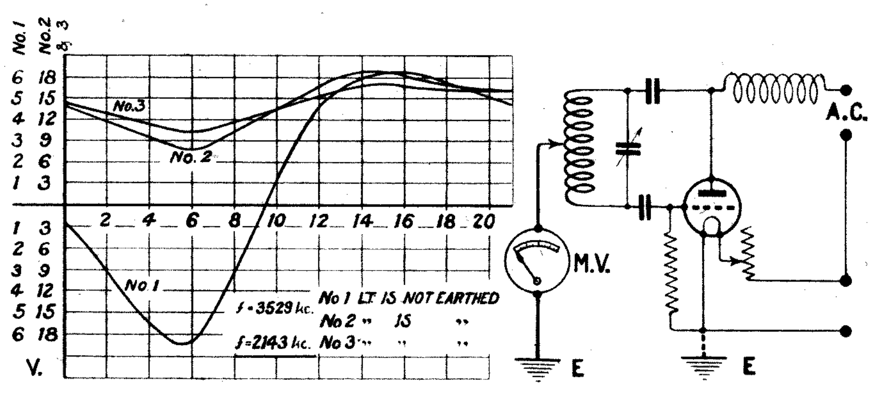
Addition of Aerial

The next point was to try the effect of connecting aerial and counterpoise to the oscillatory circuit, making the necessary adjustment to obtain the maximum aerial current, and then take a number of readings with the Moullin voltmeter.

The curves obtained are shown in Fig. 3a, Fig. 3b showing the circuit employed. With regard to this latter, it is interesting to note that the best position for the L.T. tap on the transmitting inductance was found to be at the fourteenth turn, but the counterpoise lead had to go to the eleventh turn, which is approximately the nodal point on the coil (which consists of twenty-one turns). The aerial tap went to the fifteenth turn, and it was found that if tighter coupling was used by including a larger number of turns in the aerial circuit, the set went out of oscillation. Actually a loading coil was used in the aerial lead, but this is not included in the circuit diagram, for clearness sake. The No. 1 curve was taken with L.T. negative connected to earth, and it will be seen that it is quite regular in shape. This would seem to indicate that the aerial and counterpoise connections had been correctly made.

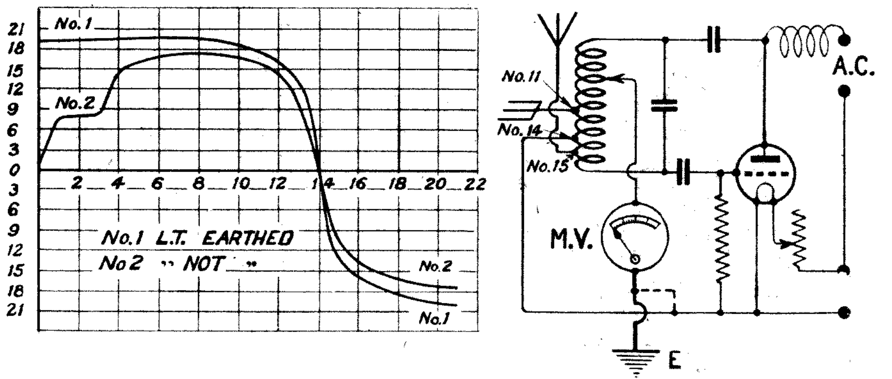
Lower Potentials

As it was noticed in the course of experiments that the largest aerial current was registered when the low-tension side of the filament supply was not connected to earth, a further set of readings was taken under these circumstances. The curve obtained is that shown in Fig. 3, No. 2. Here we find that,



Figs. 2a and 2b.—Curve No. 1 in this diagram is drawn to a different scale from that of Nos. 2 and 3.

as the anode is the point of the transmitter which is nearest to earth potential, owing to the fact that the H.T. supply is obtained from A.C. mains, a very low reading is obtained at this end of the coil, although this point is not actually at zero potential, as is shown in the curve. The curious step formation obtained with this curve will be noticed, but after the fourth turn from the plate end of the coil the curve becomes perfectly regular. It may be noted that, although the maximum potentials obtained with this curve are not so



Figs. 3a and 3b.—Further readings were taken on the circuit of Fig. 2b, with the addition of the aerial system.

great as those shown in the No. 1 curve, a larger reading was obtained on the hot-wire aerial meter.

Moullin Voltmeter

For the guidance of those who may wish to take similar measurements on their own transmitters, it should be noted that the Moullin voltmeter employed used the leaky grid-condenser rectification method, the grid-leak being connected between the grid and low-tension. It will be realised, of course, that the readings obtained are not actually positive and negative as shown in the curves, but started at a certain positive value, declined to zero, and then rose again. As, however, we are dealing with oscillatory circuits, it follows that if one end is at a certain potential and we then pass to another turn of the inductance beyond the nodal point, at any given instant this part of the coil will be of opposite potential to the other.

The curves have therefore been drawn as reproduced herewith, since thus a better idea is obtained of the shape of the curves and what is going on in the circuit.

Voltage Distribution in Aerial System

The method described may further be used to plot the voltage distribution in the aerial-counterpoise circuit. In this case, of course, we shall not get any point which is actually at zero potential, but we shall be able to determine, from the curve obtained, which is the nodal point.

It should be noted that the nodal point is not that point at which the lowest reading is obtained. To determine which is the nodal point in the case of a curve such as that shown at No. 2 or No. 3 in Fig. 2, a horizontal straight line should be drawn, so as to divide the curve into two equal portions above and below the line. The point at which this horizontal line crosses the curve is the nodal point.

Application of Readings

In cases where it is desired to employ the coupling method shown in Fig. 1 it would be advisable in the first place to couple L2 to L1, plot the curve for the aerial circuit, and determine the nodal point. The transmitter can now be placed where suitable, the aerial inductance L1 being connected to the aerial and counterpoise leads wherever convenient, irrespective of the position of the transmitter. The R.F. feeder is then connected to point B on the coil, which has been found to be the nodal point, whilst the other end A may be connected to what has been found to be a high-voltage point of the transmitting inductance L2. It should, of course, be remembered that the nodal point will shift if any alteration in frequency is made.

DISTORTION IN L.F. AMPLIFIERS

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

In this article Mr. Reyner discusses valve characteristics and shows how the usual representation of static characteristics may be misleading in practice. He further demonstrates how dynamic characteristics may be utilised to determine the correct value of grid bias to apply in L.F. amplifiers for the prevention of distortion.

THERE are many ideas which are held on the subject of the operation of low-frequency amplifiers in order to avoid distortion. It is now an almost universal practice to equip low-frequency amplifiers with suitable grid bias arrangements, but there seems to be little definite information as to the correct value of grid bias to employ.

Necessity for Grid Bias

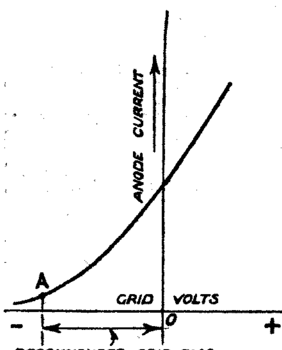
Now the use of grid bias is necessary for two reasons. The first of these is that the steady voltage applied to the grid controls the working position on the characteristic of the valve, and the second is that if the reproduction is to be reasonably faithful, then the grid current must be reduced to a small value.

Avoiding Distortion

If, however, one refers to the characteristics of some types of power valves, it will be observed that the value of grid bias recommended by the makers usually occurs at a point such as A in Fig. 1. According to the theory of proportionate amplification, it is necessary to arrange the working point of the valve characteristic such that over the variation of voltage on the grid the anode current characteristic is approximately a straight line. This is by no means the state of affairs, as shown in Fig. 1, and at first sight it would appear that this would give considerable distortion.

Questionable Utility of Valve Characteristics

The fact of the matter is that our present method of giving valve characteristics is unsound, and indeed the



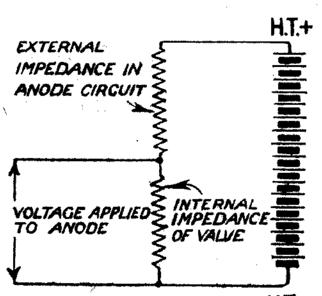


***Fig. 1.**—The grid bias recommended is often such as to bring the working point well down on the curved portion of the static characteristic.*

***Fig. 2.**—The actual voltage applied to the anode of the valve is less than the H.T. voltage due to the voltage drop on the external impedance in the anode circuit.*

information which can be extracted direct from the characteristics is very small. The ordinary type of characteristic is obtained under steady conditions, *i.e.*, with no impedance in the anode circuit of the valve.

In practice, of course, there is always an impedance of some sort in the anode circuit, to enable the energy developed by the valve to be suitably extracted. The presence of this external impedance, however, modifies

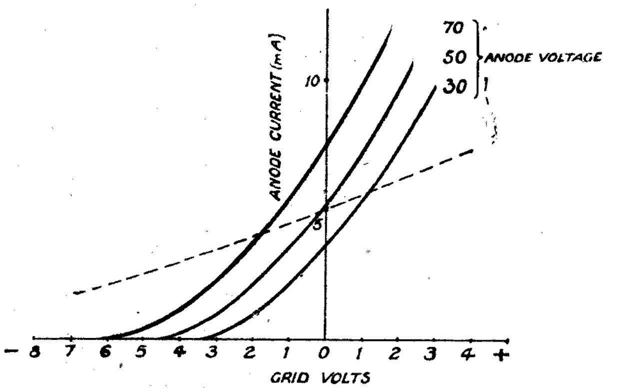


***Fig. 3.**—Due to the presence of the external circuit the actual working characteristic is as shown by the dotted line.*

the characteristics so completely that totally misleading results can be obtained if this principle is not borne in mind.

Effect of Impedance in Anode Circuit

The current supplied by the high-tension battery flows first of all through the external impedance in the anode circuit and then through the impedance of anode to filament path of the valve, *i.e.*, the internal impedance of the valve. Consequently the actual voltage applied to the anode will be that of the high-tension battery minus the voltage drop of the external impedance. This point will be made clear from Fig. 2. Obviously the value of the voltage drop in the external circuit depends upon the current flowing in the circuit, so that the actual voltage applied to the anode of the valve is continually varying, if the anode current varies, as is always the case in practical reception.

A Practical Instance

Let us consider a practical case. We will assume that the valve employed has an impedance of 10,000 ohms at zero grid volts, and we will assume that the resistance of the output circuit of the valve, whatever it may be, is 20,000 ohms. The current supplied by a high-tension battery of 150 volts will then be 5 milliamps. The actual voltage on the anode of the valve will be 50 volts, and it will be seen from the characteristics shown in Fig. 3 that at zero grid volts and 50 volts on the anode the current obtained is 5 milliamps.

Application of Grid Voltage

Consider now what happens if a voltage is applied to the grid which causes the anode current to vary. If the anode current is increased by 1 milliamp., so that the total anode current becomes 6 milliamps., the voltage drop on the external circuit then becomes .006 × 20,000 = 120 volts, so that the voltage actually applied to the anode becomes 150 − 120 = 30 volts.

Comparison with Curve

Referring again to the curves in Fig. 3, it will be seen that to obtain 6 milliamps. at 30 volts on the anode requires about 1.2 volts positive on the grid, whereas if the anode voltage had remained at 50, we should have required only about 0.5 volts positive.

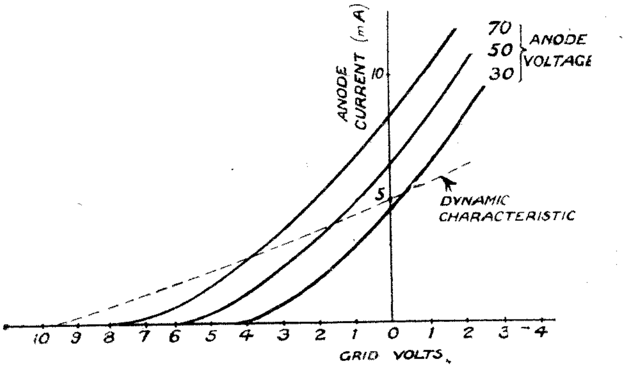


Fig. 4.—In a practical case the dynamic characteristic would be somewhat as shown in this figure.

Similarly, if the anode current decreases to 4 milliamps., the external voltage drop is only 80 volts, giving an actual anode voltage of 70. Here again we can produce the current with about −2 grid volts, whereas with 50 volts on the anode we should only have required about − 0.8.

The Actual Working Curve

It will be obvious from these considerations that the characteristic over which we are working is not any of the usual curves drawn for a constant anode voltage, but one such as is shown by the dotted line in Fig. 3.

It is this working or dynamic characteristic which we require in estimating the performance of the valve under practical conditions.

It may be observed in passing that the change of ± 1 milliamp requires a grid voltage variation of 3.2 volts, whereas from the static characteristic the grid swing would be only 1.3 volts. Thus the effective amplification of the valve has been reduced.

This difference between the actual and the theoretical amplification factor has been dealt with before in these columns by Mr. A. Johnson Randall (*Wireless Weekly*, Vol. 6, No. 1).

A Slight Modification

It will be noted that in Fig. 3 the current with 50 volts on the anode is given as 5 milliamps., a figure which is obtained by dividing the anode voltage by the internal resistance of the valve. In practice the actual anode current is somewhat greater than this, by a certain small constant amount.

A practical case, therefore, would be somewhat as shown in Fig. 4. The only difference is that the static characteristics are all raised slightly relative to the dynamic characteristic. This modification does not affect the fundamental principle as developed in the original simplified case.

Flattening of Curve

It will thus be seen that the effect of the load in the anode circuit has been to flatten out the characteristic very considerably. Not only this, but the dynamic characteristic actually crosses the static characteristic at a small negative grid voltage, and also it remains appreciably a straight line over a large range of negative grid voltage.

Grid Current

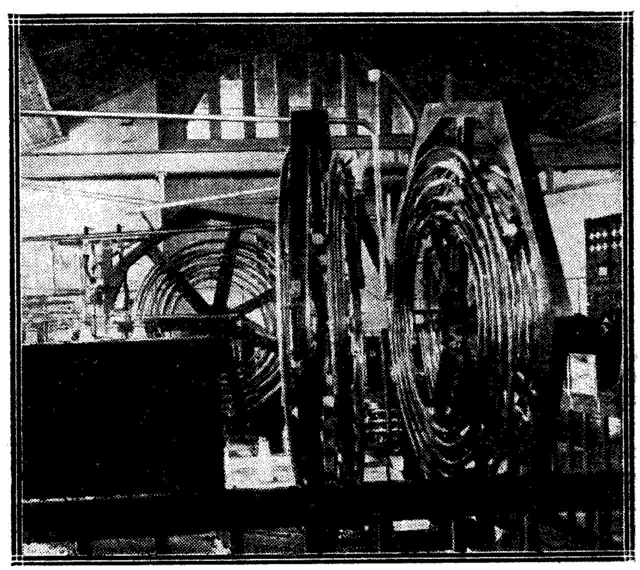
Now the grid current commences to flow at or around zero grid volts. Although a small amount of grid current is permissible, any considerable grid current immediately produces distortion, and therefore we endeavour to arrange that the maximum voltage variation of the grid is never sufficient to make the grid positive in respect to the filament.

Working Point on Characteristic

Equally obviously, if we are to avoid distortion, it is essential that the grid voltage swings shall not reduce the anode current quite to zero, because this would produce rectification and would again introduce distortion. Thus the best working point on the characteristic would be midway between these two extremes, and in the case shown would require about − 4½ grid volts. This point, however, on the static characteristics is well down the curved portion thereof. It will thus be seen how very misleading the static characteristics may be and also why the recommended value of this voltage often does occur at a point such as A in Fig. 1.

Plotting Dynamic Characteristic

The plotting of the dynamic characteristic of a particular valve is a fairly easy matter, but involves a certain amount of calculation, and it is possible to obtain a rough estimate of the performance of any particular valve by working out the curve in the manner just described.



A view in the transmitter building of the new wireless station at Konigswusterhausen, showing the type of inductance used. These may be compared with those designed for Rugby, illustrated on page 399 of our last issue.

Data Required

The value of the external impedance in the anode circuit is the only factor which is likely to be at all difficult to determine, the valve constants being usually supplied by the makers. It may be remembered, however, that in the case of a good choke or transformer the impedance is of the order of 50,000 ohms at the mean speech frequency, *i.e.*, 800 cycles per second.

Approximate Calculation

Actually, of course, the value of the impedance is varying from time to time, because the frequency of the current is continually varying in accordance with the speech or music, so that an accurate calculation cannot be made in a simple manner. The approximate figure quoted, however, will give an indication of the type of dynamic characteristic one may expect, and will prove of assistance in determining what value of grid bias should be employed.

A Useful Rule

Captain Round has given a very useful rule of thumb, which certainly gives satisfactory results in the majority of cases. This rule is that the necessary grid bias required in volts is equal to the value of the H.T. voltage divided by twice the amplification factor of the valve. Thus a general purpose valve having an amplification factor of 10 used with 60-volt H.T. battery would require 3 volts negative grid bias.

Check with Milliammeter

The possession of a milliammeter enables one to make a very good practical test as to whether the correct value of grid bias is being employed. If any distortion is present, then this current which is produced by the valve will not be proportional to the voltage, but will be proportional to some power thereof. For the sake of argument let us assume that the current is proportional to the square of the voltage. Then let the applied voltage on the grid be $V \sin \omega t$, let $V_a + V_g$ be the steady values of anode and grid voltage. Then the anode current

$$I_a = A\left[V_a + \mu(V_g + V \sin \omega t)\right]^2$$

$$= A(V_a + \mu V_g)^2 + 2A\mu(V_a + \mu V_g) V \sin \omega t$$

$$+ \mu^2 \frac{AV^2}{2} \cos (2\omega t + \pi) + \mu^2 \frac{AV^2}{2}$$

The first term is a constant. The second term varies as the input voltage. The third term varies as the square of the input voltage, and so introduces distortion, and the fourth term is dependent on the actual amplitude of the applied E.M.F., but does not normally vary. With a varying input, however, such as telephony, this last term continuously varies, so that a milliammeter in the anode circuit will fluctuate. If there were no distortion, this variation of the mean anode current would not take place.

Slight Distortion Only

In a similar manner it can be shown that whatever the relation between the current and voltage, there will always be a change in the mean anode current, unless the current and voltage are directly proportional, which, of course, is the condition required for distortionless amplification. If this method is employed it will usually be found that even with a satisfactory value of grid bias, there will be very slight quiver of the needle. This will usually be found to be quite satisfactory. Such quivering may be produced by a variety of causes, some of which are referred to in the Inventions and Developments column; but such distortion as is present is usually not evident in the quality of the loud-speaker output.

Slight Swing Permissible

In practice, as this grid bias voltage is increased it is found that the needle, which perhaps was first of all fluctuating violently, gradually settles down to a more or less steady state, after which the fluctuation begins to reappear. This latter condition, of course, is obtained when grid bias is so heavy that we are actually working on the bottom bend of the dynamic characteristic. This would correspond to about −10 volts in Fig. 4, where rectification would obviously take place, so that the output current would not be a faithful replica of the input current and distortion would result. In between these two extremes, the one without sufficient grid bias and the other with too much, it will be found that there is a region over which the variation of one or two grid volts does not make very much difference, and this is the satisfactory region for the operation of the amplifier.

Correct Value of Grid Bias

As has been stated, those who do not possess a milliammeter may ascertain the correct value of grid bias either by obtaining the dynamic characteristic and then choosing the mid-point of the portion which lies between zero grid volts and zero anode current. Alternatively a rough and ready check may be obtained by utilising the formula of Captain Round which was given, or by inspection of the static characteristic, choosing a point such as A in Fig. 1.

AMATEUR TRANSMITTERS IN GERMANY.

We hear that the German station KXH, who was frequently heard in this country a few weeks ago, is now officially authorised to transmit on 8,571 and 3,333 kc. (35 metres and 90 metres), using the call-sign K-K7. He has already worked a number of British amateurs on both these frequencies.

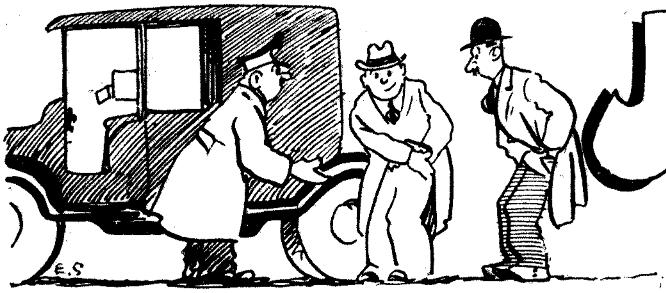
The German transmitters have organised a scheme whereby all correspondence intended for them may be sent to Mr. Rolf Formis (K-Y4), of Stuttgart, who forwards it each week to the stations for whom it is intended. They have also succeeded in obtaining certain concessions from the Government in respect of postage rates.

CALL SIGN "INTERMEDIATES"

Several American ships, in addition to the licensed amateurs in Hawaii, are now using the intermediate "HU." In connection with ship stations, the American Radio Relay League has standardised the practice of using the official intermediate of the country nearest which they are passing at the time. This will help to avoid confusion.

* * * *

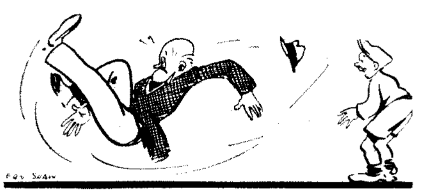
Various stations with similar call-signs to X3F, Y2A, L6C, etc., using the intermediate "V," are United States Army stations. Some are portable and others use higher power at their various headquarters.



JOTTINGS BY THE WAY

By Wireless Wayfarer.

I WAS sitting comfortably before the fire the other evening, and thanking heaven that I was not a fog signalman, when my handmaiden announced Professor Goop. Leaping up to receive him, I was horrified to see that he was, if I may so express it, in a somewhat part-worn condition. His right ear had lost its usual shell-like form, and had taken on in its stead something of the cauliflower or National Sporting Club shape. His left eye was completely closed and not a little swollen, whilst as he advanced towards me I noticed that he walked with a pronounced limp. "Good heavens, Professor!" I cried. "What *have* you been doing? Surely you have not crashed once more from your aerial mast!" "No," said the Professor, with a little sad smile. "No. I obtained these wounds, not whilst endeavouring to tighten my aerial halliards, but in the course of descending the hill from the Microfarads towards your comfortable home. The dear little lads of the town had made a slide upon the pavement, and I had forgotten all about it, until I suddenly slid. Still, these trifling scars are nothing at all. Nature will repair the damage in the course of a day or two."



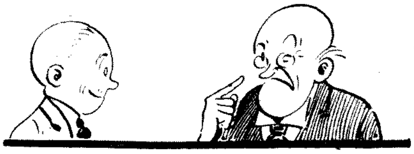
. . . *the lads had made a slide* . . .

Inspiration

Having ministered to the eye and the ear—Professor Goop was quite nasty about my suggestion that I should make him less lopsided by giving the other ear a biff with the fire shovel—I placed a comfortable chair before the fire and sat down myself to listen to the words of wisdom that I was sure would pour from his lips. "I am not at all sorry," he said at length, "that I had that little spill on the slide." "I am sorry," I murmured, with the old-world politeness that never deserts me, "sorry that you took a toss, but glad that you are not sorry." "No one," growled the Professor, "can be both glad and sorry at the same time." "Nevertheless that is my condition," I returned, "and in any case there is no need for you to wink at me, as I have observed you doing several times during the last few minutes." The Professor assured me that he was not winking; the damaged eye would not work properly—that was all. I was thinking of offering once more to even matters up when he burst into speech anew. "I am not sorry," he proceeded, "that this little misadventure happened to me, for it has given me an idea. We have spoken on several occasions of the groove or rut into which our most noted designers of wireless sets have fallen at the present time. Take portable sets, for example. . . ." "I never take portable sets," I said, quickly. "Mrs. Poddleby nearly let me in for one once at a picnic, but I hastily hid behind Gubbsworthy, who got the job of carrying the one that she had brought. Gubbsworthy has never been quite the same man since he lugged it the necessary hundred yards or so. In fact, he was quite rude to Poddleby about what he called the Insup set." "In—what?" exclaimed the Professor. "Insup," I repeated. "Insup portable, insupportable. See? Ha, ha." The Professor did not see, and it took me quite a long time to explain the thing to him. Professor Goop has been known to boast of an old Scottish strain in his blood.

Motorists Only

When I had done quite a lot of laughing myself, and had at length coaxed a sickly grin from the Professor, I allowed him to continue to develop his account of inspiration. "Who are portable sets designed for?" he asked. "Professional strong men," I replied, without hesitation. "No," said the Professor. "Henpecked husbands," I hazarded. "No," said the Professor. "Navvies," I tried. "No," said the Professor. I gave it up in order to save time. "If," said the Professor, "you will examine the designs of the portable sets that have appeared during the last twelve months, you will observe that all are designed for motorists. Now not everyone is a motorist. Take yourself, for example." "I don't know about that," said I. "Why, I often go to Bilgewater Magna by the 'bus, and if I am in Town I always take taxis, if there is anybody else with me. I am such a practised fumbler that it comes far cheaper than 'buses or tubes. You know what I mean. You get out first and say 'This is mine.' The other fellow, who probably knows something about fumbling, crawls out after you and says, 'No, no, I'll do this.' You then have extraordinary difficulty in getting off your glove and in unbuttoning your overcoat. If the other chap is a pretty practised hand you can always refer, as Wallows does, to the arm that you broke out hunting a year or two ago, and cuss the thing for being so clumsy. If he has a shred of manhood in him, he will at once produce the necessary shekels, but if not it is simply a question of keeping on until he does." "I am not referring," the Professor went on icily, "to casual motorists. I maintain that every portable set so



. . . *the damaged eye wouldn't work properly* . . .

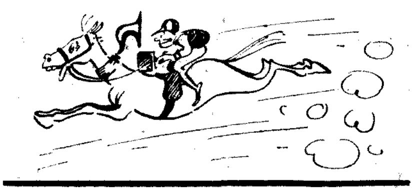
far designed has been made up with a view to its use purely and simply by the real, genuine motorist, the fellow who owns a car." "I know," I cried, "chaps like Dippleswade who pay 4s. 9d. down and the balance by monthly instalments of 7s. $11\frac{3}{4}$d."

Professor Goop Explains

"The whole basis of journalism," Professor Goop continued, "is that one should be topical. Portable sets should always meet the need of the moment." "A splendid idea," I cried. "The time draws nigh for the season of Quarter-Day. Let us design a portable set for moonlighters. That would be just a beginning. For the issue of *Wireless Weekly* which appears just before Derby Day we will have one for jockeys, and in case the favourite should win we will have in the same number one for bookmakers who practise in the half-crown enclosure."

The Great Idea

"All of these," said the Professor, "are quite good suggestions. We will deal with them in due course. Meanwhile what is happening at the present time of the year? For whom shall we design portable sets that are topical?" "For snow-shovellers," I cried; "for unemployed hop-pickers, for fellows who charge you tuppence for sitting on a chair in the park (theirs must be a dull existence during the winter months) . . ." The Professor held up his hand. "I think," he said, "what is really required is a portable set for skaters. Has it never occurred



. . . wireless for jockeys . . .

to you that when the country is in the grip, as it now is, of an iron frost, wireless enthusiasts such as Bumpleby Brown or General Blood Thunderby must be torn by conflicting desires?" "Why, yes," I exclaimed, "only yesterday I saw two of them being so rent—no, I will not use the word rent; it is too topical to be pleasant. Two of them were being fairly pulled to pieces. I was lunching at the Giddy Goat, and I found myself at the same table as the General and Bumpleby Brown. Each of them ardently desired to have Yorkshire pudding with his roast beef, though neither really dared, because they had both found that they were putting on weight of late."

Topical Sets.

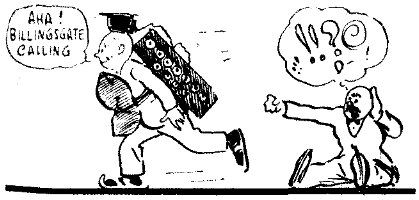
"No, no," gurgled the Professor. "What I mean is this. Winklesworth, say, comes back from a long day in the City and feels a twofold urge. He desires (*a*) to listen to wireless, and (*b*) to go skating upon the flooded meadows by the side of the Pud. As things are, he cannot do both. He must choose one or the other. How about yourself? What would you do in such circumstances?" "I should go to the movies," I said. "I always believe in splitting the difference." "That," said the Professor, "is just because there exists at the present moment no really suitable portable set for the skater. This is a defect that I propose to remedy without delay. Now what in your opinion should be the outstanding feature of such a set?" I rubbed myself thoroughly at various points which had come into violent contact on recent days with the ice that covers a large area around the Pud. "Air cushions," I suggested; "several air cushions."

A Noble Scheme

The Professor was very much taken with my last idea. It occurred to him at once that there was not the slightest reason why the "low-loss" and "safety first" slogans should not be combined by winding coils round air-cushions, thus obtaining both air-spacing and protection. "If," he said, "you will give me a sheet of paper, I will show you the circuit that I have in mind." I dashed to my writing table. Usually it is covered with pieces of paper. At the moment there was not one. It was borne in upon me that it was the day upon which my den suffers its weekly tidying-up by the domestic staff. The Professor was therefore forced to describe in words the circuit that he would otherwise have recorded in black and white. Though you have missed a great deal on this account, the special draughtsman retained by the Radio Press for the purpose of drawing the Goop circuits was so overjoyed on hearing the news that he dashed from the office, when after seventeen different efforts at boarding motor 'buses whose standing room capacity was already filled, he eventually picked up a Black Maria, and has not been heard of since.

The Circuit

Let me briefly outline in these poor halting words of mine the circuit which the Professor's pencil was unable to set down on paper for you. The receiving set itself consists of an eleven-valve super-heterodyne, made up in a cabinet



. . . a simple little arrangement . .

measuring 36 in. x 10 in. x 10 in. This is strapped to the skater's back by a simple little arrangement of girths and things. The loud-speaker is made by fixing a single telephone receiver to the crown of a bowler hat, which the skater must wear upside down when he wishes to tell the world what 2LO or any of the other stations is doing. The high-tension battery is carried in the right-hand pocket of the coat, and the grid battery in the left. The coat itself should be provided with poacher's pockets, and can be obtained from Messrs. Grabbit & Tabbs, my own tailors, a royalty of ten per cent. being payable to me. If only readers of *Wireless Weekly* do the right thing, my own tailor's bill will be paid off in simply no time at all, and I shall be able to think about my spring suiting. The accumulator presented a certain amount of difficulty at first, until we got into touch with the Ososophto Rubber Company, who have designed a special air cushion and accumulator combined, which the enthusiast can wear either upon his back or over his knees, according to the direction in which he is most accustomed to falling when indulging in skating. We are, however, in correspondence with the Selfwatt Company, who are designing a neat little rubber-cushioned dynamo, to be worked by the skater himself as he moves forward with alternate thrusts of the right and left foot over the ice.

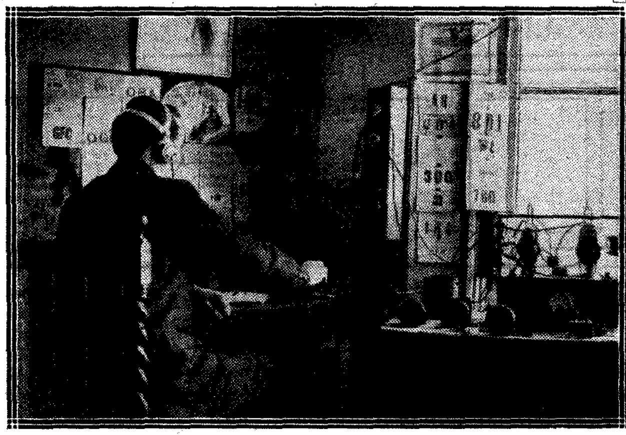
WIRELESS WAYFARER.

(Next week the "Jorrocks" set for fox-hunters.)

Some Practical Transmitting Circuits

By the Staff of the Radio Press Laboratories.

Continuing the "Radio Transmission" series of articles, a number of practical transmitting circuits are discussed, including both simple arrangements and more complicated apparatus, special attention being paid to methods of maintaining constant frequency in transmission.



THIS week it is proposed to discuss some of the more general circuits that are used in valve transmission. The question is often asked as to what is the best circuit for transmission work. The perfect transmitting circuit does not exist, just as there is no ideal receiving circuit. Each circuit has its own special features to suit certain conditions, and it is generally found that if an advantage is gained in one direction it is usually at the sacrifice of some other feature.

The Single-Circuit Oscillator

This circuit consists of the well-known "Hartley" circuit, and is shown in Fig. 1. The tuning condenser C, which controls the frequency, is connected across

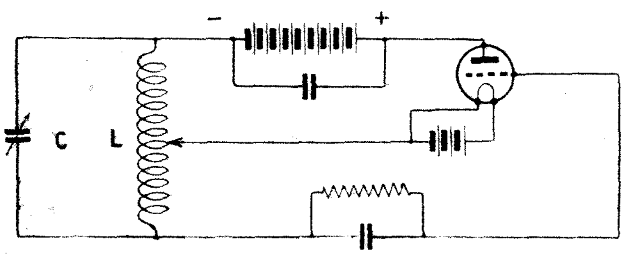


Fig. 1.—The "Hartley" circuit in its simplest form.

the whole of the inductance L, included in both the grid and anode circuits. The filament is taken to a tapping point somewhere about the centre of the coil. The high-tension supply is connected between the anode and one end of the tuning coil. In this type of circuit it is very easy to realise the phase relation existing between the grid and anode voltages. When the grid end of the coil is maximum positive with respect to the filament the anode end of the coil must be maximum negative with respect to filament, and the voltage across the anode-filament of the valve under these conditions is equal to the difference between the high-tension supply voltage and the voltage across the part of the inductance in the anode circuit.

Similar Circuits

Fig. 2 shows the same circuit as above, but with entirely separate inductances L1 and L2 connected in the anode and grid circuits. There need be no coupling between L1 and L2, as the reaction is obtained electrostatically by means of the main condenser C.

The Hartley circuit is very convenient for many purposes. It is simple, and will cover efficiently a wide band of frequencies with a single condenser adjustment. It is particularly suitable for directional transmission work from a frame aerial, the latter being connected in place of the inductance L of Fig. 1, as shown in Fig. 3.

Effect of Capacities to Earth of Anode and Filament Batteries

It will be seen from Fig. 1 that if the anode and filament batteries have a large capacity to earth, these will be the equivalent of a condenser across the anode part of the inductance L. This makes the circuit asymmetrical, and is liable to cause inefficiency and possibly failure to oscillate. It is therefore important if the circuit shown in Fig. 1 is used that both the high-tension battery or generator and the filament battery are not only well insulated from earth, but also have a low capacity to earth and, of course, to each other.

A Remedy

To overcome the difficulty, particularly if the high-tension supply is from a generator, it is preferable to use the circuit shown in Fig. 4, in which the positive high-tension supply is fed to the anode through an efficient high-frequency inductance L1, the negative end of the supply being connected direct to the filament.

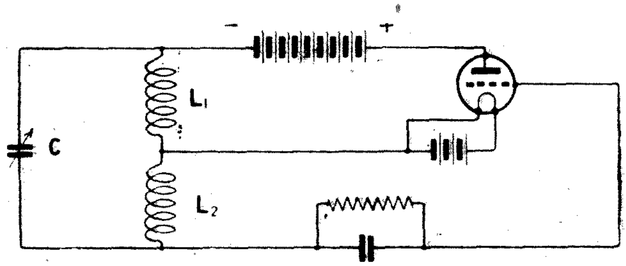


Fig. 2.—Another version of the "Hartley" circuit, no coupling being provided between the grid and anode inductances.

The anode must be connected to the coil through a condenser C1 in order to prevent the H.T. supply being shorted.

This method of "top feed" to the anode has the disadvantage that it is difficult to obtain a high-frequency choke which is suitable for more than a limited band of frequencies.

Another Method

Another circuit which overcomes the trouble of stray capacities to earth is shown in Fig. 5. In this circuit the inductance L is broken at about its middle point, and a large condenser is inserted. The high-tension supply is connected across this condenser, the positive being fed through a high-frequency choke to the anode side of the condenser. The choke in this case is not so vitally important, and is used more as a protection against the high frequency getting back through the generator.

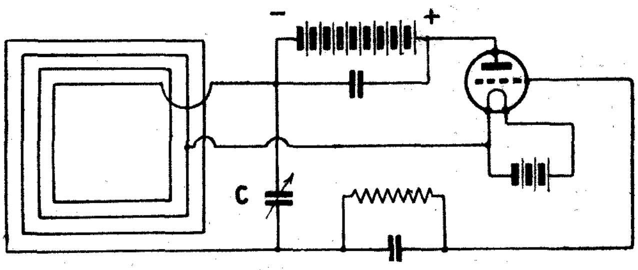


Fig. 3.—The "Hartley" circuit is particularly suitable for directional transmission with a frame aerial.

Aerial and Earth System

The Hartley circuit is not very convenient for connecting directly to an aerial and earth system, because, unless the filament is fed through efficient high-frequency chokes, the filament battery will necessarily be at a high-frequency potential above earth, and this will cause trouble through the circuit becoming asymmetrical. It is generally preferable to use a loosely-coupled aerial circuit to overcome these difficulties when using the Hartley circuit, although chokes in the filament leads may be found satisfactory under certain conditions.

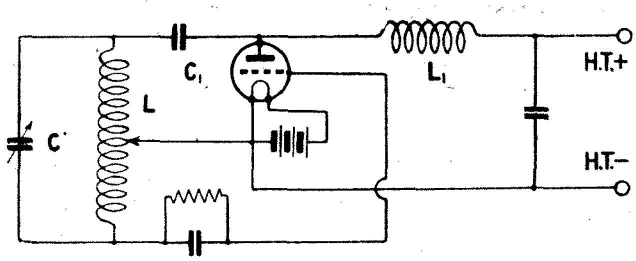


Fig. 4.—A method of "top feed" to the anode of the valve, which has the advantage of separating the high-tension supply from the oscillatory circuits.

Another Reaction Method

Another circuit which may be considered to operate by means of electrostatic reaction is shown in Fig. 6. By making C1 small, the voltage in L1 is 180 degrees out of phase with the voltage across L2, which is the condition for oscillation. An aerial and earth system can be connected to the circuit in place of the condenser C, as shown by the dotted lines.

Reaction by Inductive Coupling

The ordinary inductive reaction circuit, suitable for low or medium power work, is shown in Fig. 7. It is simple, and with a reaction coil L1, designed to suit the particular bands of frequencies required, it can be made very efficient. The condenser C can be replaced by an aerial and earth system. As the positive H.T. supply is connected to the aerial coil, it is important that the blocking condensers C1 and C2 be placed in the aerial and earth leads, so as to protect the generator, and prevent the aerial being at a high D.C. potential above earth.

High-Power Transmission

A circuit which is used for high-power transmission is shown in Fig. 8. One or two turns of the aerial circuit are coupled to the grid coil L2, across which there is a variable condenser C1, not for the purpose of tuning, but as a phase compensator to ensure that the grid voltage is exactly opposite in phase with the voltage across the anode inductance. The positive H.T. supply is fed direct to the anode through an efficient high-frequency choke L3, the negative supply being connected to the filament through the H.F. choke L4.

Constant Frequency

A very important requirement in continuous wave transmission, both for telegraphy and telephony, is that the frequency of the oscillation be maintained steady to within a few cycles. This is not an easy problem, particularly with regard to the higher frequencies. Any variation in high-tension voltage, filament current, aerial, or stray capacity effects will cause wide fluctuations in frequency when frequencies greater than 3,000 kilocycles (100 metres) are considered. Even at frequencies of the order of 300 kilocycles (1,000 metres), swaying of the aerial in the wind will cause variations of the frequency unless special precautions are taken. By loosely coupling the aerial to the valve circuit these variations due to aerial swing can be considerably reduced, but this precaution alone is not sufficient, particularly at very high frequencies.

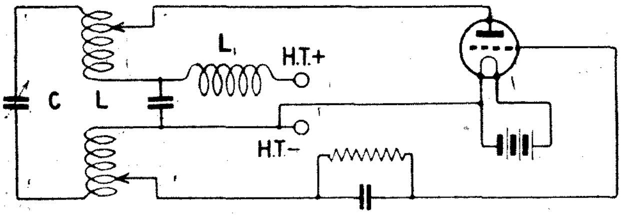


Fig. 5.—An alternative circuit to that of Fig. 4, which also overcomes the trouble of stray capacities to earth through the H.T. generator or battery.

Independent Drive Oscillator

The usual method now employed for maintaining constancy of frequency is the independent drive, or separately excited grid circuit.

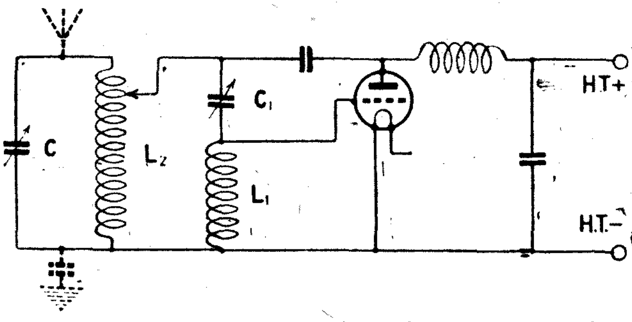


Fig. 6.—In this circuit, in which electrostatic reaction is operative, the condenser C1 should have a small value.

This circuit consists essentially of a high-frequency amplifying circuit, by which the oscillations from a constant frequency valve oscillator are amplified before transference to the aerial. Normally there is only one high-frequency amplifying or power valve, but two or more may be used if found necessary, and this may be the case if the initial oscillation is comparatively weak. With this type of transmitter it is possible to obtain oscillations in the aerial which are practically

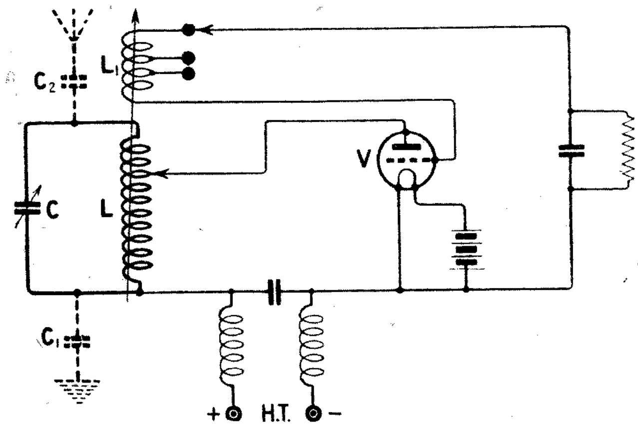


Fig. 7.—A circuit suitable for medium or low-power transmission, in which ordinary inductive reaction is employed.

independent, as far as frequency is concerned, of any small variations in aerial capacity.

Undesirable Oscillation

There are several important points to bear in mind when such a circuit is used, as otherwise the frequency of the independent oscillation will be affected by outside variations in aerial capacity and load on the power valve. In other words, the amplifying or power valve is very liable to take control of the oscillations. It is often found with such a circuit that on switching off the independent oscillator practically no effect is produced on the current in the aerial. This means that the amplifying or power valve is

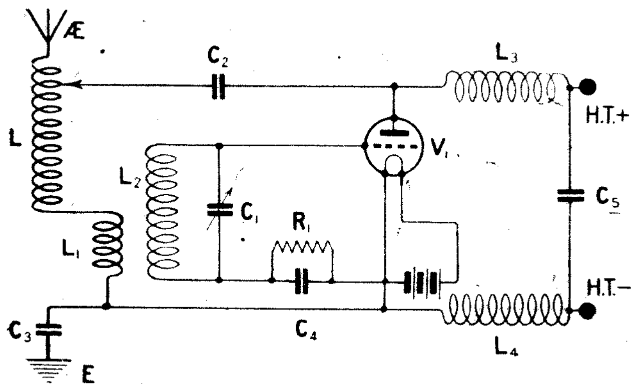


Fig. 8.—A circuit used for high-power transmission with a direct coupled aerial. The condenser C1 is adjusted so that the correct phase relationship is obtained between the grid voltage and the anode inductance voltage.

oscillating on its own, due to stray reaction coupling through the capacity of the valve, or through capacity or inductive coupling between the various leads in the circuit. This trouble is particularly liable to occur when working at the higher frequencies.

Neutrodyning

One comes up against exactly the same trouble in receiving circuits, when the grid and anode circuits of a high-frequency amplifier are tuned to the same frequency. This tendency for oscillations to occur under such conditions is well known to everyone who has used such circuits.

The most obvious solution of the difficulty would appear to be the incorporation of some form of neutrodyne circuit, in which the effect of the valve capacity is balanced out by means of an external condenser.

Fig. 9 shows the general principles of an independent drive oscillator with a neutrodyne adjustment to balance out the effect of the anode grid capacity of the power valve. When the neutrodyne condenser is properly adjusted, slight variations in the aerial capacity should not affect the frequency of the radiated wave.

Grid Bias

Another important precaution is the incorporation of a grid bias battery or generator instead of the usual grid-leak and condenser. This is done with a view

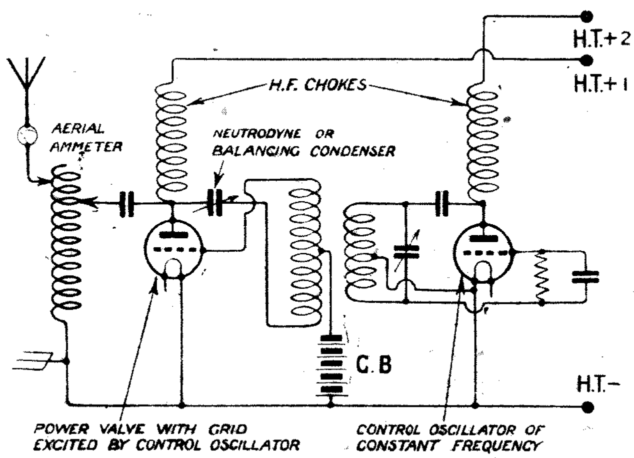


Fig. 9.—Illustrating the principle of the independent drive oscillator.

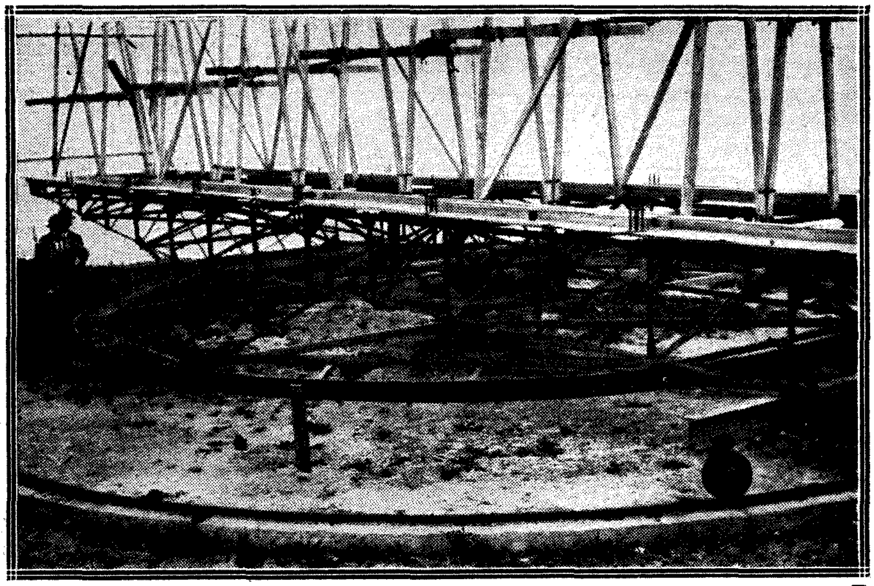
to keeping the load on the control oscillator as small as possible. A grid condenser and leak necessarily requires a certain amount of power to maintain a negative bias, and as this is liable to vary under working conditions when the load on the power valve is altered there is a tendency for the frequency of the control oscillator to vary. It is important to arrange for a sufficient negative grid bias to prevent the grid of the power valve from becoming positive, in order that no load may be taken from the control oscillator due to grid current.

In the next article in this series it is proposed to deal with the various methods by which a continuous wave can be modulated.

Short Waves for Long Ranges—a Review

An abstract of a Paper read by Captain W. G. H. MILES, R.M., before the Radio Society of Great Britain.

We give here a general summary of Capt. Miles' Paper, which deals with the increasing use of short waves for long range wireless communication since 1922, compares the main features of long and short-wave working, and discusses some of the problems incident on the employment of the beam system of short-wave propagation.



The wireless lighthouse which was demonstrated recently by Senatore Marconi, uses a very high frequency for transmission.

CAPT. W. G. H. MILES, R.M., lecturing on "Short Waves for Long Ranges—a Review," gave some interesting facts in relation to modern short-wave practice. Dividing wireless progress into three eras—spark, long-wave, and, lastly, short-wave—he dealt briefly with wireless history before dealing more fully with short waves.

Advantages of Short Waves

There are four main advantages in the use of short waves for long range telegraphy :—

(*a*) Economy in power. This is well illustrated in the comparison between the power which will be utilised by two G.P.O. stations.

Rugby, which is a long-wave station designed to work Australia, requires 1,000 kw., whereas the short-wave beam station now in course of construction, designed for the same purpose, will require only about 40 kw.

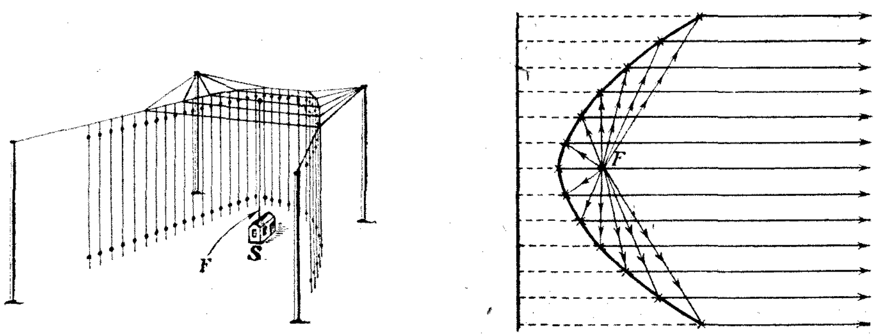


Fig. 1.—A sketch and plan diagram of one system adopted for beam transmission, vertical wires of equal length being hung round a parabolic support, with the transmitting apparatus at the focal point.

Solution for Overcrowding

(*b*) The possibility of utilising a hitherto unused wave, or frequency, band.

On the longer wavelengths the number of stations which could be allotted to the 300-30,000 metre (10 to 1,000 kc.) band were practically all employed.

Below 100 metres (3,000 kc.) the field for new services is not so restricted as might appear at first sight. An example will make this clear. Between 9 and 10 metres (30,000 and 33,333 kc.) there is as large a frequency difference as between 100 and 30,000 metres (10 and 3,000 kc.).

(*c*) The concentration of the propagation of short waves by means of a reflector.

Long waves may, of course, be reflected, but the size of the reflector required in such a case is quite impracticable.

(*d*) Freedom from atmospheric interference, as compared with that experienced on long waves.

The Work of Amateurs

With these many advantages it became obvious that short waves had come to stay. Developed, as they were, from the services of amateurs, to whom a great debt was due by the professional wireless engineer, they yet became of great commercial and professional importance.

How greatly the amateurs assisted this development will be realised from the fact that when wavelengths were being allocated for the various services, those then thought to be of value were allotted to the professional users. The range 220 metres (136 kc.) and below, which was thought to be of no commercial or service use was given to the amateurs, and as a great concession 1,000 metres (300 kc.), which was thought to be the only wave with which they could possibly obtain any range.

The importance of the progress achieved between December, 1921, and May, 1925, which has resulted in practically every part of the world being bridged in daylight with a power of less than 1 kw., is too obvious to need comment.

Empire Wireless Chain

In 1920 a Government Committee proposed an Empire chain of stations every 2,000 miles, so that a message intended for Australia could be relayed by the various links. The

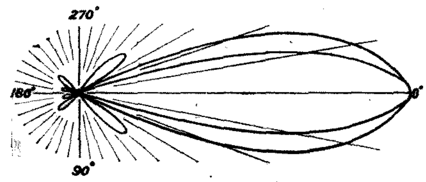


Fig. 2.—Illustrating the concentrated radiation mainly in one direction from a transmitting station using a reflector.

Dominions replied that they would prefer higher power to work direct.

Another committee in 1924 agreed to this, and the G.P.O. commenced the construction of Rugby, which cost about £350,000. The Dominions followed suit, and also entered into contracts.

Senatore Marconi's Beam Experiments

In July, 1924, Senatore Marconi announced the results of his 92 metre (3,261 kc.) experiments. These results were the satisfactory communication with Australia so long as darkness extended over the whole route.

December, 1924, produced the information that using a 30-metre (10,000 kc.) wave he had communicated with Montreal, Rio de Janeiro, and Sydney during daylight, without a reflector. September, 1925, during which his most recent experiments were conducted, gave daylight results only, on 15 metres (20,000 kc.).

As the result of these announcements, all the high-power station contracts entered into by the Dominions were cancelled, and contracts for short-wave beam stations were substituted for them.

Short-wave Technique

There are certain differences in technique between long- and short-wave working. In transmission on short waves every precaution must be taken to keep a constant wavelength and to avoid undesired capacity effects. An independent drive or master oscillator must be employed, as a valve cannot be allowed to oscillate the aerial direct.

Wavelength and Aerial Length

Account must be taken of the length of the aerial in proportion to the wavelength on which it is desired to transmit.

It is possible, and is in fact standard practice, to make the wavelength on short waves bear a definite relation to the length of the aerial. When this is done, it is found that the radiation is directed upwards at an angle instead of horizontally.

The theory that energy is propagated in an upward direction is borne out by the fact that there is (except in the case where the wavelength is one quarter of the aerial length) a zone near the transmitter where signals are not heard.

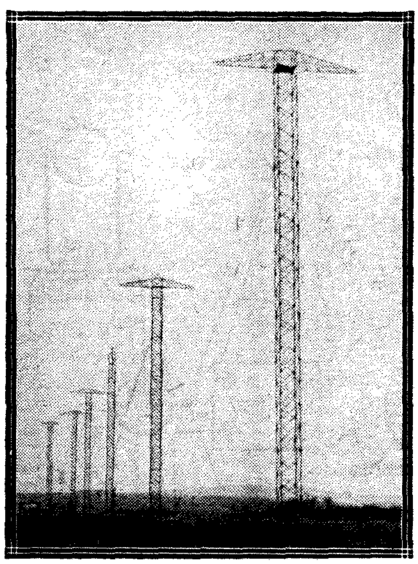
Optimum Radiation Angle

This conception suggests that there is a best angle for this energy radiation, according to the time of day and the range required, and that the wavelength and the aerial length ratio should be arranged so as to give this angle.

The energy radiated at this optimum angle can reach a higher value than when the vertical aerial is energised at its fundamental wavelength, that is to say that the third harmonic radiated at an angle of 47 degrees is $1\frac{1}{2}$ times that radiated by a vertical aerial oscillating at a $\frac{1}{4}$ of its wavelength. On the fifteenth harmonic, radiated at 72 degrees, the energy is $4\frac{1}{2}$ times that on the fundamental.

Daylight Losses

It would have been thought that,



The masts of the Marconi beam station at Bodmin, Cornwall, are arranged on the system shown diagrammatically in Fig. 3.

as shorter waves are more efficient, there would have been something of a scramble for them. One factor militating against the use of the short waves was the greater daylight losses.

Also, before the merits of short waves were realised, it was thought that the greater the range the greater must be the power put into the aerial. It would appear, however, that it seems to be more important to choose one's wavelength correctly.

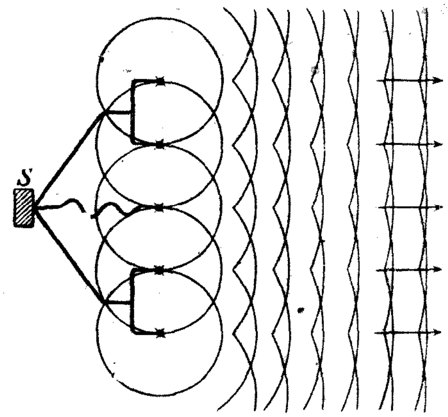


Fig. 3. — The modern beam system utilises a number of aerials in a row, fed in parallel from the transmitter.

Beam Station Reflectors

Turning to the question of beam transmission, it is well known that any ether wave may be focussed into a beam if the correct sort of reflector is used.

In the case of the wireless beam, the reflector takes the form of a number of wires hung up behind the transmitting aerial (see Fig. 1). The shape of the reflector in plan may be either parabolic or flat. The wires constituting the reflector are each separately tuned to the transmitting wave.

Energising the Reflector

When the transmitting aerial is energised it sets all the wires of the reflector in oscillation, and the resultant radiation from them reinforces that of the transmitting aerial in the required direction, while behind the reflector and to the sides there is little radiation (Fig. 2).

A parabolic reflector is not very convenient for long ranges, owing to the difficulty of sufficiently energising such a short aerial.

The Modern Reflector

It is more convenient to have a number of aerials in a row and feed them in parallel (Fig. 3).

These reflectors concentrate energy in one direction—at right angles to the plane of the aerial.

The aerial wires have no tendency to radiate in a direction in line with themselves by reason of the manner in which they are spaced. This form of aerial is being adopted by the Marconi Company both for transmission and reception.

Inventions and Developments

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

A VERY interesting paper* has recently been read before the Institute of Electrical Engineers on the performance of amplifiers, in which the result of a large series of measurements made at the National Physical Laboratory on the amplification of amplifiers is discussed. Hitherto the method of measuring the amplification has been subject to somewhat serious error. The telephone method, in which the actual measurement consists of comparing two sounds, is not at all satisfactory, and indirect methods of measuring signal strength, such as "slide back" methods, are of somewhat doubtful accuracy.

Method Employed

The actual circuit employed by the author is shown in Fig. 1. It consists essentially of a radio-frequency oscillator, which is made to supply current to the amplifier under test. The current input to the amplifier is required to be very small indeed, and in order to obtain this, the current in the oscillating circuit is first of all cut down by a suitable current transformer, across the secondary of which is an accurately calibrated high-frequency potentiometer. Thus it is possible, by measuring the current in the primary of the transformer with a thermo-galvanometer, to obtain a definite and accurate knowledge of the voltage supplied to the terminals of the amplifier.

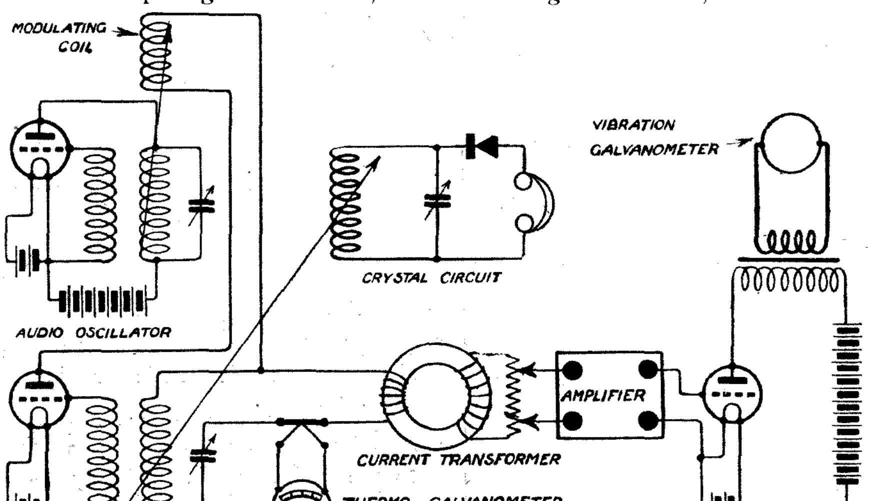


Fig. 1.—Showing the general scheme of the apparatus employed by the author.

Sound Output Misleading

Although sound output is of importance, in that our interest is ultimately concerned with the sound obtained, it does not follow that this is the best method of measuring the amplification of an amplifier. It is suggested in this paper that it is better to measure the actual amplification of the fundamental frequency only, treating any harmonics which may be introduced as detrimental to the main amplification and therefore not to be included. It is found that the difference between the two possible amplifications, one measured in terms of the R.M.S. value of output current and the other the value of the fundamental component only, may be as much as 20 per cent.

Arrangements are made, therefore, to modulate the high frequency with a suitable low frequency at about 1,000 cycles.

Vibration Galvanometer

The current in the amplifier is subsequently rectified either in the amplifier itself or externally, and the low-frequency current produced is applied to a vibration galvanometer. This is an instrument having a small mechanical oscillating system, which is tuned to the frequency of the applied current. The actual extent of the mechanical vibration is measured by means of a spot of light thrown on to a suitable scale.

Being tuned, it will not respond appreciably to currents of a frequency other than the resonant frequency of the vibrating system. By this means, therefore, the only output measured is that at the fundamental frequency, and the harmonics do not produce any appreciable effect.

Modulation

The modulation of the radio-frequency current is produced by means of a low-frequency oscillator, which is coupled to the radio-frequency oscillator through the

*"The Performance of Amplifiers," By H. A. Thomas, M.Sc.

medium of the modulating coil shown in Fig. 1. The low-frequency pulsations then actually vary the voltage applied to the anode of the radio frequency oscillator and the circuit is so arranged that complete modulation may be obtained.

If it is desired to obtain the rectifier characteristic of the amplifier as well, it is essential that the actual percentage modulation shall be known. In the measurements described the modulation was therefore adjusted to be 100 per cent. in

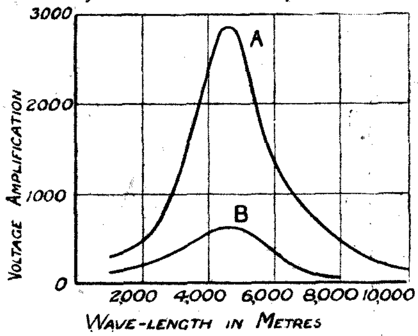


Fig. 2.—A marked difference was observed between two apparently identical 3-stage H.F. amplifiers. In curve A reaction effects increase the overall amplification.

each case, this being tested by listening in on a suitable crystal circuit loosely coupled to the radio frequency oscillator. If the radio frequency is over modulated then harmonics, i.e., octaves of the fundamental 1,000 cycle note, can easily be detected on the telephones, and the modulation is reduced until the harmonics just cease. Tests with an electrostatic voltmeter demonstrate that this method of ascertaining complete modulation is quite adequate.

Some Conclusions

The results obtained show that

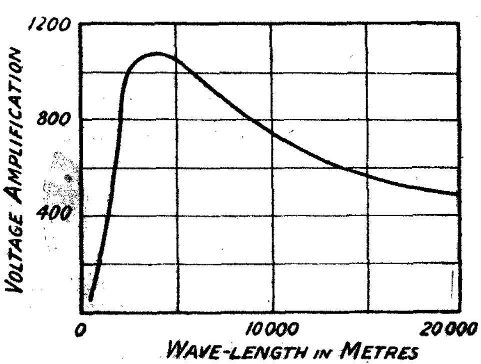


Fig. 3.—In this curve of a 6-stage resistance-coupled amplifier, it will be seen that the overall amplification falls off sharply below 4,000 metres (75 kc.).

there are considerable differences between amplifiers even of the same type, due to varying reaction effects between the various valves. An interesting point, however, is that the amplification of a high-frequency amplifier increases considerably as the input is decreased. Certain authorities claim that for very weak input the amplification falls once more, but no tests are described in the present paper with sufficiently small input voltages to obtain any confirmation of this point.

Low-Frequency Amplifiers

With low-frequency amplifiers the matter of measurement presents less difficulty. In this case the audio-frequency oscillator in Fig. 1 is coupled direct to the amplifier through an ordinary low-frequency potentiometer, and the output is measured in the same way as before. It is found that in the majority of cases the amplification on a two-stage amplifier is not equal to the product of the amplifications of each individual stage. By taking suitable precautions, however, the difference can be made about 1 per cent. only.

Effect of Amplifier on Tuned Circuit

In the middle section of the paper the effect of the amplifier on the tuned circuit connected across the input terminals is investigated both theoretically and experimentally. Theoretically it is shown that the effect of the amplifier is to add a shunt resistance and capacity in series across the tuning circuit, as shown in Fig. 5. The results which are obtained on this assumption are found to agree very well with practical conditions.

Measurement of this Effect

The method of measuring the effects on the tuning circuit consisted in obtaining the resonance curves and plotting the decrement of the circuit under the varying conditions. It is interesting to note that the method adopted for these measurements was the reactance variation method employed in the measurements of coil resistance which have recently been published in *Wireless Weekly*, the only difference being that in this case the frequency was varied and not the tuning capacity.

Values Obtained

It appears that the value of the capacity C_1 is approximately constant irrespective of the conditions, and the value given in the paper is of the order of 9 $\mu\mu$F.

The resistance depends upon the inductance in the tuning circuit, and increases as the inductance increases. When L was 156 μH, the resistance R_1 was approximately 20,000 ohms, while if the inductance was increased to 654 μH, R_1 increased to about 87,000 ohms. The effects due to reaction are discussed theoretically and practical

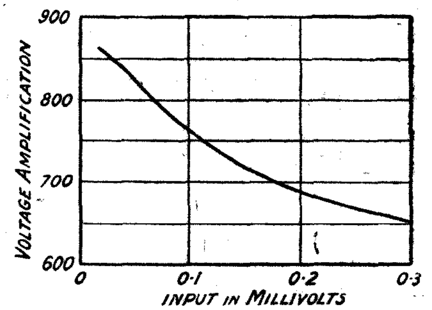


Fig. 4.—From the curve of a 6-valve untuned transformer-coupled amplifier it appears that the amplification falls with increasing input.

results indicate that the theory is correct.

Distortion

The third section of the paper deals with the question of distortion in low-frequency amplifiers. It would appear from the results obtained that as long as the output is small the distortion is not serious, but the effect of increasing output produces harmonics which increase much more rapidly than the fundamental. Secondly, as the frequency is lowered the distortion becomes more serious. It is pointed out that at a frequency as low as 150 cycles, with an output of about 1 milliampere only, the fundamental may be almost completely eclipsed by harmonics.

Negative Grid Bias

The effect of negative grid bias is to reduce the magnitude of the second and third harmonic, but to introduce, on the other hand, smaller harmonics of a higher order such as the 4th, 5th, 6th, etc. It will thus be seen that the introduc-

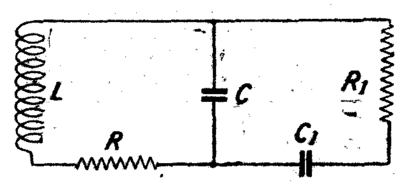


Fig. 5.—Showing how an amplifier has the effect of adding a shunt resistance and capacity across a tuned circuit.

tion of grid bias does not necessarily prove an infallible cure for distortion. The results given in this section of the paper, however, are only preliminary, and work is actually being carried on at the National Physical Laboratory on this subject, so that further developments will probably be forthcoming.

THE FUTURE OF

EVIDENCE BEFORE THE

The Committee of Inquiry appointed to investigate the B... recommendations with regard to the future organisatio... subject of Broadcasting. We give below a summary of th...

The Earl of Crawford, chairman of the Committee of Inquiry.

WHAT is to be the future organisation controlling the broadcasting in this country? This subject is at present under consideration of the Committee of Inquiry appointed by the Government.

Evidence Heard

Already evidence has been taken by the representatives of three interested parties. The first, the Post Office witness, was heard "in camera." On December 3 Mr. J. C. W. Reith, the managing director of the B.B.C., appeared on behalf of the existing organisation. The Wireless League, represented by Sir A. Stanley, Chairman, Prof. A. M. Low, Secretary, and Mr. D. S. Richards, Chairman of the Ilford and Home Counties Area Committee, gave evidence on December 4, claiming to submit the listener's point of view.

The Committee of Inquiry

The members of the Committee present on each day were the Earl of Crawford, Chairman, Lord Blanesburgh, Sir P. Royden, Sir H. Hadow, Mr. Wm. Graham, M.P., Mr. Ian McPherson, M.P., Dame M. Talbot, and Capt. Ian Frazer.

Further interested parties have applied to be heard, and on December 17 Lord Riddell will appear for the Press, and on December 18 various artistes' organisations, music publishers, and Messrs. Chappells will submit memoranda.

B.B.C. Evidence

Mr. J. C. W. Reith, in his memorandum, submitted evidence on the scope and conduct of the broadcasting service, and emphasised particularly that he made no recommendation as to any future constitution.

The main object of his memorandum was to show the desirability for the service of broadcasting to be conducted as a public service, with the adoption and maintenance of definite policies and standards in all its activities and for unity of control.

An Impartial Statement

It was submitted as an impartial statement on the administration of a public service, and must not be regarded as a submission of evidence by specific interests.

The service should not be used for entertainment alone, for, if rightly developed and controlled, its future as an influence—a world influence—for good could hardly be conceived. It was equally capable, if abused, of being a harmful influence of equal potentialities.

Mr. Reith said that the B.B.C. received an average of 8,810 letters per week, of which total 4,700 came from the London area. On analysis these showed that 95 per cent. were expressive of appreciation, 3.5 per cent. were critical, and 1 per cent. were suggestions or constructive criticism. He thought their Sunday programmes were universally appreciated and approved. He did not concur with the view that the Sunday programmes should be secularised. At the same time, they did not wish to encroach upon the work done by the various churches, unless a complete service were broadcast. They might consider the question of a secular and a religious programme transmitted on different wavelengths, so that listeners could choose for themselves.

A National Influence

The B.B.C. already have some 10,000,000 listeners, and the broadcast service is available to 85 per cent. of the population, using the very simplest of apparatus.

The influence of the service was such as to "make the nation as one man." This could clearly be realised on such occasions as the opening of the British Empire Exhibition.

At present the broadcasting of such ceremonies as the Armistice Day Service at the Cenotaph, or the speeches on the signing of the Locarno Pact, depended entirely upon the individual views of the Minister or Government Departments concerned. It was to be expected and hoped that the broadcasting of such ceremonies would become automatic.

Relations with other Interests

Their relations with other interests had progressed greatly. The advent of broadcasting had been viewed with uneasiness and hostility in certain quarters. They had adopted a conciliatory attitude, and this had resulted in co-operation in practically every case.

The Press had been of great assistance in the development and progress which they had achieved,

BROADCASTING

COMMITTEE OF INQUIRY.

oadcasting service existing in this country, and to make of this service, are engaged in hearing evidence on the evidence submitted by the B.B.C. and the Wireless League.

and they were now regarded more as an ally than a rival.

Broadcast News

In reply to a member of the Committee, Mr. Reith said that he did not think there was a general call for news to be broadcast before 7 p.m., although it would be beneficial to have this restriction removed. They felt that an extension of their powers for news transmission was very necessary.

At present the B.B.C. were limited to what the microphones could pick up direct. Mr. Reith did feel that the presence of a narrator, as at the signing of the Locarno Pact, or the races at Brooklands, giving a "word picture" of events, would greatly increase the value and interest of such items.

Present Restrictions

Another development would be the presence of an eye-witness at the studio to describe daily events.

The present news arrangement is that news may only be taken from four agencies, only bulletins of a certain length may be broadcast, and these not before 7 p.m.

Broadcasting of Parliament

Replying to Mr. W. Graham as to what amount was paid for news, Mr. Reith said he had an idea it was in the nature of £6,000 per annum. Queried again as to whether he thought they got "value for money," he said they did. Questioned by Capt. Ian Frazer as to the broadcasting of debates in the Houses of Parliament, he said that they had evidence that there was a definite demand for this. Asked: "Was this practicable?" Mr. Reith said that the B.B.C. engineers were quite capable of undertaking the necessary installation. When Capt. Frazer said that the Committee might make a recommendation to this effect, Mr. Reith said he hoped they would.

International Aspects

The B.B.C. realised the importance of the international aspect, and they are the moving spirit in the founding of the International Bureau at Geneva. They had made routine arrangements for regular relaying of foreign programmes and a special weekly broadcast by them from their high-power station for European listeners.

B.B.C. Announcers

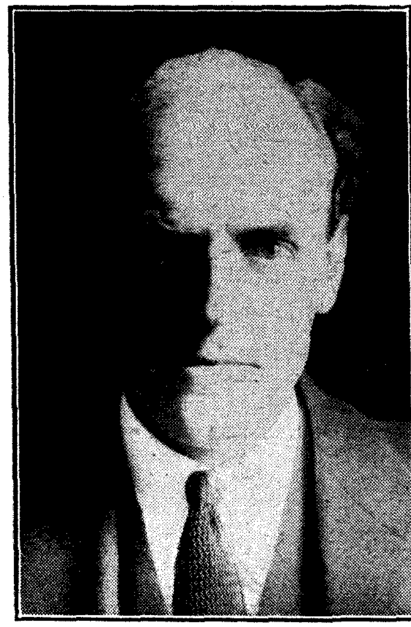
The service was available for all non-party Government propaganda, and various Ministries gave a regular series of talks. Efforts were made to secure as regular announcers and speakers only those who employed the right pronunciation. The daily introduction of cultured speech into most family circles would have a considerable effect in the course of a few years.

Education

This important aspect of their activities received great consideration. Any broadcasting service must be in touch with university, education and school authorities. The present organisation included the Education Advisory Committee, wherever there existed a broadcasting station. The educational side may be sub-divided into general informative talks, talks on specialised interests, and school talks supplementary to the existing curricula. The present development is towards a rate of some 10,000 talks a year, of an average length of 15 minutes. Some talks formed a series for the study of a particular branch.

Transmissions for Schools

The progress with the school transmissions had been rapid, and an estimate gave the result that over 1,000 primary and secondary schools utilise these talks, and many of the broadcasts had received unqualified praise from teachers.



Mr. J. C. W. Reith, managing director of the British Broadcasting Company.

Sir Henry Hadow rather doubted whether any definite gain could be obtained from a 15-minute lecture. Mr. Reith said that psychologically it was difficult, with this medium, to hold listeners' attention for longer than that time.

Music

The subject of the type of music to be broadcast was a vexed problem. A great number of people wrongly endeavoured to classify music arbitrarily, with resulting acrimonious disputes between so-called "high-brows" and "low-brows." All varieties of taste had to be catered for to the best of their ability. The B.B.C. considered they had a mission in educating the public musical taste. The average man had so few opportunities of hearing good music that he could not easily discriminate. They had evidence that the musical taste of the nation was now higher than ever before.

Choice of Programmes

In reply to various questions, Mr. Reith again advanced the idea of two wavelengths from one or two stations, one sending a "Jazz" type of programme, and the other a programme of classical music. Listeners could then choose.

Their aim was to satisfy everybody by some method. Alternative programmes, two or more for the humblest crystal-set user and many for the cheap one-valve set, would appear to be a partial solution of the problem.

Religion

It was submitted that there should be a definite association with religion in general and the Christian religion in particular. Christianity is the official religion of this country, and this fact can be given as a justification, if required.

Various questions were addressed to Mr. Reith on this subject by Dame Meriel Talbot, who was anxious about the responsibility for the religious side of broadcasting. Mr. Reith said that there existed a religious advisory body for each station, including a prominent local minister or ministers, who held their position with the approval of the Bishop.

Many eminent preachers had been enabled to reach a larger audience than they could otherwise in a lifetime's work. This was instanced when the Archbishop of Canterbury, on Armistice Day, delivered an address to possibly the largest audience that has ever heard a sermon simultaneously.

Unity of Control

Dealing with the existing virtual monopoly, there was little doubt that the many objections in ordinary cases to a monopoly were well founded. Without such a monopoly, however, it was quite rational to doubt whether broadcasting could have expanded with sufficient rapidity and facility and at the same time have dealt with such diverse problems.

The opinion would appear to be generally held now that unity of control, in whatever hands it might be placed, was the only possible system for the beneficial development of this infant service.

Constitution of B.B.C.

Mr. Wm. Graham wished to know about the existing constitution. Mr. Reith explained that a number of manufacturers were member shareholders. It was originally intended that shareholders should benefit. All ideas of benefits for shareholders had now disappeared.

Sir Arthur Stanley, Chairman of the Wireless League.

The B.B.C. paid a fixed rate of 7½ per cent., and were not allowed to make any profits.

Future Policy

The B.B.C. proposed to develop fewer stations, say 15, instead of the present 22, and to increase power. Certain stations, say Manchester, might transmit alternative programmes on two wavelengths. The state of the ether in Europe had suggested the desirability of reducing the number of stations, and perhaps even abandoning part of the wavelength range allowed. This was conditional upon higher power being sanctioned for the remaining stations. They would then have what might be termed "regional centres" for the transmission and collection of local interest items. The new Oxford studio was the first example of this. Another station similar to Daventry might be needed.

Finance

The early days were very unsatisfactory from this point of view. In October, 1923, the licence regulations evolved in consultation with the G.P.O. were put into force. In that month 334,000 licences were taken out, representing an income of almost £200,000. When compared with the total received prior to that date of £46,500, it will be realised that the financial outlook suddenly improved. From that date there has been a steady increase in licensees of 40,000 per month.

Restricted Revenue

Mr. Reith spoke bitterly of the recent restriction of the B.B.C.'s income to £500,000 per annum. They would require at least £750,000 for next year's demands. The raising of a Treasury loan on the assets of the company might be a solution.

Should the constitution be changed as a result of the recommendations of the Committee, he thought their members should be paid at par.

He foresaw difficulties in liquidation and change over, and thought legislation might be necessary in connection with finances.

Increasing Expenditure

The estimated figure in 1922 of £148,000 per annum being required for operation expenses did not and could not take cognisance of the future developments. In fact, the extent of the actual development which has since taken place was not appreciated.

With the increase in the number of hours of transmission, the advent of relay stations and continual improvement in programmes, the increased revenue from the new licensing position was quickly absorbed.

During the year 1924-25 over 50 per cent. of the total expenditure was devoted to direct programme expenditure.

Copyright

Mr. Reith said with regard to copyright that the B.B.C. had never admitted any legal obligation. They do not admit that broadcasting is a public performance, and therefore the question of infringement does not arise.

Realising, to some extent, a moral obligation, they have met copyright charges, so long as the demand was reasonable.

The B.B.C. feel that they should secure some measure of protection against exorbitant demands.

The foregoing main features of the B.B.C. memorandum closed the submission of evidence by the B.B.C.

The Wireless League

On December 4 evidence was tendered to the Committee by the Wireless League.

The League claimed to represent the "listeners" of this country. In answer to the Chairman, Sir

Arthur Stanley stated that their membership was, roughly, 86,000.

On taking over the organisation in July from the *Daily Express*, who founded the League, the membership was about 80,000. Not all the members had paid their 2s. subscription.

The Committee appeared a little surprised that the membership had increased so slightly, in view of the fact that they were to tender evidence on behalf of listeners.

Suggested Constitution

Sir A. Stanley then presented the memorandum of the Wireless League.

A sound constitution, in their opinion, would be a British Broadcasting Commission, *i.e.*, Government control through a central authority. The P.M.G. would be represented, but not in a position of control as at present.

The suggested constitution would be as follows:—

(*a*) A Chairman (unpaid).

(*b*) A Vice-Chairman (an M.P., to be Parliamentary Commissioner).

(*c*) A Chief Commissioner (Head Executive Officer, whole time, paid).

(*d*) Seven Commissioners (appointed after consultation with the various interests concerned) and representing—

1. The Post Office.
2. The Listener (two Commissioners).
3. The Radio Manufacturers.
4. Science.
5. Education.
6. The Arts.

The Government would, of course, consult the responsible organisation. For Education, the President of the Board of Education; for Manufacturers, the N.A.R.M.A.T.; for the listener, the Wireless League.

The Commission would combine the Post Office licence work with the provision of a broadcasting service. Licences to be issued as at present. Revenues, less cost of collection of licences, to be wholly devoted to the improvement of the service.

The assets and staff of the B.B.C. to be transferred to the Commission, the shareholders being paid out on a basis not exceeding par.

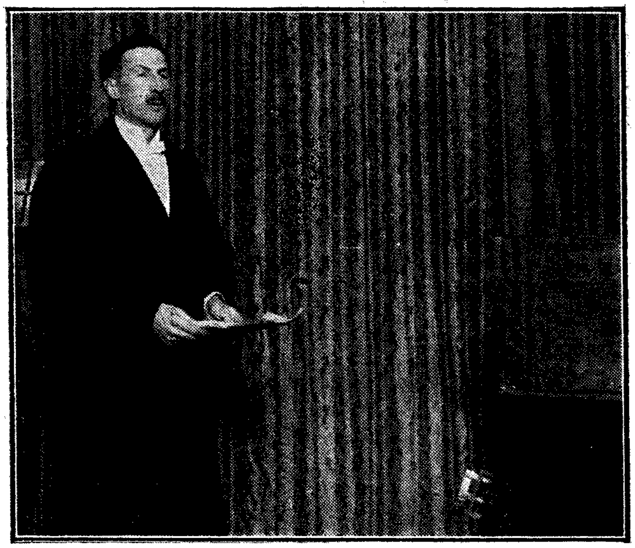
They made no reflection on the B.B.C.; in fact, they had nothing but praise for the pioneer work, and the standard of service hitherto maintained. In reply to a question, Sir A. Stanley said that had no change been suggested their members would have been quite satisfied with the present *régime*. He was opposed to a monopoly by a quasi-commercial concern, and thought that originally it was not realised what a vast monopoly the original concession was.

In reply to Mr. Ian McPherson, he agreed that the service should be a monopoly.

One Central Authority

The members agree that this is essential, and one strong body with sufficient funds to provide a good service was preferable to many with insufficient funds.

Many members wished for programmes of local interest from a local station. Educational subjects should be transmitted on a special wavelength. More news was required.



Right Hon. Lord Balfour of Burleigh recently broadcast from the London Station an appeal for the Princess Louise Kensington Hospital for children.

The Programmes

Programmes should be determined by a programme advisory committee representing the following:—

Education, the Press, Music, the Stage, Music Halls, Sport, Commerce and Industry, the Wireless League (for the listener).

This concluded Sir Arthur Stanley's memorandum.

Supplementary Evidence

Professor A. M. Low was then called. He stated that he was General Secretary and Technical Adviser of the Wireless League.

In his view the principal demands of the listener were for:—

(*a*) The best possible programmes.

(*b*) The widest choice of programme.

(*c*) A voice in association with fellow-listeners in deciding the type of programme.

(*d*) The licence revenue to be wholly devoted to the service.

(*e*) Punishment of persons who interfere with reception, either carelessly or wilfully, by means of oscillating receiving sets or other electrical disturbances.

Oscillation

Many members are of the opinion that powers should be obtained to punish offenders for oscillating and causing interference.

Other electrical disturbances had been mentioned, trams, etc., and the Post Office stations. These should also be dealt with, since any trouble was invariably caused by apparatus badly designed or improperly used. This concluded Professor Low's evidence.

Professor Low was followed by Mr. D. S. Richards, Chairman of the Ilford branch of the Wireless League and of the Home Counties Area Committee.

Mr. Richards principally concurred with Professor A. M. Low's statements.

He thought that the Ministry of Agriculture encroached upon the programme's time with too much uninteresting matter. This might lead to similar action by other Departments.

After some further questions by members of the Committee, the meeting was adjourned till December 17.

Wireless News in Brief.

B.B.C. Forthcoming Items. The following are some selections from the forthcoming B.B.C. programmes :—

December 20.—Cardiff : Symphony Concert—solo pianoforte, Leff Pouishnoff.

December 21.—London : London Chamber Orchestra, conducted by Anthony Bernard.

Glasgow : The Pianoforte Sonatas of Beethoven.

December 23. — Newcastle : 5NO's Birthday. London : Sir Harry Lauder.

December 24.—Manchester : A Christmas Pantomime.

December 25.—London : Bow Bells.

December 26. Christmas Gather-round with John Henry.

* * *

Daventry's Aerial. The recent collapse of the 600-ft. T-type cage aerial of the Daventry station caused much concern. After considerable trouble a temporary aerial was erected from the top of one of the 500-ft. masts to the roof of the transmitting building. Later, this arrangement was improved upon by slinging a wire between the top of one mast and a point half-way up the other. Shortly afterwards the wire was raised to the top of the second mast.

* * *

Geneva Conference. We understand that, in addition to the two conferences which have already been held at Geneva to decide the allocation of frequencies for the European broadcasting stations, another meeting is to take place shortly. It will be remembered that at the second conference it was decided that since it had been found undesirable to allot the same frequency to two stations, the best plan would be to reduce the number of stations and provide those remaining with more power, as a solution to the mutual interference problem. It is now understood, however, that no alterations will be made before the coming meeting takes place.

Entirely new plans will be discussed, which it is understood will involve up to a point the retention of the old grouping, reliance being placed upon the distance separating stations of closely related frequencies to prevent mutual jamming.

* * *

Wireless Operators on Strike. The recent strike of marine wireless operators, which involved several hundred men, and which had not been settled at the time of going to press, was brought about by a proposal to reduce their wages by 22s. 6d. a month. The operators who refused to sign on at the new rates are members of the Association of Wireless Cable Telegraphists, and they regarded the movement to reduce their pay as a sequel to the surrender of the National Sailors' and Firemen's Union this year to a proposal to cancel the £1 advance conceded by shipowners in 1924.

* * *

Morse Interference. There appears to have been a recrudescence of jamming by Morse on the broadcast frequencies within the last few weeks. We are informed that among recent offenders are Newhaven, Dieppe, Madrid (EGC) (jamming Daventry), Ushant, Boulogne, and a French steamer working on three different frequencies in the Channel.

* * *

Broadcasting in Germany. A new high - power broadcasting station is being erected at Frankfurt, and will probably commence operations in February of next year. This station will employ the same power as Konigswusterhausen and Munich, viz., 10 kilowatts, and will represent a considerable improvement on the present station, which is situated in the Post Office buildings.

* * *

The removal of restrictions on wireless receivers in occupied territory will give a new impulse to the wireless industry in that district. An official statement in regard to the release has not yet been issued by the Post Office, and it appears that there is some doubt as to the interpretation of the exemption. It is certain, however, that listeners will have to notify the police, who will in turn supply a list of names of the listeners to the military authorities. Broadcasting stations within the occupied zones will continue to be prohibited.

* * *

Wireless Control of Aeroplanes. We hear that official trials in this country of aeroplanes controlled from a distance by wireless have been successfully carried out. So far the tests have been confined to small areas, the aeroplane never travelling far enough to be outside the ground operator's range of vision.

A further development of this method of control will be to devise some method of keeping an aeroplane to the correct course over long-distance flights.

* * *

International Radio Conference. Representatives of no fewer than sixty countries have accepted the invitation of the State Department at Washington to take part in the great International Radio Conference which is to be held in Washington next spring.

THE ISOFARAD RECEIVER

By B. B. MINNIUM.

In the receiver described here, which is of American design, a capacity balancing arrangement is used to stabilise the high-frequency valves. Since the operation of this circuit as detailed by Mr. Minnium would seem to require further explanation, we append to the article a discussion of its principal features by the Staff of the Radio Press Laboratories.

THE receiver described below is based upon the Isofarad circuit, an all-capacity bridge circuit, in which an increasing interest is being shown. This circuit effectively balances out the grid-to-plate capacity inherent in valve receivers, and thus eliminates at its source the chief obstacle to efficient high-frequency amplification. The practical result of this is to allow the use of the lowest obtainable value of resistance in the tuned circuits and the proper design of the H.F. transformers for maximum signal strength. Furthermore, it is unnecessary to rely upon the rather uncertain aid of reaction, involving, as it does, instability and howling and the use of an additional control in the operation of the receiver.

Other Stabilising Methods

This is, of course, contrary to the usual custom of preventing self-oscillation by the addition of resistance in the secondary circuits, the use of very few primary turns in the H.F. transformers, or, what is in effect the same, the use of a somewhat greater number of primary turns and a corresponding reduction in coupling between primary and secondary. Such schemes are definitely limited to an approximate approach to the point of oscillation and make very little use of pure repeater action in amplification.

The Circuit

Fig. 2 shows the fundamental circuit of the high-frequency stages, in which C1 and C2 are mounted on the same shaft. They have capacities of about 250 and 500 $\mu\mu$F respectively. CB and CR are small variable condensers with micrometer adjustment, the former being used to balance the circuit against oscillation, and the latter to regulate automatically the amount of progressive "unbalance" introduced into the circuit, as the receiver is tuned very little to the higher frequencies. L1 L2 is a completely shielded H.F. transformer having low resistance at high frequencies. Its over-all dimensions, including shield, are 5 in. in diameter and 6 in. high, but since other parts, such as the tuning condensers and L.F. transformers, may be mounted directly against the coil shield, it is obvious that the amount of space occupied in the receiver is actually less than is the case with ordinary unshielded coils, if efficiency is given any consideration.

Transformer Shields

The efficiency of the coils has in no way been impaired by the use of shields, since this feature has been so worked out that shielding reduces the effective inductance, resistance, and distributed capacity of the coil in about the same ratio. Since selectivity is directly dependent upon resistance, the importance of reducing the tuned circuit resistance to the lowest possible value is at once apparent. In addition, the usual magnetic interaction between stages, variable with frequency, is avoided.

Filament Control

The two L.F. valves are provided with a fixed filament resistance. This arrangement of filament control has been found to preserve quality of reception and to reduce the drain on the H.T. battery, as compared with the use of fixed resistances for all valves. The

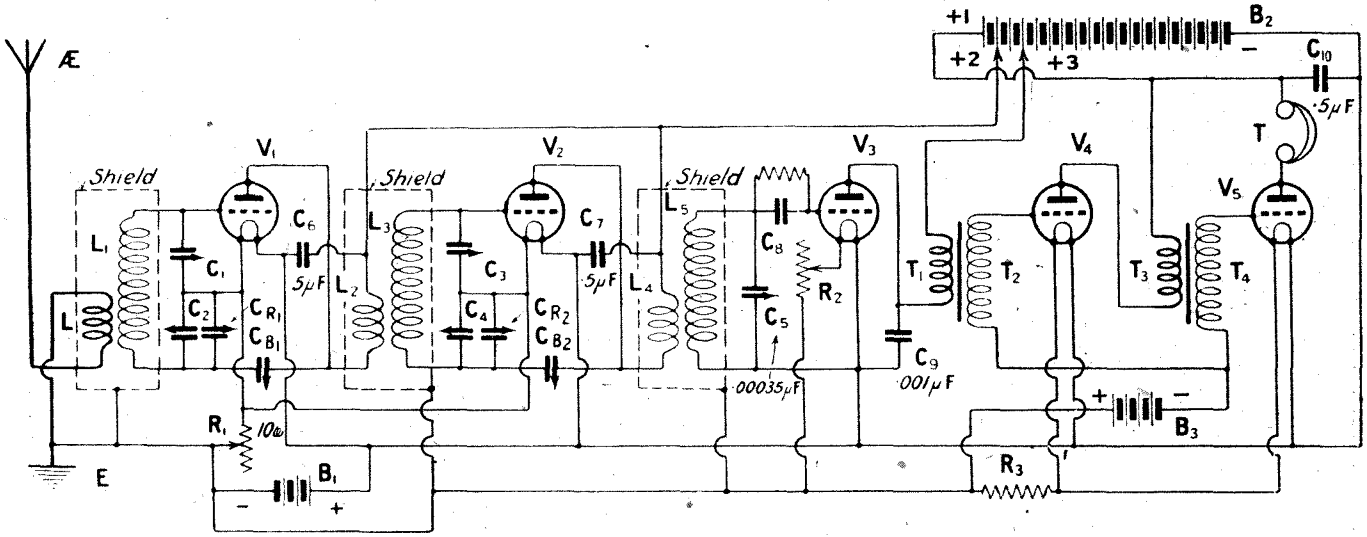


Fig. 1.—The circuit diagram of the Isofarad Receiver. Two neutralised H.F. stages precede the detector valve, the transformer shields being indicated by the dotted lines.

adjustment of filament temperature on the L.F. valves is not at all critical, and for this purpose fixed resistances are admirably suited. It will be found, however, that the adjustment of detector filament

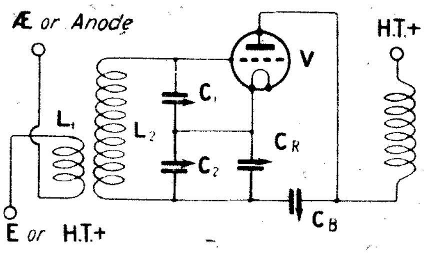


Fig. 2.—The circuit of one of the H.F. stages, CR and CB being the stabilising condensers.

temperature is rather critical. In addition to giving better reception, this scheme reduces the H.T. battery drain. H.T. batteries will be found to last about twice as long as when all filaments have fixed resistances. The total H.T. battery load of this set is from 7 to 10 milliamperes, depending upon the setting of the valve rheostats.

Special Features

The detector valve is held in an anti-vibrating socket, in order to prevent low-frequency feed-back to it from the loud-speaker through the medium of sound impulses.

The complete wiring diagram is shown in Fig. 1. Note that each of the H.F. stages has its plate supply by-passed to its filament through a $0.5\ \mu F$ condenser.

Adjusting the Set

The initial adjustment of the set is as follows: Set condensers CR_1 and CR_2 approximately together at any arbitrary point. Tune in the highest frequency (lowest wavelength) station of moderate volume that can be found. Remove the first H.F. valve and cover one of its filament prongs with a piece of paper. Insert the valve in its socket, and, with this valve in place but its filament cold, adjust the first balancing condenser CB_1 until the signal disappears. Remove the paper from the prong of valve V_1, put it back in its socket, and repeat this procedure with the second valve.

Final Balancing

When both stages are balanced, tune the set to the lowest frequency (highest wavelength) to which it will tune, and if it does not oscillate the adjustment may be considered satisfactory. If, however, oscillations occur, as indicated by squealing or steady ticking in the loud-speaker, the capacity of condensers CR_1 and CR_2 should be increased slightly and the balancing process repeated on a high-frequency (low-wave) station. In general, the lower the value of CR_1 and CR_2 the greater will be the tendency to oscillation at low frequencies (high wavelengths) after the set has been balanced at a high-frequency (low wavelength) adjustment.

Aerial Recommended

The complete set will be found to have remarkably fine tone quality with exceptional range and selectivity. It should be operated on an aerial from 50 to 100 feet long, including lead-in, depending upon the amount of interference from nearby stations.

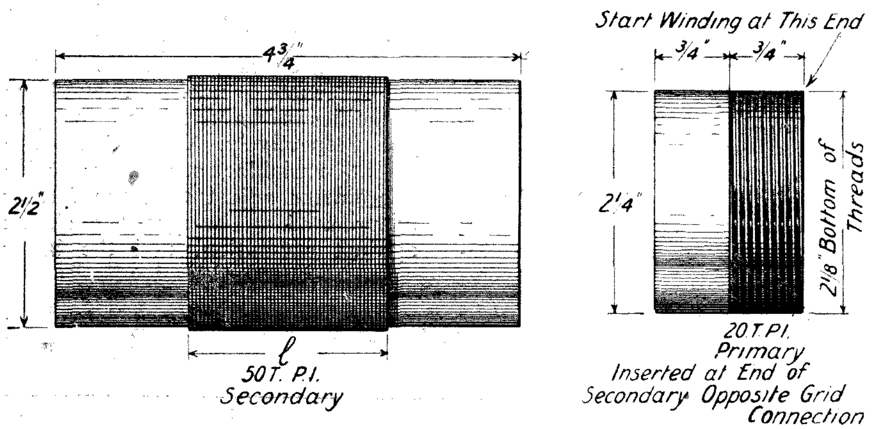


***Fig. 3.**—Dimensions and details of the H.F. transformer windings may be gathered from this sketch.*

Criticism of the Isofarad Receiver

By the Staff of the Radio Press Laboratories

The Isofarad receiver described in the above article has several interesting features which are different from those found in a British designed instrument of a similar type. It is essentially a neutrodyne circuit consisting of two balanced or neutrodyned high - frequency valves, a detector, and two note amplifiers. The advantages of a neutrodyne circuit for balancing out the effect of the self-capacity between the grid and plate of a valve are so well known that they need not be discussed here.

Principle of Neutralising Method

The principle of the method for neutralising the effect of the valve capacity in the Isofarad receiver is perhaps best explained by redrawing one of the high-frequency valve circuits and representing it in the form of a "bridge" as shown in Fig. 5. The bridge is balanced by adjusting the condenser CB, so that the ratio of the anode-grid capacity CV to CB is equal to the ratio of C_1 to (C_2+CR). Under these conditions there will be no transfer of oscillations from the tuned grid circuit to the anode coil and vice versa due to the self-capacity of the valve.

Effect of Frequency Changes

If the circuit is balanced for the minimum values of C_1 and C_2 it is clear that, with any additional fixed capacity CR across C_2, the bridge becomes unbalanced as soon as the frequency of the circuit is decreased by increasing C_1 and C_2 to the same relative extent. It is assumed that the condensers C_1 and C_2 are mounted on the same shaft with a view to obtaining a constant ratio of capacity between them. It is stated in the article that "in general, the lower the value of CR_1 and CR_2, the greater will be the tendency to oscillation at low frequencies (high wavelengths) after the set has been balanced at a high-frequency (low wavelength) adjustment."

A Suggested Explanation

This point is not easily explained, as it would appear from the "bridge" circuit of Fig. 5 that the greater the value of CR the more unbalanced would the bridge become on tuning in to the low frequency (long wavelength), and consequently there would be a greater tendency to oscillate. If, however, the grid filament capacity is considered, and is represented by a fixed condenser Cf across C_1, then if CR is about twice the value of Cf, the bridge can be balanced for both the high and the low frequencies. For lower values of CR the bridge will tend to become unbalanced as the frequency is decreased. Therefore up to a point an increase in the value of CR will tend to make the set more stable over the whole range of frequencies.

The High-Frequency Transformers

The screening of the high-frequency transformers is probably quite a feature of the receiver, as it prevents stray magnetic coupling between the valve circuits, assuming, of course, that the self-capacity between the actual wires of the circuit has been reduced to a minimum. Stray magnetic coupling between the valve circuits is

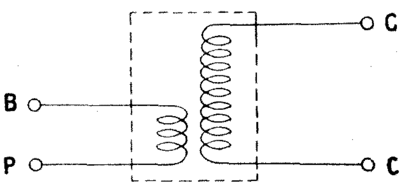


Fig. 4.—Showing the correct method of connection for the ends of the H.F. transformer windings.

particularly objectionable, as it is a variable quantity depending on the frequency, and any method of overcoming this leads to considerable improvement.

Screens

The screens for the high-frequency transformers must, of course, be made of copper so as to avoid any serious loss, and they should be carefully earthed. It should be noted that the screens are made considerably larger than the transformers themselves. The outside dimensions of the screening cases are given as 5 in. in diameter by 6 in. long, whereas the windings of the transformers are $2\frac{1}{2}$ in. diameter by about 2 in. in length. It is important that the windings do not come too near the metal shields, as otherwise there may be serious losses.

Doubtful Claims

In the description of the set there is a statement that the use of shields in no way impairs the efficiency of the coils, since the unit has been so designed that the shielding reduces the effective inductance, resistance, and distributed capacity of the coil in about the same ratio. The inductance of a coil is certainly reduced by enclosing it in a copper shield, but a reduced high-frequency resistance and self-capacity would seem a little doubtful. Some definite figures on this question would be interesting.

By-pass Condensers

The provision of high-frequency by-pass condensers, between the anode ends of the anode coil and the filament of the associated valve, is a good feature, as it eliminates the possibility of stray coupling between the circuits due to a common H.T. battery condenser, and possibly to long leads which are common to the high-frequency circuits.

Construction of Receiver

In constructing a receiver of this type from British-made components there would be several points that would require consideration. With regard to the condensers C_1 and C_2, which are mounted on the same shaft, it is doubtful whether there is a suitable unit made in this country. Such twin condensers are usually made of equal capacity. This, however, should not present a serious difficulty.

Isolated Grids

It will be noticed from the diagram of connections that the grids of the two high-frequency valves are completely isolated from the filament. This would probably give trouble with the British-made high vacuum type of valve, owing to the grids becoming charged to an excessive negative value. It would be necessary to connect a high-

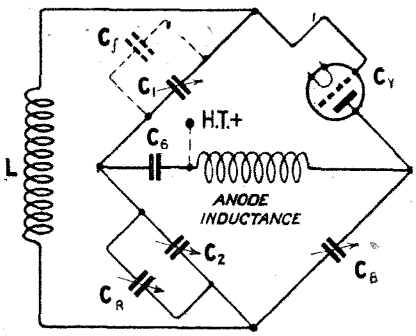
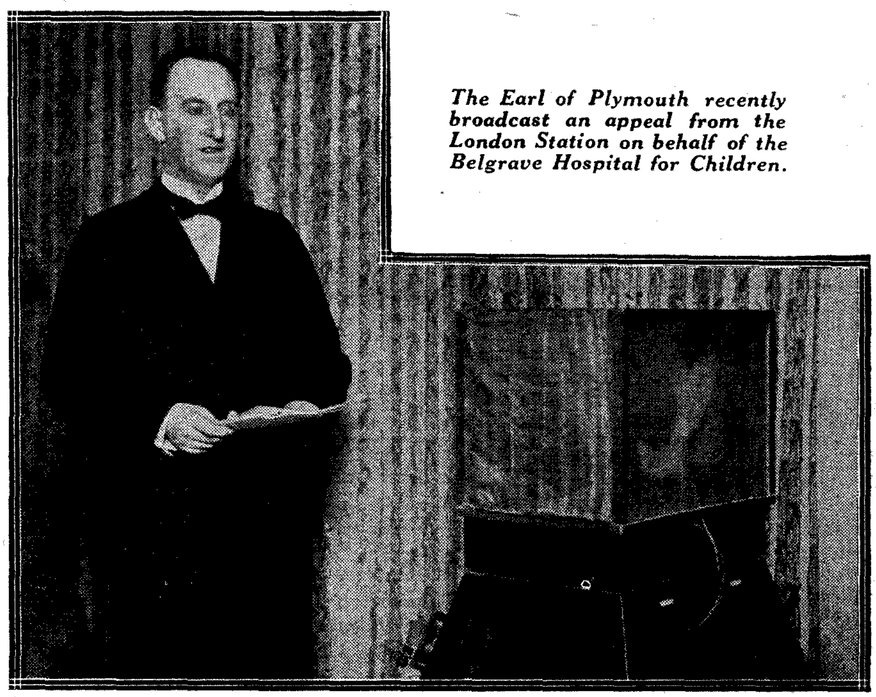


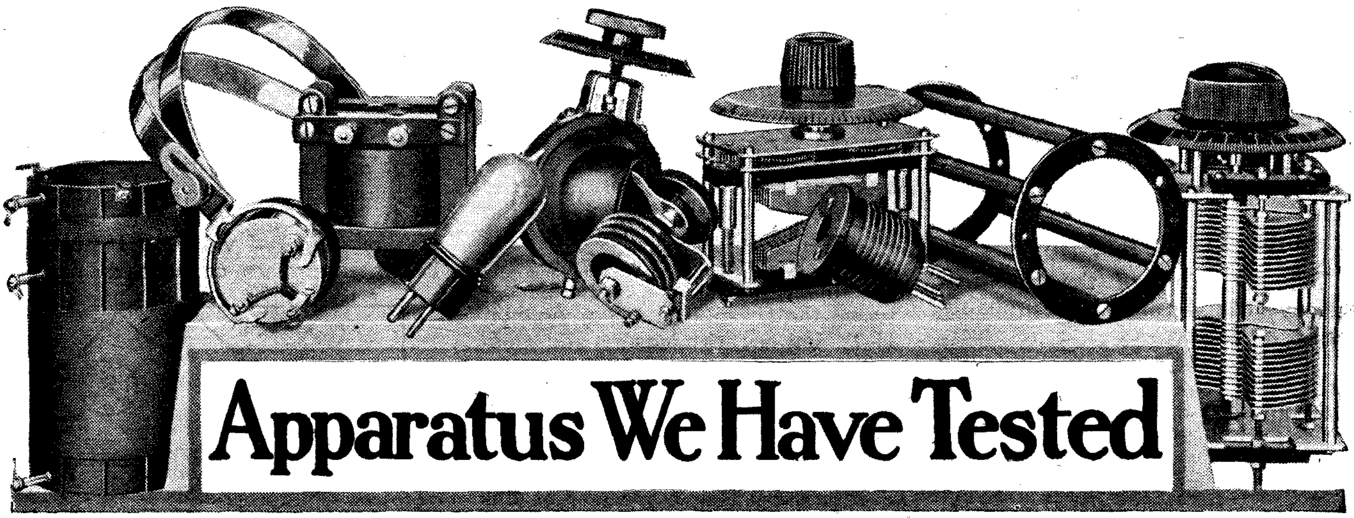
Fig. 5.—The circuit of Fig. 2 re-drawn in "bridge" form, to indicate the action of the method adopted for stabilisation.

resistance leak of about 5 megohms between the grids and the filaments of these two valves.



The Earl of Plymouth recently broadcast an appeal from the London Station on behalf of the Belgrave Hospital for Children.

Another point worthy of note is that the method of adjustment as described is hardly applicable to the 4-pin type of valves, as it would be difficult to isolate one of the filament pins by a piece of paper. Another method of disconnecting the filament would have to be devised.



Apparatus We Have Tested

Conducted by Radio Press Laboratories, Elstree.

Fixed Condenser

Messrs. The British Sangamo Co., Ltd., have submitted to us for test a sample of their Sangamo mica condenser. It is claimed that this condenser is moulded throughout in bakelite, and its capacity is guaranteed under varying conditions of temperature, moisture, and pressure.

Description of Component.

This condenser is made of brown insulating material, and is rectangular in shape, except for its ends, which are rounded off. Its over-all length is $1\frac{7}{8}$ in., and its width $1\frac{3}{8}$ in. At each end of the condenser a screwed metal bush passes right through it, and evidently makes contact with the appropriate set of plates inside. A round-headed screw is used at each end of the bushes, making four screws in all. These serve as terminals, the wires being secured between the protruding ends of the bushes and the screw heads. No soldering tags are provided, but both the maker's name and the rated capacity are marked on the case. The condenser is hermetically sealed.

Laboratory Tests.

The condenser was found to be of the rated capacity within a sufficient degree of accuracy, and its insulation resistance was infinite. Both these qualities were found to be unaffected by exposure, the condenser having been left for a night in the open under particularly adverse atmospheric conditions. This condenser has a particularly pleasing appearance, and from the purely electrical standpoint can be recommended. It is unfortunate, however, that no adequate provision is made for soldering, and panel or baseboard mounting. Two of the terminals could, however, be utilised for fixing to a thin bracket or even to a panel 3-16 in. thick or less.

Jack

Messrs. Harmo Products have submitted a "Crawford" Jack for test in our Elstree Laboratories.

Construction of Component.

The plug is made from an ebonite cylinder nearly $\frac{3}{4}$ in. in diameter and $\frac{1}{2}$ in. high. Two pins are fixed in this plug to register with the holes in the socket. Small terminal heads screw on to the tops of these brass pins, and slots are cut in the ebonite for the insertion of telephone tags, while spade terminals are readily fixed under the terminals.

The jack consists of an ebonite cylinder $1\frac{1}{2}$ in. diameter and $\frac{5}{8}$ in. long. Two holes are provided for the purpose of securing the jack to a baseboard by means of countersunk screws, while in the centre of the jack is a hole for observing the contacts. Two terminals fix into the sides of the jack so that normally they are short-circuited, the ends of the terminals making good electrical contact with each other. They are provided with $\frac{1}{8}$-in. holes to accommodate the jack pins. One of these terminals has an axial movement of about $\frac{1}{8}$ in., being held tight against the other terminal through the agency of a strong spring. This movable terminal, which is lengthened about $\frac{1}{8}$ in. to allow for wear, can also rotate, so that it is necessary to see that the hole in the ebonite registers with the hole in the terminal before inserting the plug.

General Remarks.

This component is very useful where telephones or loud-speakers are wired in series, the withdrawal of the plug merely shorting that portion of the circuit. In the sample submitted the terminal heads were very eccentric, but the component has a reasonable insulation resistance and the finish is of fairly satisfactory order. It would be advantageous if the movable terminal was modified to prevent the rotary movement previously mentioned.

Crystal Set

Messrs. Ward & Goldstone have submitted a new model Goltone super-crystal set for test.

Description of Set.

It consists of a single layer solenoid inductance wound with enamelled wire and mounted between a circular moulded base and a circular moulded disc. The crystal has the usual cat-whisker with universal bearing and friction tight adjustment, and is enclosed in a glass tube which is held in position on the top of the disc by two upright pillars and nuts. Four terminals are fixed to the base for connection to aerial, earth and telephones. Tuning is effected by turning a milled knob which rotates a quick thread spiral screwed pillar carrying the movable contact bearing on the outside of the solenoidal inductance. Thus on five-and-a-half turns of the milled knob the movable contact travels the length of the tuning inductance—about $3\frac{1}{2}$ in. A certain amount of end-play is present between contact and pillar, and this should be remedied. In order to tune in Daventry a plug is provided for insertion into a socket common with the earth terminal, and this inserts a loading coil accommodated inside the solenoid inductance.

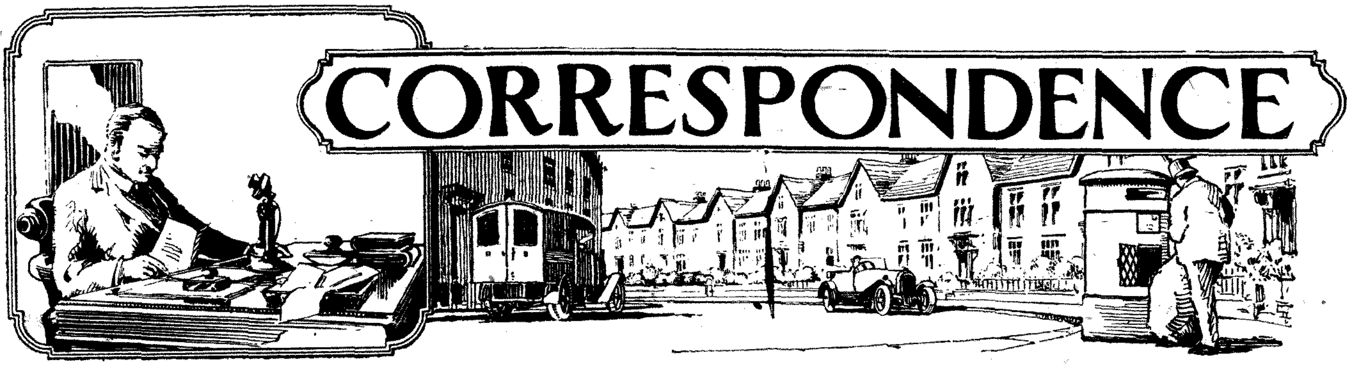
Laboratory Tests.

On test it was found that the crystal had a large percentage of sensitive spots, and London was received quite clearly at the Elstree Laboratories. A deflection of 40 micro-amperes was measured on receiving London.

On inserting the plug and testing for Daventry signals were very faint, and difficulty was experienced in tuning this station.

Fixed Condenser and Seven-way Leads

As a result of the alterations recommended by Radio Press Laboratories in the report on Messrs. Ward & Goldstone's FIXED CONDENSER and SEVEN-WAY LEADS (*Wireless Weekly, Vol. 7*, No. 10), we are informed by this firm that they are providing soldering tags for their fixed condensers and heavier spade terminals for the accumulator leads.



CORRESPONDENCE

IRISH AMATEUR TRANSMISSION

SIR,—Referring to the paragraph headed "Ireland" in "Short-Wave Notes and News" in the December 2 issue of *Wireless Weekly*, my station has now received a permit for the use of the following wavelengths and bands: 23, 45 and 90 metres (13,044, 6,667 and 3,333 kc.) and 115-130 metres (2,609-2,308 kc.) and 150-200 metres (2,000-1,500 kc.). The index letters GW have been allotted, and I understand that these are in future to be the official ones for the Irish Free State, instead of IR, which have been used. This may be of interest. This station will work mainly on 45 metres (6,667 kc.) by day and on 90 or 115 metres (3,333 or 2,609 kc.) after dark, the latter wavelength being more free from jamming than the 90-metre wavelength.

I only commenced on 45 metres within the last few days, and using only 4 watts input, signals are reported *by daylight* R 6-7 in various parts of England. After dark, however, they seem to "skip" England altogether, but are reported in France R 6-8 after dark with the same input (4 watts). This "skipping" effect is being investigated.—Yours faithfully,

MEADE J. DENNIS (Col.).
(Radio GW-11B.)

Baltinglass, Co. Wicklow.

THE "LOW-LOSS TUNER FOR SHORT WAVES"

SIR,—In these days of ultra-efficiency in short-wave apparatus it may be of interest to mention that Mr. Percy W. Harris' "Low-Loss Tuner for Short Waves" (*Wireless Weekly*, November 19, 1924) is still capable of good work. For example, on Saturday, November 28, for two hours commencing at 11.30 p.m., I listened to KDKA on the first valve alone. Reception throughout was comparable both in clarity and in volume with that of the best Spanish stations. Strangely enough, the night was cold and clear, with bright moonlight.

With regard to CW, using detector only, I have received British, French, Belgian, German, Dutch, Danish, Norwegian, Italian and Spanish amateurs. Not the least numerous of these are the Frenchmen and Belgians of the "Journal des 8" and "Réseau Belge" varieties.

Also, of course, WIR, WQO and other U.S.A. Government stations come in powerfully on one valve, whilst both valves have brought in American amateurs strongly enough to be read with the 'phones on the lap.

Your correspondent, Mr. J. M. Drudge, inquires about the QRA of PCLL. This is the station of the Dutch State Telegraph Laboratory, Kazernestrasse 33, The Hague, Holland. I heard their CQ call last week, in which they asked for QSL's. They would probably appreciate one from Mr. Drudge.

With best wishes for the continued success of Radio Press publications.—Yours faithfully,

Swansea. C. M. DEVONALD.

SIR,—I have had such excellent results with the low-loss short-wave two-valve circuit fully described in *Wireless Weekly* for November 19, 1924, by Percy W. Harris, M.I.R.E., that I feel I must write and tell how pleased I am with it.

On the evening of November 28, at 11.20 p.m., I received KDKA on 63 metres (4,762 kc.) without the slightest trouble, loud and clear as crystal, and not a trace of atmospherics or morse. This, by the way, was on a beautiful moonlight night.

The programme which they gave came through splendidly and without distortion.

Mr. David Rennie, one of the Westinghouse officials, gave a talk on learning a trade, and following this was a talk by an Indian orator. It was now 12.28 a.m. The next item was the children's corner, and I switched off after a most interesting hour with KDKA.

I should like to say I have departed a little from your details regarding the coils, as you will observe from the photograph which I enclose.

By removing these and inserting Nos. 35, 50 and 75 I can get most of the B.B.C. stations and many Continental stations with the aid of a "B" wave-trap, as described in your Radio Press book, "Twelve Tested Wireless Sets" (by Percy W. Harris, M.I.R.E.). This helps to eliminate London to a great extent, especially when receiving the nearer stations. London comes in at loud-speaker strength.

By inserting Nos. 150, 200 and 250 coils I receive Daventry and Radio-Paris. You will therefore see that I can work on wavelengths from 40 up to 1,700 metres.

The valves I use are Cossor W.1 for the first valve and a Cosmos S.P. "red-spot" for the second. I should just like to add in closing that if any of your readers are interested in short-wave transmission, especially KDKA, I can thoroughly recommend this most efficient little wonder, which to me is *a priceless set*. Congratulations and good wishes.—Yours faithfully,

J. J. McCONOCHIE.

London, N.8.

[A photograph of Mr. McConochie's receiver will be found on page 423 in this issue.—ED.]

During the first simultaneous broadcast programme in Australia, Mr. J. R. Collins (centre), Secretary to the Treasury, broadcast an appeal from the special studio in Melbourne. With Mr. Collins are seen Mr. S. H. Witt (left), Research Engineer, and Mr. L. Fanning (right), Superintendent of Telephones.

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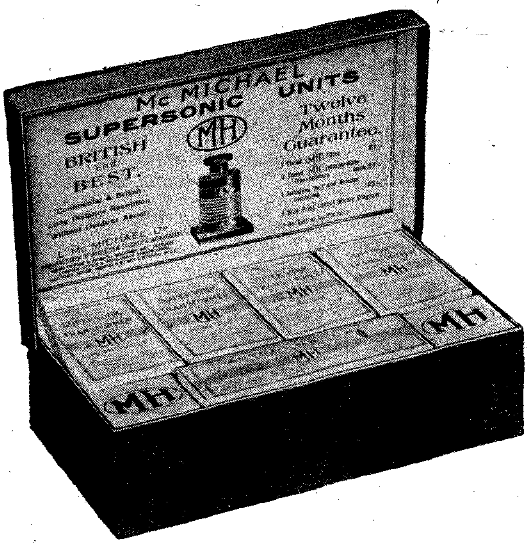

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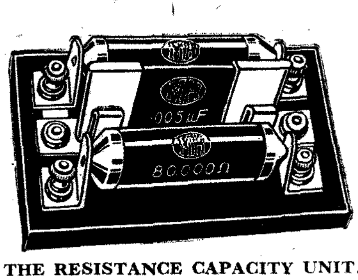

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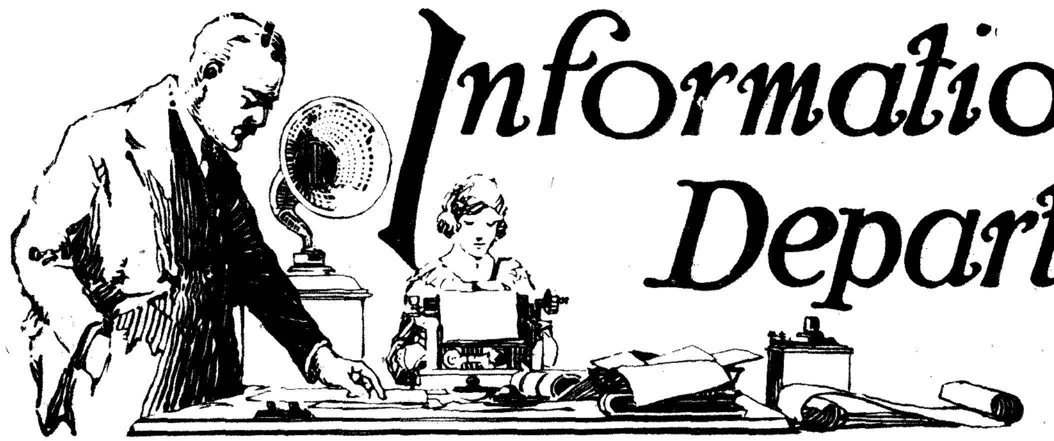


Information Department.

F. W. P. (E.C.2.) has constructed the receiver described by Mr. A. Johnson-Randall in the July, 1925, issue of "MODERN WIRELESS," under the title of "Full Volume with Three Valves," and constantly suffers from a howl or wail (like the tuning note, only mellower), which comes on faintly at first but gets louder and louder until it is unbearable.

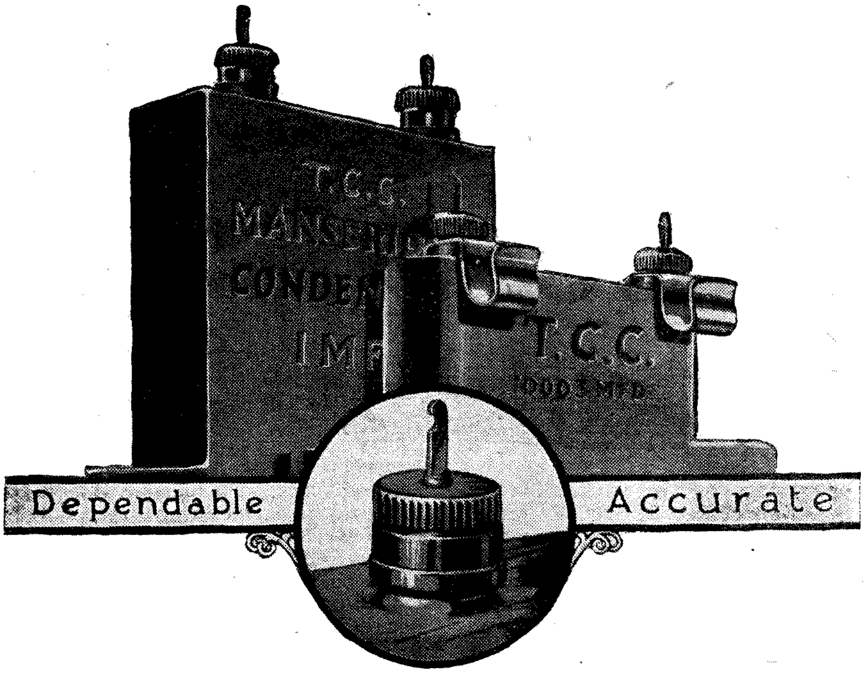
Our correspondent states that he is using two .06 ampere and one .12 ampere type dull emitter valves and has the loud-speaker and the set placed on a table close to the lead-in wire.

From these particulars it would seem likely that the trouble is due to microphonic effects, the electrodes of the valves being set into vibration at audible frequency by sound waves emitted from the loud-speaker, which would result in the set emitting a roar or howl. Our correspondent should try, therefore, the effect of removing the loud-speaker to some remote part of the room, when we think it is quite likely that the difficulty will be overcome.

S. G. (SOUTHPORT) asks us to give him a theoretical circuit and rough layout plans for a 2 valve high-frequency amplifier to add to his "Family 4-valve" receiver.

Although we can give a theoretical circuit of the type requested by our correspondent, it is outside the scope of this department to give special layout plans, since before we could confidently do this it would be necessary for us to build and test the amplifier. It will be readily understood that this cannot be done in the case of an individual reader.

Further, we would strongly advise our correspondent to drop the project, since to build any two-valve high-frequency amplifier considerable experience in design is necessary before the instrument can be made to work successfully, and we feel certain that in practice the addition of two further high-frequency stages to the "Family Four-valve" receiver, which has one



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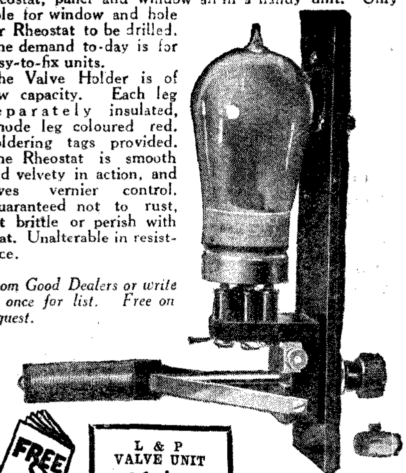

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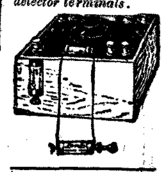

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stage incorporated in it already, would not be successful.

C. O. (HULL) has been using a crystal set with satisfactory results and has recently connected up a long length of twin flex in order to use high resistance telephones several rooms away from that in which the set is situated. Upon slightly retuning, he now finds that signal strength is considerably improved and asks us for an explanation.

The effect of increased signal strength noted by our correspondent is by no means unusual, and is due to the fact that the long telephone extension leads are acting as a counterpoise, which would appear to be considerably more efficient than the normal earth connection used alone. It is quite probable that by dispensing with the ordinary earth connection altogether results will be still further improved.

W. F. (CARDIFF) employs a single-valve detector type of receiver on board ship, but experiences considerable difficulty in getting high-tension batteries when abroad, and if these are obtainable they are usually old and costly. He asks us whether he can employ the ship's direct current supply of 100 volts for high-tension.

Little difficulty should be experienced in obtaining an excellent high-tension supply from the ship's direct current mains, and we give below in Fig. 1 the type of circuit which should be used. Two lamps of equal wattage and of the voltage employed on the ship's lighting system should be connected in series across the mains as shown. The negative terminal of the mains should be joined directly to the H.T. negative

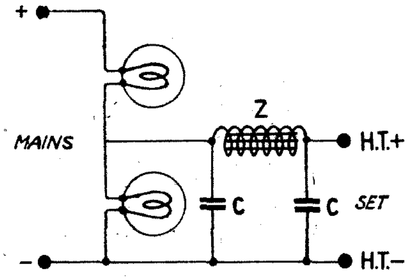


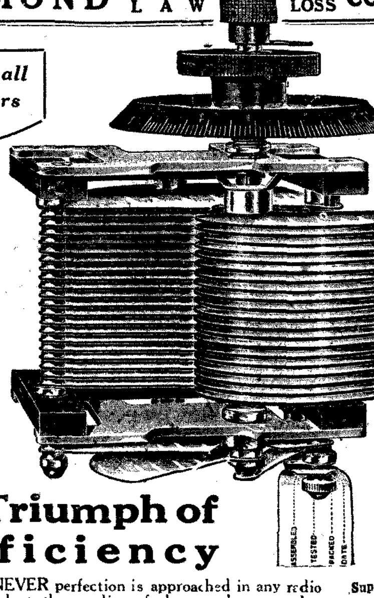
Fig. 1.—Showing the method recommended for obtaining high-tension supply from the D.C. mains on board ship. (*W. F.—Cardiff.*)

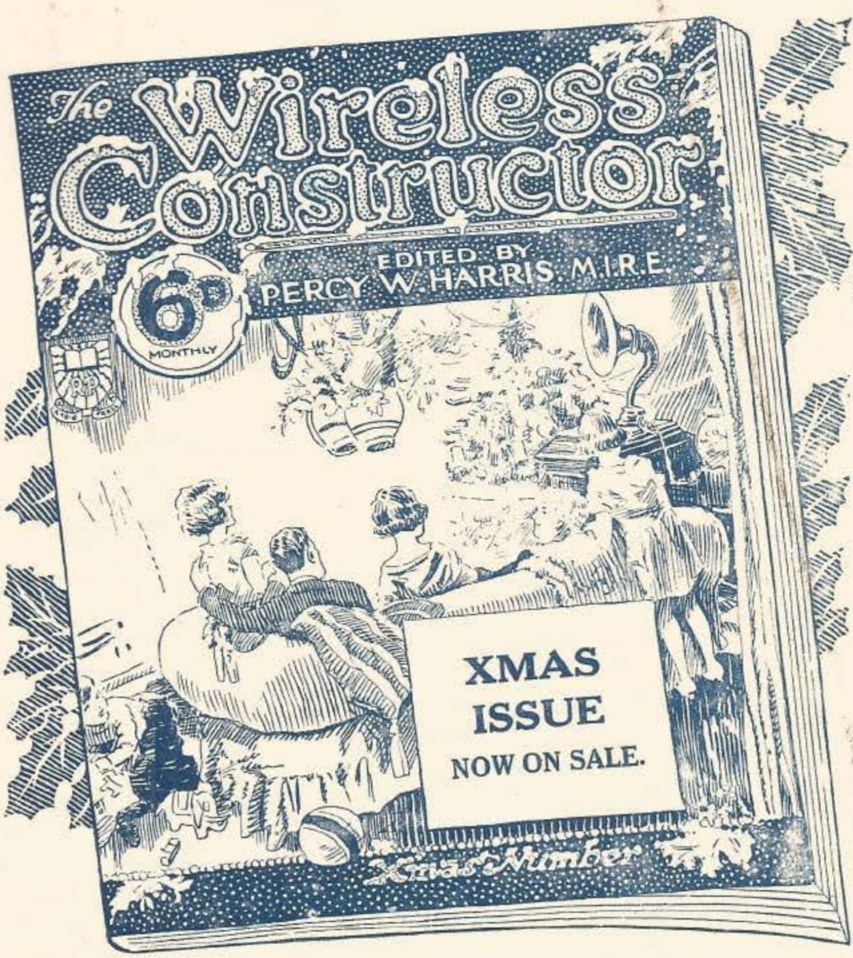
terminal of the receiver, and the H.T. positive terminal of the latter should be connected through a choke coil to the mid-point between the two lamps, two large condensers, shown as C, being connected across either side of the choke and H.T. negative. The choke should be of fairly high inductance, values of 60 to 100 henries being suitable, whilst the condensers C should be of 2 μF each, or greater capacity.

For safety a large condenser should be placed between the earth terminal of the receiver and the actual earth connection, which in this case is to the hull of the ship. A suitable value for this condenser would be of .01 μF. With the arrangement outlined, approximately 50 volts is obtained for the H.T. supply to the set.

S. D. (BASINGSTOKE) has constructed the "Special Five" receiver described by Mr. Percy W. Harris, M.I.R.E., in the November, 1925, issue of "MODERN WIRELESS," but cannot successfully neutrodyne the set. One setting of the neutrodyne condenser will not hold for the whole of the frequency range covered by the two low-loss H.F. transformers, and adjustment of the first neutrodyne condenser seems to make scarcely any difference.

It would appear likely from the particulars given by our correspondent that something is radically wrong with the wiring in the first neutralising circuit. Trouble of this kind is often traced to a broken joint, or to the two leads to the neutrodyne condenser not making actual contact with the plates. Test, therefore, for continuity, with telephones and a dry cell, between the actual plates of the neutrodyne condensers and the leads which should be connected to them.





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Edited by ***Percy W. Harris, M.I.R.E.***

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Wireless Weekly

Vol. 7. No. 14.

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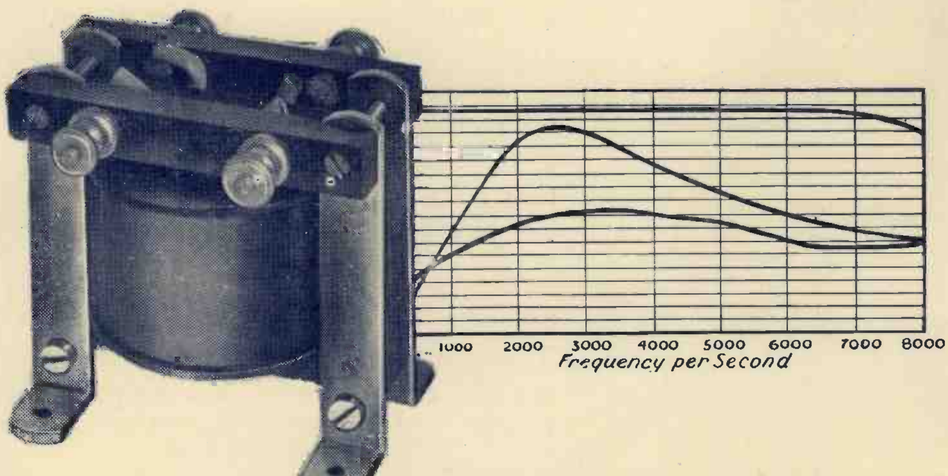
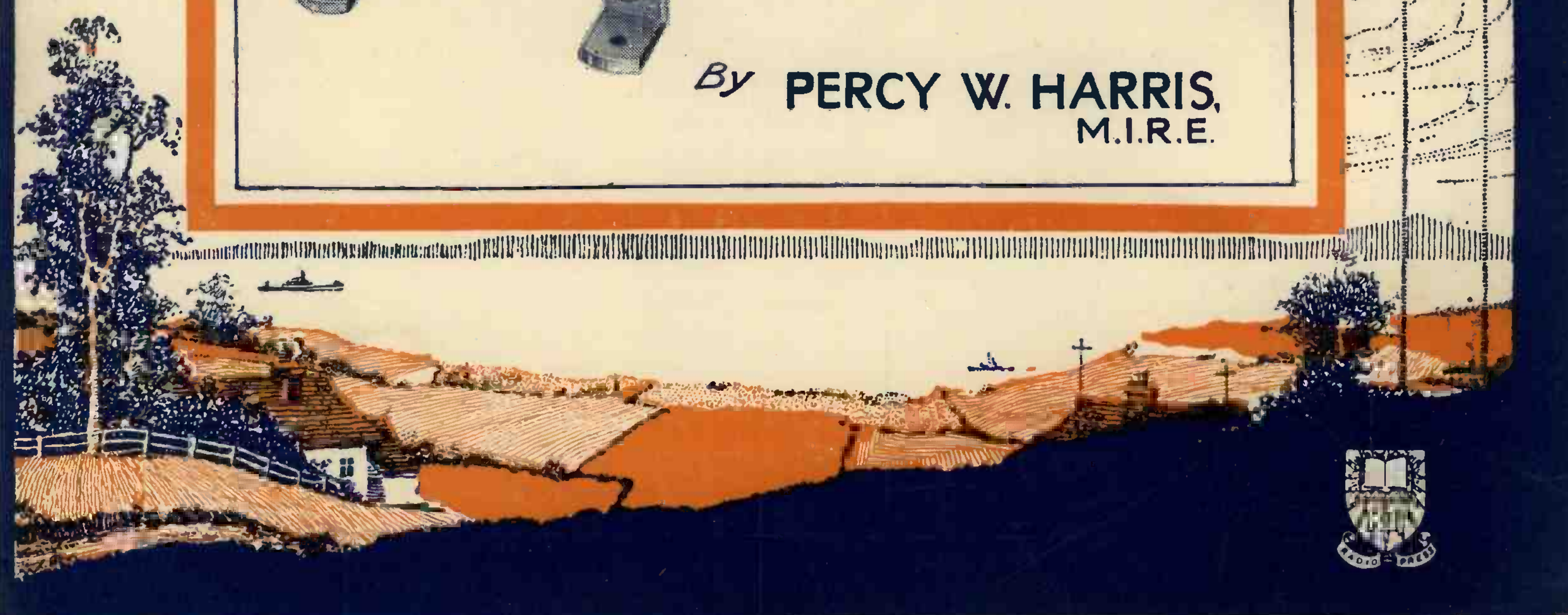


By PERCY W. HARRIS, M.I.R.E.



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Alternative Programmes

THE insistent demand of the public that the Daventry station shall do more than relay London programmes during the greater part of the week, thus giving the listeners within range of the London station some adequate reason for tuning to the lower frequency, has at last compelled the British Broadcasting Company to reconsider the whole question of alternative programmes, and the methods by which they can be provided. So far as 5XX is concerned, the Company's stated reason why the London programme is relayed almost every night is that the London programmes are the best of all those provided. While on the whole this may be true, the explanation assumes that Daventry is bound to utilise one of the programmes designed for the main stations There is, of course, no technical reason why the Daventry station should not give its own programme, i.e., one entirely different from that sent out from all of the other stations, thus giving an alternative programme to London listeners, as well as to those who are within range of the provincial stations. Probably the British Broadcasting Company object to this scheme on the grounds of expense.

Recently, we understand, experiments have been carried out with a view to seeing whether the main stations, or at least some of them, can send out two programmes at different frequencies. If the British Broadcasting Company have any intention of proceeding with this scheme, it is essential that adequate notice be given to the trade, for such a scheme would be bound to have an immense and immediate effect upon the design of apparatus. Let us assume for the moment that the present installation at Oxford Street retains its present frequency, and another station in the London area simultaneously transmits a programme at, say, 682 kilocycles (440 metres). Several million crystal users would immediately find their present apparatus useless, as both programmes would be received simultaneously. So far as valve users are concerned, a very large proportion would have either to scrap or to rebuild their sets, and, in fact, relatively few listeners would be able with existing apparatus to enjoy alternative programmes sent out in this fashion.

The selectivity of crystal receivers can, of course, be greatly improved, but up to the present, as the crystal set has been able to receive only one of the main stations, the need for such selectivity has not been apparent, and no attempt has been made by the trade to provide such sets. Selectivity in valve sets is steadily improving, although in this, so far as our commercial sets are concerned, we are still a long way behind America.

It will thus be seen that any scheme of sending out alternative programmes at two frequencies within the same area is one of immense importance to the trade, and one which should not be embarked upon without the fullest possible warning being given to all concerned. Furthermore, when such experiments are conducted, or planned, it is inadvisable that, as has happened during the last week, the first notification the trade receives should come from stray paragraphs in the newspapers indicating that such experiments are in progress.

CONTENTS.

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

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A Single-Control Regenerative Receiver

The controls on the front panel of the receiver consist of one tuning knob, and a jack by means of which the filaments are switched on when the telephone plug is inserted.

By SYLVAN HARRIS.

This article suggests a method of constructing a receiver which possesses the benefits provided by reaction and yet has only one main tuning control. Though the method adopted is perhaps open to criticism, it is not lacking in features of interest.

THE quest for an *absolute* single-control, non-radiating regenerative receiver has been going on for a long time, and a multitude of methods for controlling the tendency to oscillate have been proposed, but have not been found to be successful. It is true that self-oscillation in a regenerative detector can be prevented, but in all cases to date this has been accomplished at the cost of reducing the amplification. The phenomenon is familiar to the owners of all so-called " self-neutralised " radio-frequency amplifiers, which are built in so inefficient a manner that the regeneration never reaches the critical point. In these receivers the amplification is good at the higher frequencies, but falls off considerably at the lower.

Simplicity

The author of this article has been working for a long time on this problem, just like many others, and he is glad to present in this article a method that he believes is the most successful yet found. And, more than this, the very simplicity of the method will no doubt surprise the reader.

The Laws of Regeneration

To begin with, it is necessary to know the laws controlling regeneration in the valve circuit. There are two ways in which regeneration is accomplished, viz., by means of inductive feed-back (through a reaction coil) and by means of feed-back through the valve capacity. We will consider only the first of these two ways in which regeneration is accomplished, for it can be shown that the method of controlling regeneration explained here will apply only to the case of feed-back through a reaction coil. No solution has yet been obtained for the other case.

Reaction and Effective Resistance

It is well known that, due to the feed-back through the reaction coil, the effective resistance of the input (grid) circuit of the detector valve is reduced, and when the feed-back becomes sufficiently great the effect is the same as if the resistance of the input circuit had been removed. We shall not consider the theory of the matter in this article, for there are many diverse opinions on this subject. However, whatever the true explanation may be, the results are always the same, and it will be found that the *apparent* reduction of the grid resistance, as far as the signal current is concerned, is in accordance with the formula

$$\Delta R = \frac{\mu M}{r_p C}$$

in which ΔR is the *reduction* in the resistance, μ is the amplification constant of the valve, M is the mutual inductance existing between the reaction coil and the coil in the input circuit, r_p is the internal output resistance of the valve, and C is the capacity in the tuned circuit connected to the input of the valve.

Frequency and Resistance

Now if we consider that the setting of the reaction coil remains fixed; in other words, that we have a constant value of the mutual inductance between the reaction coil and the coil in the grid circuit, and that we have a certain value of inductance in the tuned circuit and a certain amplification factor in the valve, it can easily be shown that the reduction of the grid resistance is in accordance with the formula

$$\Delta R = k f^2,$$

where k is a constant. In other words, the apparent resistance of the valve input circuit is reduced in proportion to the *square* of the frequency.

Method Employed

Now if we can obtain some means of increasing the resistance of the circuit *at the same rate* as it is decreased by the feed-back, it is evident that the

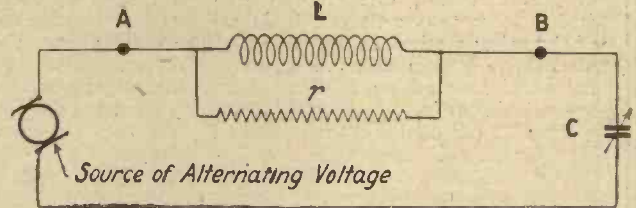


Fig. 1.—The effect of connecting a resistance r across the coil L may have the effect of either increasing or decreasing the apparent resistance between the points A and B, according to the value of r relative to L.

apparent resistance will remain constant and the amplification will be the same for all frequencies. This is what has been done in this method. A circuit arrangement has been chosen in which the apparent resistance of this circuit increases in proportion to the square of the frequency.

In other words, we have, on the one hand, the tendency of the tuned circuit to *decrease as the square of the frequency,* due to regeneration, and, on the other hand, the tendency of the special circuit to have its resistance *increase as the square of the frequency,* so that the net effect on the apparent resistance of the circuit is *nil.* Let us see how this is accomplished.

The Fundamental Circuit

The fundamental circuit arrangement is shown in Fig. 1. Here we have a source of alternating voltage, shown in Fig. 1 as an alternating current generator, but which may be replaced by a coupling coil placed in inductive relation with a (primary) coil in the aerial circuit. In series with this e.m.f. is a coil shunted by a resistance, and a tuning condenser.

Now, if the impedance of that part of the circuit between the points A and B be derived, it will be found that the apparent resistance between A and B and likewise the apparent inductance will be different from the true resistance and inductance of the coil. For the sake of simplicity let us consider the case of a coil, the resistance of which is small compared with its reactance, so that its own resistance may be neglected.

The apparent inductance between A and B is changed only a very slight amount, if the shunted resistance r is large, so that this effect will be neglected. Besides, the only effect of this change of inductance would be to change the tuning slightly.

Changes of Apparent Resistance

The apparent resistance between A and B (Fig. 1), on the other hand, changes considerably when r is connected across the coil, and it may either increase or decrease the apparent resistance, depending upon how large r is in comparison with the inductance L. The variation of the resistance is given by the formula

$$\Delta R = 0.0000395 \frac{f^2 L^2}{r}$$

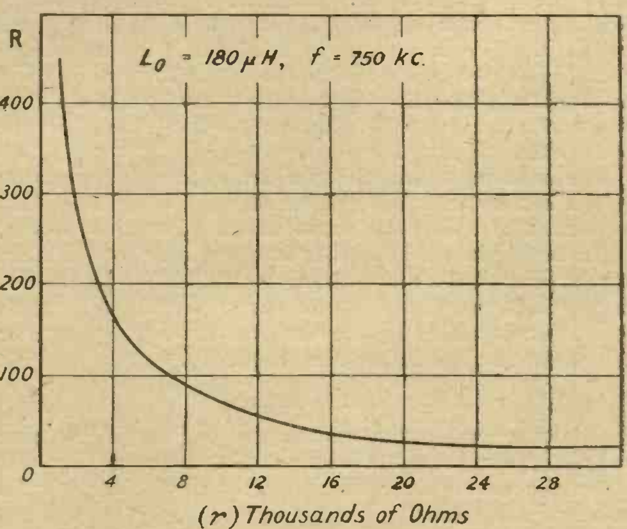


Fig. 2.—This curve shows the variation of apparent resistance of an inductance of 180 μH for different values of resistance shunted across it.

when r is very large. In this formula, f is the frequency in kilocycles per second, L is the inductance of the coil in microhenries, and r is the shunted resistance in ohms. The way in which the apparent resistance changes as the shunted resistance r is increased is very interesting. This is shown in Fig. 2, which has been calculated for an inductance of 180 microhenries and a frequency of 750 kilocycles per second.

The Critical Point

When the shunted resistance r is less than a certain amount, the apparent resistance increases very rapidly as r is increased. After this certain value has been

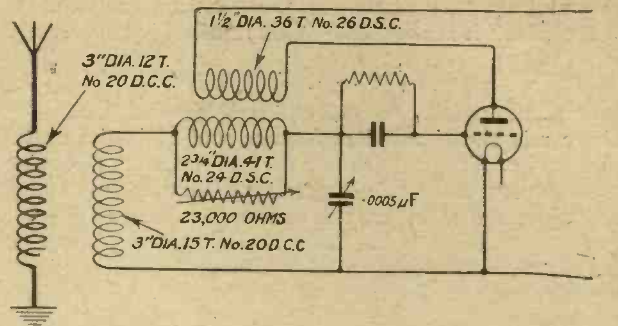


Fig. 3.—The actual dimensions and winding data of the coils used by the author.

exceeded, the apparent resistance decreases as r is increased. This seeming paradox of decreasing the resistance of a circuit by increasing the resistance of a part of it may trouble many of my readers, but it must not be forgotten that we have here a parallel arrangement of parts, viz., a resistance in parallel with an impedance.

A Balancing Effect

However, it will be noted that this applies only for a constant frequency. We are more interested in how the apparent resistance will vary with the frequency, for it is due to the increase of frequency on the shorter wavelengths that the circuits oscillate more easily on these wavelengths. The formula given immediately above shows that, for given values of inductance and shunted, resistance, the apparent resistance *increases* in proportion to the *square of the frequency.* This is the same rate at which the resistance *decreases* due to the feed-back, so that the two effects ought to annul each other.

Slight Discrepancy

This is exactly what happens, to a close approximation. There have been several approximations made in the theory, so that it cannot be claimed that the system works perfectly. Experiment shows that the increase of resistance is *not quite* equal to the decrease, so that there is a very slight decrease in amplification at the lower frequencies of the broadcast range. The decrease of amplification is small, however, and is not noticeable.

Practical Application

Let us now consider the application of these principles to the detector circuit obtaining regeneration by reaction coil feed-back. As has been intimated before, the generator shown in Fig. 1 may be replaced by a pick-up coil coupled to the aerial circuit. The inductance L in Fig. 1 therefore becomes a loading coil. The remainder of the circuit is the same as in any other three-circuit tuner. The coupling between the reaction coil and the coil L remains fixed, the only variable instrument in the set being the tuning condenser C. It will be noted that this method, besides taking care of the regeneration automatically, at the same time furnishes us with a true one-control receiver.

Fixed Coupling and Variable Resistance

To obtain such a condition that the increase of resistance is equalled by the decrease, or *vice versa,* it is evident that there must be a certain constant relation between the shunted resistance r and the mutual inductance between the reaction coil and the coil to which it is coupled. This relation is expressed as

$$r = \frac{k}{M}$$

where r is the shunted resistance and M is the mutual inductance. There is thus a certain amount of coupling required for a certain amount of shunted resistance. To adjust the receiver, the shunted resistance is set at some convenient value, say about 25,000 ohms, and the reaction coupling is then adjusted so that the set operates just on the verge of oscillation. Theoretically

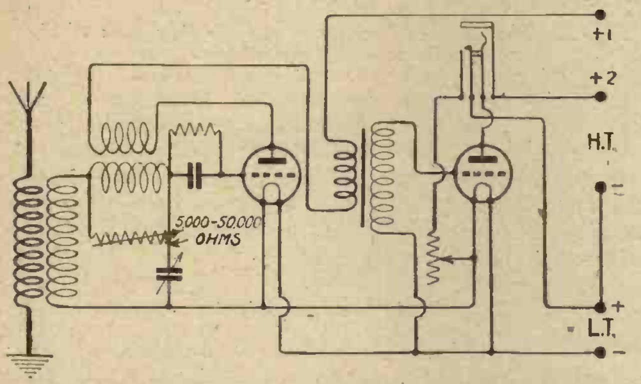


Fig. 4.—It is recommended that a variable resistance be used across the inductance coil coupled to the reaction coil. A filament control jack provides a simple means of switching on the set.

this procedure should do the trick, no matter at what frequency the adjustment is made or under what conditions, but on account of the approximations mentioned before, several trials may be necessary.

Frequency and Amplification

If it is found that the amplification drops off at the lower frequencies, the setting of the resistance should be changed a little and the reaction coil readjusted. If this does not do the trick, another adjustment should be tried—and so until the best setting is obtained. After two or three trials it will be found that the set can be operated without whistling and without decrease in amplification at the lower frequencies. The particular value of resistance required depends upon the way in which the coils are built. In the particular set described here, using valves of the DE5 or similar type, a .0005 μF condenser and a standard coupler on the market, the best value for r was found to be 23,000 ohms.

Details of Coils

Two stages of transformer amplification may be added to the automatically controlled detector, one stage only being shown in Fig. 4. The pick-up coil consists of 15 turns of No. 20 d.c.c. wire wound on a 3-in. tube. The primary winding, to be connected to the aerial and earth, is wound immediately on top of the secondary or pick-up coil, and consists of 12 turns of No. 20 d.c.c. wire. The loading inductance, across the terminals of which is connected the shunting resistance, was originally the secondary winding of a standard three-circuit tuner. The primary winding has been removed, as it is not needed in this circuit. The winding has a mean diameter of 2¾ in. and has 41 turns of No. 24 d.s.c. wire on it. The reaction coil has 36 turns of No. 26 d.s.c. wire on it, having a mean diameter of 1½ in., and is located at the end of the main coil.

Other Components

The resistance used for shunting the large inductance is a special one, having a range of from 10,000 to 100,000 ohms. The tuning condenser has a maximum capacity of .0005 μF and should be used with a vernier or slow-motion dial. The slow-motion dial is required, because when tuning there is no whistle to give evidence of the presence of a station, and, because of the selectivity of the receiver, the station is likely to be passed over.

The set should not be used on a very long aerial for ordinary broadcast reception, for if it is, it may tune broadly. With a single-wire aerial about 50 ft. long, the selectivity is very good. A filament control jack is used in the circuit, and all that appear on the panel of the receiver are a single dial and a 'phone jack.

Reversed Action

There is a phenomenon in connection with this receiver which will surprise many of those who try it out, and that is that there is slightly greater tendency to oscillate at the lower frequencies than at the higher. This, as everyone knows, is contrary to what happens in the usual set. The reason for it is easily explained on the basis of the approximations which were made in outlining the theory of operation of the receiver.

Reason for Reversal

In the first place the resistance of the secondary loading coil was neglected, as well as its distributed capacity. The coil capacity causes the inductance to change with changes in frequency, so that tuning will be slightly affected. This, at the same time, changes the resistance of the coil, due to the effects of the distributed capacity.

The most important thing which affects the operation of the set is the change of resistance of the condenser by means of which the set is tuned. For this reason, when tuning in on the higher frequencies, the resistance of the circuit is more than neutralised, due to this extra resistance in the condenser. In other words, resistance is added to the circuits at a slightly greater rate than the square of the frequency.

Flat Tuning

A happy combination of shunted resistance, reaction coupling, etc., can be secured, however, which will make the set operate continuously very close to the point of oscillation.

The set is likely to tune broadly if it is not adjusted properly, but when the adjustments are right, it will be found to be an ideal receiver for short-distance reception. It will bring in distant stations, however, for it is rendered very sensitive because of the regeneration, which does considerably more than merely make up for the decrease in sensitivity due to the resistance added to the input circuit.

SHORT-WAVE Notes & News

ALTHOUGH the past week has seen no startling developments in short-wave work, it has afforded some very useful examples of what we may expect in the future. All stations now appear to have some definite time during the day at which their signal-strength reaches a maximum.

Times for Distant Stations in this Country

The list below, compiled from a month's observations, gives the approximate times at which various stations, or groups of stations, are most easily audible.

G.M.T.

00.00-04.00.—1, 2, 3, 4 and 8 U.S.A. districts and all South Americans.

05.00-06.30.—All above, and 5 and 9 districts, also Bermuda, Mexico and more distant Europeans.

06.30-08.30.—New Zealand, 5, 6 and 9 U.S.A. districts, all Europeans, and South Africans.

08.30-09.30.—6 U.S.A. district, and Australia.

09.30-17.30.—All Europeans.

14.30-15.00.—Western Australia only, and Philippine Islands.

15.00-17.30.—Sometimes U.S.A. 6 district, and China.

18.30.—Europeans fade out, and Australians, South Africans and Indian stations become audible. *No* New Zealand stations usually audible at this time.

21.00.—Most Europeans inaudible. 1 and 2 U.S.A. districts just audible, increasing in strength until midnight.

22.30.—Brazil, Chile and Argentine usually very strong.

23.30.—1, 2, 3, 4, and 8 U.S.A. districts and Canadians very strong.

Of course, no definite rule can, as yet, be given, but it is a step forward to be able to tell, with any degree of certainty, what stations we may expect to hear at a given time.

Recent Work

During the week-end (December 12 and 13), the greatest amount of DX work was apparently done by British transmitters. 2KF, on Sunday, established communication with Z-2XA, a U.S.A. 8th district station, A-6AG, O-A6N and C-1DQ. Z-2XA gave him a message to the G.P.O. relating to the reception of the Rugby station in New Zealand. There have also been several complaints from the Antipodes of the interference caused by the G.P.O. station 5DH working on 6,670 kc. !

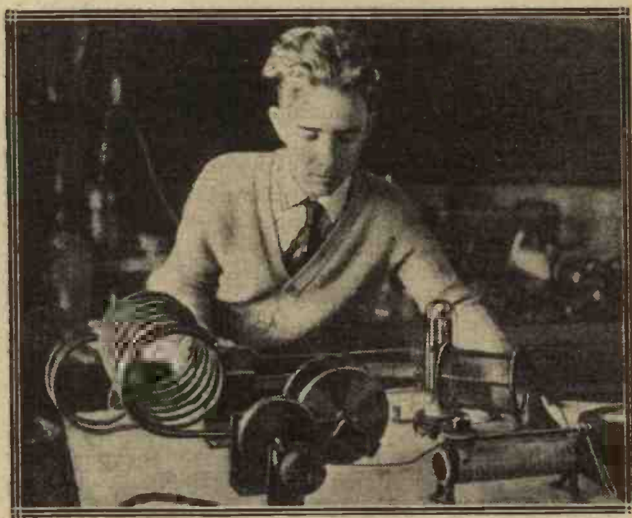
Reception

On the reception side several new stations have been heard, including FI-8QQ (French Indo-China), PI-NUQQ, and O-A6N (South Africa). The latter made his first contact with this country by working 2KF, and also worked 5QV immediately after! O-A4Z worked 2LZ and several Antipodes stations.

The list of intermediates published previously should be amended to the effect that Yugo-Slavia now uses "YS" and India "Y" for prefix.

"Dead Spots"

The South of England does not show very much activity at present, the only stations operating on the 6,670 kc. band being 2AO and 2RB, both of Eastbourne. 2AO specialises in working Australia in the evenings. Hastings is a very curious example of a "dead spot." Its only two representatives, 5QM and 6FQ, are both very difficult to receive in London, while their signals may be reported at loud-speaker strength further north. 6FQ now operates on the lower frequencies, about 2,730 kc. (110 metres) being his present adjustment. 5QM has received a high-power permit for "trans-world" working, but has not yet been heard in London.



An American amateur, Mr. W. W. Salisbury, of Iowa, who is carrying out experiments with oscillations at the highest frequencies yet attained.

Italy

An Italian transmitters' "DX competition" has led some of the

Italian stations to achieve all manner of great feats, during which many "miles per watt" records have become badly out of date. I-1AS, with an input of 15 watts, has worked 17 New Zealand stations, as have some of the other "I's."

A Suggestion

Incidentally, a writer to "QST," the organ of the American Radio Relay League, points out that the standard "miles per watt" rating gives the low-power man more credit than is due to him, making it appear that to cover 10 miles with .1 watt is as good an achievement as working over 10,000 miles with 100 watts, namely, 100 miles per watt. He suggests that it would be more accurate scientifically, and also more logical, to speak of "miles^2 per watt," the former then becoming 1,000, and the latter 1,000,000, of these units.

New Zealand

The call-sign VMG, which may be heard occasionally on 9,090 kc. (33 metres), belongs to the station of the New Zealand Government at Samoa. Fairly high power is used, and the signals are extremely strong at times. Z-2XA has been working the Philippine Islands, and Z-2AC has been in touch with CS-OK1 for the first time.

Brazil

Several new Brazilian stations have been in evidence during the past week, some of those received in London being 1AB, 1IA, 1IN, 1IP, 2AF, 5AB, and 5IF. 7AA is also heard sometimes. His address is Mr. A. A. Santos, Maranhao, Brazil, and he welcomes reports. The address of 5AB is J. C. Ayres, Box 257, Pernambuco, and he is one of the strongest Brazilian stations heard by the writer.

The "Q" Signals

We are publishing this week a list of the "Q" signals, together with their meanings as used in *amateur* radio. These are not necessarily identical with the "official" interpretations, but are naturally those that will be more useful to short-wave enthusiasts.

QRA	I am at——
QRB	Our distance apart is——
QRK	I am receiving you well.
QRM	Interference is bad.
QRN	Atmospherics are bad.
QRO	Increase power.
QRP	Decrease power.
QRQ	Send faster.
QRS	Send slower.
QRT	Stop transmitting.
QRU	I have nothing for you.
QRV	I am ready.
QRW	I am busy.
QRX	Please stand by.
QRZ	Your signals are weak.
QSA	Your signals are strong.
QSB	Your note is——
QSC	Your spacing is——
QSL	Please acknowledge.
QSO	In communication with——
QSR	I will forward a message to——
QSS	Fading is bad.
QST	General call.
QSU	I will call you {at / on} ——
QSY	Change your wavelength to——
QSZ	Repeat each word twice.
QTA	Repeat the message twice.
QTC	I have something to transmit.
QSLL	I will QSL : please do the same.
QSSS	Your signals are swinging.
QSYU	Change your wave to——metres.
QSYI	I will change my wave to——metres.

Application of These Signals

Some explanation of their significance will probably be desirable, as the various ways in which they may be employed are sometimes distinctly "loose." For instance, if a station is heard sending "QRA Wellington, New Zealand," the meaning is obviously "I am at ——," or "I am situated at ——," Wellington, New Zealand. This signal, and all the others, may be used as a query, and it is here that the ambiguity sometimes arises. If a station is heard sending simply "QRA?" then the meaning is "Where are you?"; in other words, he wishes to know the location of the station with whom he is in communication. If, however, he sends "QRA 6AG?" he means "Where is 6AG situated?" This applies equally well to nearly all of them.

Special Meanings

"QRK" is now taken to mean simply an "O.K." to the signals of the station being worked, and is generally used in conjunction with the "R" scale; the general procedure after establishing contact is to send "QRK R——," so that QRK does not necessarily mean "I am receiving you well."

"QRO" alone means "Please increase power," but "Hr QRO" means "I will increase power," "Hr" being, of course, an abbreviation for "here." Similarly "Hr QRW" means "I am busy," while "QRW?" signifies "Are you busy?"

Four-letter Signals

The four four-letter signals at the end of the list are not so often used as the others, but are, nevertheless, very useful in some circumstances. They were originated by the American Radio Relay League.

Other Abbreviations

In connection with these "Q" signals, it will also be desirable to outline briefly the transmission practice and abbreviations usually associated with them. The more familiar abbreviations, such as "GA," "GE," and "GN" need not be touched upon. Usually, a station (say F-8JL) calling another (U-1CMP) for the first time would simply send 1CMP, 1CMP, etc. UF 8JL, 8JL, etc. QRK? AR. No "K" (invitation to transmit) should be used here, according to standard I.A.R.U. practice. 1CMP having replied, however, 8JL would in turn reply "1CMP UF 8JL rrOK QRK R . . ., etc., etc.," finishing up "1CMP UF 8JL K." It is most important that the transmitting station should give his call-sign at the end of the message, for the benefit of those who did not hear him begin.

Another point is that "VA" ("End of work") should not be sent until the station sending it has definitely finished. Sending this signal signifies that he is not going to listen again to the station with whom he has been in touch.

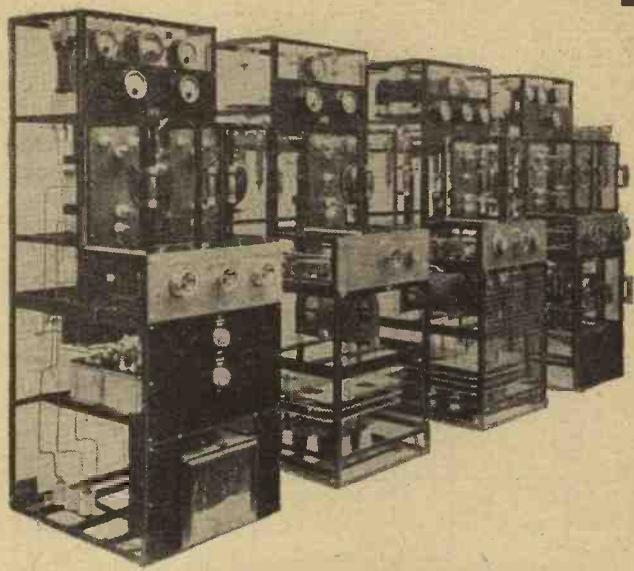
Advantages of Strict Procedure

If all stations bore the above rules in mind, the ether would probably be a little more orderly than it is at present. Abbreviations, though frequently a source of annoyance to the puzzled receiving operator, are really, when not overdone, a great boon, in that they shorten the period during which each station is actually in operation, thus lessening by a considerable amount the interference which is so grave a problem to the transmitting amateur.

Methods of Modulation in Transmission

By the Staff of the Radio Press Laboratories.

In discussing the problems connected with modulation, the keying of transmitters for the purpose of signalling by means of the Morse code is dealt with here. Methods are described which are applicable to high- and low-power transmitters.



A standard Marconi 6 kw. broadcasting transmitter.

IN the previous articles on Radio Transmission in *Wireless Weekly* we have only dealt with the generation of continuous oscillations of a constant amplitude. In order to make possible the transmission of intelligible signals it is essential that the continuous oscillation be modulated in some way.

The Morse Code

The simplest way of doing this is to break up the continuous oscillations into "longs" and "shorts" of the Morse code. If the signals are to be received by the ear, which is the method most commonly used, the continuous oscillations have to be still further broken up. This further breaking up of the oscillations for the purpose of making them audible can, however, be carried out either at the receiving station or at the transmitter. By means of a local continuous

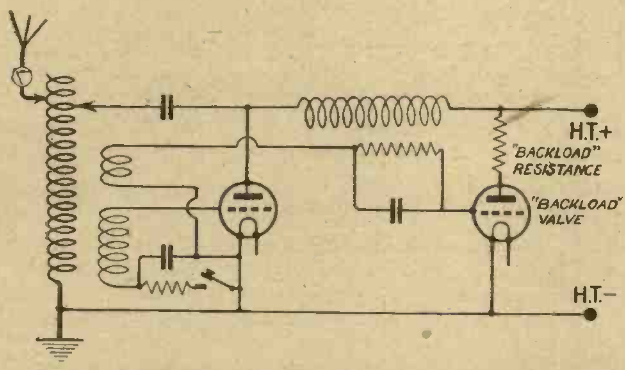


Fig. 1.—Illustrating the principle of one method used to obtain a constant load on the high-tension supply during keying.

wave oscillator at the receiving station, tuned to approximately the frequency of the transmitted wave, the incoming signal can be modulated so as to give a musical note of any desired frequency. This is the ordinary heterodyne method of reception.

Audible Note Transmission

If the oscillations at the transmitting station are broken up into groups at an audible frequency, then heterodyne reception is not necessary, and the signals are audible as a musical note on a crystal or any other non-oscillating receiver. There are several ways in which a valve transmitter can be modulated so as to give a musical note, and these will be described later.

Speech

If the transmitted signals are to be made intelligible by the means of speech, then a special form of modulation of the transmitted wave is necessary. The radio-frequency oscillations must be made to vary in amplitude at varying frequencies, which correspond to the speech or musical frequencies which are to be transmitted. In addition to this, the actual change in amplitude of the high-frequency oscillation must be proportional to the strength of the impressed speech or musical sounds. In other words, a faint sound must produce a small variation in amplitude, and a loud sound must give a large variation in amplitude. If

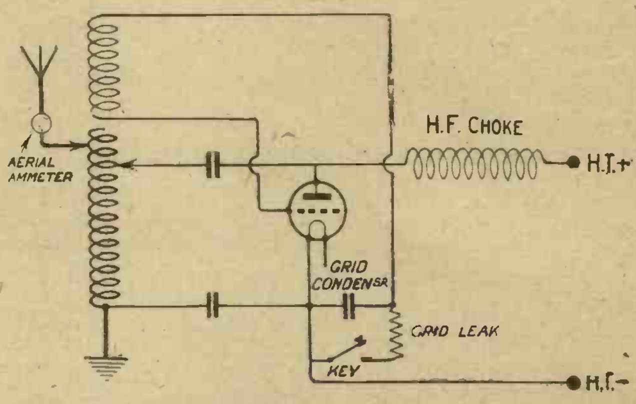


Fig. 2.—In this circuit keying is effected by making and breaking the portion of the circuit including the grid-leak.

this is carried out, then the varying amplitude and frequency of the impressed sounds will be reproduced at the receiving station on an ordinary non-oscillating receiver.

Forms of Modulation

We can thus discuss the modulation of a valve transmitter under these main headings, namely :—

(a) Modulation by keying, so as to produce, for example, the "longs" and "shorts" of the Morse code.

(b) Modulation at some definite musical frequency.

(c) Modulation of the radio oscillation by impressed sound vibrations of varying frequency and amplitude.

Each of these different types of modulation will be dealt with in more detail.

Modulation by Keying

Modulation by keying sounds a very simple operation, and one might wonder what there is to say about it. In practice, however, especially when dealing with large powers, the question of keying is often quite a problem, and many methods have been devised for overcoming the various difficulties. Of course, if the speed of signalling was of no consideration the "keying" could be done by making and breaking the main power switch. This method, however, would be very slow, and is quite useless in practice.

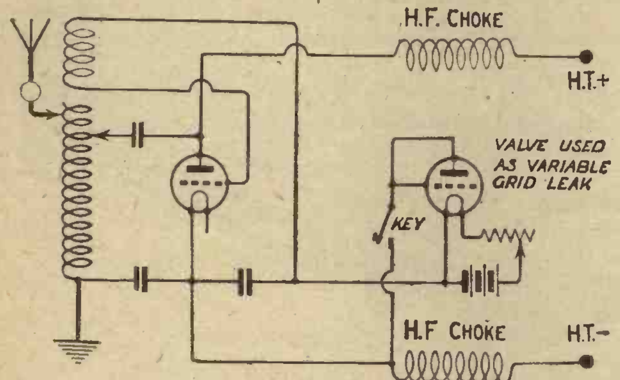


Fig. 3.—In this arrangement the method of keying used is the same as that shown in Fig. 1, but here a valve is used as a variable grid-leak.

Low-Power Working

With very small powers, of the order of a few watts, it is possible to make and break the high-tension supply to the anode by means of a Morse key, and obtain ordinary speeds of signalling. To key a powerful transmitter at high speed, however, is quite a different proposition, and many precautions are necessary.

Automatic and High-Speed Signalling

As the speed of only 60 words per minute means that the key or relay operating the valve circuit must be capable of making and breaking contact about 50 times per second, it is essential that the moving parts of the relay be as light as possible; also the movement must be kept small. It is thus essential that the sparking at the contacts must be practically negligible, otherwise a clean make and break will not be obtained and there will be sticking at the relay contacts. Also there must be no serious electrical lag in the key circuit.

Variation of Load

Another difficulty to be overcome when fairly high powers are being dealt with is the large varying load on the high-tension generating plant. When the key is depressed the sudden load on the generating plant will usually cause a serious drop in voltage. This is liable to cause a variation in frequency of the radio oscillation. To overcome this trouble, what is called a "back load" has usually to be incorporated, so that when the key is raised a load equal to that taken by the transmitting circuit is automatically connected across the power supply. By this means the load across the power supply can be kept practically constant.

Valves for Power Absorption

One possible way of overcoming this difficulty is to connect a valve and resistance in series across the high-tension terminals and control its grid potential by the actual high-frequency oscillations. The principle of the method can be seen from Fig. 1. When the key is depressed, the oscillations in the main circuit cause the grid to become so negative that the anode-filament resistance is practically infinite, and no current passes through the "back load" valve. When the key is up, however, the grid assumes zero potential and a current flows through the back load valve and its series resistance. If the valve and resistances are suitably chosen, the load taken from the high-tension supply when the key is raised can be made equal to that taken when the key is down.

Various Circuits for Keying

Various methods for keying valve transmitters, which have been actually tried out, are shown in Figs. 2, 3, 4 and 5.

A very simple method, which is largely used, is shown in Fig. 2. In this method the grid-leak across the condenser is disconnected by means of the key, when the latter is raised. This causes the grid of the valve to take up a high negative charge which, with suitable adjustments, stops the valve oscillating.

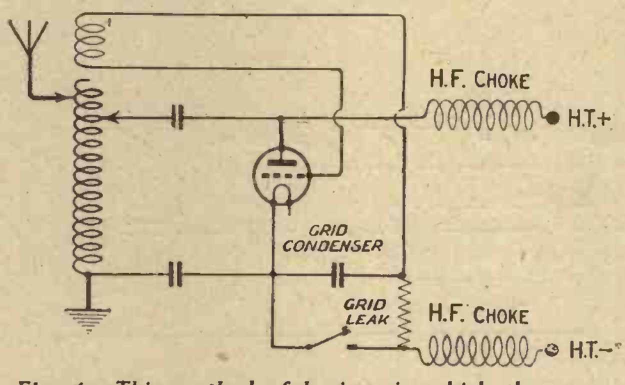


Fig. 4.—This method of keying, in which the power supply is broken, is useful for medium power transmitters when "listening through" is required.

Key "Clicks"

As, however, it is practically impossible to keep the grid charged negatively for any length of time, owing to imperfect insulation between the grid and the filament, it is found that, as the charge leaks away there is a point at which the valve will again start oscillating, although the key has not been depressed. This oscillation only occurs momentarily, as the grid at once becomes highly negative and again quenches the oscillations. This stopping and starting of the oscillations when the key is raised gives rise to the well-known phenomena of "clicking."

Valve as Variable Grid-leak

If the insulation between the grid and filament is poor these "clicks" may occur so rapidly as to give rise to a definite note or howl. With proper insulation, however, the number of clicks occurring can be reduced to less than one in two seconds. Fig. 3 shows the same method of keying, but in this case a valve is used as a variable grid-leak. The anode-filament resistance can be varied by altering the filament current by means of the rheostat.

"Listening Through"

In many cases it is necessary for the receiver to be in operation as soon as the key is raised, so that the distant station can "cut in." This is called "listening through." The circuits shown in Figs. 2 and 3 are unsuitable for the purpose, owing to the "clicking." For the purpose of listening through it is important that the transmitter be made quite "dead" when the key is raised. A very useful circuit for this purpose is shown in Fig. 4, which is applicable to transmitters of considerable power. In this method, which was developed in the Royal Air Force, the grid-leak and the negative high-tension lead are simultaneously disconnected from the filament when the key is raised.

Reduction of Sparking

Although in this method the full load taken by the valve is broken by means of a key, there is no serious sparking at the contacts if the reaction coupling is suitably adjusted. This can possibly be explained by the fact that as soon as the key breaks contact there is formed a minute arc which causes a drop of potential across the contacts. This drop of potential across the key contacts causes the grid to become more negative with respect to the filament, and this tends to stop the anode current, and, consequently, the current flowing through the key.

Keying a High-Power Transmitter

A very simple and interesting method of keying a high-power transmitter is shown in Fig. 5 (Patent No. 224574, by Wells and others). In series with the grid-leak, which should be of less than its normal value, a keying valve is connected. This keying valve should be large enough to pass the necessary grid current. A 250-watt valve is probably capable of keying a 20- or 30-kilowatt transmitter. The grid of this valve is connected through the key to the filament, a small condenser being connected across the key. When

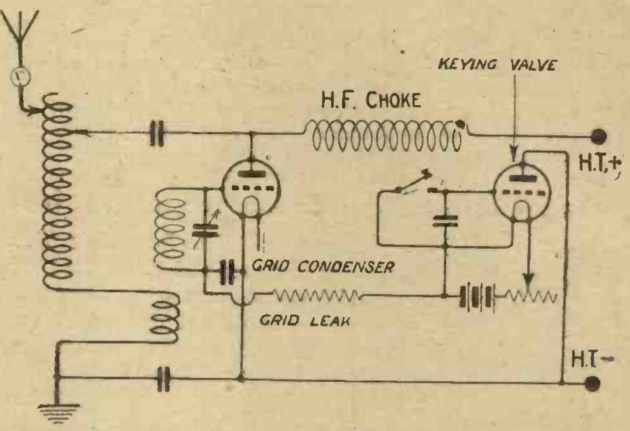


Fig. 5.—An interesting method of keying a high-power transmitter, a keying valve being used for the purpose.

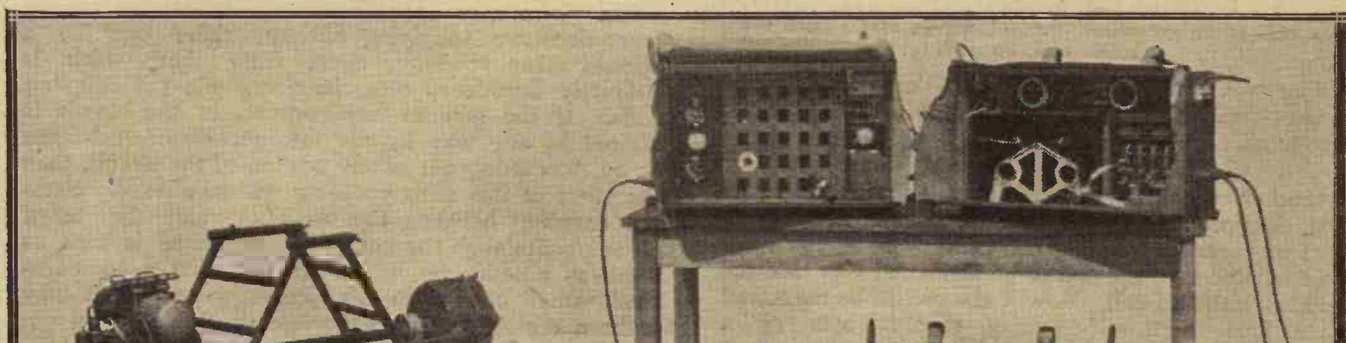
the key is raised and the grid is isolated the anode filament resistance of the valve becomes practically infinite and the circuit ceases to oscillate.

Applicable to High-Speed Signalling

When operating a 30-kilowatt transmitter by this method the sparking at the key contacts is so minute that it is difficult to see it, and it is possible to adjust the key or relay contacts so that the break is not more than 1-100th part of an inch. This method is also applicable to high-speed signalling. For further details of this method the reader is referred to the above-mentioned patent.

Other types of modulation of a valve transmitter will be discussed in the next article.

In "Wireless Weekly," Vol. 7, No. 13, page 428, col. 1, in the paragraph headed "Check with Milliammeter," "Va+Vg" should read "Va and Vg."

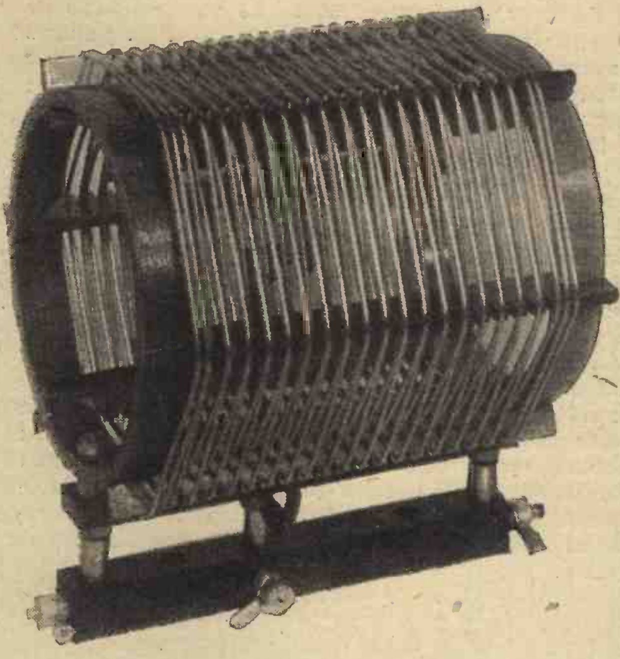


The Marconi Y.C.2 type of portable transmitter and receiver uses a generator driven by an internal combustion engine, and is designed to be serviceable in districts where transport is a difficult problem.

A New Method of Measuring Coil Resistances

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

In a recent issue of "Wireless Weekly" Mr. Reyner described the Auto-Resonator, an instrument for measuring the H.F. resistance of inductance coils. As a result of further experiments, he here gives details of a slightly modified principle of resistance measurement, which avoids certain slight errors likely to arise in the use of the Auto-Resonator.



A SHORT while ago (*Wireless Weekly*, Vol. 7, No. 7) I described a method of measuring coil resistances by means of what is known as the reactance variation method, and described an instrument which I called the Auto-Resonator, which enabled measurements of high-frequency resistance to be carried out fairly rapidly.

This instrument I have had in use for a considerable period now, and as a result of my experiences it would seem that there are several precautions which must be taken to avoid error. One of the principal sources of error lies in the difficulty of estimating the actual capacity in the circuit. This consists of not only the tuning capacity itself but also any stray capacities that may be present in the circuit, together with the distributed capacity of the coil.

Coil Capacity

With good types of coil this capacity is negligible in comparison with the rest of the capacity in circuit, except when the tuning capacity is of the order of 100 $\mu\mu$F or less. In such a case the coil capacity is by no means negligible, and considerable error may be introduced.

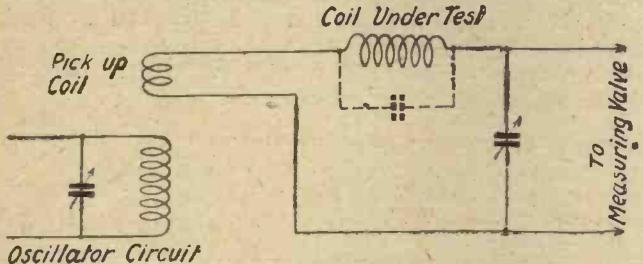


Fig. 1.—In the original circuit of the Auto-Resonator, the coil to be measured was placed in series with the small pick-up coil.

Further Objections

Another objection is that with the circuit originally used, a reproduction of which is shown in Fig. 1, there was a small coupling coil picking up energy from the oscillator, and the coil to be measured was inserted in series with this coil. Now if the coil to be measured has a fairly high self-capacity, then it acts as a rejector, and the apparent resistance of the coil is many times as great as the actual resistance. In order to estimate the extent of this error, I subsequently changed over the arrangement, so that a small coupling coil, such as is shown in Fig. 2, was placed near to the coil to be measured. I found that, as was anticipated, the difference in the majority of cases was inappreciable, except where the coil had a fairly high inductance, and was tuned with a comparatively small capacity. The possibility of error from this cause, however, is an undesirable feature.

A third objection to the method lies in the slight hand-capacity effects which are obtained, and also in the possibility of extra resistance being added due to the tuning capacities across the coil. These several effects, in themselves, are quite small, but in the aggregate they tend to render the method unsatisfactory. There are several other methods which may be employed, most of which involve either the replacement of the coil by a resistance, or the addition of resistance to the circuit, or some such modification to the layout.

Errors Due to Stray Coupling

It has been found by several investigators that any method of measurement which involves a change in the configuration of the circuit is liable to very serious error. In a case like the present, where we have a local oscillator supplying current, there will be a certain stray coupling, apart from that which is definitely introduced into the circuit via the coupling coils. If the general configuration of the circuit is altered in any way by the introduction of resistance or by the cutting out of any portion of the circuit, then the effect of this stray coupling will be altered. Since the coupling between the oscillator and the tuned circuit containing the coil to be measured is kept as weak as practicable, it will be seen that a comparatively small change in the general arrangement may make a big difference to the results.

Method Adopted

Most of these disadvantages can be overcome by adopting a slightly modified principle. Instead of varying the tuning capacity connected to the coil to be measured, we vary the frequency of the local oscillator. It can then be shown that

$$\delta = 2\pi \frac{f_0 - f_1}{f_0} \sqrt{\frac{I_1^2}{I^2 - I_1^2}}$$

where I = current at resonant frequency f_0.
I_1 = current at mistuned frequency f_1.
δ = decrement of circuit = $\frac{R}{2f_0L}$

Using the Moullin voltmeter method of measuring the current in the circuit, the deflection of the milliammeter is proportional to the square of the current in the circuit.

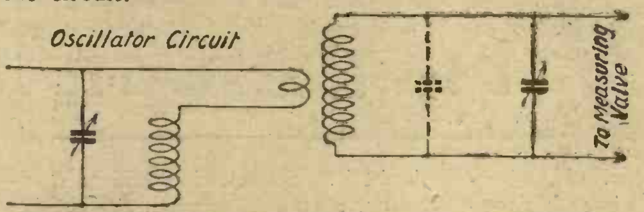


Fig. 2.—The circuit used to estimate the extent of the error introduced by the circuit arrangement of Fig. 1. Here the pick-up coil is placed in the oscillator circuit and is brought near the coil to be measured.

If the deflection at frequency f_1 is made one half that at resonance, then the expression under the root-sign reduces to unity, and we have simply

$$\delta = 2\pi \frac{f_0 - f_1}{f_0}$$

If we multiply both sides by $2f_0$ we obtain the expression

$$\frac{R}{L} = 4\pi (f_0 - f_1)$$

The Significance of Decrement

This expression is particularly simple, and is all the more useful in view of the importance of the ratio $\frac{R}{L}$. In a recent article in *Wireless Weekly* (Vol. 7, No. 11) I have discussed the significance of decrement in tuning circuits, and I have shown that this quantity gives a good indication of the suitability of any given coil. It determines at once the ratio of the resistance of the coil to its inductance at a particular frequency.

Values of Decrement

In another article I showed the value of decrement required, first of all to maintain adequate selectivity, and, secondly, to give good quality of reproduction. In both these cases it will have been noted that the decrement necessary increases as the frequency is reduced. That is to say, the product of decrement and frequency is approximately constant. This product is simply $\frac{R}{L}$, so that we are left with the fact that for satisfactory reception we require a given ratio of $\frac{R}{L}$ independent of the frequency of the oscillations. The ratio is not quite independent of frequency, but for all practical purposes the statement just made is correct.

Practical Measurements

In order to obtain a measurement of $\frac{R}{L}$ for any coil, therfore, it is simply necessary to arrange the circuit as shown in Fig. 3. The local oscillator is set at a given reading, and the tuning condenser C3 varied until the milliammeter deflection is a maximum. The setting of the vernier condenser C2 is noted, and the vernier condenser then altered until the milliammeter reading is reduced to one-half of the resonant value. From the calibration of the vernier condenser the difference in the frequency required to produce the change in current may be obtained, and by simply multiplying this by 4π the ratio of $\frac{R}{L}$ for that particular coil is obtained.

Thus the suitability of any particular coil may very rapidly be gauged.

Estimating Frequency Difference

The only difficulty lies in the estimation of the difference in frequency. This, fortunately, may be done with considerable accuracy by means of a simple method.

The variation in frequency required to produce the necessary change in milliammeter deflection is very small, being of the order of a few kilocycles only, at a mean frequency of 800 kilocycles.

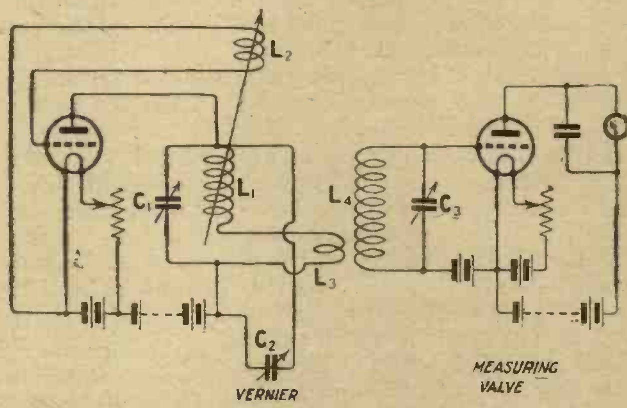


Fig. 3.—The oscillator and measuring valves are arranged as shown here, the coil to be measured being L4. The vernier condenser, C2, is varied, and the change of current on the milliammeter noted.

This is an audible frequency, and may be gauged very accurately by means of a tuning fork.

Separate Oscillator

Details of an oscillator suitable for this purpose will be given next week, and also details of the method of calibrating the vernier condenser to read $f_0 - f_1$ direct.

Direct Determination of Resistance

The method can be made to give the actual resistance of the coil with very little extra trouble. By inserting in the circuit under test a small resistance of such a kind that its H.F. and D.C. resistances are nearly the same, and therefore easily calculable (as described by Mr. H. J. Barton-Chapple in *Wireless Weekly*, Vol. 7, No. 10), we obtain the expression

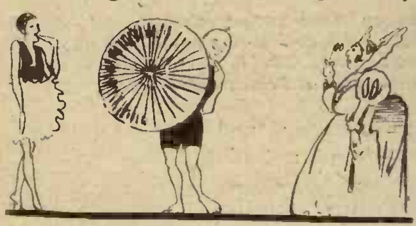
$$\frac{R+r}{L} = 4\pi(f_0 - f_2)$$

$$\frac{R}{L} = 4\pi (f_0 - f_1)$$

$$\frac{R}{r} = \frac{f_0 - f_1}{f_1 - f_2}$$

Thus R is determinable without any reference to the inductance or capacity, so that any troubles due to self-capacity are obviated.

I SUPPOSE that there have been few more successful functions in the history of Little Puddleton than the great wireless fancy dress ball which was given during Christmas week by the Professor and Mrs. Goop to members of the club, and, of course, their better halves. For days before the event took place everybody was saying to everybody else, " What are you going as? " but, of course, each of us refused point blank to give away any information about the ingenious costume that he had devised, or was still devising, for the occasion. Personally, I was not a little worried about the business, and found it most difficult to think of a character demanding a costume perfectly



. . . *thought of going in a bathing costume* . . .

suited to my own particular and exclusive type of manly beauty.

My Own Costume

For some time I thought of going in a bathing suit and carrying in my right hand a large hoop covered with pleated paper—a loud-speaker, of course. The bathing suit, however, seemed rather a chilly sort of idea, and I simply hate dancing without shoes on, especially with the more athletic type of partner. Then I thought that it would not be half a bad scheme to represent an earth. This is an excellent costume. You cover your face and hands with bronze paint, and don an evening suit. You then go and roll in the garden for a spell. If only Snaggsby would have lent me his evening suit, I think that I should have decided upon this dress. He absolutely refused to hand over his toggery, even when I told him the novel use that I intended to make of it. Heaps of other ideas coursed through my fertile brain, but I was not quite satisfied with any of them, until on the very day before the dance an inspiration came. I would go, quite simply, in what for some unknown reason our most eminent novelists style " immaculate evening dress." Naturally, this would give an opportunity to such futile idiots as Bumpleby-Brown of asking if I was disguised as a gentleman. Any person of discrimination would see at once that I represented a nut.

Woman

Women are a little trying at these times. Either they have no ideas at all, or else their inspirations run into an outlay that is incommensurate with hubby's bank balance. I gave my wife simply heaps of ideas; one of my very best was that she should wear the slinkiest costume she possessed, bearing upon her back a placard inscribed with a large V crossed out. Vamp – V = Amp. Got it? This having been turned down, I proposed that she should appear as a wireless wave, wearing a garment with a silvery sheen (her last year's mermaid costume adapted), and entering the ballroom with sine wave motions of the arms. By the time that I had explained what a sine wave was the thing was perfectly told. She decided in the end to go as Northolt, in a most fitting character, since Northolt is always interfering with everybody else and cannot be reduced to silence.

The Time Arrives

The great night dawned . . . that does not sound quite right. There is obviously something wrong with this language of ours. You can say without fear of criticism " the great morning dawned," but you certainly cannot say, write, or whisper " the great night sunsetted." Have we a word? I doubt it. Sunsetted would be cumbrous, even if it existed, and sunset does not appeal to the æsthetic eye and ear. What are we to do about it? Gloomed? No, no; that is not in keeping with the spirit of the occasion. Tenebrated? Too classical. Came along? Too colloquial. Arrived? Banal to a degree. There is simply no word in modern English to express such an event. Perhaps we had better return to the classics for a moment, and say that " the sun-god's chariot had dipped beneath the western waves." That is more the kind of stuff to give them, is it not? Anyhow, the six peeps whizzed out from 2LO and announced that it was ten o'clock, the time at which the great dance was due to begin.

. . . *putting the clocks backward or forward* . . .

Those Peeps

Talking about those peeps, has it ever occurred to you that they provide a partial solution of the unemployment problem in this country? Directly I hear them I remove my own wrist-watch and turn its hands backwards (or forwards, as the case may be) so that they register the exact hour. To do so it is necessary that I should open the case, and when I close it I invariably crack the glass with the pressure of my manly thumb. This provides on the following morning a little job for Mr. Coggs, our local watchmaker. Having set my watch I run rapidly all round the house, putting the hands of the clocks back or forward as may be required. The result is that the grandfather in the hall strikes four at half-past three, and

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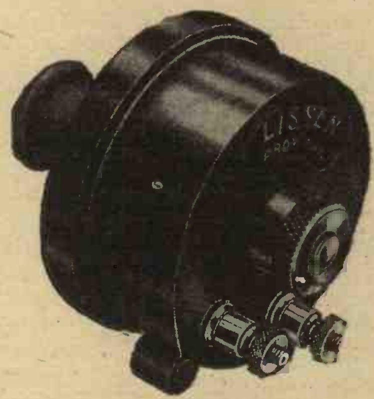

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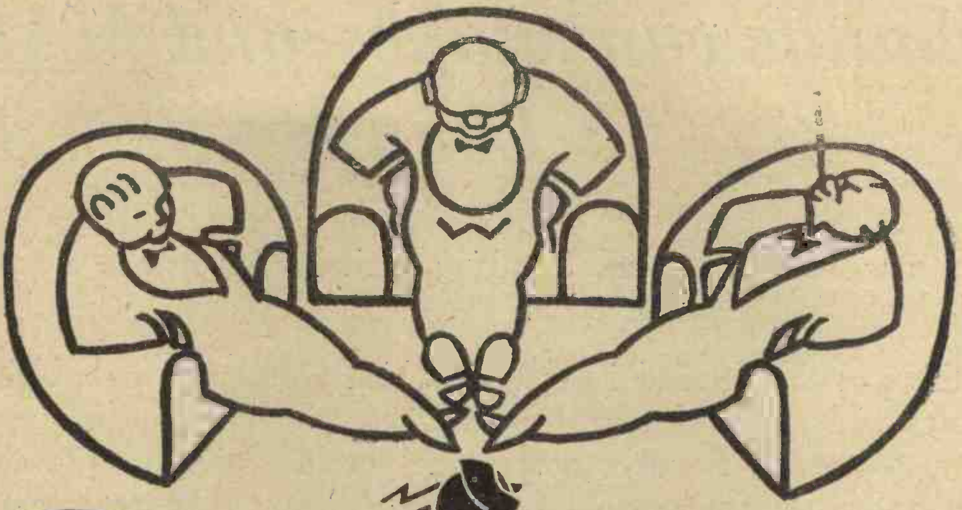

Brandes

"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."

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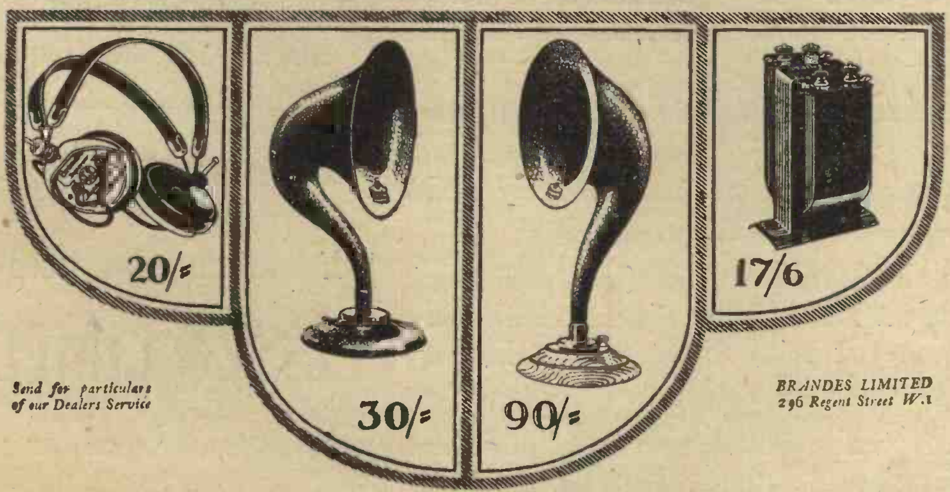

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W-232 *Service Advertising*

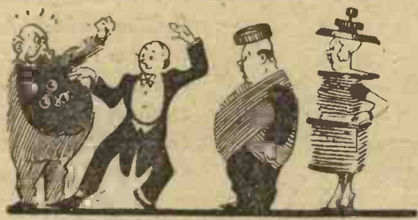
gives a single pong at mid-day. The nice fat clock on the dining room mantelpiece refuses to strike anything at all, whilst the little fellow on my bedside table goes on striking twelve and simply will not stop. I can assure you that Mr. Coggs blesses the time signals, for he is seldom off my doorstep during his working hours, to correct in my clocks the effects of the corrections that I have made.

We Assemble

Anyhow, it was time for the dance to begin, and the *élite* of Little Puddleton began to roll up in strength at the Microfarads. Just as my wife and I arrived we heard and saw Mrs. Goop telling the Professor that he would never be ready in time. I quite thought that she was giving the old joke another run for its money by appearing as a loud-speaker, but I discovered later on that she really represented Simultaneous Broadcasting. Professor Goop's figure adapted itself excellently to the zig-zags of a Variable Gridleak, and with a silver-covered wooden arrow under his arm he was a very creditable representation of the familiar symbol. General Blood Thunderby wore a brown suit with a large expanse of black shirt front covered with knobs and dials. He was not a Fascist, but a Five-valve Set. Just to test him out I seized two of the knobs and twiddled them. Loud howls issued from the General. As he subsequently told me that I had been standing at the moment upon his gouty toe, I gathered that they were due to foot-capacity effects. Gubbsworthy and Dippleswade entered together as a Pair of Telephones. But the hit of the evening was made by Poddleby and Mrs. Poddleby. Our stout friend made an admirable Variometer, and nothing could have been more realistic than Mrs. Poddleby's Variable Condenser costume.

The Revels Begin

When everyone had finished admiring and criticising everyone else, Professor Goop advanced towards the receiving set which he had designed specially for the occasion and switched on. There was a painful silence. The Professor opened the cabinet and peered in. "Ah!" he said after a few moments, "I perceive that I have made a slight mistake in the construction of my aerial tuning inductance. I expect that in the course of my calculations one of those annoying little noughts has gone astray. Some people say that nought is nothing, which I can assure you is entirely wrong. I suspect that by a slight oversight I have made the tuning minimum of my aerial coil 50,000 kilocycles instead of 500,000." I dashed forward to the rescue of my good friend. "All that you have to do," I exclaimed, "is to put in a good fat loading coil in order to bring up your kilocycles." It took the Professor some time to explain that when you are working in kilocycles you go down when you really mean that you are going up, and *vice versa*. It is all rather difficult, is it not? Leaving the party to wait he and I dashed off to his workshop, where we hastily wound another aerial coil tunable to the right minimum kilocyclage.



. . . Loud howls issued from the General . . .

We Tango

This we at length bore back to the ballroom, fitting it into its place amidst thunders of applause from the assembled company. A tweak here, a twiddle there, and the room was filled with a flood of the horrible noises to which we dance to-day. Walking gracefully across the room, I begged Mrs. Poddleby to do me the honour of tangoing with me. She said that she hardly knew the steps, but I assured her that that did not matter in the least, so long as she left it all to her strong silent partner. Take my advice, and never dance with a lady who is wearing the costume of a Variable Condenser. The upper and lower end-plates stick respectively into your ribs and your shins in the most unpleasant way. However, such is my skill in the dance hall that, despite all handicaps, we got on very nicely to begin with. Trouble came when I was showing her that extremely neat step in which you draw back the right foot, swing it round and plant it down outside the left. Naturally, disaster is likely to occur if a Variable Gridleak, even if he is your host, goes and shoves (quite unintentionally) his beastly arrow in between your feet. Mrs. Poddleby and I promptly took the count, and by unanimous vote it was decided that for the rest of the evening Professor Goop should represent a Fixed and not a Variable Gridleak.

". . . I don't work that there blinkin' gramerfone no more . . ."

We Tangle

Gubbsworthy and Dippleswade, too, were a little trying with their telephone costume. They refused to dance together, but each selected a partner, though they retained their connecting headband. When you get a pair of living telephones charging about a ballroom, things are likely to happen, and things did. We had to reduce these stalwarts to single earpieces before the first dance was over. Still, despite the little mishaps that I have mentioned, the evening was a glorious success. Having danced to 2LO until he closed down, we switched over to Radio-Paris, and when he gave out Professor Goop was immediately able to tune in WGY. The Professor was absolutely beaming over the success of his set, upon which everyone congratulated him.

The Strike

The fun was still at its height in the early hours of the morning, when the music suddenly stopped, leaving us all with one foot in the air. The next instant a small and very dirty boy, whom, despite his covering of grime, I recognised as Edward Bugsnipp, came in and went straight up to Professor Goop. "Look 'ere!" he said. "Sh! my little fellow," said the Professor, "I'll come and talk to you outside." "No, you won't. Not 'alf!" objected young Edward. "If you gets me outside I shan't be able to tell the ladies and gemmen. What I mean is, I'm on strike. Unless yer gives me another coupler bob, I don't work that there blinkin' gramerfone no more to-night, strike me pink if I do." Of course, it was a very awkward moment, and all of us talked as hard as we possibly could, pretending that we had heard nothing at all. Professor Goop hastily pressed a florin into the lad's hand, telling us that he could not dispense with his services, since the central heating apparatus was being looked after by him. With extreme tact I dashed to the receiving set and cried, "Why the aerial is disconnected!" I got it fixed up again just as young Edward settled down to work once more.

WIRELESS WAYFARER.

A Non-Radiating Receiver Circuit

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

In this article Dr. Robinson describes a practical circuit, using neutrodyned high-frequency amplification, which has been tested for radiation. When a receiver, built in accordance with this circuit, was oscillating, so that telephony stations could be picked up easily by their carrier waves, no trace of interference was caused to a second receiver in close proximity.

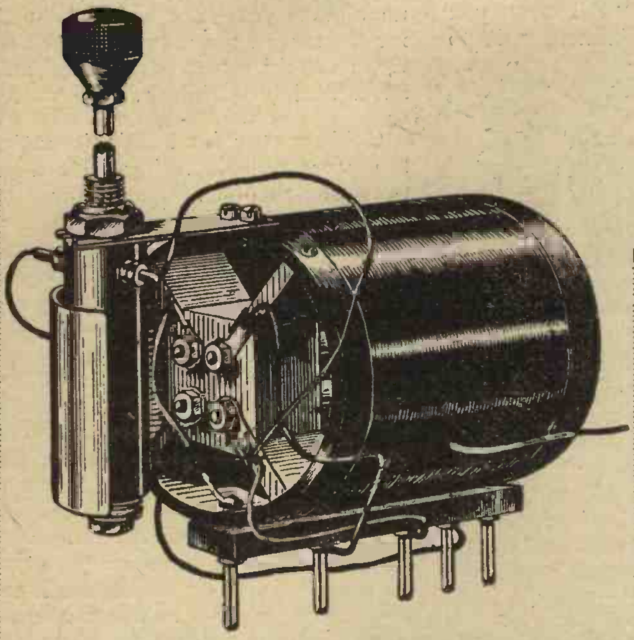


Fig. 1.—The H.F. valve is mounted inside the anode coil, in order to keep the leads short, and the neutrodyne condenser is attached rigidly to the coil former. All the connections, with the exception of the centre tapping, are brought out to plugs.

IN *Wireless Weekly*, Vol. 7, No. 12, some circuits were described which enable amateurs to search for distant stations by finding the heterodyne note, while at the same time their aerials are not oscillating. It is possible, when using two valves, to oscillate the second valve and to hear thereby the heterodyne note with the carrier wave of the station which is being searched for, while if the first valve is completely neutrodyned, these oscillations will not be communicated to the aerial, and thus one will not disturb one's neighbours.

Complete Neutrodyning Necessary

In order to obtain the best possible conditions for this purpose it is essential to have the first valve completely neutrodyned, and the amount of balancing for this purpose, whether in the form of a condenser or of a coupling coil with condenser, should be exactly correct.

Stray Capacities

The object of neutrodyning is to balance the capacity between the anode and filament of the valve, but if there are other stray capacities in the circuit it is quite possible that complete balancing will not be obtained.

It is of the utmost importance that leads should be as short as possible, and with this object in view a valve to be neutrodyned has been placed inside the anode coil.

A Suggested Arrangement

A diagram of this arrangement is shown in Fig. 1. The anode coil is wound on a former 4 in. long by 3 in. diameter. The wire is No. 22 gauge enamelled wire, and is wound spaced, there being 64 turns on the former. This former is, in fact, similar to one used by Mr. Percy W. Harris in his "Special Five" receiver, described in *Modern Wireless* for November, 1925. The valve holder is fixed on to a cross piece which is attached to the former inside by four screws. A Polar neutrodyne condenser is attached to the same end of the valve holder. Along the side of the coil there is a number of plugs, so that the unit as a whole can be plugged conveniently into corresponding sockets. In this way the leads to the neutrodyne condenser, and from the anode to the anode coil can be kept very short.

An Experimental Circuit

Such a unit will be useful for constructing multi-valve neutrodyne sets. Before proceeding to do this, however, it is essential to investigate how far such a unit is useful in giving neutrodyne effects. A circuit was fixed up, as shown in Fig. 2. The anode coil is tapped at a centre point B. It will be observed in the circuit of Fig. 2 that we are not using transformer coupling to the second valve V2. The second valve is used purely

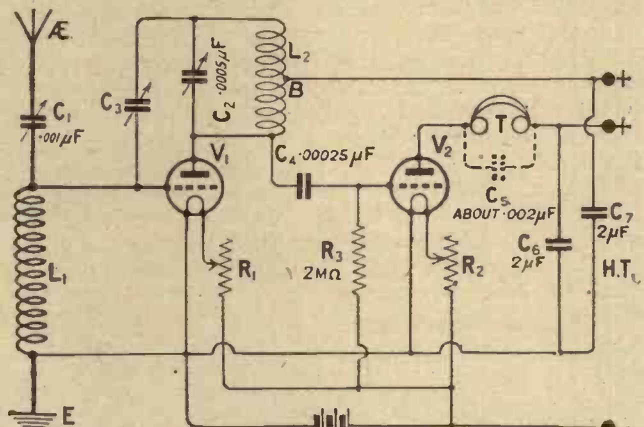


Fig. 2.—The form of circuit first arranged to investigate the practicability of the neutrodyne unit shown in Fig. 1. C3 is the neutrodyne condenser.

as a detector. To tune the anode coil of the valve V1 a variable condenser of .0005 μF is used.

Aerial Connection

The aerial was attached to the grid coil L1 through a variable condenser of .001 μF capacity. The connections from the anode of the valve V1 to the grid of the valve V2 were made through a condenser C4 of value .00025 μF. A grid leak of 2 megohms was used between the grid and filament of the valve V2. The anode of V2 was connected through the telephones to the positive high-tension. A condenser of value .002 μF was placed across the telephones, though this value may be varied to suit individual requirements.

Good Stability

Excellent neutrodyning is obtained with this circuit. There is only one point on the neutrodyne condenser C3 which prevents the circuit of the valve V1 from oscillating, and both higher and lower values of this condenser will cause the valve to oscillate. It will be noticed that we used here the method of attaching the aerial to the circuit which allows oscillations to take place most easily, that is, the series condenser arrangement.

A Further Satisfactory Test

Another test was made to guarantee that correct neutrodyning was obtained and that was to switch out the filament of valve V1 and attempt to hear signals in the telephone circuit. No trace of London's signals could be obtained, nor again of signals from a buzzer which was placed very close to the grid coil L1, when this valve was cut out of circuit, and when the neutrodyne condenser was correctly adjusted.

Various valves were tried, and in all cases it was possible to obtain this zero point on the neutrodyne condenser, although the value of the condenser varied from valve to valve for correct neutrodyning.

Obtaining Reaction Effects

In order that the circuit of the valve V2 could be made to oscillate without causing the aerial to radiate it was essential to include a reaction coil L3 in the anode circuit of the valve V2. The type of anode coil that was used for this purpose was one which could

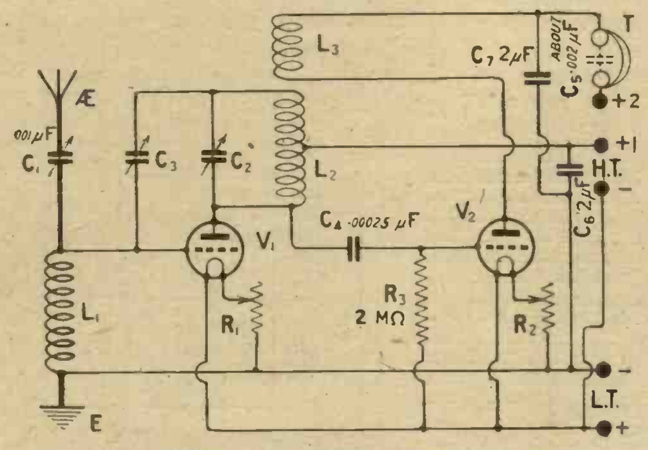


Fig. 3.—A reaction coil L3 is here added to the Fig. 2 circuit, in order to obtain oscillations in the circuit of the valve V2. From this arrangement no radiation could be detected, when the neutrodyne condenser C3 was correctly adjusted.

be brought near to the valve end of the anode coil L2. The coil used was one which could be placed over the valve V1 and a suitable size was a No. 50 or No. 75 plug-in type of coil. By bringing this coil close to the anode coil L2 of the valve V1, oscillations were produced in the circuit of the valve V2.

No Radiation Detected

No trace of radiation could be obtained from the aerial. A neighbouring aerial was made use of to listen for any trace of oscillation, this test aerial being a few feet from the aerial in use. A single valve reflex circuit was used on the test aerial. When the correct neutrodyne condition was obtained, no trace of oscillation could be heard. When the correct neutrodyne conditions were not obtained the heterodyne note of the valve V2 could be heard faintly.

A Safe Circuit

The circuit described was used to search for a number of distant stations, by finding the carrier waves of these stations, and it formed a very easy way for finding distant stations, without causing trouble to one's neighbours.

RADIO PRESS CALIBRATION SCHEME: FURTHER FREQUENCY TESTS.

The great popularity of the "Radio Press" calibration scheme, the results of which have been published recently, has been shown by the numerous requests received by us for a repetition of this test in the near future.

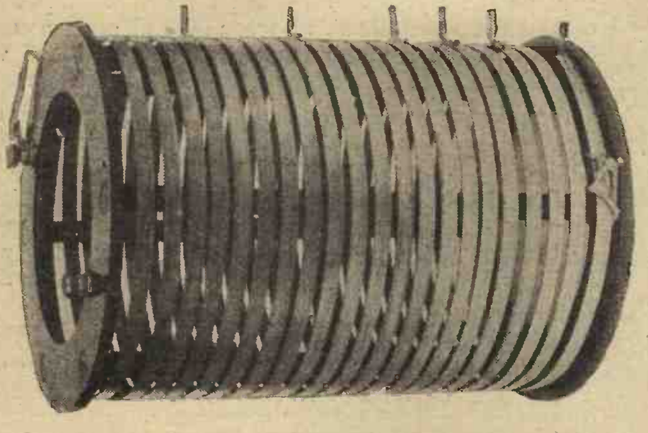
We are accordingly pleased to announce that the frequencies of all the B.B.C. main stations, and also of certain Continental stations, will be measured on Wednesday, December 30, commencing at 7.45 p.m. The exact times of measurement for each station are given below, together with their approximate frequencies :—

Time.	Station.	Frequency. Kilocycles	Wavelength metres.
7.45 p.m.	Cardiff	850	353
7.50 p.m.	Seville	840	357
7.55 p.m.	London	822	365
8.0 p.m.	Madrid (Union Radio) ..	804	373
8. 5 p.m.	Manchester	794	378
8.10 p.m.	Oslo	785	382
8.15 p.m.	Bournemouth	777	386
8.20 p.m.	Madrid (Radio Iberica) ..	765	392
8.25 p.m.	Dublin	752	399
8.30 p.m.	Newcastle	743	404
8.35 p.m.	Munster	732	410
8.40 p.m.	Glasgow	711	422
8.50 p.m.	Rome	706	425
8.55 p.m.	Toulouse	696	431
9. 0 p.m.	Belfast	682	440
9. 5 p.m.	Ecole Superieure	655	458
9.10 p.m.	Frankfurt	638	470
9.15 p.m.	Birmingham	626	479
9.20 p.m.	Aberdeen	606	495
9.25 p.m.	Zurich	583	515

It is, of course, possible that some of the above stations may be badly jammed, or not working, at the above times; this, however, will be stated in the report of the results.

Calibrations of other stations may be taken at the same time, so that it will be well worth while to listen to, and take the readings of, any other stations that may be heard on that evening.

Further Notes on Finding the Nodal Point



In last week's issue details were given of a method of finding the nodal point on transmitting inductances. Some additional information is given here, applying the same principles to the determination of nodal points on inductances at different frequencies, together with notes on the Hertz type of aerial system.

IN last week's issue of *Wireless Weekly* the writer gave a brief description of a method used for finding the voltage distribution across a transmitting inductance and some of the curves obtained thereby. Some further curves are given in this article, and further on will be found some remarks relevant to the case where an R.F. feeder is used to couple the transmitter to the aerial.

The Hartley Circuit

The curves shown in Fig. 1a were obtained with the circuit shown in Fig. 1b. This will be seen to be the ordinary Hartley oscillator, in which a tap is taken from the transmitting inductance to low-tension negative. These curves were taken at a frequency of 1,579 kilocycles (190 metres) and with the L.T. tap connected to the fifth and tenth turns respectively. Actually it will be noted that the nodal point does not occur exactly at these turns, which is due to the fact that the earth connection was taken to the low-tension terminal and not to the tap itself on the coil. There was, therefore, a certain voltage drop across this lead, with the result that the nodal point was displaced a trifle from the actual position of the L.T. tap. With the L.T. tap connected to the fifteenth turn the circuit would not oscillate, and it was therefore not possible to plot a curve for this.

Change of Frequency

The curves shown in Fig. 2a were obtained with the same circuit, but at a frequency of 3,529 kilocycles (85 metres). It will be seen that the shape of these curves is similar to the Fig. 1a curves, except for the fact that they are not quite regular for the plate end of the coil.

A point of interest with regard to these curves is that the maximum potential on the grid side of the earth tap on the coil is in every case higher than the maximum potential obtained on the plate side. This explains a point that has been noted by the writer in transmitting, to the effect that when using either the Hartley or the Reinartz oscillator coupled directly to the aerial the maximum aerial current was obtained when the aerial tap was on the grid side of the earth tap and not on the plate side, as is usually shown in diagrams of transmitters. This effect has also been noticed by other transmitting amateurs with whom the writer is acquainted.

Constant Frequency

Two of the advantages of the method quoted of coupling a transmitter to the aerial circuit are that the R.F. feeder does not carry any appreciable current, being connected, as it is, to a high voltage point of the transmitter inductance. Its resistance, therefore, does not greatly matter, and it can be of any convenient length according to the position of the transmitter with respect to the aerial. Further, the transmitter will behave very much like a master oscillator, and swinging of the aerial or counterpoise leads will in no way affect the emitted frequency, a point of particular importance when dealing with the very high frequencies.

The Coupling Condenser

The coupling condenser can be very small, and it may be variable with advantage, to determine what is the best value with which to work. A convenient way of making up this condenser is to have two copper or brass plates about 3 in. in diameter and about ¼ in. away from each other. If one of these be mounted on a screw, it is an easy matter to alter the capacity of the condenser by bringing the plates closer together or moving them away from each other.

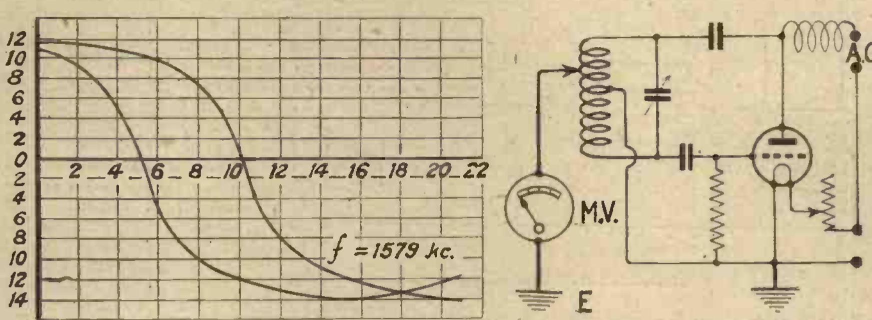


Fig. 1.—Curves of the type shown here were obtained with the Hartley oscillator circuit. It should be noted that the earth connection was made direct to the low tension.

A Difficult Case

A point to be borne in mind by those wishing to experiment with this method of coupling the aerial to the receiver is that it is quite possible, especially in cases where a very small aerial inductance is being employed, that the nodal point may not actually lie on the inductance itself, but may be somewhere in the leads from the aerial or counterpoise, or in the aerial or counterpoise itself. Under these circumstances the determination of the nodal point is not so easy a matter, as it is hardly practicable to climb out on the roof or to crawl out along the aerial with a Moullin voltmeter in one hand, taking the readings as you go along.

The Hertz Aerial

As this type of coupling is particularly suitable for use with what is called a Hertzian aerial, and for working on the very high frequencies in the neighbourhood of 15,000 kilocycles (20 metres), the best plan is to put up an aerial of this description which has a natural frequency of this order and take the R.F. feeder to a point exactly one quarter the way along from one end.

The Hertzian aerial may either be vertical, as used at KDKA and described by Mr. Percy W. Harris in the Vol. 6, No. 16 issue of *Wireless Weekly*, or it may be horizontal, of the type used by some of our leading amateurs over here.

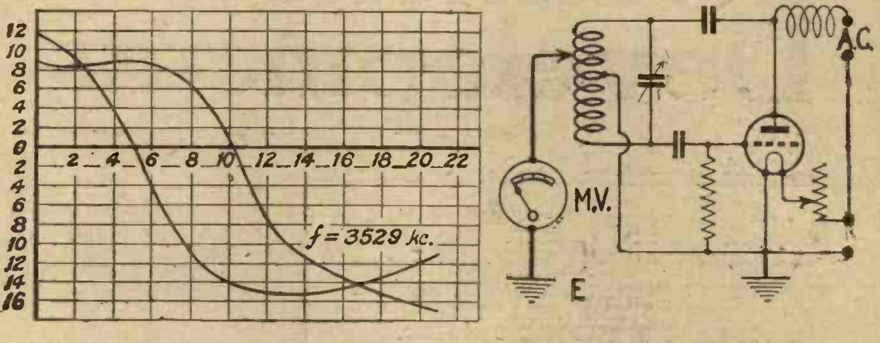


Fig. 2.—These curves, obtained at a frequency of 3,529 kilocycles, may be compared with those shown in Fig. 1, the same circuit being used in each case.

For working at a frequency of 15,000 kc. (20 metres), the Hertzian aerial may be 20 metres long, with the feeder connected 5 metres from one end.

Resonance Indicator

For indicating resonance a hot-wire meter may be shunted across a small portion of the aerial at its centre, but as it is not very convenient to read a meter placed at some distance from the set a flash-lamp bulb may be employed, and when the transmitter is being adjusted it will glow brightest when the frequency of the transmitter is in resonance with the natural frequency of the aerial.

If the aerial is located near to earthed objects, trees, buildings, etc., it will probably tune to a slightly lower frequency than would be expected, and it will then need to be shortened a little.

C. P. A.

An Improved Lead-In

In spite of the many articles published in Radio Press publications from time to time emphasising the importance of an efficient lead-in, many experimenters still do not seem to pay half as much attention to this as to the rest of their aerial, and feel that "anything will do."

The best way out of the difficulty in many cases is to bore a hole in the centre of the window-pane, but this does not appeal to many, probably on account of domestic difficulties.

Lead-in Tubes

The chief difficulty with the ordinary popular ebonite tube with a threaded 2B.A. rod through it is that if it is fixed at the bottom of the window no provision can readily be made to protect it from rain. On the other hand, if it is fixed at the top, being then in the shelter of the brickwork jutting out above the window, the actual wire generally has to pass very near this brickwork, unless a special guying arrangement is used, and, also, the whole length of the tube runs parallel to, and very close to, this brickwork.

An Improved Arrangement

The writer has done his best to improve a lead-in of this cheap type, and to eliminate the disadvantages mentioned above. A reference to the sketch will show the scheme of construction. First, two reel insulators

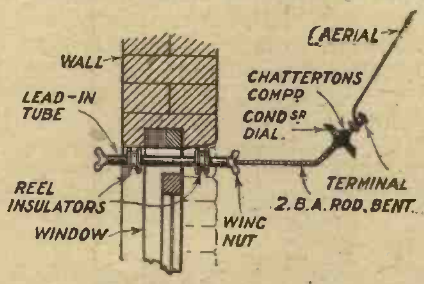


Fig. 1.—Details of the suggested method of arranging the lead-in may be gathered from this sketch.

are fixed to the top of the window frame by binding them round the outer groove several times with wire, and fixing the ends of the wire to screws or nails knocked upwards into the wall.

Fitting the Lead-In

An ordinary ready-made ebonite lead-in tube is then pushed through the centre holes (a fairly tight fit results), and a large wing nut, such as is used for accumulator terminals, is half screwed on the end of the 2B.A. rod. Another length of 2B.A. rod, preferably about 14 in. long, is then screwed tightly into the other end of this nut. If desired a lock-nut may be placed on either side of the wing-nut, a large washer being necessary on one side.

Protection Against Rain

The 2B.A. rod is then bent upwards (this can be done quite easily by hand), and an ebonite disc, or an old condenser dial, fixed as shown, to act as a watershed. This should be "sealed" to the rod on either side by Chatterton's compound. Another pair of nuts, or a nut and a terminal, are then screwed on the end of this rod, to which the aerial wire is attached.

Advantages

It will be seen that the lead-in is thus kept at a reasonable distance from the building without guys, and the tube itself is at a sufficient distance from the top of the window-frame to reduce losses considerably.

L. H. T.

Inventions and Developments

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

TWO somewhat interesting patents for variable condensers have recently been taken out. The first of these, No. 242425. of the Dubilier Condenser Co., employs an arrangement of two metal plates, these being sheets of tinfoil, separated by a mica or other suitable dielectric. One of these is fixed but has a hole in the centre. Through

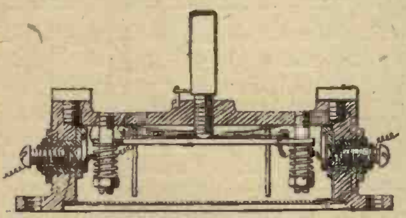


Fig. 1.—In this variable condenser, Patent No. 242425 of the Dubilier Condenser Company, the screw forces the moving plate downwards against the two springs.

this hole a screw, mounted in the casing of the instrument, projects and bears on the moving plate, which is carried on two guide rods, as will be seen from Fig. 1. As the screw is moved down, therefore, the moving plate is pushed away from the fixed plate, and on the reverse motion of the screw the springs shown in the figure cause the plates to return into proximity to the fixed plates once more. Variation of capacity is thus obtained.

Main Objects of Invention

It is claimed that the object of the invention is to provide an improved form of condenser, which is simple in structure and easy to operate, and which may readily be mounted on a panel. In addition, that very precise adjustments of capacity may be obtained, and that ample protection for the moving parts is provided by housing them in case.

A Mercury Electrode

The second type of condenser, which is described in Patent No. 241992 of Rudolf Woods, employs mercury for one of the electrodes of the condenser. The construction of the instrument is illustrated in Fig. 2, there being one semi-circular plate carried on a suitable disc. Over this there is a sheet of suitable insulating material, such as mica. The whole is enclosed in a shell of insulating material, and into the space between the walls of the shell and the insulating disc previously referred to a small amount of mercury is introduced. This mercury forms the second plate of the condenser, so that the capacity may be conveniently altered by a rotation of the whole. This form of construction, of course, has several advantages, but the instrument must always be mounted in a vertical position, as shown in the drawing.

A Further Refinement

In another form of this variable condenser provision is made for controlling the amount of mercury present inside the shell, the minimum capacity of the condenser being therefore reducible to a small value. A small hole is provided at the lower end of the mercury chamber, communicating with a cylinder and plunger. This plunger is fitted to a screwed rod, so that its position in the cylinder can be slowly varied, thereby withdrawing from or returning to the mercury chamber the exact amount of mercury required.

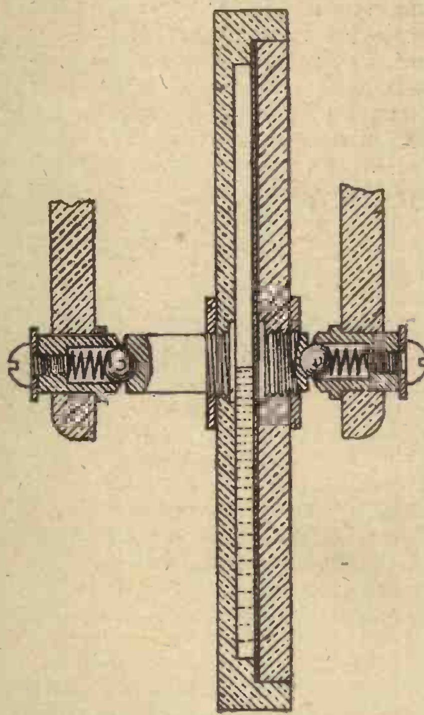


Fig. 2.—The mercury which forms one electrode in Rudolf Woods' variable condenser, Patent No. 241992, is contained in the lower half of a shell of insulating material.

QRA'S WANTED

As we are at present revising our list of British amateur call signs, all amateurs who are licensed for transmission are invited to send the following particulars:—Call sign, name, and full address.

Please address communications to Book Editorial Dept., Radio Press, Ltd., Bush House, Strand, London, W.C.2.

WE have good reason to be proud of the new Brown H.4. To produce a complete Loud Speaker —a miniature in every respect of the larger Brown models—at the price of a pair of good headphones is a wonderful manufacturing feat. You must remember that this new H.4 is a real Brown—it is fitted with a similar tuned reed movement to that found in Brown Loud Speakers costing four times as much. The Brown H.4 is the only low-priced *sensitive* loud speaker on the market.

Owing to its extreme sensitiveness it requires considerably less power to operate it. Comparative tests have proved that the Brown H.4 will give loud and clear results from two valves when other low-priced Loud Speakers require at least three valves to produce the same volume. There's a simple explanation for this. The Brown uses a cone-shaped aluminium diaphragm of extreme thinness actuated by a vibrating reed. The slightest movement of the reed is transmitted to the diaphragm and converted into audible sounds. The ordinary small Loud Speaker, however, uses a flat diaphragm of iron. The diaphragm must be made substantial in order to give it the necessary springiness to vibrate. The smaller the diaphragm the less resilient it will become—and the more power it will require to actuate it.

Don't judge the Brown H.4 on its price —the only fair test is its actual performance. Because only the Brown can use the tuned reed principles of reproduction only the Brown can obtain such sensitiveness and volume from a Loud Speaker standing but 10 inches high. If your Dealer has not one in stock yet, place your order right away. Our works are making every effort to cope with the huge orders we have already received for this amazing little H.4.

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Retail Showrooms: 19 Mortimer Street, W.1. 15 Moorfields, Liverpool. 67 High Street, Southampton.

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A genuine Brown at the price of a pair of 'phones

Gilbert Ad. 4229.

Wireless News in Brief.

Forthcoming B.B.C. Events. The following are some of the items in the B.B.C.'s programme for the week commencing December 27:—

December 27. — London: A Christmas Oratorio (Bach). Newcastle: Pianoforte Recital, by Leff Pouishnoff.

December 28. — Birmingham: Mendelssohn's Oratorio, "St. Paul."

December 29.—Manchester: A Welsh Night.

December 31.—London: A New Year's Message, by Dr. Archibald Fleming.

January 1.—Cardiff: A Phantom Pantomime.

January 2.—London: A Gather-round.

* * *

The B.B.C. time signal schedule, which will be carried out regularly in future, is as follows:—The 10.30 a.m. signal will be sent out from 5XX every day; the 1 p.m. signal from 5XX and 2LO every day except Sundays; the 4 p.m. signal from 5XX and 2LO every day; and the 10 p.m. signal from all stations every day.

* * *

Instead of superimposing the time signal on a programme which may happen to overrun its time, the B.B.C. engineers will in future cut out the programme, so that the signal will be free of interference.

* * *

A play by Mr. Bernard Shaw, which he wrote for the benefit of the Actors' Orphanage on July 14, 1905, and entitled "Passion, Poison and Petrifaction," will be broadcast on January 12. It is hoped that "G.B.S." will yield to persuasion and appear before the microphone to give a short message of explanation to the millions who will be listening to his one-act play.

* * *

Wireless in Russia. It is reported that a successful Wireless Exhibition was recently held in Moscow, many German, Dutch, and American firms taking part. Special interest appears to have been aroused by the exhibit of an American 20-watt transmitter for 1,500 kc. (200 metres).

* * *

We hear that six powerful broadcasting stations are to be built in the provincial cities of Astrakhan, Rostov-on-Don, Kharkov, Ekaterinoslav, Skerdlovsk, and Petrosavodsk, and that equipment for these new stations has already been completed.

* * *

We hear that a German inventor claims to have developed a high-frequency generator with which he hopes to supplant the valve on frequencies up to 3,000 kc. (100 metres). A high-frequency alternator is employed for the production of oscillations, a special form of rotor being used. The frequency is claimed to be held within very narrow limits by means of a special regulating device. It appears that the higher frequencies are obtained by multiplication of the normal frequency by means of harmonics.

* * *

Radio Revels. Wireless played a prominent part in the Radio Revels at Olympia last week. The enormous crowd was able to dance to music relayed from such distant places as San Sebastian, Brussels, and Berlin. At midnight music was relayed from the newly opened broadcasting station at Berne, Switzerland. The distant transmissions were picked up at Hayes, Kent, and thence relayed by land line to Olympia.

* * *

While experimenting recently, Mr. J. A. Partridge, the well-known Wimbledon amateur, established two-way communication with an amateur in Christchurch, New Zealand, and by this means learned that the Government high-power station at Rugby had been heard in that country.

* * *

Listeners in France. French listeners have at last received an answer to a question which has been exercising their minds for three years: "Will there be a State monopoly of broadcasting?"—the State virtually accepting the trust through its imposition of taxes on wireless receivers. The new taxes are about 9s. 6d. for valve sets during the first year, and 8s. for succeeding years, in English money equivalents at the present exchange rate. Cheaper rates are in force for crystal sets.

There is also a drastic provision that apprehended "pirates" must pay ten times the normal amount due.

* * *

We understand that Mr. Robert Moffat Ford, who was recently fined £10 and ten guineas costs for using a wireless receiver without a licence, was subsequently arrested at his home at Albert Gate, S.W. He refused to pay the fine and was imprisoned. After half-an-hour in the cells he paid the fine and was released. Previous to his arrest he had taken out a licence.

* * *

It is reported that no less than six hundred summonses have been taken out against residents of Aberdeen suspected of possessing unlicensed wireless sets. A great rush for licences immediately resulted.

Transformer Humbug—How F

By PERCY W. HARRIS, M

This article will come as who are bound to be un the amplification curves p makers are really indicati

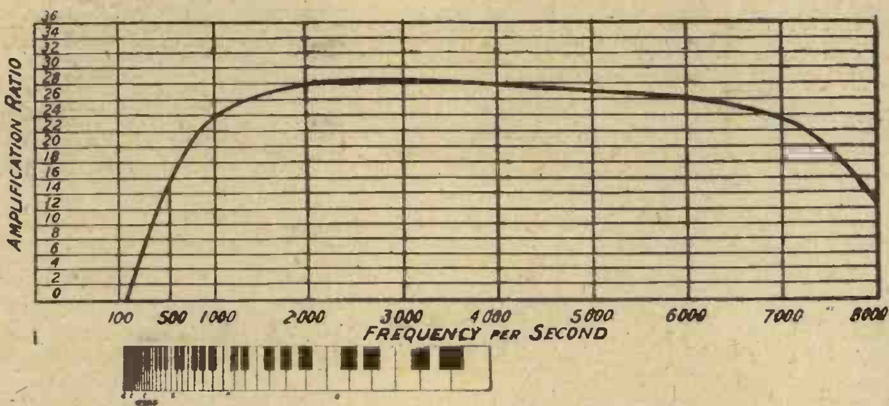


Fig. 1.—Above: an imaginary L.F. transformer curve, plotted in the conventional manner. Below: a piano keyboard drawn to correspond with the musical frequencies plotted above it.

IN the last year or two it has become fashionable for manufacturers of low-frequency transformers to publish curves for the purpose of indicating the faithfulness of reproduction by their own particular instruments. Such curves, which are often vouched for by the National Physical Laboratory, are most impressive to the uninitiated. I have one before me as I write. It is not the best I have seen, and it does not pretend to be a straight line, but on a good portion of the journey from one end of the chart to the other it is fairly level and would indicate at first glance a fair uniformity of reproduction.

Misleading Curves

Yet actually this, like other similar curves, is a piece of humbug, and it is about time we woke up to the fact. Do not mistake me. I am not suggesting for a minute that the figures given are wrong or that the curve is inaccurately drawn. To understand how grossly misleading it is we must examine it carefully and consider the manner in which the facts about the transformers are expressed.

Valves and Transformer Design

The curve is plotted to show voltage amplification against frequency. At this point it is well to mention that the curve for a transformer used with one particular type of valve may be entirely different from that given for another type. Some makers design their transformers to give good reproduction with a particular type of valve; others design them to work passably well with any of the valves generally used, while still others produce two or three different types of transformer, specifying for which kind of valve each type is designed.

Correct Connections

Now, although a good general average can be struck, every transformer will work better with some types of valve than with others, and usually there is a "best way round" for both primary and secondary workings. By this I mean that some transformers work better with I.P. anode and others with O.P., while in practically every case the O.S. goes to the grid. All these facts should be borne in mind when judging a transformer; yet even if we work the transformer with the particular type of valve for which it is designed, and with the correct connections of both primary and secondary, we may get very different results from those we are led to expect by a cursory glance at the voltage amplification curve published by the makers.

A Sample Curve

Let us look at the curve closely. The one I have in front of me is drawn on squared paper with frequency shown in cycles per second along the bottom line and the voltage amplification indicated vertically. The cycles are marked off from 0 to 5,000, while the allowance made for voltage amplification is up to 40, although the maximum at any point in this case is 21. The first reading is taken at 250 cycles, the voltage amplification being 14. At 400 cycles the figure reaches 17, while at a thousand it is 20, and then forward to 4,000 it remains roughly at this figure. Thus for a good portion of the curve the voltage amplification is fairly constant.

Musical Frequencies

What we are always liable to overlook is that 250 cycles is a fairly high note, and that, furthermore, arithmetical progression in cycles is not at all a suitable way of showing musical frequencies. If we were to show frequencies in the proportion of a piano scale we should have to go in geometrical progression—thus 2, 4, 8, 16, 32, 64, 128, and so on. Speaking in round figures, the middle C is about 250 cycles; 400 cycles is only four notes above the middle C, while 4,000 is a little beyond the upper end of the scale.

The Piano Scale

I believe that the lowest note on the piano is somewhere below 30 cycles, and in any case if you were trying over a piano with the idea of seeing whether it was good enough to buy, I do not suppose you would ignore all the notes below the middle C. I do not play the piano myself, but I should certainly want to know "what was doing" at the

ublished Curves Mislead Us

.I.R.E., Assistant Editor.

a shock to many readers der the impression that ublished by transformer be of their performance.

bass end just as much as at the treble end of the scale.

Redrawn Curves

I am not reproducing any actual curves in this article (N.P.L. or otherwise), since an actual curve of a particular transformer could perhaps be identified, and I do not want my life to be suddenly terminated by an irate transformer manufacturer with a grievance, but I can tell you, and you can work it out for yourselves if you like, that redrawing a transformer curve according to the piano scale transforms it from a rather steep cliff with long flat top to something which much more resembles the gentle gradients of a scenic railway. Of course, most of the transformer manufacturers are more or less aware of all these facts, although I am sure that some of them have not thought over the matter very carefully.

The Higher Frequencies

It is customary to say that it is the higher frequencies that are so important in faithful reproduction, for without good reproduction of these higher frequencies the delicate harmonic sounds are not properly reproduced. I do not deny that the higher frequencies are very important, but it is no good blinding ourselves to the fact that the lower frequencies are equally important if we want faithful reproduction. An inventor would not claim for a process of colour-photography that the yellow was highly important and the blue did not matter. Such arguments in relation to low-frequency transformers only pass, because the average man has not proper facilities for checking up faithful reproduction, whereas in colour-photography inaccuracies are obvious at once.

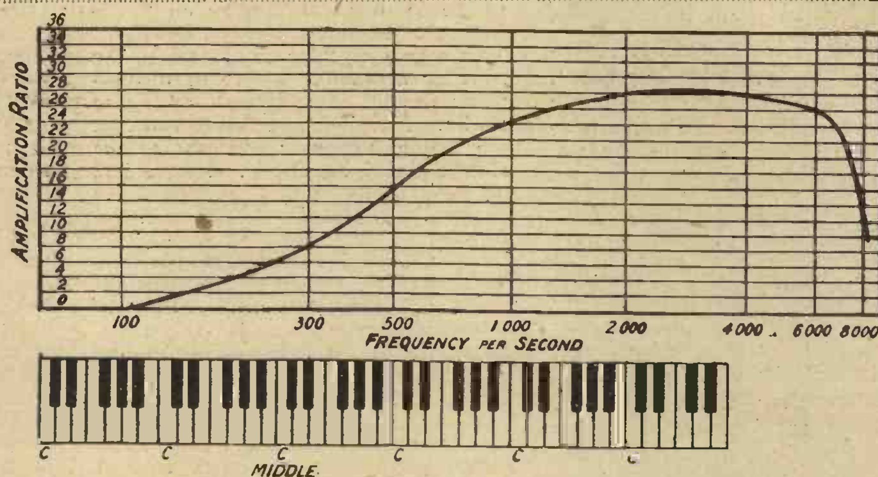


Fig. 2.—The same curve redrawn on a scale corresponding with the piano keyboard below. Notice how the shape of the curve is entirely changed.

The Kellogg Loud-Speaker

I did not realise until visiting the General Electric Company's Laboratories at Schenectady this year how much of proper reproduction the lower frequencies affect musical and vocal reproductions. Mr. Kellogg, the joint inventor of the remarkable loud-speaker, of which I have previously written, very kindly carried out some experiments before me with the aid of a microphone, which really gave a faithful reproduction of all frequencies, from the lowest to the highest, an amplifier properly corrected, and two or three types of loud-speaker, including his own. Music from the WGY Studio was on tap and was switched on to the well-known make of loud-speaker, which gave results which I immediately decided were exceedingly good and faithful.

A Startling Difference

Actually the particular loud-speaker was not perfect in its reproduction of the lower notes, and when a change was made to a loud-speaker which did give proper reproduction of the lower end of the scale, I was astonished at the difference. By comparison the first loud-speaker was exceedingly poor, and probably the reason why I thought it good, before hearing the second example, was that I had become so accustomed to the average loud-speaker reproduction that my finer judgment had been blunted.

An Interesting Experiment

There is not much difference to be noticed between the loud-speakers generally used, in the lower notes, and we have become accustomed to an absence of faithfulness at the lower end of the scale, but how important these low tones are I immediately realised when Mr. Kellogg performed a most interesting experiment with the aid of some large glass bottles, over the mouths of which were placed pieces of metal and wood, which, when struck with a drum-stick, gave musical notes. These notes, by resonance in the bottles, produced sounds of a booming quality very rich in lower tones. The experiment was performed first in my presence and then through loud-speakers in the room. On the first loud-speaker the sound reproduced was entirely different from the original, whereas on the second loud-speaker the reproduction, so far as I could judge, was scarcely distinguishable from the original.

Cramping the Loud-Speaker

I have deliberately side-stepped from my argument about transformers into an explanation about loud-speakers in fairness to the transformer manufacturers, who sometimes say that as the average loud-speaker is unresponsive to the lower notes, it is useless taking trouble to get proper reproduction from the lower end of the scale. While there is some truth in the argument, there are plenty of loud-speakers now available which, while they will not give a perfect reproduction of the low booming notes, are yet able to reproduce much better lower notes than the average transformer will give them.

Essentials for Good Reproduction

For faithful reproduction a number of factors have to be taken into account. The microphone must respond truthfully to all frequencies within the practical limits, the amplifiers and the transmitting apparatus must be free from distortions, the receiver must be good, and the loud-speaker or telephones also must be of good quality. The British Broadcasting Co. have reached a very high level of technical excellence in the microphone, and fortunately we have a number of really excellent transformers and loud-speakers available.

Iron Cores

I do not number myself among those who claim that iron-cored apparatus is bound to introduce noticeable distortion, for I have frequently heard reproduction with iron-cored instruments which I would defy anyone to distinguish from the best reproduction of resistance capacity amplifiers. What I do wish to emphasise is the absurdity of trying to get an adequate idea of the quality of the transformer from the ridiculously misleading curves now fashionable. If the transformer manufacturers want to show us curves, by all means let them do so, but let them be curves properly drawn to show the voltage amplification from, say, 50 upwards on a proper musical scale. It is possible to produce two transformers which give quite different reproduction, while their curves as at present published are practically identical.

Where the Curves Mislead

The truth of the matter is that amplification curves drawn in their present form are highly flattering to the average instrument, for by drawing them in a manner which is not at all comparable with the ordinary musical scale, the important lower frequencies, if indicated at all, are so congested at the left end of the scale that they are barely noticeable.

"THE NATURE AND SOURCES OF ATMOSPHERICS"

(See "Wireless Weekly," Vol. 7, No. 5.)

SIR,—I have read with interest the article in *Wireless Weekly* on "The Nature and Sources of Atmospherics." This article contains references to the Alps as a possible source of disturbances heard in England and also Berlin. Permit me to assure you that the Alpine region is innocent of the charge placed against it. I have had occasion to make quite a number of observations of radio reception in the Alps, and have found the region exceptionally free from atmospheric disturbances. In fact, there are locations about the Jungfrau range where in Midsummer reception is as undisturbed as in Midwinter in the less altitudinous sections of Europe. There is a peculiar and almost uncanny freedom from static in the High Alps. Static disturbances reappear in normal measure at a distance of 20 miles or so from the main Alpine range. For example, on top of Niesen-Kulm (26,000 metres) static is about normal; this peak is located at some distance from the main range. My impression from numerous observations such as these is that static is usually a quite localised affair. Indeed, marked differences in static intensity are observable within distances of a mile or so. It appears to me in general highly fallacious to reason that disturbances come, say, from Timbuctoo, because the frame aerial shows greatest strength of static when pointed in the general direction of that remote locality. If this assumption were valid, we should find a gradual increase of strength of static as we travel towards Timbuctoo. In Timbuctoo itself, at this rate, the disturbances must be so tremendous that no form of electrical signalling could possibly be carried on; I can only imagine the very distant source of all our atmospheric troubles as existing in an almost perpetual state of ear-splitting electrical uproar. To the Berliners who find their frames pointing a guilty finger at the shores of North Africa I would say: "I can show you localities a short distance south of Berlin which even in August are comparatively free from atmospherics. How do you account for your African or Alpine atmospherics jumping over these regions to reach Berlin?" I think that there has been a great mistake made on the part of most of the students of atmospherics, and that is that they have not travelled about enough to check up their observations. If the observers who studied the direction of atmospheric disturbances round the British coast had taken the trouble to so much as cross the Channel, they might have obtained results which would completely upset their deductions.

The above observations are sent in in the hope that they may be of interest and without any thought of criticising your excellent article.—Yours faithfully,

STANLEY MCCLATCHIE.

Stuttgart.

SIR,—Over-generalisation is an insidious habit which seems to assail otherwise prudent people when they begin to talk about atmospherics. Dr. Robinson's conclusion that atmospherics sometimes come from the Alps—a conclusion based on the occasional intersection of bearings which he is careful to quote as varying from season to season over a range of 30 deg.—no more implies that all atmospherics always arise in the Alps than do Mr. McClatchie's observations of occasional, or frequent, atmospheric quiet in the Jungfrau range persuade me that he has found a radiotelegraphic paradise where X's cease from troubling. Doubtless there are times in the Alps when reception conditions are very favourable; in Europe in general, on either side of the Channel, they are seldom very unfavourable. But on the other hand there is no doubt whatever that there is, in Midsummer, an important region of high thunderstorm frequency just north of the Alps, a region which can be traced from meteorological data, and which cannot fail to disturb reception in Alpine districts.

On the general question of inference from directional observations on atmospherics there is far more to be said than can be said even in the generous scope of your correspondence columns. Perhaps I may have the opportunity at some early date of saying it in another part of the paper. But meanwhile Mr. McClatchie's inference that if a number of guilty frames point to Timbuctoo, then Timbuctoo must be a very unpleasant place for DX work, is thoroughly sound, though he modestly doubts its validity. Although I have not yet had the privilege of visiting that city, I have sufficiently protected myself against your correspondent's scorn by crossing many a channel in pursuit of atmospherics, and in the course of a 15,000-mile chase I have studied atmospherics in places whose situations were not unlike that of Timbuctoo and in latitudes the same as and lower than that of Timbuctoo. As a description of the signalling conditions which sometimes prevail in those latitudes your correspondent's hypothetical picture is a model of reticence.—Yours faithfully,

R. A. WATSON WATT.

Datchet, Windsor.

[A further letter from Mr. Stanley McClatchie on this subject will be found on our correspondence pages.]

An Interesting Super-Heterodyne Circuit

By G. C. BEDDINGTON (Trinity College, Cambs.)

A few weeks ago we published an article by Mr. Beddington on a "Trigger" type of circuit suggested to him by Major Prince. We give here a brief account of the application of the same principle to the circuit of a super-heterodyne receiver, sufficient practical details being included to enable experimenters to try out the arrangement for themselves.

In a previous issue of *Wireless Weekly* (Vol. 6, No. 22) I dealt with the evolution and ultimate practical form of a "Trigger" circuit. I have recently carried out experiments in applying the same principle of intervalve coupling to the super-heterodyne. The circuit originally suggested to the author is shown in Fig. 1. In Fig. 2 is given the super-heterodyne

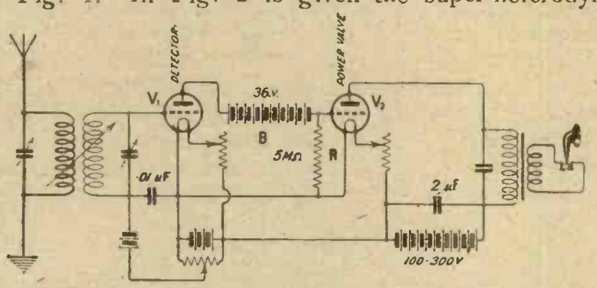


Fig. 1.—The circuit originally suggested to the author.

circuit, and comparison of the two diagrams will show the manner in which the "Trigger" principle has been incorporated in the super-heterodyne.

Five Valves

It will be seen that only five valves are employed, comprising one valve for the first detector and oscillator, one intermediate frequency amplifying valve, the second detector, one "trigger" amplifying valve, and one stage of low-frequency amplification. In spite of the apparent simplicity of the circuit, really loud loud-speaker results can be obtained with it, with good quality of reproduction.

Second Harmonic Method

As far as the operation of the circuit is concerned, the frame circuit L1C1 is, of course, tuned to the frequency of the incoming signal. The circuit L2C2 is tuned to a frequency such that its second harmonic (twice the fundamental frequency) produces with the incoming signal a beat frequency equal to that to which the transformers IF1 and IF2 are tuned. A note on the choice of the intermediate frequency is given later.

D is a good carborundum crystal detector, which helps to bring out the second harmonic. It may be found more satisfactory in some cases to tap the crystal across half only of the coil L2. The author has found that it is best to connect the circuit L2C2 in the grid circuit of the first valve as is shown in the diagram, rather than in the lead from the frame to the grid condenser.

The tropadyne method of coupling may also be used, but the author has found some advantages in the second harmonic method described.

Intermediate Frequency

The filter IF1 and the intermediate frequency transformer IF2 should be tuned to a frequency of about 150 kilocycles (2,000 metres), since this frequency appears to suit the "trigger" action best. The remaining main details of the circuit, including the "trigger" coupling components, may be gathered from the diagram. The filament resistances of all valves are shown fixed, except that controlling the second detector, which should be variable over a wide range.

Interesting Experiments

The grid of the second detector valve is maintained at a negative potential by means of a 1½-volt grid bias battery. The experiment of omitting the condenser C3 and the leak r may be tried, but when strong signals are coming in they will probably be best kept in circuit as shown. A further experiment which will sometimes give surprising results is to omit C3 and r, to cut out the final stage of transformer-coupled low-frequency amplification, and to insert immediately after the D.E.5B. type of valve a valve capable of handling really large power.

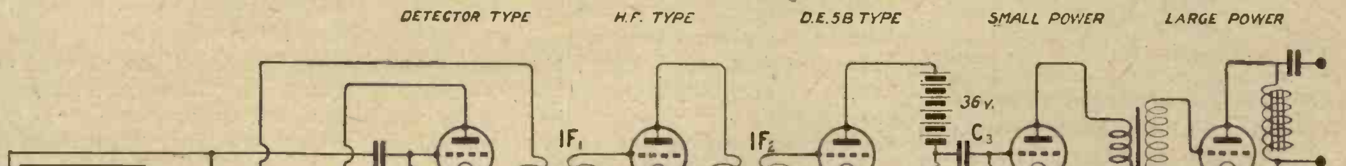


Fig. 2.—The complete super-heterodyne circuit. It should be noted that in practice it will be advisable to shunt the primary winding of the filter IF1 with a fixed or variable condenser.

AN INDUCTANCE-CAPACITY BRIDGE

By C. P. ALLINSON (6YF).

This article describes the construction of an instrument using the "bridge" method of measurement, and shows how it may be used for the measurement of unknown inductances and capacities.

The measuring instrument described in this article can be made up in a compact form.

It very frequently happens that the experimenter wishes to know the capacity of a condenser used in a particular circuit, and finds that the substitution process is rather a slow job, for he usually has to connect up two oscillatory circuits, in one of which a two-way switch is incorporated for comparing the unknown with a known capacity.

Source of Oscillations

If the local broadcast station is working he may be able to make use of this source of high-frequency oscillations, but if the unknown condenser is fixed it is very unlikely that it will tune any coil exactly to the frequency of this transmission,

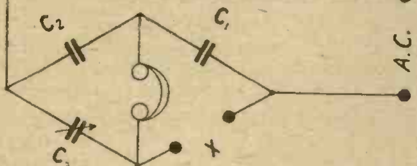


Fig. 1.—The basic circuit of the bridge. The capacity to be measured is connected in circuit at the points marked X.

and therefore the local oscillator method has to be used.

Measuring Inductance

If the experimenter wishes to know the approximate value of an inductance he has constructed, it becomes a rather more difficult thing. He must tune it with a known condenser to a known frequency, and calculate its value by means of the formula $f = \frac{1}{\sqrt{LC}}$, and then he has to make an allowance either for the self capacity of the coil or its attendant circuits.

All these methods take time on every occasion that it is desired to make any measurements of this description. The best thing to do, therefore, is to make use of a method which will take a certain amount of time once and once only, so that all future measurements may be done quickly and accurately. This is conveniently done by constructing an inductance-capacity bridge. The purpose of the following article is to indicate how to make use of such a bridge.

Circuit

The basic circuit of the bridge is shown in Fig. 1. If C_3 is a calibrated condenser, and the ratio of C_1/C_2 is known, we can determine the value of an unknown capacity inserted at X from the equation

$$X = \frac{C_1}{C_2} \times C_3$$

The correct value of C_3 is obtained when, on connecting a source of A.C., as shown across two of the arms of the bridge and a pair of telephones across the other two, a minimum sound is heard in the telephones at a certain adjustment of the calibrated condenser C_3.

To take a practical example: Suppose $C_1/C_2 = 2$, and, with an unknown condenser connected at X, the least sound is heard in the telephones when C_3 is set at 50 deg., and the calibration curve of this condenser gives us a capacity of .00028 μF at this setting, then the value of the unknown condenser is .00056 μF.

By substituting condensers of different value at C_1 and C_2 it would be possible to measure capacities above and below the range of the calibrated condenser C_3 by choosing suitable ratios. This would necessitate the possession of a number of known condensers. At the same time it would mean that one calibrated condenser would be tied up in the instrument for C_3.

Few Calibrated Components

There is, however, a method by which, with only two fixed condensers and one unknown variable, the bridge can be used to determine the capacity of any unknown capacity within certain limits. The circuit is shown in Fig. 2. If C_1 and C_2 be one fixed and one variable condenser of unknown capacities, but of which the ratios of one to the other at various settings will have been determined by a method to be described later, and the capacity of C_3 be known, the value of a

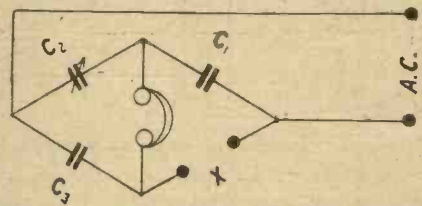


Fig. 2.—With this arrangement, the value of the condenser C3 being known, the capacity of any unknown condenser can be determined within limits.

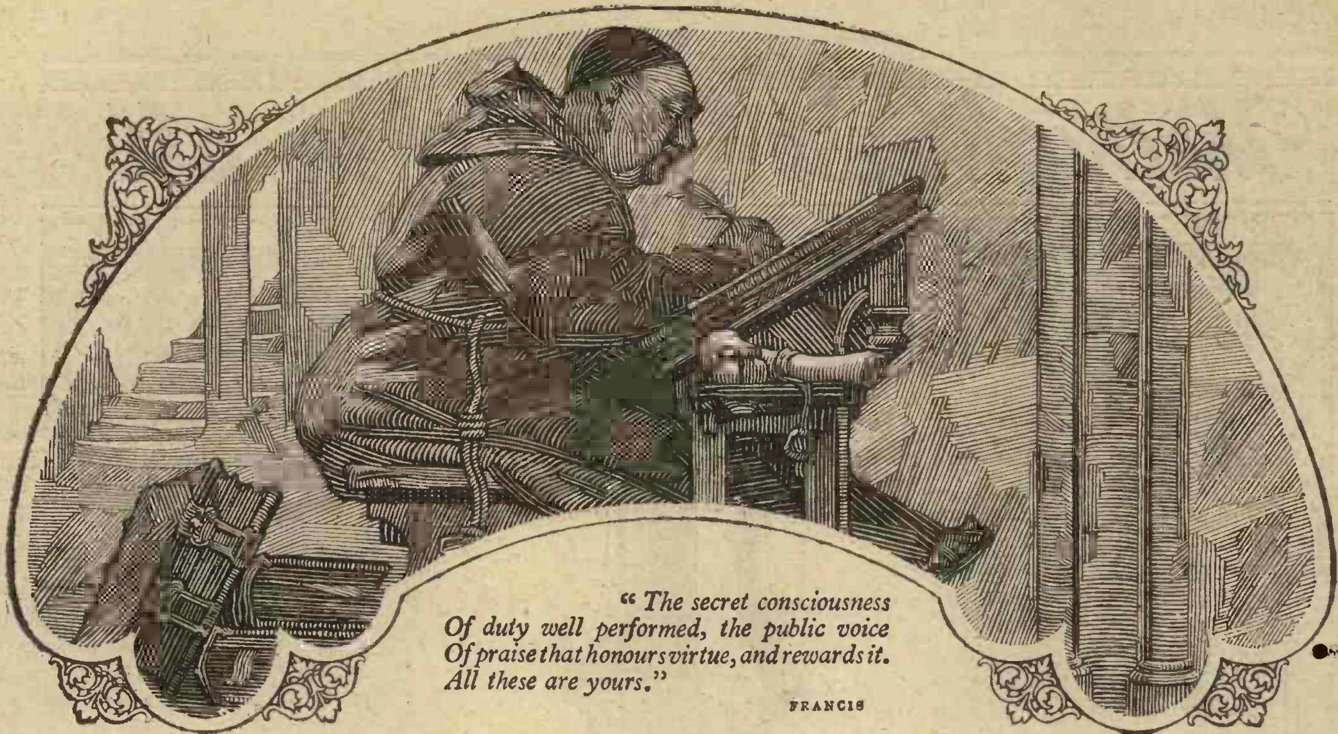
capacity connected at X can then easily be determined.

Source of A.C.

The experimenter who has one calibrated variable condenser can easily set up this bridge. The method employed in determining the various ratios and the value of C_3 is shown in Fig. 3. A buzzer is connected in series with its battery and the primary of a microphone transformer T_1 T_2, the secondary serving as the source of A.C. required, The ends of the ratio arms containing the ratio condensers are connected to a reversing switch S as shown, the fixed condenser that is to serve as C_3 being connected in one of the remaining arms. Across the terminals provided for the connection of an unknown condenser we connect the calibrated variable condenser shown at C_4.

Measurement

Suppose the maximum capacity of this is a little over .001 μF, and that the condenser C_3 has a nominal value of .001 μF. Then, if the ratio of C_1/C_2 at a certain setting of C_2 is 1 when C_4 is adjusted to



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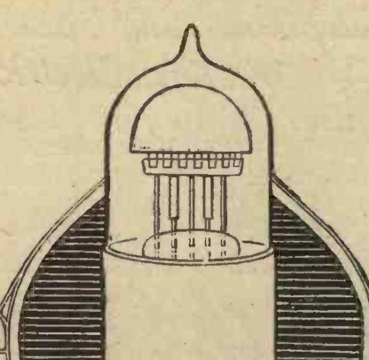

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give a minimum sound in the 'phones with the buzzer switched on, the value given by the calibration curve for C4 will be the value of C3. If C1/C2 is 1, reversing the switch S will not shift the silent point adjustment of C4, therefore the condenser C2 is adjusted till this condition is reached. The condensers C1 and C2 are chosen, of course, to have nominal values very near to each other, C1 being a little less than C2.

Various Ratios

We now know C3. Next set C4 at half the value of C3 and adjust C2 with the switch to the right till the silent point is found. Then the ratio of C1 to C2 is 2 to 1. Set C4 to another fraction of C3 and obtain another reading of C2, and so on till a number of ratios have been obtained.

Another Method

Another method is to plot a curve as shown in Fig. 4. Since the value of C1 is fixed any change in C2 will produce a certain variation in the ratio of C1 to C2, and this can easily be plotted, ratio against degrees, as shown in the figure. It will, of course, be necessary to plot a second curve in which the ratio is a fractional one for measuring capacities which are less than C3, and this, of course, is quite a simple matter.

For instance, when C1/C2 is 3:1 then C2/C1 will be 1/3, and when C1/C2=2.5:1, then C2/C1 is 2/5, and so on.

These two curves then enable us to obtain the ratio of C1/C2 or C2/C1 as required, according to whether the switch is to the left or the right for obtaining the value of an unknown condenser which is

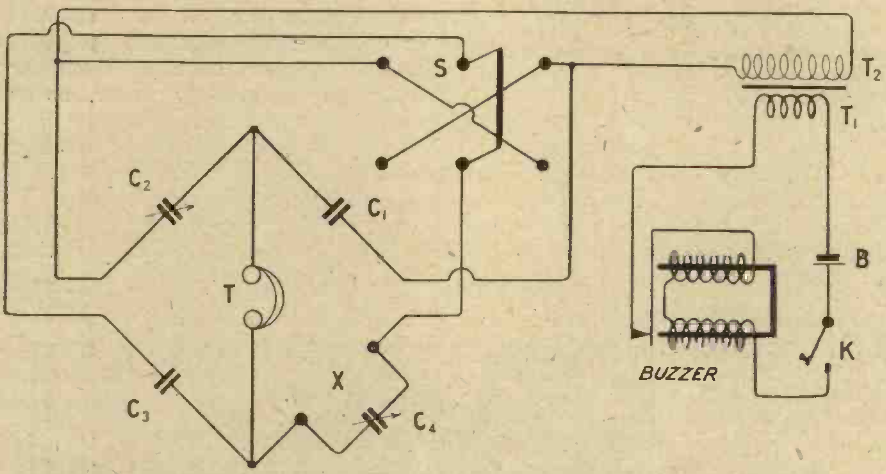


Fig. 3.—The circuit used for determining the value of the condenser C3, C4 being a calibrated variable condenser.

The next point will be to plot some scale or chart by which the ratios of C1/C2 may be read off for most settings of these condensers. One method is to make up a table such as shown below, obtaining each of the values given experimentally.

C1	C2	C1/C2	C2/C1
Fixed	180	1	1
,,	170	1.06	.943
,,	160	1.125	.888
,,	150	1.2	.833
,,	140	1.25	.8
etc.	etc.	etc.	etc.

The measurement of a higher or lower capacity than that of C3 is effected by reversing the switch S which reverses the ratio arms containing C1 and C2, so that a setting of C2 which gives a ratio of 2:1 will give 1:2 when the switch is reversed.

either greater or less than C3 as the case may be.

Inductance Measurements

The bridge can also be used for measuring inductances. In this case the fixed condenser C3 is replaced by an inductance of which the value is known. The unknown inductance is connected across the terminals. The action of the bridge will be exactly the same as regards operation all except one point, *i.e.*, that the ratio of C1 to C2 will need to be reversed when using this as an inductance bridge, namely, when the unknown inductance L2 is greater than L1, then the left-hand arm must be greater than the right-hand (*i.e.*, C1<C2), while the reverse holds in the case of capacities, for in Fig. 2 C1 must be greater than C2 when the unknown capacity is greater than the known. Fig. 5 shows the connections.

Reactance and Inductance

We can easily see from Fig. 3 that since the reactance of a condenser at a given frequency is *inversely* proportional to its capacity the ratio of C1 to C2 will be the

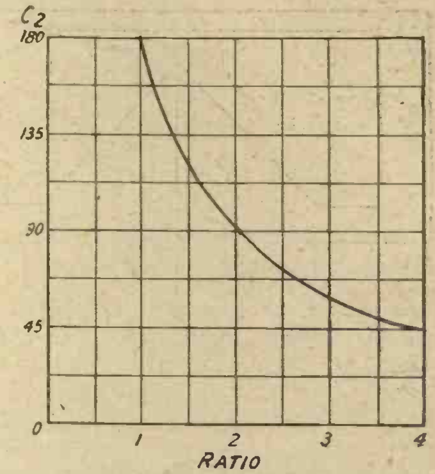


Fig. 4.—The curve obtained for various ratios of capacity between the condensers C1 and C2 in the bridge circuit.

same as that of C4 to C3, when a balance has been obtained. Since, however, the reactance of an inductance is *directly* proportional to its value of inductance, if we use capacities in one of the arms of the bridge and inductances in the other, it naturally follows that the ratio will be reversed. Thus in Fig. 5 the ratio of C1 to C2 will be the same as the ratio of L1 to L2 at the point of balance.

Comparing Inductances

It should be noted that when comparing inductances, if there is

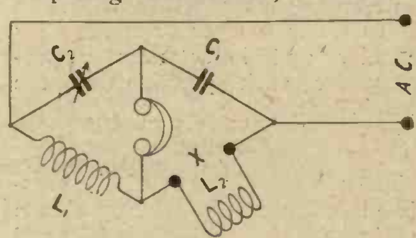


Fig. 5.—The method of comparing inductances shown here may be employed when the resistances of the coils to be measured are approximately equal.

any serious difference in resistance in these, it will be difficult to find the silent point or point of balance. It therefore becomes necessary to insert a small resistance in series with one or other of the coils, the correct one being ascertained by trial. Under these conditions it will probably be found easier to obtain a point of balance.

A small resistance should therefore be provided with a switch, by means of which it may be placed in either arm of the bridge when measuring inductances. This resistance will, of course, need to be variable and may be of the carbon compression type.

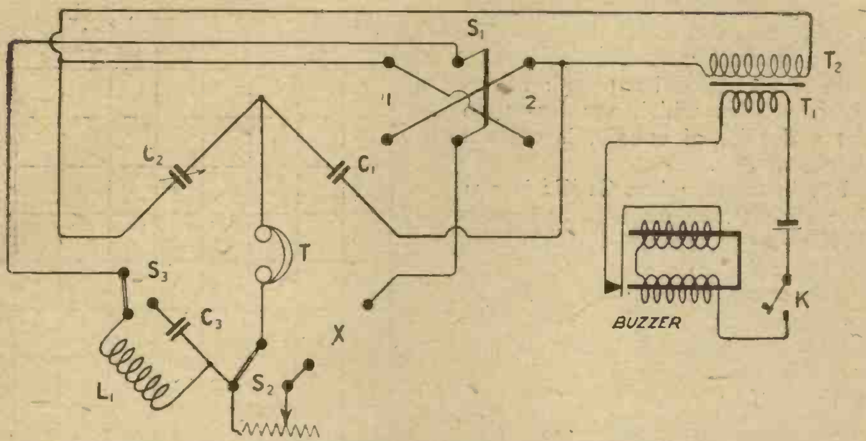


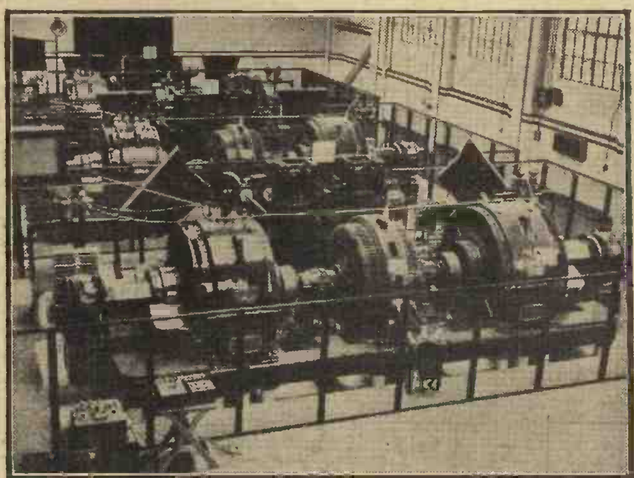
Fig. 6.—The circuit diagram of the complete instrument, for measuring or comparing either inductances or capacities. The switch S2 is used to insert resistance if required when comparing inductances whose resistances are widely different.

Marking of Instrument

Now it has been necessary to fit a reversing switch in order that the ratio of C1 to C2 may be a greater or smaller one as required, and it should be clearly marked on the instrument as to whether this ratio applies to inductances or capacities. It would therefore be advisable to mark one side of the switch "greater for capacities," "smaller for inductances," and the other side "smaller for capacities" and "greater for inductances," representing as whether the ratio C1 to C2 is greater or smaller for capacity and inductances respectively for each position of the switch.

Wiring

The wiring diagram of the completed instrument will be as shown in Fig. 6. If the wiring is followed exactly as shown in the diagram, when the reversing switch S1 is thrown on the left-hand side, it will be in the position for measurement of condensers equal to or greater than C3. In this position, when inductances are being measured, the value of the unknown inductance will be equal to or less than that of L1. With the switch in the position 2, the reverse applies, of course. A switch S2 is provided, by means of which the balancing resistance previously referred to may be placed in either arm of the bridge when measuring inductances. This may be found useful in certain cases, and should preferably, if possible, be non-inductive. At a pinch a 6-ohm filament resistance will be found suitable, but a resistance will probably seldom be required when measuring small inductances of low resistance. Also with condensers it will probably not be found necessary to use this resistance. The switch S3 enables the known capacity or inductance to be connected according to whether a capacity or inductance is being measured.



A veiw of the big generators for power supply at the Rugby Station, which develop 18,000 volts.

Precautions

The following warnings may be sounded to the intending constructor of an instrument on these lines:—

(1) First of all, the switch S1 should be an anti-capacity switch, and all wiring to it and components should be spaced out as far as possible. If this is not carefully done the instrument may be found perfectly satisfactory for measuring capacities, but difficulty will be experienced in obtaining a balance when taking measurements of inductances.

(2) A reliable high-note buzzer should preferably be used, also one that will not vary in note, as any large variation in the pitch of the buzz may alter the calibration to a certain extent.

Sound Components

(3) The two fixed condensers C1 and C3 should be of good make, so that they will not alter in value in the course of time. C2 again should be a mechanically well-designed condenser, and in this case its electrical properties are not quite so important. The chief points are that the spindle should be free from all shake. The dial should be securely locked on the spindle, otherwise the calibration will be upset. A good contact should be made to the moving vanes, so as not to introduce any unnecessary resistance, which again might make it difficult to get a balance.

Preliminary Tests

It will be realised, of course, that quite a large amount of preliminary work is necessary in order to get all the ratios of C1 and C2, but once this has been completed the constructor will be in possession of an instrument that will save him much time when wishing to find the capacity of an unknown condenser or the inductance of an unknown coil. In fact, it makes measurements of this kind a pleasure instead of the bugbear it usually is in cases where ordinary substitution methods are employed.

Random Technicalities

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

I NOTICED among the many novelties being sold this year as Christmas presents in the United States an instrument known as a "Tube Rejuvenator." Listen to what the advertisements say about it. "Does he own a radio? Then here is the Christmas gift which will make him happy. It is the . . . Tube Rejuvenator. Every owner of a radio wants one. Radio tubes, as you no doubt know, deteriorate rapidly with use, but they are again made like new—in any home—with the Tube Rejuvenator. It brings back each tube in just 10 minutes!"

What it is

I had a look at several of these devices for "gingering up" tired valves when I was in America this summer. There is no mystery about them, as at the present time everyone in the States uses thoriated filament valves, the bright emitters having passed out. Such valves, if over-run, lose their emission rapidly and are often discarded as useless, when really they can be restored to good working order with very little trouble. A tube or valve rejuvenator is a small box with a valve socket on the top and a lead which will plug into any electric light socket. It will only work with alternating current, as it contains inside a transformer which steps down the voltage to a figure suitable for the filament of the valve. There is no high-tension supply, and when the device is switched on it lights the filament with alternating current, the voltage across the filament being higher than that normally given to the valve.

A.C. Mains Needed

The price of the instrument, from the advertisement of which I have just quoted, is $7.50 (about 30s.), and you can, if you like, buy it in "a colorful holly gift packet." I have no doubt that these devices are selling, and will sell, very freely in the United States, where practically every home has an alternating current supply with a voltage of 110 and a periodicity of 60 cycles. In England, of course, we have so many different voltages, both D.C. and A.C., that the sale of this device would be limited. Much, however, can be done to restore valves of the thoriated filament type without any special device such as this.

AT THE RUGBY STATION

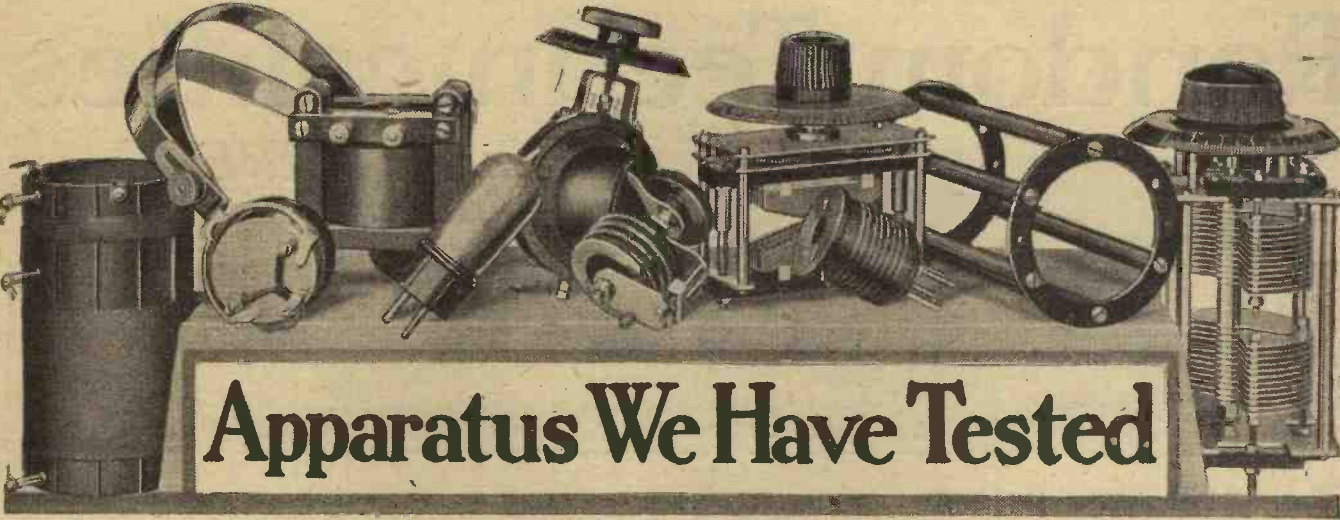
One of the insulating anchorages for the steel cable stays supporting the masts at the Rugby station.

Our Own Valves

I recently found in my stock a B6 valve, which had lost its emission and showed only the tiniest flick on the anode milliammeter when tested. I knew the reason for this loss, as the particular valve had suffered during experiments with a super-heterodyne circuit, when, owing to the breaking of a flexible lead a high-tension voltage had been momentarily applied to the filament. The B6 valve is rated at 3 volts on the filament. It should be pointed out that the voltage rating for these dull emitter valves is that which gives a good emission without unduly dissipating the thorium coating. This does not mean that the filament will burn out if a higher voltage is applied (as is the case with the bright emitter valve), and, as a matter of fact, such valves will run for many hours, without burning out, at more than twice the rated voltage. The effect of such over-running, if the anode voltage is simultaneously applied, is to ruin the sensitivity of the valve almost immediately.

Restoring the Emission

The constitution of the filament is such that if, when the sensitivity is lost, we run it at a higher voltage than its normal rating *with the high-tension battery cut off* (this is most important) a new supply of thorium will be driven to the active surface of the filament. In the case of this particular B6 valve I ran it with 6 volts on the filament for half a minute with the plate voltage cut off, and then reducing the filament voltage to normal (3 volts) I tested for emission with the milliammeter in circuit. I found that there was an appreciable increase in emission after the first half minute, and I thereupon repeated the process. After six half-minute runs at 6 volts on the filament with the high-tension cut off, the valve was restored to its original sensitivity, and when its characteristic was plotted it proved to be the same as that of another new valve of the same type.



Conducted by Radio Press Laboratories, Elstree.

"Dynic" D.C. Regulator

A new model (October, 1925) Dynic D.C. Regulator has been submitted to our laboratories for test by Messrs. Jones & Stewart.

Makers' Claim.

This instrument is designed for using the mains as aerial and earth, with provision for five positive H.T. tappings and six negative grid bias tappings. Hum from average mains is almost entirely eliminated.

Description of Component.

The unit is enclosed in a wooden box about 7in. square and 3in. deep, with a top panel of ebonite. Twelve small sockets are arranged in this panel, six for high-tension working and six for grid bias voltage. Inside the box is a combination of inductances and condensers arranged in the usual fashion for smoothing purposes. The H.T. tappings are made on to a solenoid wound resistance, while the grid bias tappings are a continuation backwards of the H.T. resistance. A length of yellow flexible lighting cord with an adaptor is provided for plugging into a lamp socket. Two rubber flexible leads project from the box sides, and their spade terminal ends are for connecting to the aerial and earth terminals of a receiving set, so that the house mains can be employed in lieu of a receiving aerial. Suitable insulation is provided by means of two condensers between the mains and these aerial and earth leads.

Laboratory Tests.

The unit was connected to mains which were only about 200 yards from the main generator. After testing for the correct mains polarity, measurements of the actual voltages from the panel sockets were made, and these were found to be 45, 80, 100, 130 and 180 volts for the high-tension, with grid bias voltages of 2.8, 5, 8, 11 and 13 volts. On testing in conjunction with a five-valve receiving set embodying three L.F. amplifiers, the hum from the mains was sufficient to drown all signals in the loud-speaker. Used as a high-tension unit only on a four-valve set, the hum was quite low, and with the strong signals from neighbouring stations did not cause any unpleasant noises. On using the aerial and earth terminals, however, in place of the normal outside aerial, the extraneous noises reached a sufficient magnitude to spoil all signals. Insertion of extra condensers into the aerial and earth leads failed to reduce these unpleasant effects.

General Remarks.

With very strong signals this unit appears to be fairly satisfactory, but with medium signals and average L.F. amplifiers, for loud-speaker work, it fails to fulfil its purpose, as the hum is far too pronounced. For these tests comparison was made with an ordinary smoothing unit constructed on our own work bench.

Brackets

Messrs. The Formo Co. have submitted samples of brackets to us for test at our Elstree Laboratories. It is claimed that these brackets are useful as a method for saving time in building up experimental sets, and represent a considerable advance on the type of bracket hitherto obtainable.

Description of Component.

A pair of these brackets placed at the two ends of the panel are designed to support it either vertically or at an angle of 75 degrees to the horizontal. They are made of metal castings of T-shaped section, and are each composed of two parts. One of these is horizontal, and is about 6 in. long by nearly ½ in. wide. At each end it bends down and then flattens out to form a foot. One of these, placed at either end of the baseboard, supports it at a height of just over an inch from the bench. Screws are provided to fix the brackets to the baseboard. The front foot of each bracket has an almost circular elevation as seen from the side, and a hole is drilled in its centre. Two circular projections from the other part of the bracket fit over this foot, and are pierced with holes to register with this. A nut and bolt secure the two parts of the bracket together and permit rotation, which is, however, limited to the necessary 15 degrees by stops. The second part of the bracket can be fixed to the panel by screws. The horizontal part of the bracket is also provided with holes for fixing to the side of the cabinet when the set is completed.

Laboratory Tests.

The brackets supplied were found very convenient for experimental sets in which an ebonite baseboard was used. The casting was quite strong enough for the purpose for which it was designed, but care should be taken to avoid subjecting the brackets to any unnecessary strain.

Amateurs should find these brackets exceedingly useful for experimental work. Longer screws for the baseboard would enable thick wooden baseboards to be employed when desired, but we understand that these are now being supplied by the firm. By having the baseboard clear of the bench or table, through the agency of the supporting feet, it is possible to conceal some of the wiring of the set where desired.

Reco H.T. Battery

The Radio Equipment Co., Ltd., have submitted two sample 60-volt "Reco" H.T. units for test at our Elstree Laboratories.

Makers' Claims.

The H.T. battery can be recharged, the charging current not to exceed 0.1 ampere. After use for a short period the battery will recover some of its voltage if left standing for a time. The electrolyte does not contain any acid, is free from poison, and can be used without detriment to hands and clothes.

Description of Apparatus.

The forty small cells are contained in a black wooden box 9 in. by 6 in. by 3¼ in., with a detachable lid. The cell containers are 2 in. high and 1 in. in diameter, and are covered with white enamel, together with the terminals and series connectors. Tappings are taken to seven metal sockets arranged in the side of the box, with labelled voltages of 15, 24, 33, 42, 51 and 60 volts. Full instructions for preparing the cells for use are given on the underside of the detachable lid.

Laboratory Tests.

The solution was added to each unit and the voltage was found to be 60. For 48 hours a leak of 100,000 ohms was placed across the terminals of each battery and the voltage registered at the end of this period was 55 volts. The batteries were then employed in our Test Department for use while testing customers' receiving sets, the voltages being taken every morning. The voltage dropped to 51 volts after five days and then recovered slightly after 48 hours' rest, after which the battery voltages fell to 48 volts at the end of a further two days' use. The average daily employment for these units was at least six hours. The electrolyte was found to evaporate slightly, but it sufficed only to add boiling water which had been left to cool, as recommended by the makers.

The units were recharged according to makers' instructions, and were found to work quite well again. They have a capacity of at least 500 milliampere hours to reduce the voltage from 60 to 48 volts.

General Remarks.

These H.T. units should prove very useful accessories, as they work exceedingly well and can be recommended with confidence. No extraneous noises attributable to the batteries were found when employing them on set testing, and the absence of any dangerous chemicals or acid in the electrolyte is a feature worthy of note.

Single-Pole Double-Throw Switch

Messrs. The Penton Engineering Co. have sent us for test at our Elstree Laboratories a sample of their single-pole double-throw switch.

Description of Component.

This switch consists of three spring jaws of plated copper mounted on a piece of ebonite 4 in. by 1 in. by 3-16 in. The centre spring jaw carries the blade, also of plated copper, which is pivoted on a screw passing through the latter. This screw has a milled terminal on one end to which connection can be made. The spring jaws are provided with screws and washers which serve as terminals, the screws being threaded directly into the ebonite base.

Laboratory Tests.

The insulation resistance was found to be infinite, and the switch action was very smooth and effective. The contact resistance between blade and jaws was of a very low order, and remained steady during blade movement, measurements being made on a special low resistance bridge instrument. When the screw terminal for one switch-jaw was loosened, however, the thread in the ebonite stripped.

General Remarks.

The finish of this component is only moderate, and it would appear desirable to have a thicker base. It is generally bad practice to tap the ebonite where the thread is likely to be subjected to the slightest strain, but where this is done the ebonite should always be of adequate thickness.

P.V. 6 D.E. Power Valves

The Edison Swan Electric Co., Ltd., have sent us one sample of their new type P.V.6 D.E. power valve for test purposes.

Makers' Claim.

This valve differs slightly from the previous P.V. 6D.E. valve in that certain improvements have been made both in construction and its characteristics.

Description of Valve.

The electrodes were difficult to observe through the glass bulb walls owing to the presence of a silver deposit, but the anode and grid are made in an oval box form with the filament of a V pattern. The bulb is pipless, while the cap is made of hard moulded ebonite, the position of the anode pin being indicated by a green line.

Laboratory Tests.

The valve was subjected to the usual tests on our valve test bench, and the results of these tests are indicated in the appended table. It will be observed that the amplification ratio is slightly less than the manufacturers' rating, while the impedance is in excess of the stated value. In a Radio Press receiving set the valve functioned quite well, giving slightly better results than an Edison Swan A.R.D.E. green stripe. No trace of microphonic noises was apparent, and the valve legs fitted well into various valve holders.

Valve Type P.V. 6 D.E. (New Type) Dull Emitter.

Filament Potential = 1.8 V. Filament Current = 0.44 A.
Flash Emission = 14.2 mA for an Anode Potential of 60 V.
Flash Emission per Filament Watt = 18.0 mA.

Anode Potential in volts.	Grid Potential in volts.	Anode Current in Milliamps.	Amplification Ratio (μ).	Internal Impedance in Ohms (R_0).
70	−6	2.05	5.6	14,000
90	−9	2.35	5.6	14,000

Manufacturer's Rating.

Filament Potential = 1.8—2.0 V.
Filament Current = 0.5 A.
Anode Potential = 60—120 V.
Amplification Ratio = 6.0.
Internal Impedance = 10,000 ohms.
Flash Emission = 15.0 mA.

Clix Ring Tags

Messrs. Autoveyors, Ltd., have supplied some sample packets of their Clix ring tags for test at our Elstree Laboratories.

Makers' Claim.

The ring tags are perfect terminators for every kind of wire, and are suitable for use with every type of terminal.

Description of Component.

The ring tag consists of a metal eyelet with a centre hole of approximately ¼ in. diameter. It is 3/32 in. thick and is pressed into its shape so that a channel round the periphery can accommodate the wire. When a tag is used with flexible wire, the strands can be split and passed round each side of the ring tag, and after twisting the ends together the excess wire can be cut away, making a very neat finish. No solder appears to be necessary, as the wire can be firmly gripped in the ring tag by compression with ordinary pliers and a good joint is ensured.

General Remarks.

These small eyelets appear to be very useful if a neat termination of wire leads is desired. They avoid the possibility of the wire strands coming away from the terminal when screwing the unit into position.

Grid Bias Battery Holders

Mr. A. G. Brine has sent us a sample pair of the "Secure" grid cell holders for examination.

Description of Component.

The holders consist of two right-angled metal brackets made from aluminium just under 1/16 in. thick. Each has a vertical strip of metal 2 in. by ¾ in., with two side flanges ¾ in. square and a metal base of the same dimensions. By means of a countersunk screw hole at the centre of this base the holders are fixed into position on the baseboard. The holder is pressed into shape and the distance between the insides of the flanges (⅞ in.) just allows an ordinary Ever-Ready 9-volt grid bias battery to slip into position, these holders having been primarily designed for this cell. The feet are turned inwards with the object of economising space, and when mounted on the baseboard conveniently accommodate the grid bias battery, the length of that battery being immaterial as long as the width does not exceed ⅞ in.

These holders should prove useful to constructors.

CORRESPONDENCE

RADIO PRESS CALIBRATION

SIR,—In reply to your request for comments on the *Wireless Weekly* Calibration Scheme, permit me to say that the scheme as devised in your office would leave nothing to be desired but for the fact of the lax methods of the B.B.C.

My watch (a very good one, by the way) was set exactly to G.M.T. as transmitted by the B.B.C., and I listened the whole way through the period for the purpose of calibrating a new wavemeter. Unfortunately, I had to use also a very new receiver of neutrodyne design (3 H.F., D., L.F. optional) which had been previously adjusted for dial readings but not calibrated exactly, as the purpose was to do both at the same time.

The scheme therefore resulted in fairly complete failure due mainly to the fact that no station was heard to give its call sign more than once in its period except Manchester, and others did not give any indication at all during their 10-minute periods, and with foreign stations so close in frequency it was impossible for anyone without a complete knowledge of a wide range of musical pieces to identify by programme.

I am not aware by what right the B.B.C. is exempt from the usual rules of giving of call signs, but the lack of this detail must not only interfere with such arrangements as you made, but also largely spoil the interests of a large number of seekers for distant stations, both Britishers and foreigners. I might add that while looking round in the region London, Manchester, during the 20 minutes assigned there, I heard Radio San Sebastian repeat the name no fewer than seven times. The announceress repeated this twice very clearly on *each* occasion. Comment is needless.—Yours faithfully,

GINGER UP THE B.B.C.

Wakefield.

[We agree with our correspondent's view that more frequent indications of the identity of stations might well be given by the B.B.C. At the same time we would point out that for the purpose of our calibration tests it was assumed that readers would already have identified the necessary stations, so that the results of the tests would merely tell them the exact frequencies indicated by the appropriate settings of their tuning controls and enable them to calibrate their wavemeters or receivers.—ED.]

SIR,—I think your calibration scheme an excellent idea, but please don't do it when the Hallé Orchestra is on.

I should like to see the following stations included in another test, as they usually come in better than the B.B.C. stations: Brussels, Malmo, Hamburg, Hanover, Toulouse.—Yours faithfully,

J. W. ROWE.

Kew Gardens.

P.S.—You might check KDKA on the short wave any night about 23.30 hours.

IRISH AMATEUR TRANSMISSION

SIR,—In the December 2 issue of *Wireless Weekly* you mention that 5NJ has not yet got a smooth note. Well, the note is now pure D.C., and I would be grateful if you would correct the former statement when convenient to you.

You may be interested to know that I was successful on December 5 in working 8QQ of Saigon, *French-Indo China*, and I *think*—but am not sure—that this is the first occasion upon which communication has been *established* between the British Isles and French Indo-China. If this is so, it adds another country to the long list already worked by British transmitters. My wavelength was 45 metres (6,667 kc.) and a power of 100 watts was used. I have also worked many Australians, Americans and New Zealand, and understand my signals have been heard in Mombasa and Hongkong.

With best wishes.—Yours faithfully,

F. R. NEILL.

Whitehead, Co. Antrim.

"THE NATURE AND SOURCES OF ATMOSPHERICS"

[Other correspondence on this subject will be found on page 474.]

SIR,—I have had a long talk with Mr. R. A. Watson Watt on the subject of this correspondence. Mr. Watt was so kind as to show me some of the material collected and correlated by him at the Radio Research Station. This data is most interesting, and it is greatly to be hoped that Mr. Watt will find time in the near future to publish some of the results of his research to the general radio public. I think we were both quite agreed that vastly more data is needed on the subject of atmospherics. My observations, which I can only put forward in all modesty, are probably not at all irreconcilable with the observations collected by Mr. Watt. It would appear that his data concerns to a considerable extent the "crasher" variety of disturbance which is associated apparently with not far-distant storms. Furthermore, the Radio Research Station concerns itself largely with very long wavelengths (of the order of 20,000 metres). My limited observations have been usually in the broadcast and short-wave band, and it is the daily steady "grinder" variety of static which has concerned me. My measure has been the ratio of disturbance to signal for the case of broadcasting within about a 500-mile radius. I consider a good ratio one in which the atmospherics are not more in evidence than the scratch of a good gramophone record. I think I have determined in some cases a considerable difference in the general signal-to-static ratio between points only a few miles apart. I am almost certain of having determined very wide differences between points a hundred miles or so apart. For instance, in Stuttgart the ratio is apparently consistently far worse than in a number of surrounding locations. The following case is interesting: In the middle of August last my wife listened in for about a week at a small town just south of Leipzig. During the same period I was listening in at Stuttgart. She reported hearing Zurich and Rome almost as clear as a bell, with hardly a trace of static; every word spoken was clearly intelligible. At Stuttgart the reception of these same stations was so marred by static that the intelligibility was certainly not over 50 per cent. In view of the fact that Stuttgart lies between Leipzig and the Alps, this observation is very interesting. I think it would be excellent if others making observations along these lines would correspond with Dr. Robinson or Mr. Watt. There is a great lack of data, and if many amateurs would co-operate in supplying observations, our knowledge of the nature and distribution of atmospherics might be considerably furthered. The battle with this disturbing element concerns every radio listener.—Yours faithfully,

STANLEY MCCLATCHIE.

FROM CAPE PROVINCE

SIR,—I have erected a short-wave aerial as suggested in *Modern Wireless* of August, that is a 40-ft. one, and find it about a third more sensitive than my standard 40 ft. high and 60 ft. horizontal length one. Wire used was 20/32 enamelled wound by myself. On the broadcast wave band it loses by about a third on the standard aerial.

I have built the Reinartz one-valve in the June issue, which together with a two-valve power amplifier is everything that could be desired on both the broadcast band and the short waves. I consider it a jewel. My Reinartz does marvels on the short waves. KDKA and WGY come in splendidly, although X's are very bad here just now.

Last night I tried for 6BM on my 7-valve T.A.T., but owing to X's could only use 2-V-1; music came through loudly just a little to one—that would be your 11 o'clock. And 1½ minutes past one I heard a clock striking an hour with very loud clanging. I was so flurried at the idea that it might be Big Ben that I forgot to count and make sure that it did strike 11. Was it Big Ben? I wonder!

Now about the T.A.T. I have constructed the 7-valve (*Modern Wireless* for January) about three months ago, but the amplifier was put under a separate panel.

The resistance coils were constructed thus: When I came to a tapping turn the wire was doubled back and given a knot, winding then proceeded, leaving a loop behind. When soldering on to the studs then I had two leads to solder to each stud except at the beginning and the end. This is a very easy and neat method; one has only to be careful that both leads are soldered and make good contact.

Selectivity is everything that could be desired on our stations, and tuning-in is simplicity itself. Body capacity when using a frame aerial is very bad on the second anode condenser.

Now for results. JB comes in with full loud-speaker volume in the middle of the day. It is hardly credible when I tell you that JB uses only 500 watts and is roughly 400 miles distant. At the same time, I must remark, though, that Durban, only 300 miles distant, and with 6kw. comes in only at fair L.S. strength. Of course, I can't report on evening reception as I can then work only on 2-V-1 or 0-V-2, or else the set is too loud. Yes, I daresay we do more with our sets than you could dream of there, *e.g.* last night I worked Cape Town, 500 miles distant, for the greater part of the evening on the Reinartz as follows, 0-V-1 getting medium L.S. reception.

Best wishes to your esteemed papers. —Yours faithfully,

J. P. MALAN.

Cape Province.

Simultaneous dancing to simultaneous broadcast music took place in many of the capitals of Europe on December 15, the occasion of the Radio Revels. Some of the dancers at Olympia are seen here.

PRESTON AND DISTRICT RADIO RESEARCH SOCIETY

An interesting lecture was given on December 9 at the Society's Rooms, Tommony's Yard, by W. E. Bamber, Esq., on the subject of "Batteries." The lecturer explained fairly extensively the process of manufacture and the advantages and disadvantages of each type of battery. He laid particular stress on the importance of giving a battery the correct initial charge, and explained why this has such a tremendous effect on the life of the cell. Samples of various makes in many stages of manufacture were handed round for inspection.

The lecture closed with a vote of thanks, proposed by the Secretary, Mr. John B. Cookson, and seconded by the Chairman, Mr. H. Guest.

ENVELOPE NO. 2

SIR,—I am sending herewith a photograph of my "Family" Four-Valve Receiver, described by Percy W. Harris, M.I.R.E., in Radio Press Envelope No. 2, to which I have added another stage of H.F. by the very excellent T.A.T. method. Although the "Family" was my first valver, the instructions, etc., were so simple that I had no difficulty at all in making it up, and the results were really remarkable.

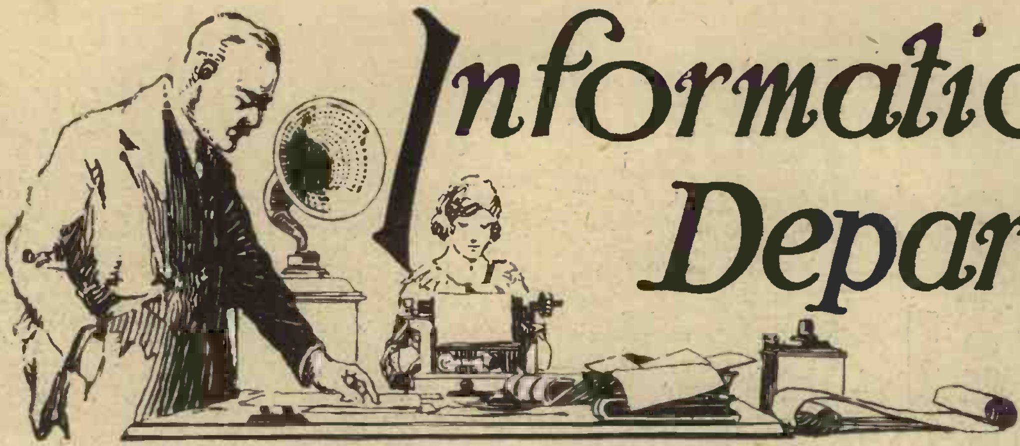
I have now built the set on an ebonite panel, using Clix sockets and plugs for all switches and terminals, which I think enhances the neatness of the completed panel. All coils I have made myself, including the reactance coil. The cabinet I also made out of oak, and the whole makes a nice piece of furniture. I get all the B.B.C. stations on the large-sized loud-speaker, using only four valves, and under favourable conditions very loud using only three. Most of the main Continental stations come in strong on the speaker using 2 H.F., Det. and 1 L.F. I have also had KDKA, WGY, WBZ and WPB, the two latter at fair loud-speaker strength. My aerial is 60 ft. twin, about 30 ft. high, and as my locality is in a rather low part of the city, I think the results speak volumes for the circuit, the only departures I have made from the original being separate H.T. and grid bias.

As I am barely a mile and a half from 5IT, I can get to within 50 metres of his wavelength, *i.e.*, I can get Rome, 425 (also whilst Glasgow is on), but nothing nearer. Is this good or should the set be more selective? I can separate all the B.B.C. stations, also Radio-Paris and 5XX, but not, of course, Birmingham and Aberdeen. I think I have already taken up too much of your time, but as I have just finished testing the T.A.T. addition, I thought you would be interested to know that I am more than satisfied with the extra time and outlay I have spent on it, the 2 H.F. being as docile as a little lamb. In conclusion I would like to say that my experience with Mr. Percy Harris' "Family" Four-Valve leads me to the opinion that it is about the most selective and sensitive straight circuit yet designed, and with Mr. J. Scott-Taggart's T.A.T.-coupled H.F. it is everything that the most exacting amateur would wish for for all-round American and European reception.

Wishing your papers every success and thanking you for the very excellent information contained therein, which is and has been my only source of wireless education.—Yours faithfully,

F. H. SALSBURY.

Birmingham.



Information Department.

F. B. D. (BARROW-IN-FURNESS) has constructed the single-valve Reinartz receiver described by Mr. A. Johnson-Randall in "WIRELESS" for October 10, and with it wishes to employ the 2-valve choke coupled amplifier described by Mr. J. W. Barber in the September, 1925, issue of "THE WIRELESS CONSTRUCTOR." Although the former set works well on its own, and the amplifier functions admirably after a crystal set, the two will not work together. Our correspondent states that when the choke-amplifier is coupled to the single-valve receiver, only very faint and distorted signals can be obtained, and the set appears to be oscillating continuously before these can be heard.

It is obvious from the particulars given that the single-valve receiver is correct, and it would appear, therefore, that the trouble is located in the first part of the amplifier, in the components which are not brought into use when the amplifier follows a crystal receiver, as shown on the right in Fig. 6 of *The Wireless Constructor* article. In all probability, therefore, the fault is either located in the choke Z_1, the condenser C_1 or the gridleak R_3. The former should therefore be tested for continuity with telephones and a dry cell, and if only very weak "plonks" or none at all are heard, it should be replaced. The condenser C_1 should also be replaced by one of the larger condensers used in the tone control unit, values of from .006 μF upwards being suitable for this substitution. The gridleak R_3 is best checked by substituting another in this position known to be working effectively.

D. I. G. (NORWOOD) uses his receiving set, which is a valve detector with reaction and one transformer-coupled stage of low-frequency amplification, in a shed at the end of his garden, remote from the house, to which the free end of his aerial is attached. He asks our advice as to the best method of running leads for his loud-speaker, which is placed in the house, since he understands that howling sometimes takes

place, when long leads to the loud-speaker are employed.

In Fig. 1 we give a simple diagram of an easy method of running the loud-speaker at some considerable distance from the receiving set, which at the same time necessitates one lead only.

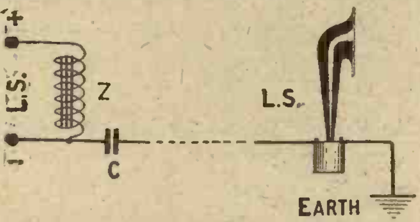


Fig. 1.—With this arrangement of a single wire and earth return the loud-speaker may be placed at some distance from the receiver.

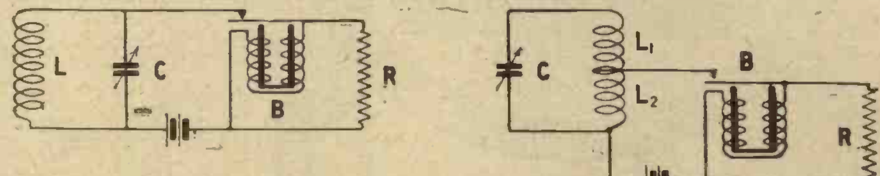
The method has been successfully employed by Mr. Underdown, and his experimental results are given in Vol. 6, No. 10, of this journal.

It will be seen (Fig. 1) that a filter arrangement is employed, a choke Z being connected across the loud-speaker terminals of the receiver, whilst connection is made to one loud-speaker terminal through a condenser C, the other side of the loud-speaker being earthed. The choke Z may conveniently be one of the chokes used in choke-coupled amplifiers, or the secondary winding of an old low-frequency transformer will prove satisfactory. The condenser C should be of 1 or 2 μF capacity, and its insulation should be good. The earth connection from the loud-speaker terminal shown may consist of an ordinary earth tube driven into the soil outside the house and near the room in which the loud-speaker is situated. In practice this arrangement functions excellently and little diminution in signal strength should be noticeable in our correspondent's case.

S. D. (CAPE TOWN) asks us for the theoretical circuit arrangement of a simple wavemeter.

In practice we think our correspondent will find that a simple type of buzzer wavemeter will meet his requirements adequately, and in Figs. 2a and 2b two arrangements are outlined. L (Fig. 2a) may be a plug-in coil to cover the wavelength range required, in conjunction with the parallel condenser C, and the former should preferably be of a type which is rigidly constructed, so that a fair degree of constancy is obtained. The condenser C should preferably be of the square-law type, and a good general value of capacity is .0005 μF. B is an ordinary buzzer, whilst R is a non-inductive resistance, connected as shown to minimise sparking effects at its contacts. Often this resistance is already incorporated in the buzzer unit. The battery shown may conveniently consist of one or two dry cells.

The arrangement of Fig. 2a is simpler to construct, but that of Fig. 2b will in practice give sharper tuning. L_1L_2 may be a centre-tapped coil or two plug-in coils of similar size connected in series, with the tapping point to the buzzer taken from the common connection of the two coils. In making up an arrangement of this type the two coils may be placed side by side, but care should be taken to arrange the connections so that they work together and not with their fields opposed.



(a) *(b)*

Fig. 2.—While the wavemeter circuit shown at (a) may give quite good results, the circuit of (b) will usually be found to provide sharper tuning. A switch to cut out the battery when not in use may be placed between the buzzer and the negative terminal of the battery.

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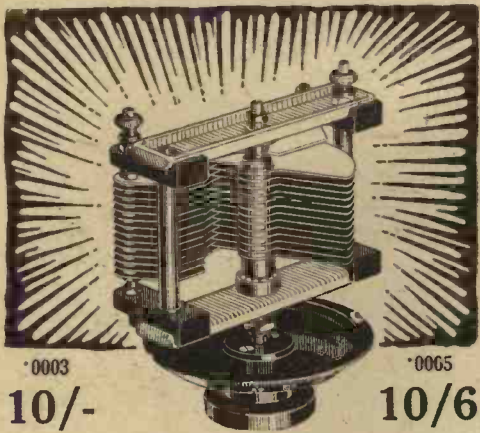

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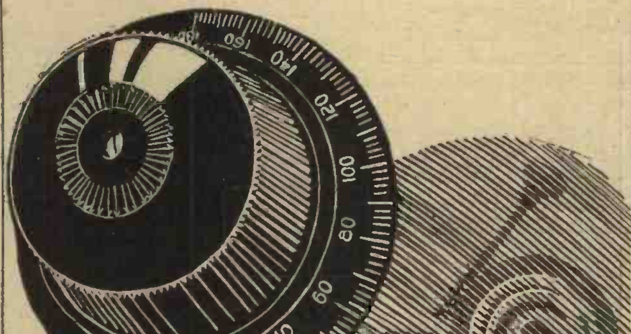

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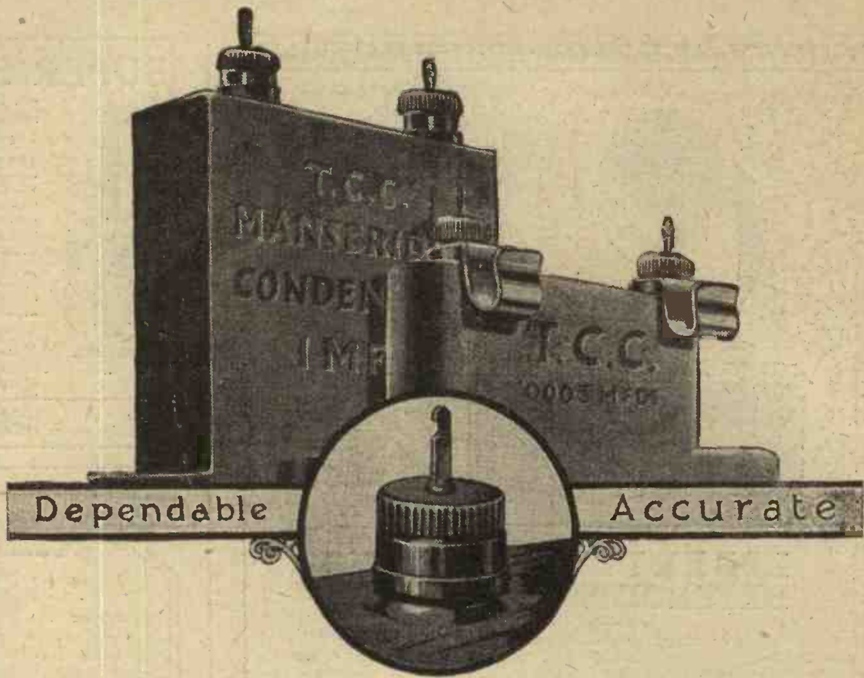

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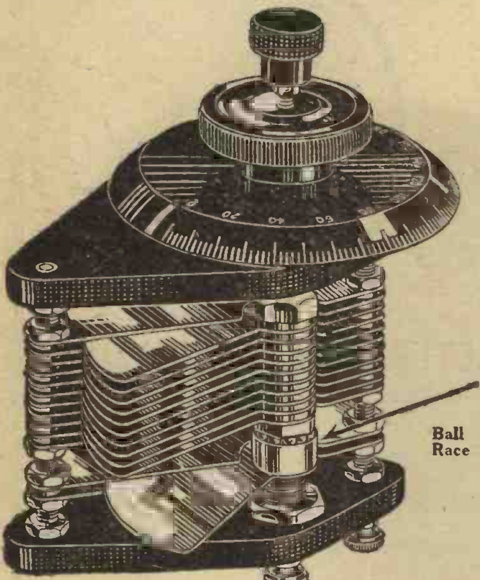

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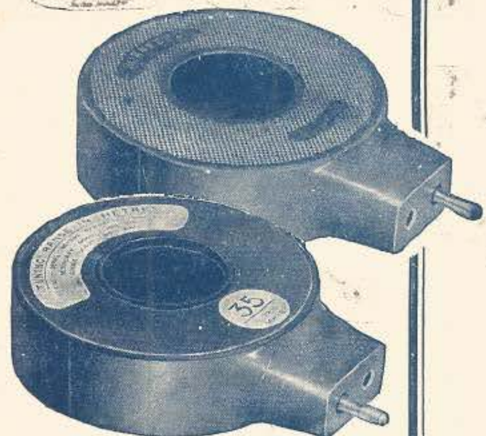
Wireless Weekly, 6d. Net. Wednesday December 30th, 1925

Wireless Weekly

Vol. 7. No. 15.



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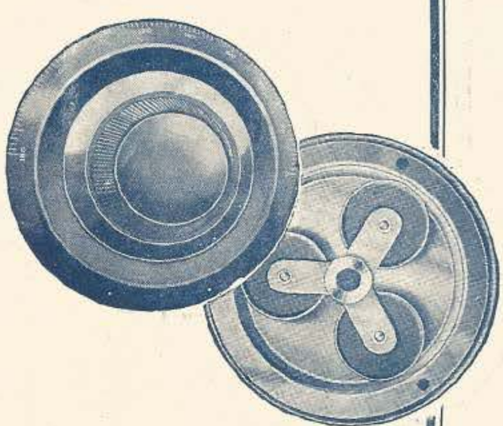

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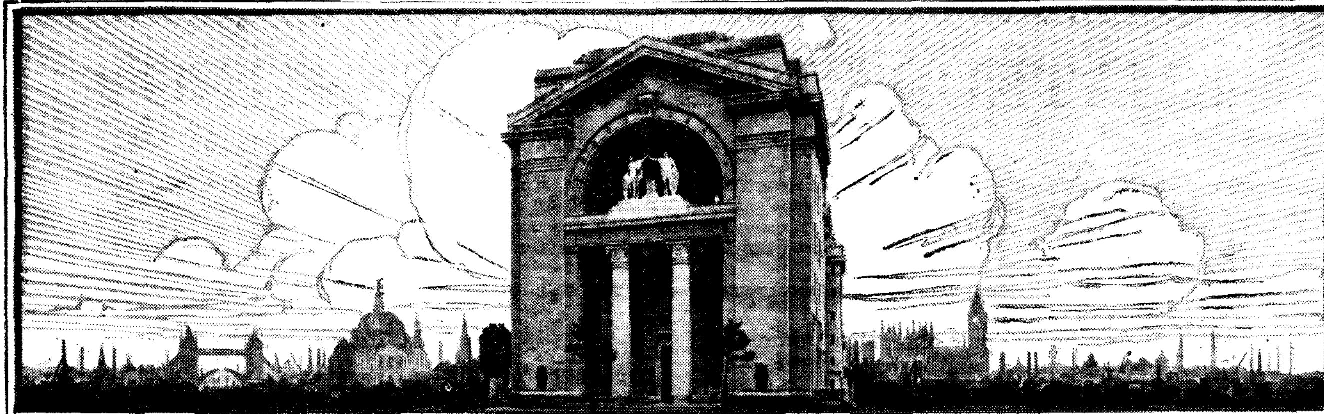

Radio Press LTD. Wireless Weekly Phone City, 9911. Bush House STRAND·W·C·2

Captain Eckersley's Amazing Statement

THE wireless public and trade alike have read with considerable surprise the extraordinary statements made by Captain Eckersley in the Christmas number of "The Radio Times." In an article, entitled "A Talk to Home Makers," he writes as follows:—

"Surely it is only fair to the trade to point out that the justification for home making only arises when a home maker is really legitimately an experimenter and knows what he is doing. If home making simply means copying what someone else has taken pains to design, might I suggest that mental indigestion may result and more, might I point out that a new and great industry is being hampered? I feel that even if we could do it the issuing of cut and dried instructions on how to make a particular set would be unfair to those whose livelihood is to sell sets at a legitimate profit to the public." He then goes on to argue that it costs thousands and thousands of pounds to find out a new thing, and that there is no inducement to spend such money if the manufacturer receives no return for it.

Captain Eckersley is Assistant Controller and Chief Engineer of the B.B.C., and any statements of his are looked upon as official. Speaking bluntly, Captain Eckersley's policy is purely concerned with the broadcasting service, and not with emitting propaganda on matters which are entirely outside his province.

On the merits of his remarks, the manufacturers of sets are almost a clique in the trade, the great bulk of which is done in component parts. Indeed, the proportion of set to component advertisements in, for example, a leading trade journal, is but one to ten—so small as to remove any possible doubt. The Albert Hall Exhibition, in September last, showed quite clearly that the trade was preponderatingly inclined to components.

In the early days of broadcasting the "set" clique very actively combated the tendency for the listener to build his own apparatus, but commonsense removed the irksome and unfair restrictions which had been placed upon home building, and the trade, as a whole, immensely benefited. There are thousands, if not millions, of people to whom the advantages of home construction make a strong appeal, and who, without the facility to build their own sets, would undoubtedly forego the pleasure that broadcasting brings. It is thus perfectly clear that a very great proportion of the revenue of the B.B.C. comes from the home constructor.

The reference to the "experimenter" is almost ingenuous. We all know that the title, "genuine experimenter," is an old gag which was used by the Post Office to cover up its antagonism to the home constructor. According to the Post Office, the number of "genuine experimenters" in this country reckoned by their own standard is but a few thousands.

Previous indiscretions by the Chief Engineer of the B.B.C. have related to the radio situation in America. After having all facilities afforded him in U.S.A., his descriptions of the state of affairs, subsequently expressed in articles and broadcast through the microphone, were deeply resented on the other side of the Atlantic, as being distorted. This resentment was expressed on numerous occasions to Mr. Harris during his recent trip to the United States.

We regard Captain Eckersley as a very likeable and popular personality—perhaps because he does tend to be irresponsible—but his incursions into journalism seem to lead him into officious indiscretions.

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Director of Research:
Major JAMES ROBINSON, D.Sc., Ph.D., F.Inst.P.
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December 30, Vol. 7, No. 15.

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AMATEUR RE-BROADCASTING

By F. A. MAYER (G-2LZ).

Mr. Mayer's achievement in re-broadcasting the programme from Daventry and successfully transmitting it to Tasmania is well known. In the following article he discusses the possibilities of Imperial Broadcasting and the value of the higher frequencies for such transmissions, giving also some account of the apparatus used at his own station.

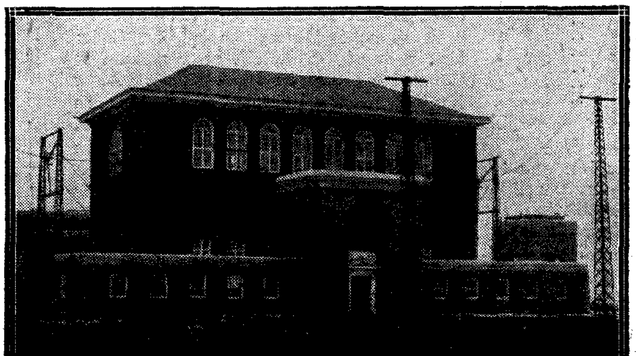
SEVERAL articles have appeared from time to time in various technical and other publications on the possibilities of inter-Empire re-broadcasting, but there are many divergent views on how such a scheme is to be carried out, and no one appears to know much about it from the practical point of view.

Imperial Wireless

The B.B.C. have a vision of such a scheme, and there is no doubt that sooner or later programmes will be exchanged with all parts of the Empire. The question of the moment is how to link up, and a great deal of experimental work will have to be done before the most practical way of accomplishing the link is found out. If it is to be by wireless all the way, will it be at low frequencies with high power, or at ultra-high frequencies with low power? The only remaining way is partly by wireless and partly by land-line, and I believe such a scheme has already been put forward as a possibility, but I doubt if it would be as practicable as the wireless all-the-way link.

Distortion

Take, for instance, linking up with Australia. It has been suggested that wireless be used from England to Canada, then across Canada by land-line, with another wireless link from Western Canada to Australia. One of the greatest difficulties to be overcome is the elimination of distortion, and this difficulty is usually greater with land-line work than with wireless. Also the greater the number of times the transmission is relayed, the more possibility would there be of distortion occurring, owing to the amount of apparatus employed.



The main station building at the Rugby wireless station, which has been carrying out its first test transmissions, and has been heard in New Zealand.

Relaying Daventry

I have recently carried out several experiments on relaying one of the B.B.C. stations, mostly Daventry, at a frequency of 6,667 kilocycles (45 metres). Several reports have appeared in the Press lately of the Daventry programme being received at a frequency of 6,667 kilocycles (45 metres), and it has been suggested that Daventry has been experimenting at this frequency, but I do not think this is correct, and it is probable that the transmission which has been reported on has emanated from my station.

Broadcasting at High Frequencies

Considering the possibilities of a frequency of 6,667 kilocycles (45 metres) to begin with, this frequency is quite unsuitable for local broadcasting. Local conditions change very rapidly at various times of the day. After dark it is almost impossible to use this frequency for local communication under 150 to 200 miles. During daylight local signals are very strong, but a very rapid fading effect takes place, which results in bad distortion of speech every few seconds at these fading periods. At the same time perfect speech may be received at the Antipodes, when the distortion observed locally is non-existent at such a great distance.

Distant and Local Distortion

The question is—how far away does this distortion trouble end? This varies at different times of the day and at different periods of the year. Even at 3,000 miles this trouble is often apparent, as has often been noticed with the transmissions of KDKA on 4,839 kilocycles (62 metres). I have carried out several tests with Mosul, Iraq, about 2,500 miles away, and on one occasion, when bad distortion was reported by this station on a Daventry re-broadcast, the transmission was received quite well at Hobart, Tasmania. I have found that it is far easier to work Australia on telephony than other countries comparatively near.

Modulation

The degree of modulation which can be used on these short waves is another question to be determined. I do not think that more than 25 per cent. to 30 per cent. modulation of the carrier wave dare be attempted, owing to the possibility of a slight frequency change which again will produce bad distortion. Even with a master-oscillator transmitter this frequency change tends to take place.

High or Low Frequency ?

Another point in favour of the higher frequencies is the elimination of interference from other stations and the comparative absence of static as compared with the lower frequencies. Also quite low power can be used, so that the upkeep cost of such a station would be very low.

As regards the utilisation of a low frequency, this would probably be the most practicable, but enormous power would have to be used, and it would only be possible to establish such a link with a super station of the Rugby type. For broadcast relaying a station of this type would be almost out of the question, owing to the high initial cost and the great expense of upkeep.

Land-Lines

To relay to Australia partly by wireless and partly by land-line would also be almost out of the question when utilising the present band of broadcast frequencies. There would be great possibility of interference in both the wireless links between this country and Eastern Canada, and between Western Canada and Australia. Then there is the upkeep cost of the two wireless stations required, and the cost of the use of the land-line across Canada, and the possibility of breakdowns. With luck an intelligible transmission might be got through, but it could not be depended upon at any time.

High Frequencies the Best Solution

My experiments have been confined to 6,667 kilocycles (45 metres), but there are, of course, innumerable other ultra-high frequencies which could be experimented with and which would probably produce the desired result. It might be necessary to use different frequencies on different occasions, according to atmospheric conditions. I certainly think that these high frequencies should be thoroughly explored, to find out the practicability of using them for inter-Empire re-broadcasting, as this could be done with comparatively little expense, and there is little doubt that herein lies the solution of the problem.

The Time Problem

The principal disadvantage in exchanging programmes with other countries at great distances is the time difference. When our transmissions are taking place in the evening it is early morning at the Antipodes, and if we wanted to hear Canada or the U.S.A. we should have to get up in the middle of the night. This would appeal to very few broadcast listeners after the novelty had worn off. The only country favourably placed as regards time is South Africa, which is about 1½ hours ahead of us, but from my experiences this is the most difficult country to communicate with. South Africa seems to be suffering from perpetual static interference, even on the ultra-high frequencies, so that it must be very bad on the lower ones. Also conditions vary enormously from day to day and hour to hour, whereas this trouble is not experienced so much at the Antipodes, as communication at the higher frequencies can be effected practically daily and at almost any time.

Difficulties Experienced

My experiments have been carried out under certain difficulties which would not be experienced by the B.B.C. I have to receive by wireless in the first instance, whereas it would be much better and more successful to have the transmission in the first place by land-line. The arrangement I have is as follows: An ordinary loose-coupled receiver operating on an aerial parallel to and within 20 ft. of the transmitting aerial is used. No interference whatever is experienced from the transmitter operating at 6,667 kilocycles (45 metres), although the two aerials are so close together.

The Apparatus Used

The set consists of one H.F., detector and one L.F. transformer coupled. The output of this set is passed by land-line over to my transmitting room, and is plugged direct into the modulator panel. A change-over switch is fitted to this panel, and when relaying this switch substitutes a one-to-one open-core transformer for the microphone transformer which is used for speech. This transformer is coupled to a resistance-coupled amplifier using 1,000 volts H.T., suitably biased. The valve is a low-power, dull-emitter transmitting valve, type D.E.T.1. This circuit is coupled to the grids of the main control valves.

Choke control is used, with two type T250 transmitting valves in parallel. Two more T250 valves are used as oscillator valves. The power input to the oscillator valves is 500 watts, and to the modulators about 180 watts; filament consumption, 21 amps. total. Osram valves are used throughout.

Experimental Stations Needed

As a final remark, I have no doubt that some of the critics will disagree with my suggestion as to the utilisation of the higher frequencies for re-broadcasting, but my remarks are based on actual results and experiments with low power, and I should like to see the results achieved by the B.B.C. or other parties, with the cash available to equip and maintain a high frequency station for this purpose. So long as they keep off the present band of frequencies allotted to the amateur experimenters, I am sure there will be no opposition from this direction.

The low-tension switchboard in the valve room at the Rugby wireless station.

A NEW METHOD OF MEASURING COIL RESISTANCES.

Mr. J. H. Reyner's second article on the above subject is unavoidably held over until next week's issue of *Wireless Weekly*.

THE FUTURE OF BROADCASTING

FURTHER EVIDENCE BEFORE THE COMMITTEE OF ENQUIRY

We give below a summary of the evidence submitted to the Broadcasting Committee on behalf of the Press, the Theatres, the Music Publishers' Associations and Messrs. Chappell. An account of the evidence given previously, by the B.B.C. and the Wireless League, will be found in the issue of "Wireless Weekly" for December 16.

Lord Riddell, who submitted evidence to the Committee on behalf of the Press.

ON December 17 Lord Riddell and Sir James Owen appeared on behalf of the Press interests to give evidence before the Committee on Broadcasting. They were supported by Mr. H. D. Robertson, of the Scottish Daily Newspaper Society.

The "7 p.m. Rule"

The Press representatives were emphatically opposed to any extension of the existing facilities for the broadcasting of news. Especially was exception taken to a modification of what one might term the "7 p.m. rule," *i.e.*, the existing agreement which provides

Mr. Walter Payne, O.B.E., who represented the interests of the theatres.

that no item of news shall be transmitted before 7 p.m.

Reasons for Opposition

The three main conclusions on which the Press based their opposition were:—

That the reasonable requirements of the public do not necessitate any change in existing arrangements for the supply of broadcast news; and that, by placing their news services at the disposal of the B.B.C., subject to certain limitations as to hours, the newspapers have shown sympathy with broadcasting, and have given an adequate *quid pro quo* for any concession involved in existing arrangements.

Advertising and Propaganda

That from all points of view it is unnecessary and undesirable to utilise the broadcasting organisation for advertising purposes.

That adequate safeguards must be imposed to prevent broadcasting from being used for propaganda or party purposes; and that the final decision in such matters should not be vested in a Government department or a Minister of the Crown.

Possible Effects of Broadcasting More News

Lord Riddell constantly reiterated the importance of the Press as a national industry, both from the point of view of financial expenditure and the number of persons to whom this industry gives employment both directly and indirectly. It was submitted that if, as a result of the broadcasting of news, newspaper circulations were seriously curtailed, large numbers of people would be deprived of a livelihood, without any corresponding gain by the public, "as there was no reason for contending that the oral communication of news was superior to its visual communication, or that the newspapers had failed to meet public requirements."

Comparative Outlay on News

Some interesting financial details of the expenditure of the papers were disclosed. About £62,000,000 per annum were spent in newspaper production, and some 700,000 tons of paper, mostly manufactured in this country, to the value of £12,500,000, were absorbed.

The cost of the collection of news accounted for £5,000,000.

The B.B.C. paid only £8,000 a year for their news service, little more than the sum paid by any one newspaper.

Lord Riddell was questioned by Sir Thomas Royden as to whether the Press would withdraw any opposition if a greater sum were paid. Lord Riddell said that the question of payment did not enter into the case.

Further Points

They were opposed to the broadcasting of news at all hours.

Sir Thomas Royden then dealt with the question of people who did not buy newspapers—people in inaccessible districts.

Lord Riddell thought the number was so small as to be negligible.

Questioned further as to whether the present restrictions should be retained in their entirety, Lord Riddell thought they should, not only because of the points quoted about the Press, but also in the public interest.

In his opinion various subjects which could be dealt with in the news sheet were not suitable for general dissemination into the family circle. He instanced certain classics, topics such as birth control, racing and betting, and the Law Courts reports.

Lord Rayleigh desired to be informed to what extent the Press had been prejudiced by the existing news service.

Provincial Papers

Lord Riddell said there had been no competition up to the present. Sir James Owen here stated that a questionnaire, addressed to provincial papers which could not be in the hands of readers until after 7 p.m., had disclosed a noticeably prejudicial effect.

Sir James Owen was most insistent that the 7 p.m. rule should not be removed. He felt sure that the provincial papers would be so seriously affected that many of them would be withdrawn. In this case the public would sustain a very definite loss, since many of these papers were devoted to diverse local interests, social, administrative, and general. Much good was done in aiding the administration of justice, and so on.

Broadcasting of Parliament

Captain Frazer, who has asked various witnesses regarding their attitude towards the broadcasting of the proceedings of Parliament, again put the same query. Lord Riddell suggested that many of the proceedings would not be of general interest, but stated that the Press had no objection, and that the present agreement with the B.B.C. allowed them to accomplish this, so long as they confined themselves to speeches which could be picked up directly by the microphone.

Vitalising the News

In reply to further questions by Captain Frazer with regard to narrators or observers, as, for instance, at the signing of the Locarno treaty, Lord Riddell made the interesting disclosure that a committee had been set up to which the B.B.C. would apply for special permission for this type of broadcast. In the case of the Locarno Treaty, they had not made any such application.

Public Demand

Lord Blanesburgh desired to be informed on what authority or on what grounds the Press were entitled to prevent a legitimate demand (if such demand existed) from the public for more news.

Lord Riddell did not see that the public should be indulged in all their demands. Perhaps Lord Blanesburgh thought they should have free beer if they demanded it. Lord Blanesburgh did not concur in the view that this was an analogy. He quite realised that the Press had something to sell, and that they were entitled to inflict conditions as some return for their services. Should the

Sir James Owen supported Lord Riddell in giving evidence for the Press.

public, however, desire more news, there was no reason in law to prevent the B.B.C. from supplying it. In fact, should a certain agreement entered into between the B.B.C. and the Press appear to restrict the public demand unreasonably, then the B.B.C. would be entitled to repudiate such agreement. The public, he had no doubt, would desire to be informed as to why they were so deprived.

Supply of News to the B.B.C.

Lord Riddell said the restrictions were agreed to by the P.M.G., who had many interests to reconcile before granting the B.B.C. their licence. If the news service were to be extended they would have to reconsider their position. He felt sure that the four Press agencies, of which number the Press owned two, would consider their best customers first. If the Press, who maintained (excepting for the "mere bagatelle" of £8,000 per annum) the Press agencies, did not desire them to supply news to the B.B.C., he felt sure they would not. If the Press agencies did not supply news, the B.B.C. would have to set up and maintain a world organisation for news alone.

The Thin End of the Wedge

Lord Blanesburgh suggested that the Press might meet the B.B.C. and allow them to broadcast events of national importance, such as the Derby and the Boat Race, immediately after the result was known.

Sir James Owen opposed even this slight extension on the grounds that it was "a slippery slope," or what one might term the thin edge of the wedge.

Religion

Dealing with religion and some other controversial matters, Lord Riddell said that, no doubt, we should have Freethinkers demanding a service. Many opponents of certain controversial matter broadcast were just realising the enormous power wielded by this new social force.

This closed the case for the Press.

The Theatres

On December 18 Mr. Walter Payne, O.B.E., gave evidence on behalf of the Society of West End Theatre Managers, Entertainments' Protection Association, and the Entertainments' and Organisations' Joint Broadcasting Committee.

The memorandum dealt with the history of the relations between the entertainment industry and the B.B.C. briefly as follows:

Unlimited Powers of the B.B.C.

Shortly after the B.B.C. received the Wireless Licence, dated January 18, 1923, those interested in the provision of public entertainment became accidentally aware of the powers which had been given to the B.B.C. to broadcast, to an unlimited extent, concerts and theatrical entertainments. Realising the very serious injury which might be done to the Entertainment Industry, a Committee was formed, representing every section of this industry, and delegates representing employers and employees were nominated.

Restriction Desired

Attention was drawn to the significant fact that negotiations had taken place with the Press which had resulted in certain restrictions. They contended, and still do contend, that such restriction was right and proper, and that it should have been extended to cover entertainments.

The B.B.C. apparently attached great importance to the value of broadcast entertainments, and endeavoured to persuade the Committee that broadcasting was an admirable advertisement. Results had not confirmed this contention. With a view to the prevention of friction, the B.B.C. had voluntarily agreed to certain restrictions. In the opinion of the Society of Theatre Managers not more than 10 per

(Continued on page 516.)

SHORT-WAVE *Notes & News*

WITH the advent of the mild weather, reception conditions seem to have suffered a general decline, so far as the higher frequencies are concerned. Most of the American and Antipodes stations have only been of very moderate strength, and during the last week-end even the European stations have found some difficulty in communicating with one another.

Jamming

The problem of local interference is becoming extremely serious again, the "local" stations now being French transmitters employing their favourite high-powered "raw" A.C. Half-a-dozen of these stations can make enough noise to occupy the whole band of frequencies between 6,670 and 7,500 kc. (40 and 45 metres), so broad is their tuning and so troublesome their numerous "side-bands." One is now sometimes prevented from working with a station ten miles away on account of the interference from another transmitter two or three hundred miles distant.

News from Ireland

We hear from GI-6MU, of Belfast, that he has established two-way communication with P-3FZ, thus being the first Irish station to work Portugal. His input was then 5 watts, but he has worked several British stations on telephony with an input of 2 watts to a Cossor P2 valve. He is shortly fitting up an 80-watt generator, and hopes to make a larger "splash" in the ether.

Other Irish stations now working include 5NJ, 6TB and 6QD (all of Belfast), 2WK of Portadown, Ulster, and 2IT of Armagh. A few more hope to be working after Christmas.

The North of England

There are now more Lancashire stations active on the 6,670 kc. band than have ever been heard before. 2QV (Ormskirk) and 2QB (Widnes) are both heard at great distances, though they are unable to work each other. The former wants to erect a small aerial for short-wave work, but the powers that be do not consider that enough

The earth connections at the Rugby station are no less carefully insulated than the aerial lead-in.

sky is visible from the garden as it is! He employs an L.S.5 valve with an input of six watts. 6RW, of Rock Ferry, Cheshire, is another "big noise" from the North; in addition, 2KW, of transatlantic fame, is making a real "transatlantic noise."

Poor Conditions

2KF reports that the conditions were so bad during the week-end that he only succeeded in working one New Zealand station and one American. He heard PI-1HR on Sunday afternoon; the latter station was handling traffic with American sixth district stations for the entire afternoon. Some South Africans were also heard during the evening, but we have little doubt that conditions will improve enormously if the weather becomes colder again.

It is sad to think of the fate of those who wish to do "DX" work in the early mornings if the best conditions only accompany bitterly cold weather. This appears, however, to have been the case ever since amateurs commenced to work on the 6,670 kc. band.

3,333 kc.

We have been listening on 3,333 kc. (90 m.), and it is hard to believe that the frequency band which saw the accomplishment of so much good work last season is so absolutely deserted now. Is it possible that by next year the now overcrowded 6,670-kc. band will be in the same state? Though it does not seem likely, we must remember that, at this time last year, we little dreamt that the 3,333-kc. band would ever lose its popularity. It would certainly be a good thing if one-third of the stations now using the higher frequency would go back again to 3,333 kc., and so relieve some of the present congestion around 6,670 kc.

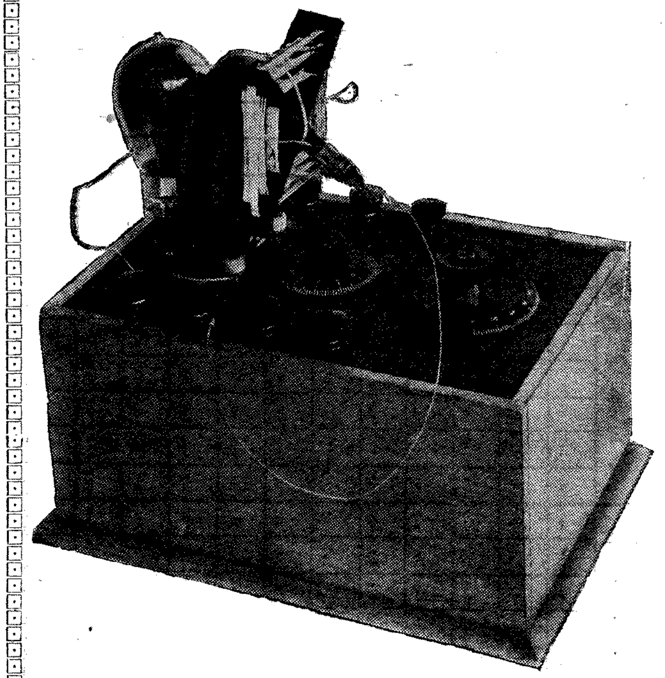
American Telephony

We hear from a correspondent that a station, apparently of American origin, with the call-sign 2XG, and using telephony, has been heard on 6,977 kc. (43 metres). We have no information as to the nature of the tests or the power used, but believe this to be an experimental station working in conjunction with one of the broadcasting stations.

Further Experiments with the Tight-Coupled Aerial Circuit

By G. P. KENDALL, B.Sc.

In previous issues of "Wireless Weekly" Mr. Kendall has discussed certain problems connected with the use of a tight-coupled aerial circuit. He now sums up the results of his investigations, and demonstrates clearly what degree of "aperiodicity" one may expect to obtain with this form of circuit.



The oscillator used by Mr. Kendall for these experiments was made up in the form shown here. The 2-turn coil (L2 in Fig. 1), to be seen in the photograph on the next page, was fixed on the side of the valve remote from the other two coils.

CONSIDERABLE practical interest attaches to the question of the degree of uniformity which can be obtained in the response over a band of frequencies of a circuit of the conventional type employing a coil of fixed turns number in the aerial circuit, fairly tightly coupled to a secondary coil which alone is tuned by means of a condenser. It has been shown that this circuit is probably simply a tuned primary and secondary scheme, in which the degree of coupling is so great that the resonance curve of the primary circuit becomes one of the familiar double-humped variety, the two humps being very considerably flattened by the tightness of coupling, and the usual practice being to work upon one of these humps, relying upon its width and relative flatness to cover the band of frequencies which it is desired to receive.

Previous Investigations

A number of experiments have been described recently in *Wireless Weekly* and elsewhere in which the method of test was to measure the signal strength obtained from the carrier wave of the local station, in my own case 2LO, with various arrangements of this type, and a certain amount of information has been obtained; but it has been evident that with only this method at command it was not possible to obtain a true idea of the actual width of the frequency band which could be covered with a practical degree of uniformity by one of these tight-coupled circuits.

A Later Method

It has been evident that some method was required in which some sort of signal was employed whose frequency could be varied at will, in order that the point might be investigated, and a good deal of work has been carried out by the writer to arrive at a suitable experimental method.

A method was finally arrived at which has given some decidedly interesting results, which I believe to be capable of yielding general deductions of practical value, and it is proposed in this article to describe the method and results in question.

Measuring Circuit

The measuring circuit consisted of the usual aerial and earth system containing a tapped primary coil, tightly coupled to the usual secondary winding tuned by a variable condenser, the signal voltage across this latter circuit being determined by the usual Moullin voltmeter arrangement. The primary and secondary coils were the same as those recently described in

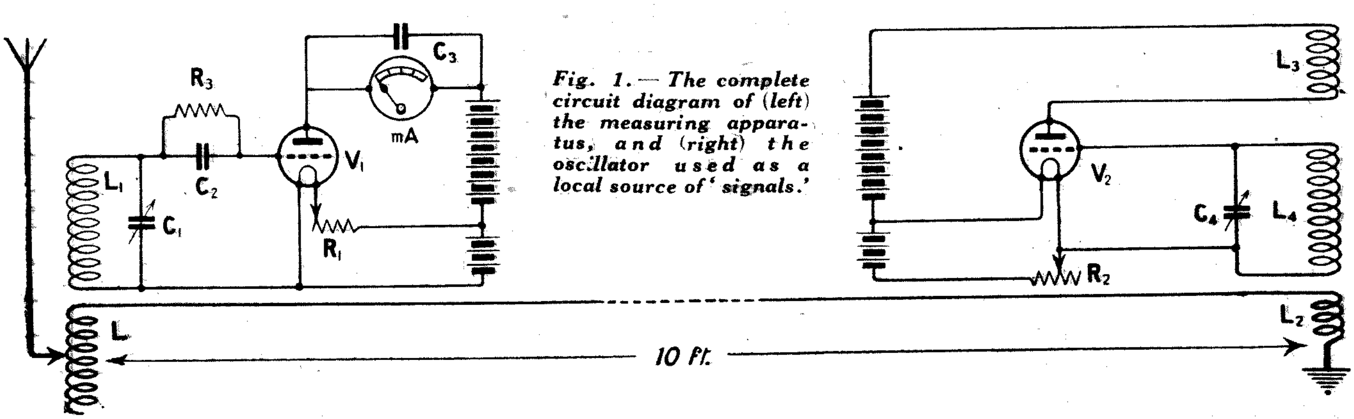


Fig. 1.—The complete circuit diagram of (left) the measuring apparatus, and (right) the oscillator used as a local source of 'signals.'

connection with a somewhat similar investigation, the primary being of the same diameter as the secondary viz., about 3¼ in., the winding being composed of No. 26 d.c.c. wire. Tappings were taken from this coil at the 6th, 9th, 12th, 15th, etc. turns, up to a total of 60. The source of signal energy was an oscillating valve circuit of conventional type, shown upon the right in Fig. 1, the method of feeding the energy into the circuit under investigation being by the use of a *small* coupling coil very loosely coupled to the oscillating circuit. This coupling coil was inserted in the earth lead, the oscillator being arranged at a distance of 10 ft. from the main portion of the measuring circuit.

A Convenient Source of Signals

We have here a means of introducing into the aerial circuit small high-frequency currents which may be taken as being equivalent to those induced by the signals of a distant station, but certain precautions must obviously be observed in its use if results of any

Illustrating the relative positions of the oscillator and pick-up coils to secure a suitable coupling between them. Referring to Fig. 1, L2 is the 2-turn coil, L3 the coil on the X former, and L4 the plug-in coil.

significance are to be obtained. In the first place, it will be observed in using any valve oscillator that as the tuning condenser of the oscillating circuit is varied so will the strength of the oscillations also vary.

Difficulties

In the oscillator employed in these experiments, for example, as the reading of the condenser governing the frequency of the oscillation was increased, *i.e.*, as more capacity was added to the circuit, so the oscillations became weaker and weaker. This in itself is a considerable difficulty, but it can be overcome in a manner which will be described at a later point. Further, the coupling between the oscillator coil and the coil in the earth lead must be decidedly weak, and in these circumstances it is necessary to employ a really strong oscillator to introduce a sufficient amount of energy into the aerial circuit.

The Oscillator

In practice, the oscillator consists of an ordinary bright emitter general-purpose valve run at rather a high filament temperature, and with fairly high anode voltages, up to 168 volts. The grid coil of the oscillating system was either a Lissen No. 60 or a Gambrell B, to this being coupled a coil consisting of two turns of Glazite wire, as a pick-up winding. This latter coil was placed at a distance of about 3 in. from the oscillator coil, and it was found under these conditions that a sufficient amount of signal energy was introduced into the receiving circuit for the purpose of

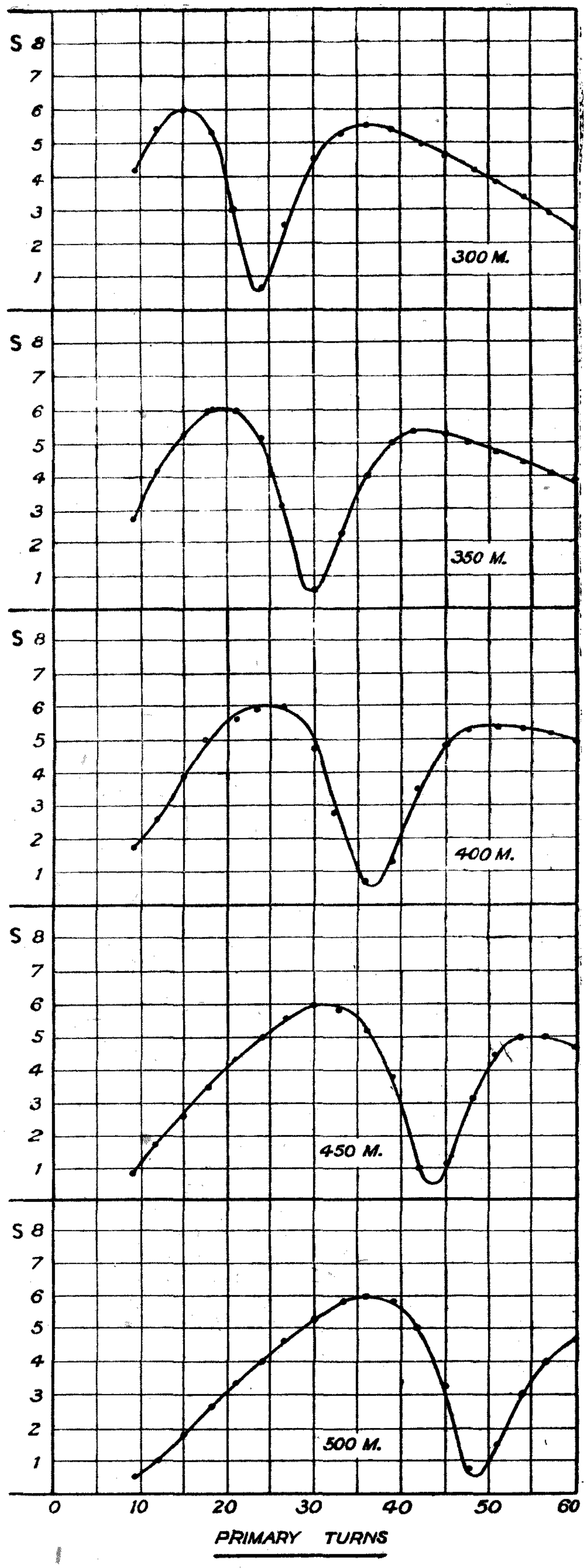


Fig. 2.—The above curves were obtained by varying the number of turns in the primary winding, and plotting turn numbers against measured signal strength at various frequencies.

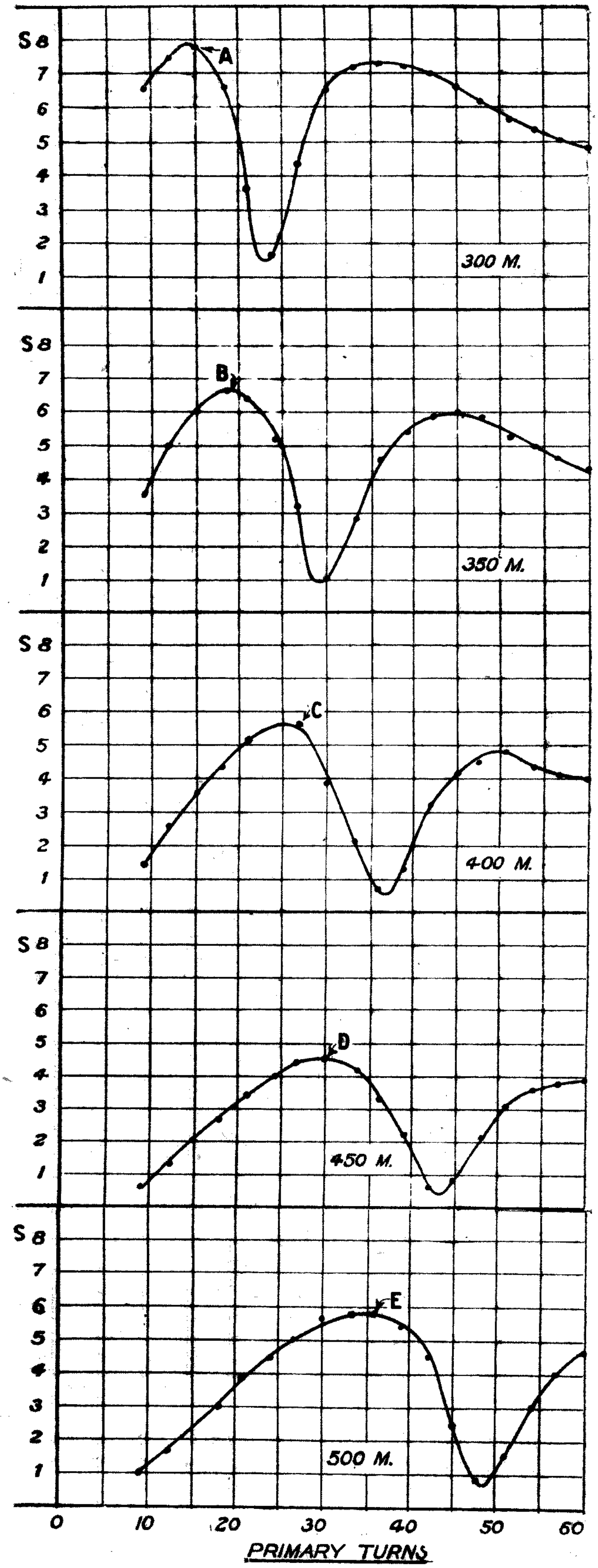


Fig. 3.—These curves were plotted in the same manner as those of Fig. 2, but in this case precautions were taken to secure a constant reading of signal strength from the oscillator at the different frequencies.

the experiment, the actual signal strength figures being roughly equivalent to those observed from the local broadcasting station, at a distance of 8 miles.

The First Experiment

The procedure in the first experiment was to set the local oscillator to give a frequency of 1,000 kilocycles (300 metres), and then to vary the number of turns upon the primary winding of the circuit under investigation, measuring the signal strength across the secondary with each tapping point. The result is shown in the top diagram of Fig. 2, and of course the familiar double humped curve is produced.

It is to be noted in passing that the two humps of this curve appear to be widely different in width, but this is largely a matter of the horizontal scale upon which the diagram is drawn.

Primary Turns and Signal Strength

It will be noted that horizontally I have marked off the turns upon the primary, while vertically is the signal strength scale, and it is to be remembered that a variation of, say, three turns in the neighbourhood of the peak of the first hump represents a very much greater percentage change of total inductance than a similar variation of three turns upon the peak of the second hump, where there are already as many as 33 turns in circuit. In the first case, of course, there would be only about 12 or 15 turns in circuit. This point should be borne in mind in all cases in interpreting diagrams of this type.

Lower Frequency Readings

The next step was to increase the reading of the condenser in the oscillating circuit to give a frequency of 857 kilocycles (350 metres) and to repeat the procedure. The curve thereby derived is shown in the second diagram from the top in Fig. 2, and once more we see a curve of the same general type, with two humps and a sharp dip between them, where the primary circuit has come into tune with the input frequency, with correspondingly poor results on account of the very tight coupling. The oscillator was next adjusted to give a frequency of 750 kilocycles (400 metres) and the procedure repeated, curve three reading from the top of Fig. 2 being plotted as a result of this series of measurements. For frequencies of 667 kilocycles (450 metres) and 600 kilocycles (500 metres) respectively, the procedure was also carried out, the curves being also seen in Fig. 2.

Comparison of Curves

Several interesting things come to light upon an examination and comparison of these curves, one being that for a given number of turns in the aerial circuit we shall find that we are working upon points of widely different character at the various different frequencies under consideration. For example, if we take 15 turns, we shall find that with a frequency of 1,000 kilocycles (300 metres) we are just nicely on the peak of the first hump; with a frequency of 857 kilocycles (350 metres) we are still in a good position upon the peak of the first hump; with a frequency of 750 kilocycles (400 metres) we are no longer in a very favourable position, being half-way down the outer slope of the first hump, where the signal strength is only half the maximum possible, but where selectivity is fairly high.

Signal strength is poorer still in the case of the frequencies of 667 kilocycles (450 metres) and 600 kilocycles (500 metres). Further, it will be observed that what one may describe as danger points, namely, the dips between the two humps (where it will be remembered that selectivity is exceedingly poor and signal strength also deficient), fall at numbers of turns ranging from 24 in the case of the 1,000 kilocycle frequency to about 48 in the case of the 600 kilocycle signal.

Varying Oscillator Output

It will be observed that these different curves rise to different maxima, resulting from the fact that the

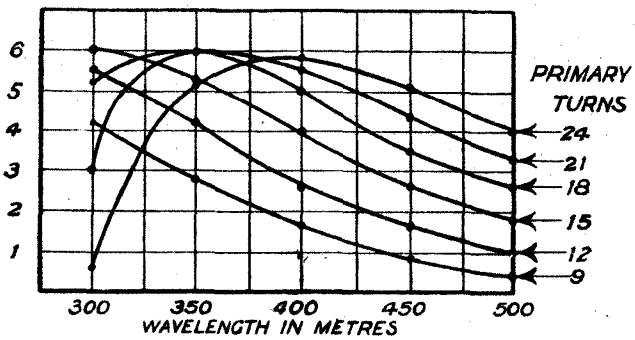


Fig. 4.—From these curves, which are plotted from the data provided in Fig. 3, and on a scale of wavelength against signal strength, may be deduced the degree of "aperiodicity" of the primary circuit over a particular band of wavelengths.

output from the oscillator was not constant in strength at the different frequencies under investigation, but altered progressively as the frequency was lowered, *i.e.*, as the wavelength was increased. This became so acute that in the case of the curve for the 600 kilocycle frequency (500 metre wavelength), it was necessary to increase the strength of the oscillator somewhat by applying a greater H.T. voltage in order to obtain a signal strength that could conveniently be measured, and it will be observed that this curve rises to a greater height than the preceding one for the 667 kilocycles (450 metres) signal.

Equalising Signal Strength

In order to carry out a proper comparison to determine the actual degree of relative efficiency obtained at different frequencies with a primary of fixed size, it was decided to determine corresponding points from the five curves of Fig. 2, and then to adjust the oscillator at the various frequencies under consideration so that an equal signal strength was obtained at each of the points chosen. It will be observed upon inspection of Fig. 2 that points A, B, C, D and E have been marked, which are all roughly equivalent to each other in relative position upon the curve appropriate to the frequency chosen.

Oscillator High-Tension Voltage

The next step was to determine by experiment what value of high-tension voltage upon the oscillator valve would give the same signal strength, a value of 6 being chosen, when turn numbers appropriate to each of the points mentioned were included in the aerial circuit. These were found to be as follows :—

Test Frequency.	Aerial Turns.	Oscillator Voltage.
1,000 kilocycles	15	84
857 ,,	18	102
750 ,,	27	120
667 ,,	30	138
600 ,,	36	168

Second Series of Curves

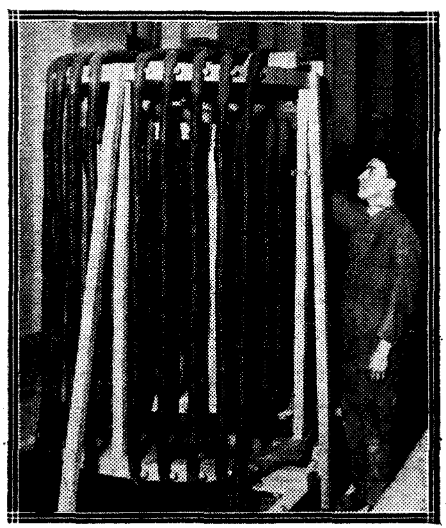
The operation of taking the series of readings upon the five different frequencies chosen was then repeated, using the voltages upon the oscillator which had been determined, and the five curves were then plotted again, the result being seen in Fig. 3, in which it will be observed that the heights of the peaks are identical in each case. From this second set of curves it is possible to read off in a vertical direction figures which can be taken as a measure of the efficiency of a given number of turns in the aerial circuit upon the five different frequencies in question. For example, with 9 turns in the aerial circuit, a signal strength of 4.2 is obtained from a signal of 300-metres wavelength, of 2.8 from one of 350-metres wavelength, 1.7 with a wavelength of 400 metres, .9 from a signal of 450-metres wavelength, and .5 from one of 500-metres wavelength.

Wavelengths and Frequencies

If we now take the figures just quoted and plot them upon a horizontal scale of wavelength and a vertical scale of signal strength, we shall obtain a graph which will show the signal strength given by that primary upon any desired wavelength between 300 and 500 metres. (It should be noted that I am now quoting wavelengths only, because it seems most convenient to do so in the case in question, wherein we are dealing with the efficiency of a primary upon a band of frequencies on which are distributed a number of wavelengths of broadcasting stations which most of us have memorised.)

Other Turn Numbers

In Fig. 4 will be seen the result of plotting this curve and a number of others, the latter being appro-



A transformer installed at the Rugby station, the dimensions of which may be gathered from the photograph.

priate to 12, 15, 18, 21 and 24 turns in the aerial circuit. The figures for the plotting of these curves were all read, of course, from those given in Fig. 3, by simply drawing an imaginary line in a vertical direction appropriate to the number of turns in question, and noting the points at which it cuts the curves. It will be observed that up to 15 turns we have a simple falling characteristic, which starts at a fairly high value for 300 metres and falls off steadily to a low one at 500 metres, these being the conditions under which we normally work with one of these tight-coupled aerial circuit arrangements, the reduction of signal strength upon the higher wavelengths having been noticed in actual practice by many experimenters.

Effect of Wavelength Changes

As a matter of fact, slight reductions in efficiency with change of frequency are not in fact so noticeable as one would expect; it must be remembered that when one passes from a station on 400 metres to another on 500 metres, it is most difficult to make an actual comparison, since one has changed from one station to another, from one programme to another, from one set of conditions as regards interference to another set, and furthermore, the two stations which are being compared are no doubt at quite different distances from the receiving point, so that some change in signal strength is naturally to be expected, regardless of the relative efficiency of the receiving circuit upon the two frequencies.

Turn Numbers for Particular Wavelengths

When larger numbers of turns than 15 are included in the aerial circuit, it will be observed that we start with a low value of signal strength for a 300-metre signal, arriving at the maximum possible figure of 6 at some point further along the wavelength scale, and then fall off again towards the upper wavelengths. This, of course, is because when the larger numbers of turns are used, we may be starting somewhere near the dead region between the humps for the short-wave signal, passing away from it as the wavelength is increased. This, as will be seen, becomes quite an acute difficulty in the case of the 24-turn primary, which would be practically useless for a 300-metre signal, although good for anything between 350 and 500 metres.

Conclusions Reached

From this latter point a useful deduction can be drawn, viz., that it is very much wiser to choose a really small number of turns in the aerial circuit and endure the falling-off of signal strength upon the lower frequencies, rather than to risk the possibility of striking a dead region for the higher frequencies.

Tappings on Primary Winding

It would further be justifiable to draw the inference that a primary of fixed turn numbers cannot be taken as covering so wide a band of frequencies as that embraced between the wavelengths of 300 and 500 metres with any reasonable degree of uniformity, and that it would seem justifiable to provide tappings, one or two in number, upon such primary windings, or alternatively, to use plug-in or other interchangeable coil units for the purpose. It must be borne in mind, however, that such changes in efficiency as are apparent in Fig. 4 are not by any means so noticeable in actual reception as one would at first sight assume.

Effects of Aerial and Earth Systems

A word of warning must be given at this point to the effect that all the measurements shown were carried out upon one particular aerial and earth, and it will be remembered that it has been shown in the past that different aerials behave somewhat differently in their response to experiments of this nature. In general, the position of the peaks and dips of the characteristic curve will fall at different numbers of turns, and the degree of sharpness or otherwise of the peaks will vary. The general inferences, however, would seem to hold good, and they are commended to the attention of those experimenters who make use of tight-coupled primary windings in their receivers.

RADIO PRESS CALIBRATION SCHEME: FREQUENCY TESTS THIS EVENING

As announced in the last issue of *Wireless Weekly*, the frequencies of all the B.B.C. main stations, and also of certain Continental stations, will be measured this evening (December 30), commencing at 7.45 p.m. The exact times of measurement for each station are given below, together with their approximate frequencies :—

Time.	Station.	Frequency. Kilocycles	Wave-length metres.
7.45 p.m.	Cardiff	850	353
7.50 p.m.	Seville	840	357
7.55 p.m.	London	822	365
8. 0 p.m.	Madrid (Union Radio) ..	804	373
8. 5 p.m.	Manchester	794	378
8.10 p.m.	Oslo	785	382
8.15 p.m.	Bournemouth	777	386
8.20 p.m.	Madrid (Radio Iberica) ..	765	392
8.25 p.m.	Dublin	752	399
8.30 p.m.	Newcastle	743	404
8.35 p.m.	Munster	732	410
8.40 p.m.	Glasgow	711	422
8.50 p.m.	Rome	706	425
8.55 p.m.	Toulouse	696	431
9. 0 p.m.	Belfast	682	440
9. 5 p.m.	Ecole Superieure	655	458
9.10 p.m.	Frankfurt	638	470
9.15 p.m.	Birmingham	626	479
9.20 p.m.	Aberdeen	606	495
9.25 p.m.	Zurich	583	515

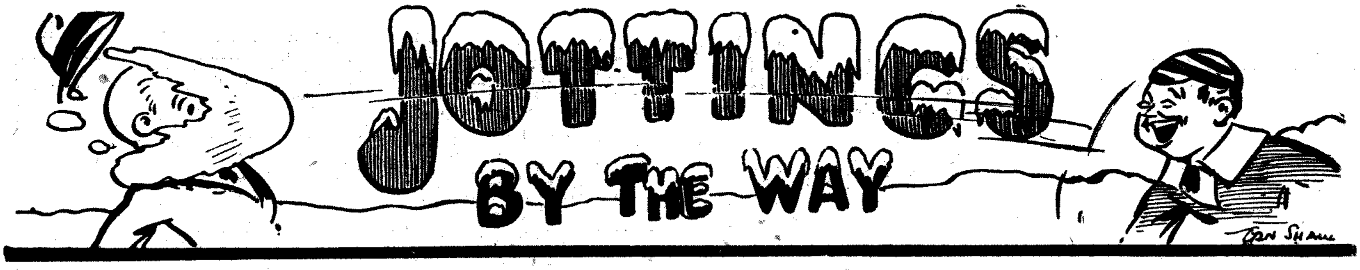
It is, of course, possible that some of the above stations may be badly jammed, or not working, at the above times; this, however, will be stated in the report of the results.

Other Calibrations

Calibrations of other stations may be taken at the same time, so that it will be well worth while to listen to, and take the readings of, any other stations that may be heard on that evening.

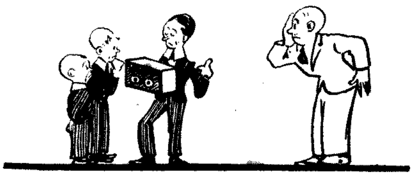
Transatlantic Tests

In view of the Transatlantic Broadcasting Tests, arranged to take place at the end of January, 1926, as announced elsewhere in this issue, listeners should find it particularly useful to calibrate their wavemeters and receivers now. The assistance rendered by accurate calibration of a receiver in picking up distant stations is too obvious to need further comment.



The Merry Season

I AM writing this on the eve of what they call the merry season. By the time that it appears in print both you and I will be experiencing that "morning after" feeling which is produced by our coming up with a jerk against rent, rates and income tax, and a lot of other little troubles of the same sort. Personally, I am



. . . They criticise my own set . . .

having just now a thoroughly bad time, and I feel sure that I shall have the sympathy of any fathers of families who read these pathetic lines.

Briefly, what has happened to me is that each and every one of my young hopefuls, who are now home for the holidays, has taken up wireless with an enthusiasm that only the very youthful know. Matters were not so bad this time last year, when only the eldest had leanings that way. I used to miss a variable condenser now and then (or rather somebody else did, since mine are invariably borrowed), and transformers would disappear, whilst occasionally one of my (that is, Snaggsby's) valves would be found to have burnt out mysteriously. I did not mind all this; I encouraged the lad, helping him with his wiring, and then leaving him to straighten things out after I had attempted to make up one of Professor Goop's supercircuits for him. But now that the other two have followed in his footsteps, I am beginning to wonder whether there should not be an age limit for wireless, and also whether a law should not be passed limiting the number of devotees in any family to one or possibly two. Four is really too much of a good thing.

The Devastated Area

Intending to undertake a small constructional job the other day, I strolled out to my workshop. Words fail me to describe the sight that met my eyes. The place was positively strewn with broken drills, taps, and hacksaw blades; my best chisels had obviously been used for trimming the edges of ebonite panels, and my most treasured files for cutting lead or solder or something equally devastating to their keenness.

The absolute limit was reached when after a frenzied search for my 4B.A. die I ran it literally to earth upon a crystal set, where it was doing duty as the top of the E. terminal. The culprit stated that he could not find a single milled nut—the same thing has been occurring to me since the holidays began—and that the die did jolly well as a substitute. I have put my foot down on valve sets for the younger ones; but does that ensure me peace? Certainly not. They have each rigged up indoor aerials and spend their time fiddling with cats-whiskers, whilst my loud-speaker clicks and scrapes unceasingly, and sometimes brings in snatches of youthful conversation, some of which is by no means complimentary to me.

Poddleby, Too

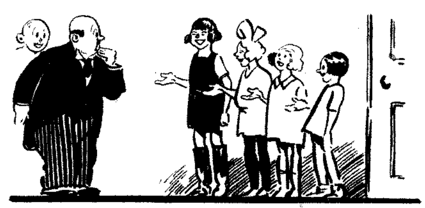
Striding in my despair from my wrecked workshop, I went round to Poddleby's house to seek consolation. I was sure that things would be all right there, for Poddleby has no boys. When I entered his den I found him looking a little worried, I thought, and he was much more silent than usual, to begin with.

When I told him I had come for sympathy and consolation, he told me that his own need was greater than mine, adding that in such cases it was infinitely more blessed to receive than to give.

As we were talking, there was a little tap at the door, and Poddleby's four small daughters, ranging from fourteen down to eight, came shyly in. When they had shaken hands very prettily with me, Poddleby suggested that they should run away and play. However, they lingered by the door, standing first on one foot and then on the other. Then suddenly they found their voices and all began to talk at once. The burden of the chorus was, "We have used all those 4B.A. nuts. Could we *please* have another dozen?" "Nuts!" screamed Poddleby, "Nuts! This place is becoming an infernal monkey house."

A Fellow Feeling

When we were alone once more I seized Poddleby by the hand. "My friend," I said, "I had no idea that you also were for it. It appears that the modern woman has taken to wireless, even as a duck takes to water. Still, you ought to be thankful that they are girls. You should just see my house, my workshop, my gadget cupboard." There is nothing so comforting as another's adversity. On hearing my tale, Poddleby at once began to brighten up. "You are not half so badly off as I am," he said warmly. "I have been



". . . We have used all those 4B.A. nuts . . ."

turned right out of my workshop. Those kids have put up their wireless set there and are using it as their receiving cabin." I saw a chance of scoring a point. "Then they have only *one* set?" I asked. "Yes," cried Poddleby. "Why, my dear fellow," I said, "you are not suffering at all. I have *three* boys and they *each* have a set. They have all rigged up aerials in their bedrooms." "My good fellow," cried Poddleby, " you are in clover. My girls may only have one set, but they have pinched my aerial ! "

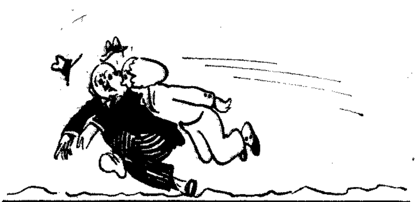
In Search of Sympathy

Eventually we agreed that we were each suffering equally badly, and, feeling brothers in adversity, we resolved to go and call upon the General. As he has no family, we felt sure that our sad tales would move him to pity. " At any rate," remarked Poddleby, " we shall be able to listen to some wireless in comfort, and that will be something. We were so cheered by this idea that we strode forward with elastic steps. As we were walking along the hedge in front of Simla Villa towards the gate, a large and very squashy snowball sailed over googly-wise, catching Poddleby, who was, luckily, on the inside. fairly and squarely upon the ear.

I hastened to render first aid by scooping the snow out of his ear with a B.A. spanner which I happened to have in my pocket. I was still engaged, despite Poddleby's protests, in my noble work of mercy when a second snowball, larger and squashier than the first, descended upon the back of my neck, and as I was leaning forward at the time, several pounds went inside my collar and slithered like an avalanche down my back. " Just you wait a moment, General ! " I yelled. " Come on, Poddleby. We are two to one, and I am never afraid of such fearful odds."

The General

Poddleby and I set off at a smart double for the gate, other snowballs removing our hats before we got there. Taking cover behind the gate posts, we collected a supply of ammunition and sailed in. There was not a soul in sight. We searched the garden thoroughly and found no trace of the enemy. Suddenly the front door opened and the General, purple in the face and roaring like an infuriated bull, came bounding down the steps. " What the blue blazes are you two doing walking all over my . . . ? " he bellowed. He would have said a good deal more, I believe, had not my own well-directed missile at that moment found its billet in his widely-opened mouth. Poddleby's first shot caught him on the fourth waistcoat button. The General leapt, but whilst he was still in the air two more clinking good shots got him. They apparently upset his balance, for he reached the ground in a sitting posture, and having him thus at our mercy, Poddleby and I took full advantage of the situation.



. . . *Larger and squashier than the first* . . .

At Simla Villa, Too

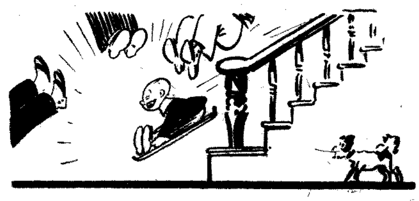
At length, when our ammunition was exhausted, we helped him to his feet. By this time he had recovered his powers of speech, but was no longer roaring; instead, he was calm and exceedingly acid. " And what," he inquired, " is the meaning of this disgraceful assault? " " Ha, ha ! " I shouted, slapping my thigh. " He, he ! " chuckled Poddleby, bending double in his glee. " Jolly good I call that. Dashed well acted, General." " Acted? " inquired our victim in scathing tones. " Will you have the goodness to tell me what you mean? " " Oh, splendid," we roared in concert. " Come, now," said Poddleby, " you can't say that you didn't ask for it." " You go slinging your beastly snowballs about over the hedge," I cried, " and then wonder why we retaliate." " Snowballs? " shouted the General, his calm deserting him. " You accuse me of going and chucking snowballs about. What on earth do you mean? I have never done such a thing for thirty years." And then, quite suddenly, his growing rage was replaced by a wave of sadness. " Well, well," he moaned, " I think I understand how it happened. Come inside, won't you? " We went in, Poddleby going first.

More Violence

As he passed the door of the dining room, a small arm holding a bladder tied to a stick was visible for a second, and Poddleby was shrewdly smitten where the thatch is thin. He was still recovering from his surprise when something whizzed down the stairs and crashed violently into our legs, sending the three of us down in a struggling heap. Picking ourselves up, we observed a small boy bearing a tea-tray and retreating as rapidly as possible up the stairs again. The General hastily pushed us into his study, banged the door, and locked it " Good heavens ! " I exclaimed, " What on earth is all this? Poddleby and I came round to see you because we were suffering at the hands of our own young, and we felt that we should be safe with you, since you have no family."

A Fellow Sufferer

" No," replied the General gloomily, " I have no family, but my sister has. She is just back from India, and I invited her down for Christmas, forgetting all about her brats. She has collected three boys and two girls from their various schools and brought them on down here, without a word of warning." Poddleby smiled. " Are they gone on wireless? " I asked. " Do they use 4B.A. nuts by the gross? " inquired Poddleby. " How on earth did you guess? " cried the General. We told him something of our own sufferings. These, he assured us, were nothing compared with the things that had happened to him. They had pulled his five-valve set to pieces and made it into five separate single-valvers. They had rigged up aerials all over the garden—he pointed them out from the window. P.C. Bottlesworth had already called upon him to insist upon his taking out five additional licences, and an official from the Post Office had threatened him with the withdrawal of the original one if he did not stop oscillating.



. . . *Something whizzed down the stairs* . . .

Never Again

We have decided that before the next holidays come round a series of large cupboards shall be erected for wireless gear. One of these will be allotted to each family man, and space will be also reserved for those who have families of others thrust upon them. When the arrival of the youngsters is imminent, the *Gazette's* Ford van will collect each threatened member's wireless apparatus and his tools, which he will be able to store in his cupboard until peace returns once more.

WIRELESS WAYFARER.

The Transatlantic Broadcasting Tests

We give below some further details of the Broadcasting Tests, which have been arranged to take place early next year between Europe and America.

IN a previous issue of *Wireless Weekly* (Vol. 7, No. 11), we published some preliminary information regarding the third annual Transatlantic Broadcasting Tests, which are to take place next month. We are now able to supply further details of the arrangements made, the organisation of the tests being well advanced.

In America the necessary arrangements are being made by our contemporary, *Radio Broadcast,* in conjunction with a representative committee, while Radio Press, Ltd., are the organisers for this side of the Atlantic.

Period Chosen for Tests

The actual period decided upon for the tests is the last week of January, 1926. This time of the year has been decided upon as a result of previous experience, and it is likely to be the most satisfactory period for the purpose. The tests will begin on Sunday, January 24, and will last for a week.

Nightly Periods

The American, Canadian, Mexican and Cuban broadcasting stations will transmit from 10 to 11 p.m., Eastern Standard Time, on every night throughout the week. These times correspond to 3 a.m. to 4 a.m., G.M.T. Following after the above transmissions, the British and Continental stations will transmit from 4 a.m. to 5 a.m., G.M.T. (11 p.m. to 12 midnight, Eastern Standard Time).

Grouping of Stations

Some interesting special tests may also be carried out in America. For instance, it is proposed to group the stations in America on one or more nights. Under this scheme the American stations might be split up into the Eastern, Central, Western Mountain, and Pacific groups, the stations in each group in turn transmitting for 15 minutes in the hour allotted, the remaining three groups meanwhile being silent. This arrangement might be expected to provide to the more distant stations a better chance of being well received and identified in Europe.

Effects of Latitude

Another special form of test, for which arrangements are in hand in America, is being planned to enable observations to be taken of the effect of latitude on reception. The stations would be grouped in a northerly and southerly direction, Canada, the Northern States, the Southern States, and Mexico and Cuba each being allotted a 15-minute period in the hour's transmission period.

Good Conditions for Reception

It is hoped that as many listeners as possible will participate in the tests, owing to the value of a number of independent observations in various parts of the country. Since the broadcasting stations in this country will not be working during the period allotted for reception of American stations, the consequent freedom from local interference should provide listeners with a good opportunity for good long-distance reception.

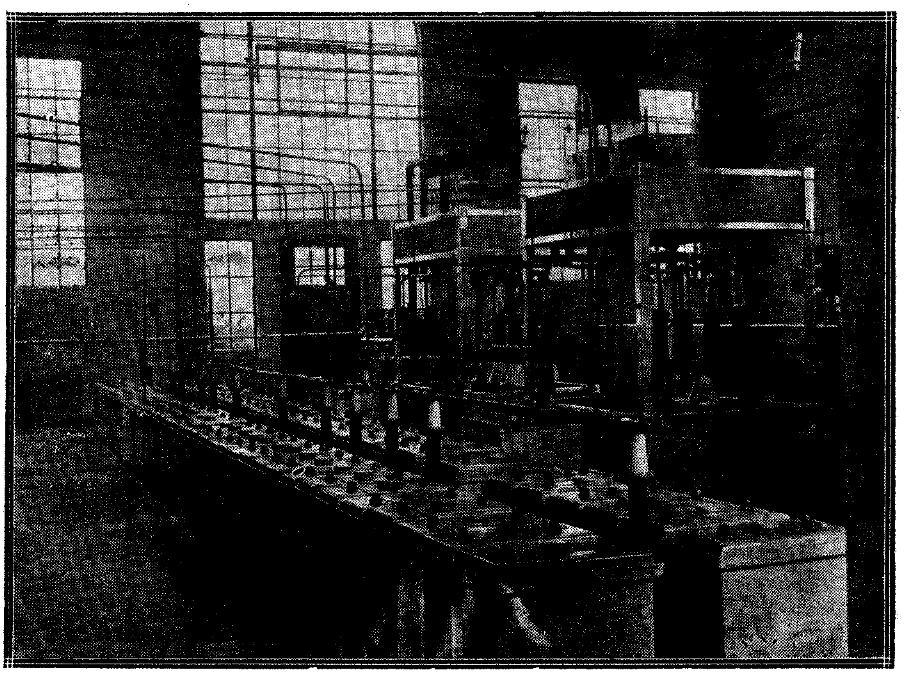
Calibrate Your Receiver

In picking-up and identifying the various stations, the assistance rendered by an accurately calibrated receiver hardly requires emphasising. Elsewhere in this issue will be found details of the Radio Press Calibration Tests to be carried out on December 30.

Another series of tests will also be carried out during January, the date and times for which will be announced later.

If listeners can adjust their receivers accurately to the required frequency, without resorting to the assistance of oscillation to find stations, a great deal of interference will be eliminated.

Further information on the subject of the tests will be published in subsequent issues of *Wireless Weekly.*



Two alternative programmes are to be broadcast from the Daventry station every week, beginning on January 11. A large bank of condensers at Daventry is shown here, and the water circulation system for cooling the transmitting valves may be seen on the right.

Methods of Modulation in Transmission

(Continued)

By the Staff of the Radio Press Laboratories.

Following on a discussion in last week's article in this series of methods of keying transmitters, modulation at definite musical frequencies is dealt with here, including the use of interrupters and the employment of A.C. for high-tension supply.

IN last week's issue of *Wireless Weekly* we showed how the modulation of an oscillating valve circuit could be divided under three headings, namely :—

(a) Modulation by keying.

(b) Modulation at some definite musical frequency.

(c) Modulation of the radio oscillation by impressed sound vibration of varying frequency and amplitude.

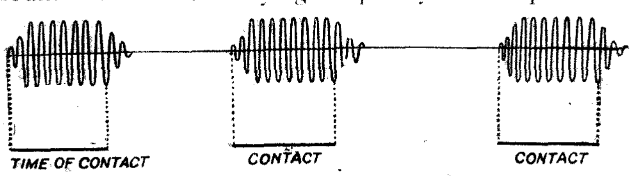


Fig. 1.—Showing the wave-form of the oscillations when the circuit is interrupted at a definite musical frequency.

We have already dealt generally with the question of keying, so we will now consider the problem of modulation under headings (b) and (c).

Modulation at a Musical Frequency

A valve oscillation can be modulated in several different ways, so as to give a so-called musical note. Although the resultant effect on an ordinary receiver is approximately the same whichever method is used, the actual wave-forms of the radio oscillations are distinctly different.

Interrupted Continuous Waves

If in series with the key shown in the circuits given in last week's *Wireless Weekly* we connect some type

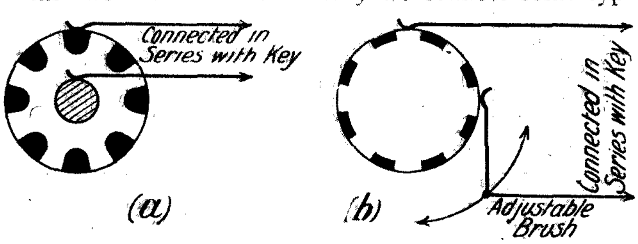
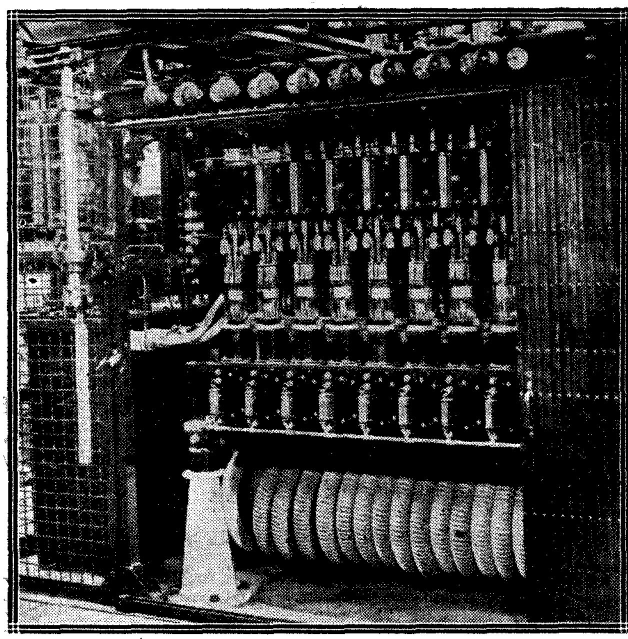


Fig. 2.—Two types of interrupter discs used for producing interrupted continuous waves. In the (b) type the adjustable brush can be moved, so as to vary the relative times of " make " and " break."

of interrupter, which opens and closes the circuit at some definite musical frequency when the key is depressed, we obtain trains of continuous wave oscillations as shown in Fig. 1. In this case the durations



One of the banks of nine transmitting valves at the Rugby station. The panels and controls are shown in the photograph on the next page.

of make and break are approximately equal. Although these relative times can be varied, it will be found that an equal ratio is the best in practice.

An Interrupter

A suitable interrupter for this purpose consists of a commutator as shown in Fig. 2, which is fixed to a small electric motor. Such an interrupter can easily be made from a solid disc of copper or brass about $2\frac{1}{4}$ in. diameter by $\frac{1}{4}$ in. to $\frac{1}{2}$ in. thick, by drilling

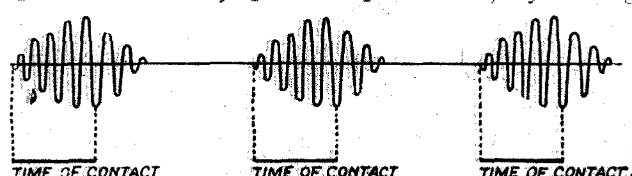


Fig. 3.—The wave-form of the oscillations when the circuit is broken at a high musical frequency. With a high musical frequency and low transmitting frequency (long wavelength) the amplitude of the radio-frequency oscillations may never remain constant.

equally-spaced holes as near the circumference as possible, and fitting these with cylindrical pieces of ebonite or other good insulating material. The disc, together with the insulator fittings, is then turned down in a lathe, so that rather less than half the diameter of the insulator rods is cut away. This will give an interrupter disc as shown in Fig. 2a.

Wave Form of I.C.W.

Referring to Fig. 1, it will be seen that when the interrupter makes contact, the amplitude of the oscillations increases to a maximum value, at which they remain steady for a number of complete oscillations. On breaking the contact the oscillations do not fall to zero immediately, but only do so after a number of oscillations of decreasing amplitude. The rate of

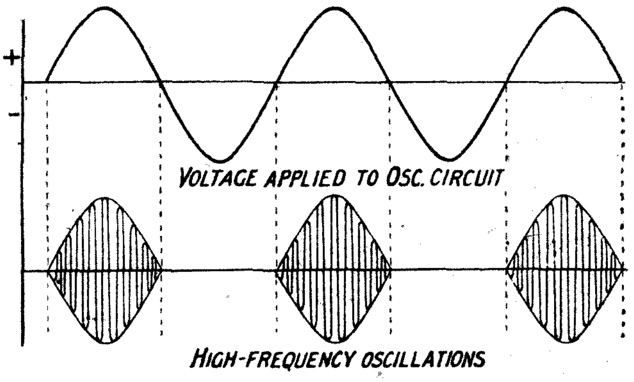
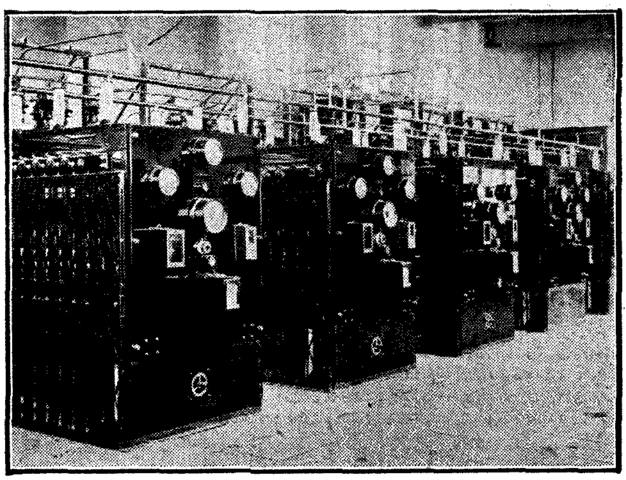


***Fig. 4.*—Showing the wave-form of the high-frequency oscillations when the oscillating valve is supplied with alternating current.**

growth at the making of the contact and the rate of decay when the contact is broken depends, of course, upon the resistance in the circuit and the frequency of the oscillations.

Frequency of Interruption

The time during which the amplitude of the oscillations remains constant, relative to the total time during which the circuit is oscillating, depends on the frequency of interruption. Thus with a high frequency of interruption and a long wavelength it is possible to get a condition under which the amplitude of the oscillations does not remain constant at all, but is either increasing or decreasing. Fig. 3 shows the wave-form under these conditions. In some cases the amplitude may not even reach its maximum value



A general view of the five banks of valve panels at the Rugby station, one of which is illustrated in greater detail on the preceding page.

before the circuit is broken. In these cases when the amplitude never remains constant the wave-form of the oscillation is practically equivalent to that of a good spark transmitter. The interference caused by such transmission may be considerable—in fact, of the same order of that caused by a spark station, the damping of which is relatively low. The interference caused by an oscillator whose wave-form is shown in Fig. 1 is, on the other hand, comparatively small.

Modulation with A.C. Supply

Another form of modulation can be obtained by applying an alternating potential to the valve circuit

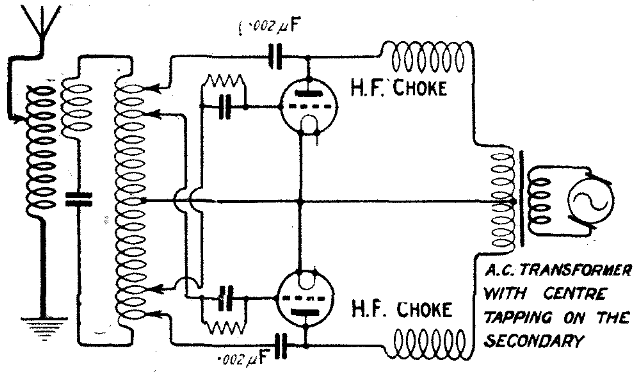


***Fig. 5.*—Illustrating the general principles of a circuit designed to make use of both halves of the A.C. cycle when an alternating current supply is employed for high-tension.**

instead of the usual D.C. voltage. If the ordinary single-valve circuit is used we obtain a wave-form as shown in Fig. 4. Oscillations only occur during the positive half of the alternating current cycle.

Using Both Halves of Cycle

By arranging two valves as shown in Fig. 5 it is possible to make use of both halves of the alternating potential. One valve operates during one half of the cycle, and the second valve operates during the other half of the cycle. Energy is therefore put into the aerial during both halves of the cycle, and we obtain a wave-form for the radio oscillations as shown in Fig. 6.

In this type of modulation the groups of oscillations are not discontinuous, as in the case in Figs. 1 and 3,

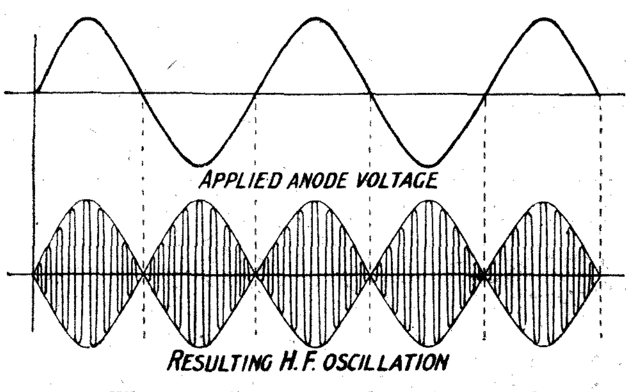


***Fig. 6.*—When an alternating voltage is applied to the type of circuit illustrated in Fig. 5 the wave-form of the radio-frequency oscillations is as shown here.**

but the whole series of groups forms one continuous function. This type of wave-form is practically equivalent to two continuous waves of equal amplitude, but differing in frequency to the extent of twice the frequency of the alternating current. This type of modulation would cause no more interference than two equal power continuous wave stations differing by, say, 500 cycles. Therefore, from an interference point of view, it is preferable to use this type of modulation rather than those shown in Fig. 1 or 2.

Superimposing A.C. on D.C. Supply

A still further method of modulating in order to give a musical note is to superimpose an alternating current potential on the direct current high-tension supply. This can easily be done by connecting the secondary of an A.C. transformer direct in one of the high-tension leads to the oscillator, and connecting the primary to a source of A.C. supply. The peak value of the voltage across the secondary should not exceed that of the D.C. supply. If the two are equal we get a wave-form as shown in Fig. 7. Although the amplitude of the oscillations falls to zero, and the curve looks very similar to that of Fig. 6, there is a distinct difference in that the "envelope" or trace in the case of Fig. 6 consists of two approximate sine waves which cross over the zero line, whereas the "envelope" in the case of Fig. 7 consists of two sine waves, one above the zero line and one below it. If the amplitude of the superimposed A.C. voltage is less than that of the D.C. supply, we get a similar wave-form to that of Fig. 7, but in this case the amplitude of the oscillations does not decrease to zero. This is shown in Fig. 8.

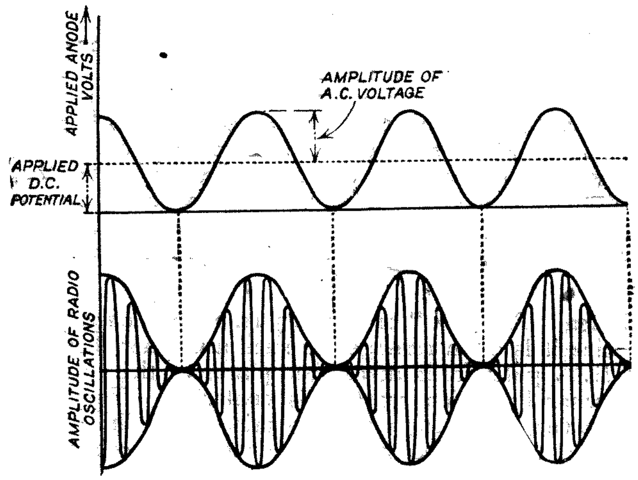


Fig. 7.—The wave-form of the modulation obtained by superimposing an alternating voltage on the direct current high-tension supply.

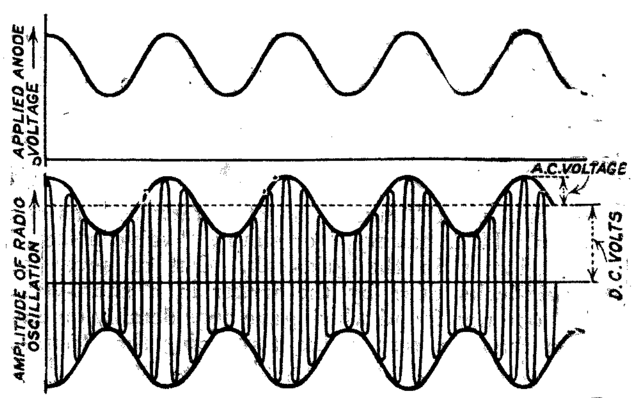


Fig. 8.—A form of modulation similar to that shown in Fig. 7. Here, however, the D.C. voltage is greater than the superimposed alternating potential.

Wave-Forms

On analysing the wave-form of the oscillations produced by this method of modulation, it will be found that it is equivalent to three continuous wave oscillations which differ in frequency to the extent of the frequency of the alternating current; that is, the difference in frequency between the two extremes is twice that of the alternating current.

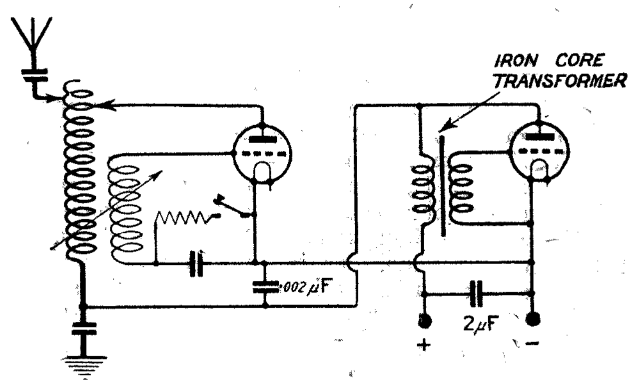
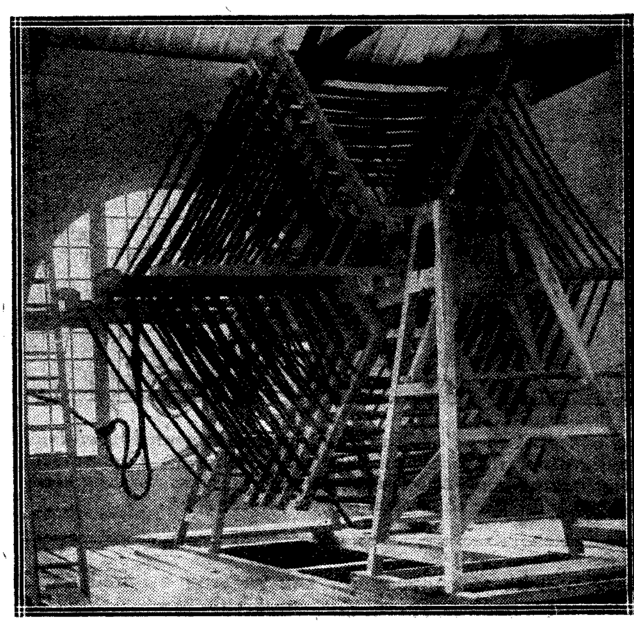


Fig. 9.—A form of circuit used for effecting modulation by means of a low-frequency oscillating valve.

Carrier Wave and Side Bands

For example, if the frequency of the alternating current is 1,000 cycles, and the frequency of the oscillations before any A.C. is applied is 500 kilocycles, then the wave-form of the modulated oscillation is equivalent to three continuous waves, whose frequencies are 499 kilocycles, 500 kilocycles, and 501 kilocycles. The mean frequency, namely, 500 kilo-



Behind these large "spider-web" form inductances at the Rugby station can be seen the lead-in insulator. An exterior view of this part of the building will be found on page 510.

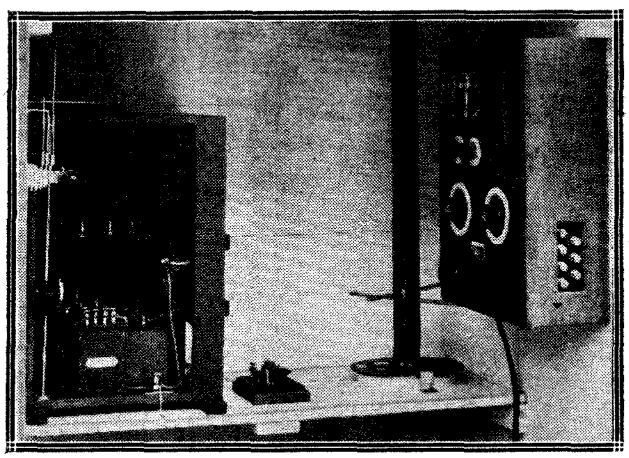
cycles, is called the carrier wave, and the two frequencies on either side are what are known as the "side band" frequencies. These two side band frequencies beat with the carrier wave frequency to produce a received note equal in frequency to that of the applied alternating potential.

Another Method of Modulation

Instead of modulating the high-tension supply voltage by means of an alternator, the same effects can be produced by means of a valve oscillating at an audio frequency. By such means any desired pitch of note can be obtained. A convenient circuit is shown in Fig. 9. One valve can be made to carry out the two functions, but in this case the circuit adjustments are rather critical for good results, particularly if a varying range of radio frequency is required.

An Important Point

One important point to be remembered in all these modulated C.W. circuits in which the main source of power is a D.C. generator, is that it is essential to connect a large condenser of the order of 2 μF across the D.C. supply. If this is not done only very feeble modulation will be obtained, owing to the choking effect of the inductance in the armature of the generator. The high-frequency by-pass condenser should, on the other hand, be kept small, otherwise



A compact form of Marconi transmitting and receiving apparatus, intended for use on lifeboats. The petrol engine and generator for power supply are mounted under the shelf seen in this photograph.

there will be a tendency for the varying applied anode voltage to be smoothed out, and the modulation will be poor.

Speech Modulation

If, instead of modulating the high-tension voltage at a constant frequency and amplitude, we vary it in accordance with the variations in current obtained from a microphone, we can obtain a radio-frequency oscillation which will give a reproduction of speech in the receiver.

Some of the problems in connection with radio telephony will be considered in the next article.

RECEIVER HINTS FOR THE EXPERIMENTER

We give below a number of useful hints, which should make a special appeal to short-wave experimenters, though applicable also, in some measure, to broadcasting and other receivers.

IT is common knowledge that the presence of dielectric material in the electrostatic field of a condenser usually has a detrimental effect on its operation. As most variable condensers are placed fairly near the baseboard of a receiver, as also are the inductances, an improvement generally results when the receiver is raised off the table by means of four "standoff" insulators or small wooden blocks. This is only materially the case with short-wave receivers.

* * *

When "Reinartz" or capacity reaction is employed, the circuit is often arranged in such a manner that the full H.T. potential is across the plates of the variable condenser by which reaction is controlled. This fact causes very worrying noises to arise when the plates of the condenser become at all dusty, on account of minute leaks between the fixed and moving plates. This may be cured very simply by connecting a fixed condenser *in series with* the variable. If the capacity of the variable condenser is larger than is necessary for the purpose (and this often is the case), it will be advantageous to use a fixed condenser of about the same capacity in series with it, thus reducing both the maximum and minimum capacity. If the variable is of the correct size, a larger fixed condenser should be used.

* * *

It is also advisable, when using capacity reaction, to take care, when designing the set, that the reaction condenser is at the end of the coil nearest earth potential; thus, instead of placing it between the anode and the end of the anode inductance, as is done in many circuits, it is sometimes preferable to break the coil in the middle, and place it between the bottom of the anode coil and the connection to the low-tension and earth. This helps to reduce hand-capacity effects to a minimum.

* * *

The troublesome "mush" so often dismissed as due to "an old H.T. battery," or simply "valve noises," often originates in the grid-leak. Out of seven or eight grid-leaks tried by the writer in a short-wave receiver, one was found which gave considerably quieter reception than the rest, *without reducing the strength of weak signals*. Incidentally, all tests such as these should be carried out on *weak* signals, as any difference in efficiency is much more noticeable than when one is listening to a signal of even moderate strength.

* * *

When "mush" is being received from external sources, such as an arc station working on the lower frequencies, it may often be reduced in volume, where L.F. amplification is employed, by using a resistance across the secondary of the L.F. transformer. This, of course, also reduces the strength of signals to some extent, but the "signal-mush" ratio almost always seems to be improved. L. H. T.

Wireless News in Brief.

Forthcoming B.B.C. Items. The following are some selections from the B.B.C. programmes for the week commencing Sunday, January 3:—

January 3.—London: Christmas Oratorio (Bach), Elsie Suddaby, Mary Foster; Leonard Gowings, Roy Henderson. Service from Glasgow: St. Enoch's U.F. Church, Prof. C. Milligan; Irene Sharrer, Chopin Recital; J. H. Squire, Celeste Octet, Helen Henschol; John Goss.

January 4.—Daventry: Broadcast to Europe. London programme.

January 5.—Glasgow: London Repertory Players in "Loyalty."

January 6. — Bournemouth: Winter Gardens Night; Ivy Fenell Williams, vocalist.

January 7.—London and Manchester: Hallé Orchestra relayed from Free Trade Hall, Manchester.

January 8.—Cardiff: "Carmen."

January 9.—Cardiff: England v. Wales—Rugger prospects.

Manchester: "Romeo and Juliet." Descriptive notes by John F. Russell.

Belfast: Band of 1st Seaforth Highlanders. Belfast Radio Players.

Daventry: London and Manchester programmes.

* * *

Broadcast Jamming. A spark station which has made itself notorious as a jammer of several of the B.B.C. stations is that situated at Boulogne, call sign FFB. Complaints have been received as far inland as Maidstone and Ashford, that FFB blots out a considerable portion of the broadcast frequency band during its transmissions.

* * *

Alternative Programmes from Daventry. We understand that from January 11 Daventry will transmit two alternative programmes every week, instead of one, as at present. In last week's issue of *Wireless Weekly* attention was drawn to the decision of the B.B.C. to reconsider the question of alternative programmes. Many listeners have expressed the opinion that Daventry should always transmit programmes of its own.

* * *

Another "Pirate" Fined. Another wireless listener, residing at Kentish Town, London, N.W., has been fined for installing apparatus for wireless telegraphy without a licence. Mr. A. G. Galagher, who prosecuted for the Postmaster-General, said that in the interests of the people who paid for their licences, the Postmaster-General felt that it was necessary to prosecute all those who failed to take out a licence.

* * *

Television Claim. M. Edouard Belin has announced at a lecture in Paris that he has solved the problem of television. The principal piece of apparatus, we understand, is a multi-faced mirror mounted on a vertical steel disc, the image to be transmitted being placed between a powerful arc lamp and the mirror, the latter being made to revolve at high speed.

* * *

Geneva Meeting. It is reported that a recent meeting of the Council of the International Radiophone Union at Geneva approved of the new plan for the redistribution of frequencies between European wireless stations. The scheme arranges for the European stations to work on frequencies between 500 and 1,500 kc. (200 and 600 metres).

* * *

A Disastrous Fire. A large amount of transmitting and receiving apparatus belonging to Captain P. P. Eckersley, the chief engineer of the British Broadcasting Company, was destroyed by fire a few days before Christmas, at his experimental station at Hendon. No clue regarding the origin of the fire could be found. Photographs of the damaged hut will be found elsewhere in this issue.

* * *

Wireless on Trains. Recent experiments in Germany in communication with railway trains having proved definitely successful, we understand that travellers between Berlin and Hamburg will be provided with means of communicating with their families and friends, etc., as conveniently as though they were at home.

* * *

We learn that Mr. R. M. Ford, who was recently prosecuted by the Postmaster-General for failing to take out a licence for a wireless installation at his house, intends to test before a civil court the application of the 1925 Act to broadcasting.

* * *

Eskimo Listeners. We hear that a four-valve receiver has been taken out to Labrador and installed at the Makkrovik boarding school by Captain J. C. Jackson on the occasion of his twenty-fifth annual visit to the mission stations of the country. Daventry is regularly picked up, and its transmissions afford the Eskimos huge glee and cause for wonder. Captain Jackson states that it is hoped to equip other mission stations with similar sets.

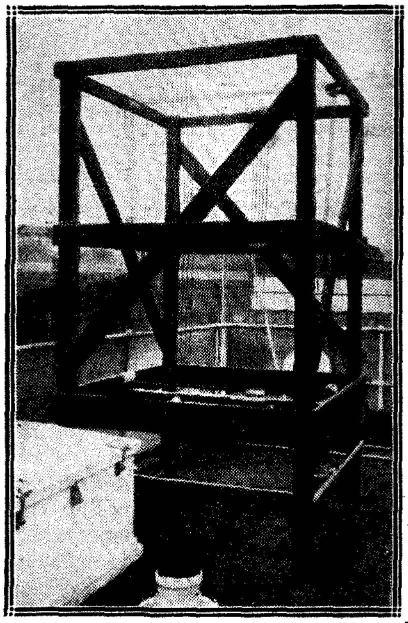
* * *

Wireless for Bart's. St. Bartholomew's Hospital, the largest in London, has been provided with wireless apparatus for the benefit of the patients, under the *Daily News* scheme for hospital wireless equipment. The equipment includes headphones for 688 beds.

The Practical Design an

By Major JAMES ROBINS
Director of Research

A substantial reduction in transmitting stations may of a frame aerial in conju ceiver. This article is t Robinson, who is recogn subject of frame aerials and



A Marconi fixed frame aerial, intended for direction finding on board ship.

THE first practical use of frame aerials was for direction-finding purposes. In the very early days there was hesitancy to use loops of such small dimensions that they could be classified as frames, but very large loops were made use of. One of the reasons for this was that amplifiers had not then reached a stage of certainty, and it was considered essential to have large loops so as to absorb as much energy from the electro-magnetic waves as possible. The system of direction-finding known as the Bellini Tosi system was the first practical

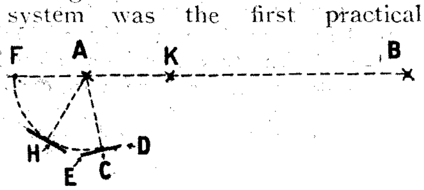
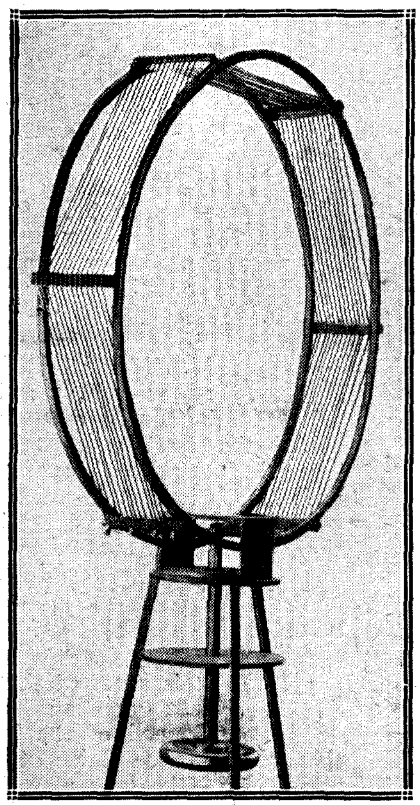


Fig. 1.—If the frame aerial ED is set at C as shown, it will be favourably placed for reception from B, while not responding strongly to A, the local station.

system, which gave good results, and the loops employed were so large that fairly high masts were necessary. A common arrangement was to have four masts, each 80 ft. in height, with the distance apart of the diagonals 60 to 80 ft. Two loops were employed at right angles, each being supported on the masts at opposite corners of the square of masts.

Development

As amplifiers came into more general use, it was found that signals could be obtained on loops of a much more convenient size, and a variety of forms of such loops made their appearance towards the end of the Great War. Amongst these types the frame aerial appeared, this consisting of a framework of various shapes, square, hexagonal, etc., on which a number of turns of wire were wound, the turns all being parallel to each other.



This home-made frame aerial is built up on two wooden hoops, and may be rotated by the wheel at the bottom.

Special Types

Loops were made of various sizes according to the purpose for which each was required. Thus on aeroplanes loops were wound with the wings and struts of the aeroplane as the framework, and such loops were made as large as possible. In the case of a Handley-Page aeroplane, a loop of side 10 ft. by 60 ft. was usual, four turns being employed. Cases when such large loops can be employed are rare, however, and the most usual situation where loops are used is on the ground. In this case the most convenient size for the framework is about 3 ft. square.

Directional Properties

Although the initial use of frame aerials was in direction finding, it was not long before they began to have application in other directions. The remarkable property of loops of receiving no energy when the direction of propagation is perpendicular to the plane of the loop began to be employed to eliminate interference.

Selective Transmission

One application of this principle was in the case of a transmitting and receiving station working with a distant station. In this case, where it was possible to separate the receiving station some little distance from the transmitter, say, by a mile, a frame aerial could be erected in such a manner as to receive no energy from the local transmitter. It could also be arranged to set the frame in its best direction for reception from a distant station.

d Use of Frame Aerials

)N, D.Sc., Ph.D., F.Inst.P.,
to Radio Press, Ltd.

nterference from unwanted ften be effected by the use ction with a sensitive re- first of a series by Dr. ed as an authority on the heir practical applications.

An Example

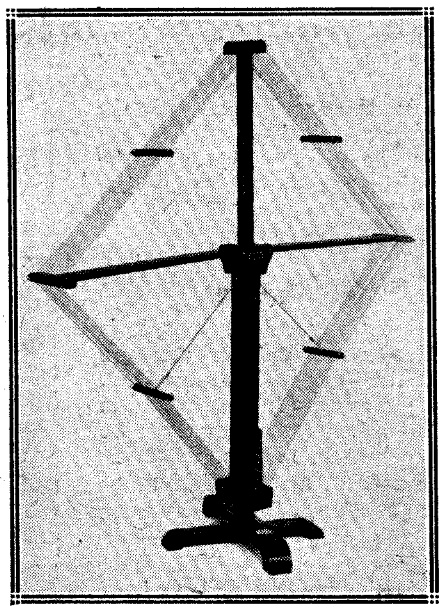
Reference to Fig. 1 shows how this is possible. A suitable position for the frame aerial with regard to its local transmitting station A is at C. The loop is arranged with its plane ED perpendicular to the line AC in order to eliminate the effect of the local signals. The position C is best for a distant transmitting station B; the position F would be bad, and H only fairly good. In the case of position H, when the frame is in the best direction for eliminating local signals from A, it is not by any means well placed for receiving maximum signals from the distant station B. In such an application it is obviously essential to prevent the direct effect of the local signals on the amplifier.

Reducing Interference

Another application of loops was in the case where two signals were arriving from two distant stations, with approximately the same signal strength and at a somewhat similar frequency. Here it is often possible to use a frame aerial and rotate it to such an orientation as to give the zero effect on one of the signals. This usually results in cutting down the signals from the other station, but the final result of a comparatively weak signal free from interference is better than a stronger signal with interference. Fig. 2 shows this case, where the receiving station is at C, and there are two transmitting stations A and B. In order to receive the strongest signals from the transmitter A, the loop should be along the line KL. In this position, however, signals would also be heard from the second transmitter B. By rotating the loop to the position DE the signals from the station A are diminished in strength, but those from the station B disappear altogether.

Application to Broadcasting

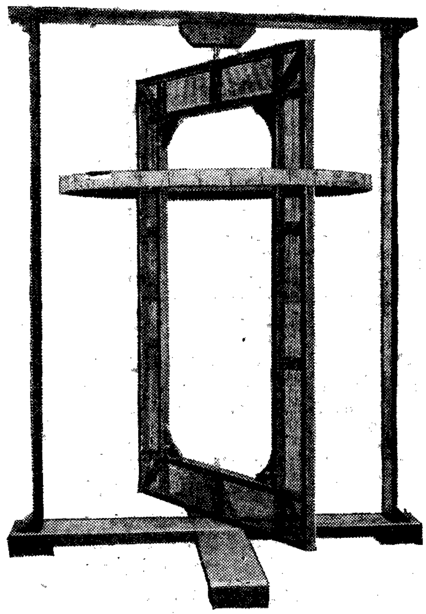
These cases are of interest in the more general application of wireless for broadcasting purposes, to enable listeners to avoid interference from a local broadcasting station or from other local transmitters such as in the case of coast towns. Again there are cases where an interfering signal may arrive from a distance, and, provided this is not in the same direction as the desired signal, it is possible with frame aerials to eliminate the interference. Atmospherics can sometimes be cut down in effect by such means, as on occasion they arrive from a definite direction over a considerable period of time.



This type of frame aerial may be folded up into a compact form when not in use.

An Extreme Case

It is even possible nowadays to eliminate interference which comes along the line along which the desired waves arrive. This may occur when the receiving station is on the line of and between the interfering station and the station from which signals are desired. In Fig. 1 the receiving station should be at K between the interfering station A and the distant station B. This is made possible by using loops which give only one zero effect for one complete rotation of 360 degrees.



A large rotatable frame aerial, of a type frequently used in laboratory work.

Analysis of Frame

Frame aerials are in fairly common use for broadcast reception, but in nearly every case they are used with good amplifiers. This is necessary because these loops do

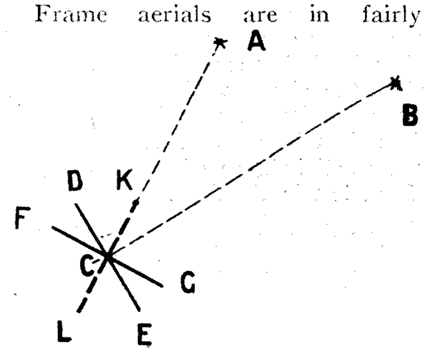


Fig. 2.—The best position for the loop to eliminate signals from B and receive them from A is shown as DE.

not pick up as much energy from electro-magnetic waves as do open aerials. In Fig. 3 a loop of a single turn is shown. This is arranged to be capable of rotation about a vertical axis, so that the loop is always vertical, no matter how it is rotated. We shall con-

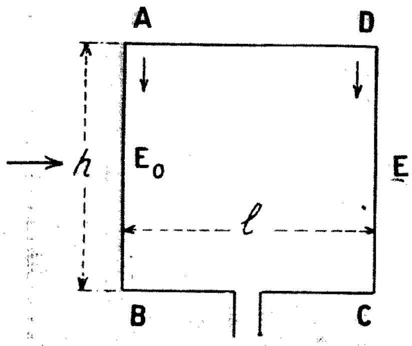


Fig. 3.—The arrow on the left of this diagram represents the wave arriving at the loop.

sider at present that waves arrive in the plane of the loop, as indicated by the arrow. The loop is equivalent to two vertical aerials AB and DC of the same size, these being joined by horizontal wires AD and BC, in the latter case through the receiver.

Time Lag

These two vertical aerials, being identical, receive the same amount of electromotive force from the waves, and, as they are joined really in opposition, it would be expected that the effects would balance out. They do not, in effect, balance out, because the electromotive force in each aerial varies with time, both being oscillatory. The waves arrive at the aerial AB some little time before they arrive at DC, so that the varying currents produced in DC lag behind those in AB. Thus when the electromotive force in AB is a maximum, that in DC is just less than its maximum, and there is a small balance of electromotive force left in the loop.

Effect of Width

The magnitude of this resultant depends on the distance apart of the two aerials. Thus, suppose that the distance l is equal to half a wavelength, the electromotive forces will be a maximum in both aerials at the same time, but in opposite directions. In this case the effects in the two aerials will assist each other. In the case where the distance l is equal to a quarter of a wavelength, the electromotive force in one aerial will be zero when it is a maximum in the other one. When the distance l is a small fraction of a wavelength there is a small lag between the effects, and we find that this lag increases as we increase l.

Actual Relationship

If at any particular instant the varying electromotive force is E_0 in AB, it will be E_1 in DC where $E_1 = E_0 \cos \theta$, where θ is the lag between the two effects, or the phase difference. θ can be represented in terms of l and the wavelength λ, and then

$$\theta = \frac{2\pi l}{\lambda}$$

Current Obtained in Loop

Without going deeply into the mathematics of the problem, it will be of interest to give the result in the form of the current obtained in the case of an open aerial, and of a loop with N turns.

In the case of an open aerial we have

$$I_r = \frac{188 A h_r}{d R \lambda}$$

Where Ir is the received current, A is a property of the transmitting aerial called the metre ampere, being the product of the effective height and the transmitting aerial current.

hr is the height of the receiving aerial.

R is the resistance of the receiving aerial.

d is the distance between the transmitting and the receiving aerials.

λ is the wavelength.

Number of Turns

In making any calculations it is essential to use the same measure for all the quantities involved. Thus if wavelength is used in metres all other quantities must be similarly given in metres.

In the case of a loop of N turns we have

$$I_r = \frac{1184\ A N h_r l}{d R \lambda^2}$$

where l is the horizontal length of the loop and all the other quantities are as in the former case.

Width and Wavelength

These formulæ apply only to cases when the width of the loop is small compared with the wavelength, and thus frame aerials of the ordinary size, whose widths are seldom more than 4 ft., are included in these cases, as the wavelengths in use for broadcasting are about 300 times as great.

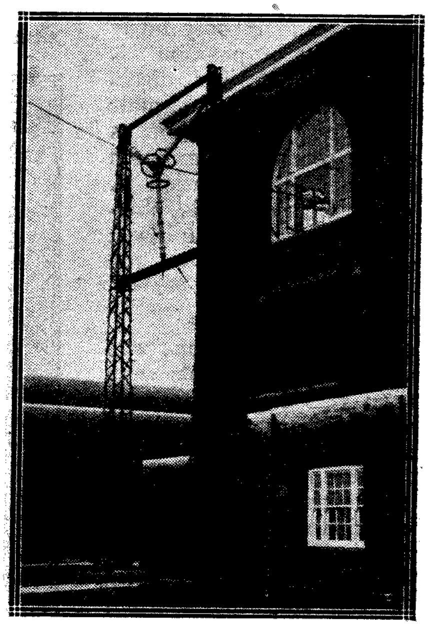
Received E. M. F.

Some idea of the magnitudes of the currents which can be obtained in loops and in open aerials will be given by an example. We shall, first of all, ignore any difference in the resistances of the receiving systems, and thus the relations we shall give will relate to the electromotive forces rather than to the currents.

The example that we shall consider is that of a plane vertical aerial of height 10 metres (33 ft.), compared with a frame aerial of 10 turns on a square frame of 1-metre side, the wavelength being 300 metres (frequency 1,000 kc.). In this case calculation by the above formulæ shows that the open aerial receives 48 times as much electromotive force as does the frame aerial.

Resistance of Open Aerial

When we consider the currents it is necessary to take into account the resistance of the two aerial systems. It is a much easier matter



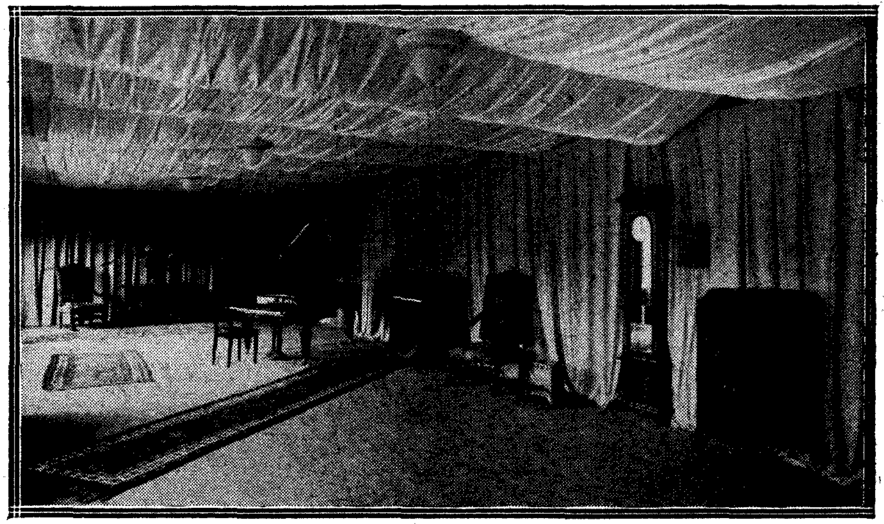
The leads-in from the aerial at the Rugby Station are taken through the end windows of the main building. An interior view of this point will be found on page 505.

to diminish the ohmic resistance of a loop than of an open aerial. In the latter case the resistance is a complex affair, being made up of ohmic losses in the aerial and leads, losses in the earth due to various causes, such as bad contacts with earth

(*Continued on page* 516.)

BROADCASTING IN NORWAY

From the account of Norwegian broadcasting conditions given in this article interesting comparisons may be made with the conditions prevailing in this country, especially at the present time, when the future organisation of the broadcasting service is under discussion.



A general view in the studio of the Oslo broadcasting station.

EVEN the least susceptible cannot fail to lose his heart to Norway, that cold virgin of the North, land of the midnight sun, split in twain by the Arctic Circle; land of rugged snow-clad mountains, of deep valleys bottomed by gleaming streams and shining lakes, of still, fathomless fjords hemmed in by precipitous heights, of roaring waterfalls and cool green forests.

Norway

A land of beauty, but beauty cruel as the jagged rocks beneath the gentle snow, a beauty treasured deep down in the hearts of the Norwegian people, but the very attributes of which form their deadliest adversary. For the loveliness that draws travellers from all the ends of the earth will not support life, and the land, greater by far than the United Kingdom, contains a population of only two-and-a-half millions.

The smallness of the population of Norway and the configuration of the country have proved a great handicap to nearly all Norwegian enterprise, and to the Kringskasting Selskap or "Broadcasting Company" it has been particularly severe.

Financial Difficulties

The "Kringskasting Selskap" is a public company with a capital of Kr. 350,000 (about £14,000), holding a concession for five years, and, as in the case of the B.B.C., the State, through the medium of the Telegraph Service Department, has a good deal to say in the matter of control and management. The official area allotted to the company extends over a radius of 150 kilometres round Oslo, the capital of the country.

It naturally follows from the size of the population that the initial difficulty faced by the company in promoting so costly an undertaking is financial, and in consequence the Norwegian, as compared to the Englishman, must pay dearly for his luxury.

Licences

Within the company's area listeners are required to pay the sum of Kr.20 (about 16s.) per annum for a licence to use a receiving set, and of this sum 80 per cent. is taken by the company and 20 per cent. is retained by the State to meet the expense of issuing and collection. Outside the area the licence costs Kr.5 (about 4s.) per annum, and the whole of this sum is kept by the State.

Duty on Apparatus

There is a further tax borne by purchasers of wireless instruments by way of a duty of 10 per cent. on all receiving sets and parts, such as head-'phones, valves, condensers, loud-speakers, etc., and the company benefits by the whole of this. To facilitate the collection of this duty all dealers in wireless instruments must obtain a licence for the sale of them, and the tax is collected by the State. Yet another tax is imposed upon those using loud-speakers in public places, as in cinemas or concert halls.

A Further Difficulty

It may seem surprising that in this large country, in which most of the towns and villages and many of the homesteads are completely isolated, no less than 80 per cent. of those licensed to receive are domiciled within the comparatively small area allotted to the company. But there is a very good reason for this, and here we arrive at the second difficulty to be faced by the Company.

Fading

Norway is one of those countries described in the Guide Book as "Mtnous," and, may we say, it is very "Mtnous" indeed. The mountains have a very deleterious effect upon reception, causing a constant fading and swelling of the sound, and so serious is this trouble in Norway that over the major portion of the country reception of Oslo is almost impossible. In some of the valleys, only 90 kilometres from the broadcasting station, this defect is so great that one cannot receive with any pleasure. The company are doing their utmost to overcome this trouble, and as soon as finances permit they hope to alleviate it by setting up broadcasting stations in other parts of the country.

Crystal Users

It is peculiar that, although conditions are such as to make powerful reception desirable, the majority of listeners own crystal sets.

In ordinary circumstances it would not be a matter for comment that Norway, out of its population of two-and-a-half millions, has 30,000 licensed listeners, but the circumstances being such as they are it speaks volumes for the enthusiasm of the people.

The Programmes

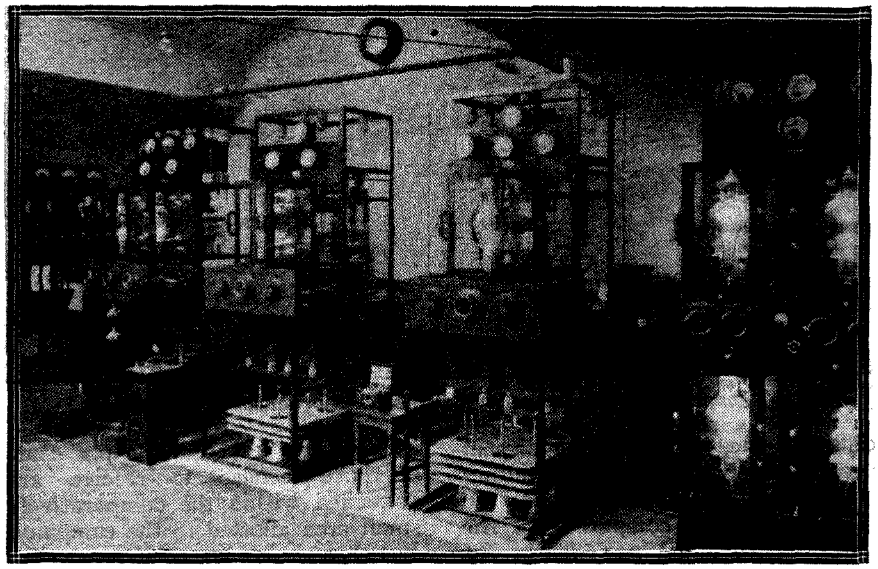
The entertainment provided by the company does not differ in kind from that offered by the B.B.C., although the financial situation does not permit of entertainment on so grand a scale. The finest native soloists, actors and singers are engaged and provide a programme of excellence. Concerted music is provided by the Radio Orchestra, which, though small in numbers, is disposed in such a manner as to obtain the best quality of tone and effect.

Good Music

On each Friday evening the "Oslo Philharmonic Orchestra," under the direction of Kapelmester Jose Eibenshutz, leave their concert hall and move to the new and roomy studio which has just been completed especially to receive them, and broadcast a carefully chosen programme of classical and good popular music. It is the aim of Mr. Berg Jaeger, who is in charge of the studios and responsible for the programmes, gradually to cultivate popular musical taste and to give modern native composers opportunities to obtain a hearing. Dancing enthusiasts have not been overlooked, and for them the Grand Hotel Dance Orchestra is broadcast from the hotel every Friday, Saturday and Sunday evening after 11 p.m.

Market Reports

But the energies of the company are not entirely expended on the provision of entertainment. By special arrangement with the State, there has been instituted a service which not only benefits the company by greatly adding to the number of subscribers, but which is also of very considerable use to the business men of the country. Twice, during the course of every morning, are broadcast the International Money Exchange, the Stock Exchange prices, and the market prices of agricultural produce, and on each Friday morning are broadcast the market prices of the principal articles of import and export.



In the transmitting room at the Oslo broadcasting station.

Assistance for Business

Every business man will at once appreciate the importance of this departure, and business men in Norway are appreciating it to some effect, for a great number of them have equipped their offices with wireless receiving sets, and the number of them who are so doing is increasing every day. In the old pre-wireless days the country banks kept *"au courant"* with the foreign exchange by means of the trunk-call telephone service, but now many of them have entirely dispensed with this method and rely upon radio, thereby greatly adding to the saving of time and expense.

State Control

We have observed that this commercial activity is being carried on by the company by a special arrangement with the State. Although it is extremely unlikely that this practice will be discontinued, it is, at present, in the nature of an experiment—for the State. The Telegraph and Telephone services in Norway are administered by the State, and it may prove that the revenue from these services will be materially diminished. Should this be the case there is no doubt that the difficulty will be solved by a monetary arrangement between the State and the company.

Advertising

Another departure, which is as yet untried in England, is the use of the broadcasting station for advertising. The Kringskasting Selskap is permitted to do this on the condition that not more than 15 per cent. of the time allotted to broadcasting is used for the purpose. The fee for advertising amounts to Kr.2 (about 1s. 8d.) a word, and it has proved to be a paying proposition both to the company and the advertiser. A considerably less time, however, than the proportion allotted is actually used for advertising, as the present financial situation of the company is such that it is under no necessity to exploit this form of revenue.

Future Prospects

It appears that, in spite of difficulties, the Kringskasting Selskap has every reason to be optimistic. Mr. Gythfeldt, the technical adviser to the company, informs us that the number of those applying for licences for reception is steadily increasing, and that it is hoped that before long it will have attained 50,000. Beyond that they dare not look at present.

Taking into consideration the enormous difficulties with which the Kringskasting Selskap has been faced, and which it has for the most part overcome, broadcasting in Norway has so far been more than a success.

QRA'S WANTED

As we are at present revising our list of British amateur call signs, all amateurs who are licensed for transmission are invited to send the following particulars:—Call sign, name, and full address.

Please address communications to Book Editorial Dept., Radio Press, Ltd., Bush House, Strand, London, W.C.2.

Inventions and Developments

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

SOME time ago reference was made to the results published by E. V. Appleton and M. A. F. Barnett in a paper read before the British Association, in which direct experimental proof of the existence of a reflecting layer of atmosphere (Heaviside Layer) was produced. Many readers must have wondered exactly what the experimental evidence was that could be taken as definitely establishing the existence of reflection in the upper atmosphere, a problem which has been disputed by the most eminent scientists of the time for some years.

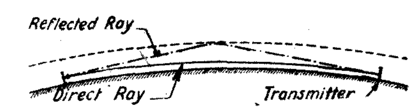


Fig. 1.—Fading may be explained as due to interference between a direct ray and a secondary ray reflected from the upper atmosphere.

Publication of Evidence

The complete paper has recently been published in the proceedings of the Royal Society (No. A752, page 621) and the results are of such importance that a brief résumé will not be out of place.

The evidence which is put forward is twofold in character. The fading which is observed on medium range transmission has been explained in terms of interference between two waves arriving at the receiving point by different routes. One of these waves is the direct ray travelling along the surface of the earth, the other being a ray which has travelled to the receiving point by another route.

If we can find any cause which will produce variations in the second ray, then we can assume that the direct ray and the indirect ray interfere with each other to a variable extent. Thus when the two waves are assisting each other, maximum signals will be produced, and when they are opposing each other, the signals will be reduced and may be completely wiped out.

Route of Indirect Ray

The only difficulty arises in deciding first by which route the second ray, the indirect ray, travels. Fading could be produced on this theory if the indirect ray merely travels in a circuitous manner along the surface of the earth, so that on the basis of the simple theory just quoted it is not necessary for any reflection from the upper atmosphere to be called into play.

Preliminary Experiments

The results of Appleton and Barnett first of all demonstrate the fact that the phenomena of fading obey all the laws which would be expected from the theory just outlined. From preliminary investigations it appeared that the maximum fading would be obtained at distances of about 100 miles from the transmitter, at which point the direct and the reflected ray would be of the same order of magnitude.

Preliminary experiments were carried out at Cambridge on the transmissions from 2LO, and suitable apparatus was devised for recording the fluctuations in signal strength.

Method of Investigation

Now assuming the fading to be due to interference between two sets of waves, one taking the shortest route and the other a roundabout route, the interaction of the two waves at the receiving point will depend upon the difference in length between the two routes and also upon the wavelength of the waves. It can easily be shown that other things being equal, a continuance of small change in wavelength will produce successive maxima and minima at the receiving point.

This point was therefore tested on the transmission from the Bournemouth Station, arrangements being made by the B.B.C. to produce periodical variations of wavelength in a special test after the normal programme was completed.

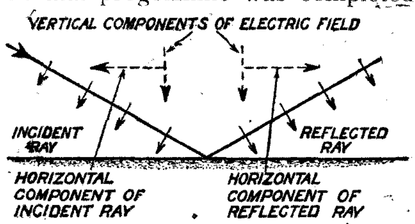


Fig. 2.—The horizontal components of the incident and reflected rays cancel out, leaving only a vertical component, as shown.

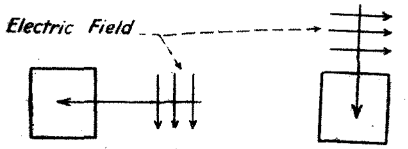
As was expected, maxima and minima were produced alternately at the receiving point, and the number of these for a given change in wavelength was exactly what would be expected if the simple theory of interference is correct.

Reflection

The next and more important question to be determined is whether the indirect wave travels by a circuitous route on the surface of the earth or whether it is reflected from an ionised layer of upper atmosphere. It should be borne in mind that in order to produce fading phenomena at such comparatively short ranges, it is necessary for reflection to take place at a fairly acute angle of the order of 60 degrees. There is considerable evidence of the existence of reflection at much longer ranges, the recent report of the Marconi Expedition to the Antipodes ("Journal I.E.E.," Vol. 63, page 933) being particularly interesting in this respect. It was found here that of all the theoretical formulæ which have been devised from time to time, that of Watson, based on the assumption of reflection at an ionised layer was in very close agreement with the actual observed values. Moreover, the values of field strength which were obtained were considerably larger than could possibly have been obtained by any purely refracting mechanism, having the constants which our atmosphere is known to have.

No Satisfactory Evidence

At short ranges, however, the existence of this comparatively acute



(a) (b)

Fig. 3.—The angle at which the reflected ray is arriving has no effect on the EMF induced in a frame, so long as the reflected ray and the frame are in the same plane.

reflection had not been thoroughly demonstrated previously, and attention was turned, therefore, to the production of some definite evidence on this particular aspect of the question. At first sight it would appear a comparatively simple matter. If there is any wave coming down to the earth at an angle from the upper atmosphere, it should be comparatively easy to detect such a wave by means of a suitably arranged frame aerial.

All attempts to detect such a wave, however, have been found fruitless by previous investigators, and it was finally shown as a result of some measurements by Smith-Rose and Barfield (*Experimental Wireless*, September, 1925) that the earth was a sufficiently good conductor to provide almost total reflection at the normal frequencies employed for broadcast purposes, so that the wave coming down at an angle was immediately reflected again at an equal angle, somewhat in the manner indicated in Fig. 2. It will be seen that the horizontal components of the incident and reflected waves cancel out, leaving only a vertical component, so that there is no evidence whatever of the existence of such an oblique wave.

Vertical and Frame Aerials

It was obviously necessary, therefore, to tackle the problem from a different aspect. Fortunately, a method is available, if it is possible to compare the signals received upon a frame aerial and a vertical aerial both receiving at the same time.

Consider the case of a simple vertical aerial. Here we have two waves arriving at the receiving point. The field strength of the direct ray is E and the field strength of the reflected ray is E_1. If the reflected ray is arriving at an angle ϕ with the ground then the EMF induced in the vertical aerial is proportional to $E+2E_1 \cos \phi$. The 2 is due to the presence of a ray reflected from the ground.

Loop Aerials

In the case of a loop aerial, however, it will be clear that the angle at which the reflected ray arrives has no effect upon the EMF induced in the loop. The EMF induced is proportional to the field strength and the dimensions of the loop only, irrespective of the angle at which the wave arrives.

Fig. 3b shows an extreme case of a wave coming down at an angle of 90 degrees. This arrangement is quite obviously exactly the same as that in Fig. 3a, except that it has been turned on its side. Thus the angle at which the reflected ray is arriving has no effect whatever upon the EMF induced in the frame, provided the reflected ray and the frame are in the same plane. Thus the total EMF in the loop is given by $E+2E_1$.

Fading

The fading produced is dependent upon the ratio of the current produced by the reflected ray to that produced by the direct ray, and inspection of the two formulæ just given will show at once that the fading is more pronounced in the case of the loop aerial. Furthermore, if the subject is investigated, it will be seen that the reverse would be the case if the reflected ray were not arriving from the upper atmosphere.

Path of Indirect Ray

If the indirect ray travelled by a different route on the surface of the earth and so arrived at the receiving point from a different direction to the direct ray, then the EMF produced in the frame aerial would be proportional to the direction of the incoming wave, whereas in this case the EMF induced in the vertical aerial would be independent of the direction. This therefore establishes at once the validity or otherwise of the reflecting layer. If it is found that the fading obtained on a loop aerial is greater than that on a vertical aerial, then the indirect ray may fairly be assumed to arrive by reflection from the upper atmosphere. If the reverse is found to be the case, then the indirect ray cannot arrive from the upper atmosphere, but must travel over the surface of the earth by a circuitous route.

Proof by Experiment

Actual experiments demonstrated perfectly conclusively that the loop aerial fading was always greater than that obtained with a vertical aerial, so that the results may be taken as conclusive proof of the

The private experimental station belonging to Capt. P. P. Eckersley, Chief Engineer of the B.B.C., was destroyed by fire on Dec. 17.

existence of a reflecting medium at some height above the earth's surface.

Horizontal Polarisation

It has previously been shown by P. Eckersley and others that reflection from an ionised layer at a fairly acute angle would give rise to horizontally polarised waves; that is to say, in addition to the ordinary reflected wave, there would be another wave produced, having its electric and magnetic fields at right angles to those of the normally polarised wave.

Errors in Direction Finding

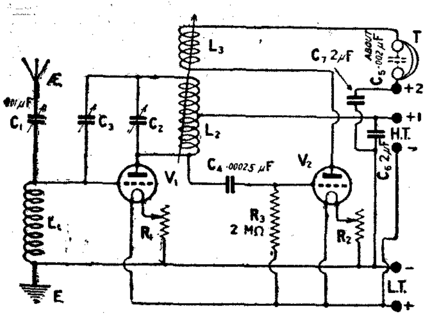
Experiments were made by Appleton and Barnett which indicated that this wave was present, and, moreover, from the values they found, they were able to verify that this horizontally polarised wave was responsible for errors in direction finding, even over quite short ranges of 30 miles only. It should be noted, however, that the presence of this wave does not affect the theory which has been outlined so far, because in all the experiments the loop aerial employed was pointing in the direction of maximum reception. It was therefore at right angles to the electric field of horizontally polarised rays.

Height of Ionised Layer

In the original paper several secondary results are deduced from the results obtained, but the one of principal interest to radio engineers is that the existence of a reflecting layer is definitely established, the height of this layer at night time being of the order of 80 to 90 kilometres.

ERRATUM

It is regretted that in last week's issue of *Wireless Weekly* Fig. 3 on page 467 was incorrectly drawn.



This should have been as shown here.

THE RADIO SOCIETY OF GREAT BRITAIN.

Report of the 12th Annual General Meeting.

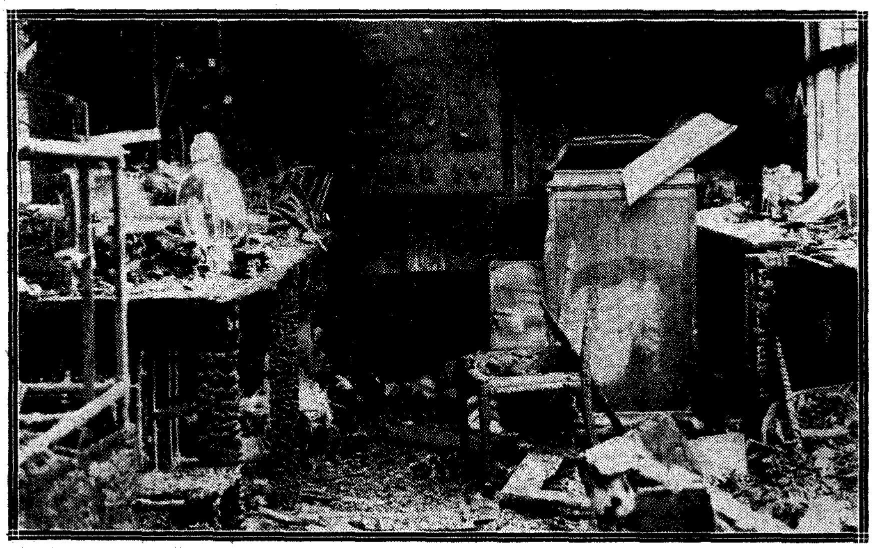
At the 12th annual general meeting of the Radio Society of Great Britain, which was held at the Institution of Electrical Engineers on Wednesday, December 16, the members had a somewhat lengthy agenda with which to deal.

Annual Report

The first item was the presentation of the annual report for the year ended September 30, 1925. A perusal of this shows that the Society has indeed had a busy year.

Standardisation of Ebonite

One point of outstanding interest to amateur constructors is worthy of particular reference in these columns. Early in the year the Society was responsible for commencing negotiations with the British Engineering Standards Association for the standardisation of ebonite for radio purposes. The negotiations were successful, and a standard specification for ebonite panels for radio purposes is now available. The result of this effort is obvious; it will be possible for every amateur constructor to purchase a reliable and guaranteed component.



The extent of the damage caused by the fire in Captain Eckersley's wireless station may be clearly seen here. The transmitting valve on the table on the left was the only one of twenty valves to survive.

Officers and Council

The next item to receive attention was the election of officers and Council for 1926. The Chairman (Brigadier-General Sir H. C. L. Holden, K.C.B., F.R.S.) announced that the following were the nominations :—

President.—Sir Oliver Lodge, D.Sc., LL.D., F.R.S. *Acting Vice-President.*—Brigadier-General Sir H. C. L. Holden, K.C.B., F.R.S. *Hon. Treasurer.*—Professor Ernest Wilson, M.Inst.C.E. *Hon. Secretary.*—Maurice Child. *Members of Council.* — O. F. Brown, Captain Ian Fraser, C.B.E., M.P., O. W. Nicholson, M.P., J. H. Reeves, M.A., M.B.E., Earl Russell, Major T. Vincent-Smith, M.I.E.E., Dr. R. L. Smith Rose, Ph.D., H. Bevan Swift, A.M.I.E.E.

These gentlemen were duly elected as officers and Council for 1926.

Paper Read

The Chairman next called upon Mr. Duncan Sinclair for his paper entitled, "Some Facts and Notions about Short Waves." The author put forward some interesting theories and suggestion, and a discussion of the paper followed.

THE FUTURE OF BROADCASTING

(Continued from page 493)

cent. of an entertainment usually given in theatres or music halls should be transmitted.

Payment for Broadcast Entertainments

If the Committee of Inquiry were of the opinion that 10 per cent. was too small a figure, then the Industry requested permission to provide an agreed proportion of such matter in the future and to receive an agreed percentage of the revenue derived from licences.

Mr. Payne considered that the broadcast version of an entertainment was very inferior to the combined visual and vocal presentation, but, owing to a natural inclination on the part of the public to obtain "something for nothing," they were kept at home, apparently satisfied with this cheap and inferior presentation. He did not think that the desire to see an entertainment was stimulated by such excerpts.

The Listeners' Point of View

Lord Blanesburgh desired to know if the Entertainment Industry had any real case for objecting to the P.M.G.'s embodying in the functions of broadcasting that which the main body of listeners desire, and which the B.B.C. can provide. Mr. Payne thought that this savoured of an entertainment dole. Lord Blanesburgh was of the opinion that it was merely the jealousy of vested and conservative interests against a new means of dissemination of entertainment.

Competition

Lord Crawford, referring to Mr. Payne's use of the word "dole," said that broadcasting was undoubtedly a cheap form of amusement. The B.B.C. and the Entertainment Industry both desired to provide entertainment. He understood that the competition of the B.B.C. was overwhelming the theatres. Mr. Payne agreed. Lord Crawford said that in that case the theatres must suffer. Mr. Payne said that if the competition became more intensive the theatres would have to close.

The Music Publishers' Association

Mr. A. V. Broadhurst then submitted evidence on behalf of the Music Publishers' Association.

He submitted that broadcasting had an adverse effect upon the sale of music. The inferior presentation on the wireless receiver deterred from buying music people who would otherwise have done so after a concert.

Licence Fees

He thought 10s. per annum far too small a licence fee, and suggested 10s. as the minimum, with a graded scale of fees dependent upon the rateable value of the residence in which the receiver was used.

Restaurants and hotels which provided music for large numbers of people by means of wireless reception should pay £10 per annum, as in Australia. Many orchestras would have to be disbanded in consequence of existing conditions.

Musical Copyright

Other evidence was given regarding the copyright situation.

Mr. Wm. Boosey submitted evidence for Messrs. Chappell and the Queen's Hall. He dealt with the effect upon the sale of instruments and gramophone records, and the learning of music.

This completed the two days' hearing, and the Committee was adjourned until a date in January, which had not been announced at the time of going to press.

THE PRACTICAL DESIGN AND USE OF FRAME AERIALS

(Continued from page 510)

plates, eddy current losses, and capacity losses. With great care it is possible to have an aerial whose resistance is less than one ohm, and this is the case with some of the large transmitting stations. The average aerial for broadcasting reception has a resistance much greater than this, being more of the order of 10 or 20 ohms.

Resistance of Loops

In the case of loops, however, losses can be kept down very much more easily, and with careful design there is no reason why the high-frequency resistance should be so great as this. To achieve the best results it will be necessary to give careful attention to the type of wire used. This point is of great importance when considering the use of loops for transmitting purposes, and will be referred to later.

The fact that the resistance of loops is usually smaller than that of open aerials tends to make the comparison between them not quite so bad for loops. The relation still exists, however, that loops do not absorb as much energy from electromagnetic waves as do open aerials.

Loops for High Frequencies

Referring to the formulæ for the received currents in the two cases, we see that the frequency (or wavelength) affects reception in different ways. In both cases the amount of electromotive force increases as the wavelength diminishes, but in the case of the loop the electromotive force is inversely proportional to the square of the wavelength, whereas in the case of the open aerial the increase is inversely proportional to the wavelength. Thus the shorter the wavelength or the greater the frequency the better are loops in relation to open aerials for reception and also for transmission.

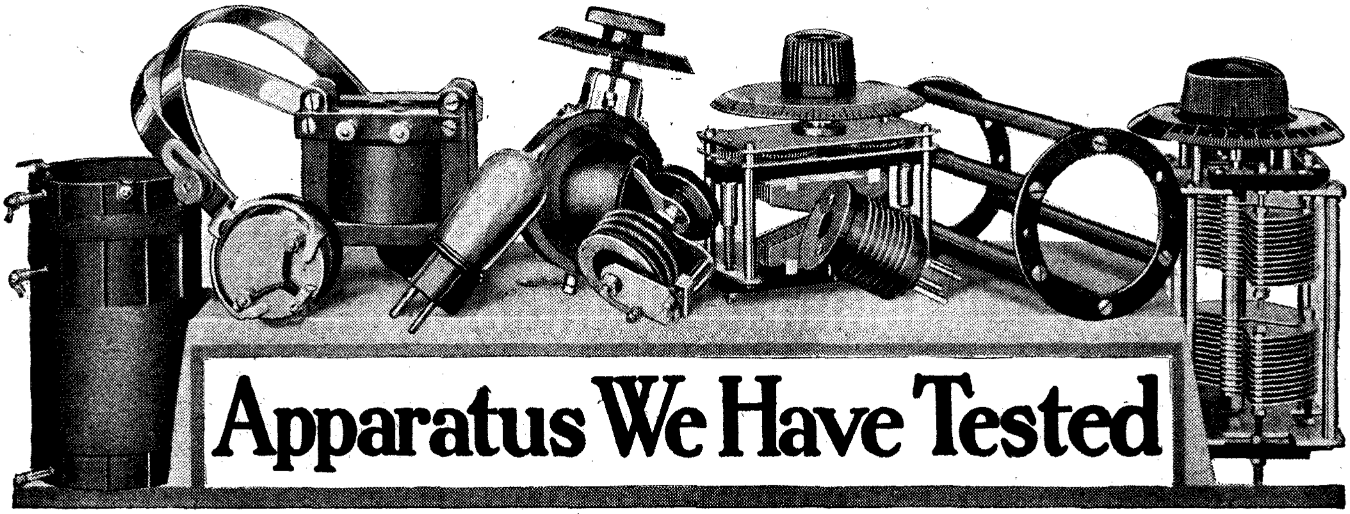
Frequency and Size of Loop

We cannot obtain a direct comparison immediately, because as the frequency changes the actual linear dimensions of the aerial must also change. Thus in the above example we assumed a loop of 10 turns. We could not apply this to another frequency, say 6,000 kc. (50 metres), because in this case there would be too many turns in the loop to allow of correct tuning. This raises a point of importance in the design of loops which will be discussed later.

"Area Turns" of Loop

Another point which arises from the formula for loops is that the electromotive force is proportional to the number of turns and to the area of each, that is, it is proportional to the total area of winding of the loop. A convenient method for describing this is to call this total area the "area turns." Thus it is advisable to have the area turns of a loop as large as possible. This means that we should either increase the size of the loop, that is, the area of each turn, or the number of turns, or both. Again, however, there is a limit to this, in so far as by increasing both of these quantities we increase the inductance of the loop, and thus affect the frequency that can be employed.

We shall consider some of these points of design in a future issue.



Apparatus We Have Tested

Conducted by Radio Press Laboratories, Elstree.

Vee Cee H.T. Battery

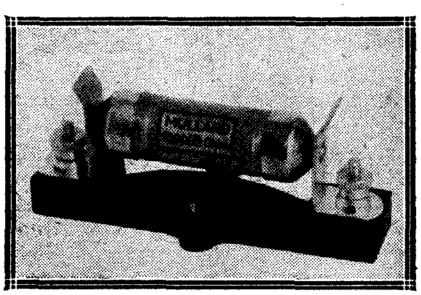
A sample of their standard 60-volt high-tension battery has been submitted for a thorough practical test by Messrs. Vee Cee Dry Cell Co., Ltd.

Description of Component.

It was contained in a cardboard case measuring 9 in. by 3 in. by 3 in., and was tapped at 18 points, which were unmarked save for the terminal ones.

Laboratory Tests.

It was given an extensive practical trial of several hours a day on most days in the week, supplying current to a small broadcast receiver taking about one to two milliamperes, and also for occasional use in experimental work with multi-valve receivers. After just over three months' use the voltage on open circuit still showed over 60 volts, and the battery was quite fit to use with a small receiver, provided that the customary 2 μF blocking condenser was placed across it. In view of the usual brief life of block H.T. batteries when submitted to the searching test of daily broadcast reception, often for seven hours a day, this must be considered a commendable performance for a battery of but moderate size.



The wire-wound Anode Resistance made by the Mullard Wireless Service Co., Ltd.

Anode Resistance

Three sample anode resistances, each of 100,000 ohms resistance, and complete with holders, were submitted by the Mullard Wireless Service Co., Ltd., and tested at our Elstree Laboratories.

Description of Component.

The resistance is contained in a fibrous insulating tube with conical metallic ends. This tube is mounted on a moulded insulating base complete with brass clips and terminals. Two screw holes provide for baseboard mounting. The resistance element itself consists of very fine wire wound on a length of string, more string being overwound in a solenoidal fashion completely to insulate the wire. The string is wax impregnated. The whole is now wound in a double layer on a $\frac{1}{8}$-in. rod, the inductance effect being thus reduced, and the ends of the wire brought to the apex of the conical ends and soldered.

Laboratory Tests.

On test the resistances were found to be within 5 per cent. of their rated values. To see if they were impervious to water one sample was left in a vessel of water all night, and on re-test the following morning it was found to be unaffected. When tested in Radio Press receiving sets no sign of "scratching noises" was present. The complete unit has a particularly good finish, and is robust, the insulation resistance also being exceptionally good.

Crystal Detector

Messrs. McLeod & McLeod have submitted an M. & M. Crystal Detector for our examination and report.

Makers' Claims.

It is a precision instrument in every sense of the word, is absolutely dust-proof, and the face of the crystal can be wholly explored. A micrometer adjustment for the catwhisker gives a sensitive control.

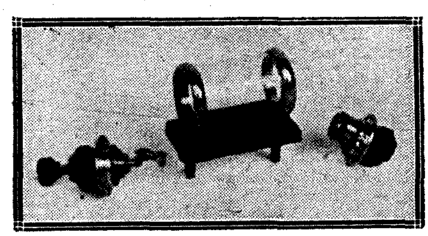
Description of Component.

The crystal and catwhisker are housed in a glass tube $1\frac{1}{2}$ in. long and nearly 1 in. in diameter, which is held in two metal collars. These collars are mounted on an insulating base, the screw threads and nuts brought out below the base being for the purpose of panel mounting and making connection to the detector. The crystal cup has a friction-tight fit over a hollow cylinder, good contact with the crystal being secured through the agency of a spring. This cup is incorporated in a metal end plate, which fits friction-tight into the metal collar and can be rotated by means of a milled insulating knob. The catwhisker is held in a jaw attached to a small "crank arm." This can be rotated bodily by means of a metal end plate similar to that for the crystal cup. Lateral movement is given to the catwhisker through the aid of a small milled knob and screw.

The face of the crystal can be wholly explored and the micrometer adjustment for the catwhisker gives a very sensitive control. The crystal and catwhisker sections are interchangeable, giving the advantage of right or left-handed control.

General Remarks.

The workmanship of this component is particularly noteworthy, the ease of operation and fineness of control being good features.



The catwhisker and crystal-holder of the M. & M. Crystal Detector are readily detachable from the glass cylinder, and are interchangeable.

Mansbridge Condensers

We have received from Messrs. Dubilier Condenser Co., Ltd., two of their Mansbridge Dubilier Condensers. These are of 1 μF and 2 μF capacity respectively, and are claimed to be suitable for use with voltages up to 300.

Description of Component.

The condensers are contained in metal cases, with small drilled sheet metal lugs at the base for fixing to a baseboard. Two terminals on the top, insulated by means of ebonite bushes, enable connections to be made to the condensers. The size of the 1 μF condenser is $2\frac{1}{4}$ in. by 2 in. by $\frac{3}{4}$ in., while the 2 μF condenser is $2\frac{1}{4}$ in. by 2 in. by 1 in.

Laboratory Tests.

When placed on test, the capacities of the two condensers were found to be as follow:—No. 1, 1 μF; No. 2, 2 μF. Insulation tests were then carried out, and the insulation of No. 1 was over 100 megohms, while that for No. 2 was 60 megohms. Both condensers were next tested at 300 volts with satisfactory results, close on double this voltage being necessary to break down the insulation.

General Remarks.

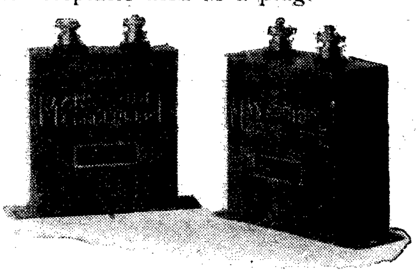
These condensers would appear to be suitable for radio work where large capacities are required, and are particularly suited to the average constructor, as they are fitted with terminals instead of soldering lugs.

Baseboard Single Coil Holder and Reversible Valve Holder

The above components have been supplied by the Athol Engineering Co. for test.

Maker's Claim.

The coil holder is made from porcelain, being rectangular in shape, and the makers claim that this component is designed for use in American type sets. It is provided with fixing holes for baseboard mounting, but in addition there is a second pair of fixing holes at right angles to the first for side mounting. This will enable it to be employed for high and low tension leads in conjunction with a coil mount or receptacle used as a plug.



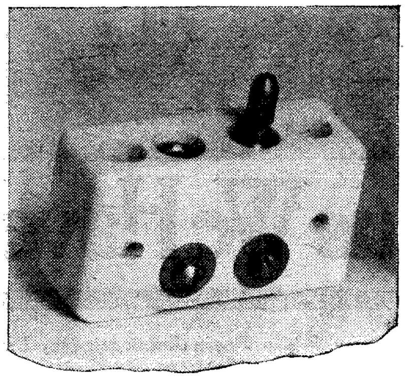
The Mansbridge Dubilier Condensers have their capacities clearly marked on the cases, and terminals are provided for making connections.

Description of Component.

An easy fit for all makes of coils was found, this fact being ensured, since the pin and socket fittings are loose in the porcelain holder. Final fixing of the brass pin and socket in the porcelain is secured by means of brass screws. These screws are also employed for the purpose of fastening the leads from the set to the coil. The insulation resistance was found to be infinity on test.

The Valve Holder

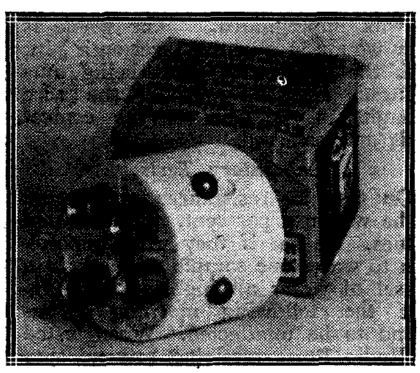
The insulating material of the valve holder was porcelain, being free from



Holes are provided in the Athol Engineering Co.'s Coil Holder to enable it to be mounted in an upright or horizontal position.

flaws, and having a cylindrical shape. The four brass sockets were held in position by four screws. The sockets can be placed at either end of the holder, "through" holes in the porcelain providing for this contingency.

It is thus possible for the sockets to be fixed flush with the top of the



In the Valve Holder made by the Athol Engineering Co., the valve sockets may be inserted in either end of the porcelain holder.

holder at one end or be reversed and project $\frac{1}{4}$ in. above the surface at the other end. This operation of reversing may be conveniently carried out by placing a valve in the sockets and removing the screws. Then pull the valve and sockets out of the holder together, reverse the porcelain and re-insert the valve and sockets again. The screw holes will now be in line with the holes in the porcelain. The grid and plate sockets are marked in the porcelain by the letters G and P respectively. Soldering tags are supplied for inserting under the screws holding the sockets.

General Remarks.

An easy fit of the sockets in the porcelain provides air spacing round the metallic fittings, with the result that long leakage paths are ensured. As can be gathered from the above description, the holder is not intended to be non-microphonic, but all makes of valves fit tight into the sockets. The insulation resistance is also particularly good. Single-hole fixing for mounting on the front or back of the panel and on baseboards is secured through the medium of a central hole in the holder.

Can'tcross Connector

Messrs. J. & W. Barton have sent us a Can'tcross Connector for report and review at our Elstree Laboratories.

Makers' Claim.

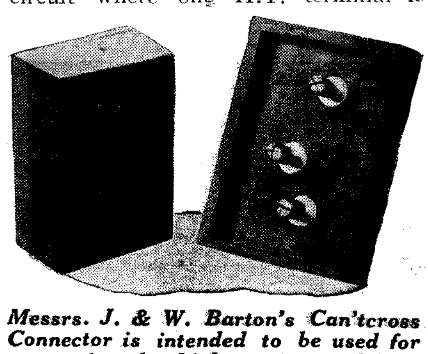
Once fitted it always prevents wrong connections being made, thus assuring full life to valve filaments. It acts as a triple switch, as by the withdrawal of the socket element, the H.T., L.T. and grid bias supplies are simultaneously cut off from the set. The live member is fully insulated, and thus prevents damage to batteries by shorting.

Description of Component.

The connector consists of a moulded base $2\frac{1}{4}$ in. by $1\frac{1}{2}$ in. by $\frac{1}{2}$ in. This base is hollowed out to a depth of $\frac{1}{4}$ in. and three split pins project from the base being stamped (H.T.+), (H.T.— and L.T.), and (L.T.). On the underside of the base, screw ends, $\frac{7}{8}$ in. in length, are provided for making connections to the pins and also for panel mounting. A moulded block fits into the hollowed base, and has three sunk sockets which fit on the pins. Connections to these three sockets are made along channels cut in the material, and a moulded lid is screwed over these terminals so that they are completely insulated.

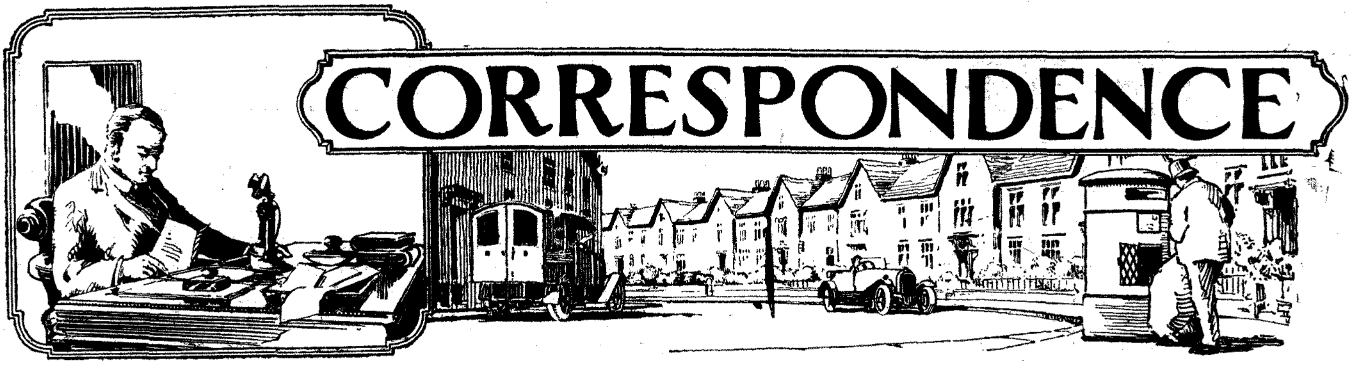
General Remarks.

This connector is adaptable to any circuit where one H.T. terminal is



Messrs. J. & W. Barton's Can'tcross Connector is intended to be used for connecting the high-tension and low-tension batteries to a receiver, without any risk of making wrong connections or short circuits.

required, but additional terminals would be needed for further H.T. tappings. When in position the battery terminals on the set are well insulated, and short circuits cannot occur. An insulation test produced good results, and the component should prove very useful.



SHORT-WAVE TRANSMISSION

SIR,—5LS, situated at 56, Humber Road, Blackheath, London, one of the experimental stations of Messrs. A. J. Stevens, of Wolverhampton and London, is now operating on 45 metres with power inputs of 25 and 50 watts. A.C. plate supply is used rectified by four "S" tubes. The present circuit is a series feed loose-coupled Hartley, employing a Mullard o/250 watt tube. A.C. also on filament.

Transmissions usually take place on Sunday afternoons and evenings, and on other evenings occasionally.

Reports will be welcomed, and 5LS will be pleased to arrange schedules with any station interested in 'phone or C.W. tests at the frequency mentioned.—Yours faithfully,

R. BLOXAM (G5LS).

Blackheath.

OXFORD UNIVERSITY RADIO SOCIETY

SIR,—Radio has at last obtained recognition in this University, and the Vice-Chancellor has given his permission for a University Society, which was formed on December 1 and already has a membership of over forty.

An attractive programme is being arranged for next term, and the Society will seek affiliation with the Radio Society of Great Britain. At the meeting on December 1 the following were elected officers of the Society for next term:—Henry Field, New College, president; Eric Cuddon, Merton, hon. secretary; C. E. G. Bailey, Balliol, hon. treasurer. Committee:—H. Richards, Merton; and E. G. Spenser, Exeter.

Of these both the president and secretary are members of the Radio Society of Great Britain and the T. & R. section.

The terminal subscription has been fixed at 7s., with an entrance fee of 10s. 6d. Will all members of the University who wish for further particulars please communicate with the Secretary.—Yours faithfully,

ERIC CUDDON.

(Founder and hon. secretary, Oxford University Radio Society.)

CONCERNING "GROUSERS"

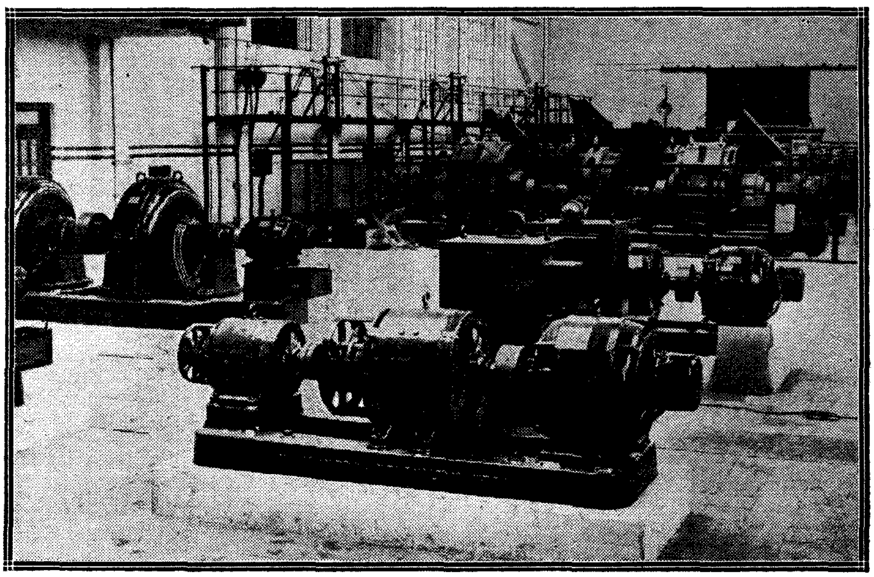
SIR,—Why is it that people will persist in grumbling about wireless? First we have the people who can only get the "Local Station" and "Daventry" on the loud-speaker, and can only get one or two others on the 'phones. They say that the B.B.C. ought to use more power and also close down the "Local Station" for about one hour a day, and some go so far as to suggest that it should be closed down for one whole day.

Now if the B.B.C. were to do as these "grousers" wanted, it would mean that the people who can only afford a crystal set and one or two pairs of headphones would have to amuse themselves as best they could during the time that their station was closed, and that, I think, would not be fair, as both the man who owns a crystal set and the man who can afford valves pay the same licence fee, and to my idea both should get full value for their money.

Now we come to another "grumble," namely, the moving of 5XX from Chelmsford to Daventry. I have no doubt whatever that the shifting of this station has thrown a good many crystal sets out of use, as the owners are now out of range of Daventry; but I noticed in one of the Radio Press weeklies, either *Wireless* or else *Wireless Weekly*, an article written by a resident of this town (Brighton) in which he states that since 5XX has moved, Brighton crystal users are out of range.

Knowing a gentleman at Hove, I tried a crystal set on his aerial (which, I may state, is shielded by trees at the back and by his house at the lead-in end, and the earth connection is a clip on the water tap), and I tuned in Daventry at good crystal strength, every word the announcer spoke being very clear, and music and singing were excellent.

On my own aerial and earth I received Daventry at loud crystal strength on the same set, and in addition I also had reception (weak) from London, so I do not think that Brighton is out of crystal range with Daventry from these results.



In the generator room at the Rugby wireless station at Hillmorton.

Now I come to the third "grumble," the "licence." In the daily and weekly papers and also in the wireless papers, both weekly and monthly, we see from time to time that people want to know why it is that the licence only lasts eleven months. Why the grumble in this case? I will own that

my first licence only covered eleven months, and also those of my friends, but our renewal licences are for twelve months, so I think the majority of listeners must jump at their first licence as a means of something to grumble about.

Hoping this letter has not bored you, and wishing the Radio Press, Ltd., the best of success with their excellent publications.—Yours faithfully,

H. R. Evans.

Brighton.

SHIELDING OF HIGH-FREQUENCY TRANSFORMERS

Sir,—In perusing the December 16 issue of *Wireless Weekly* I notice in the article on the "Isofarad" receiver reference to the shielding of H.F. transformers.

It is quite possible, in a receiver employing perhaps three stages of radio-frequency amplification, for the local station to be received on, say, the amplifier coils of the third H.F. valve.

Properly designed shields will eliminate this trouble if it is present, but at the same time it is questionable what form the shielding should take from the point of view of efficiency.

If the coils only are shielded, then they must be more or less isolated from the rest of the apparatus, particularly from the variable condensers.

If the condensers themselves are shielded either separately or in with the rest of the H.F. side of the receiver, there is the disadvantage that the minimum capacities thereof are increased, although hand-capacity effects are eliminated.

As you point out, it is again questionable whether the effective resistance and the distributed capacity are reduced to the same extent as the inductance.

The experience of some of your readers in this direction would be interesting.—Yours faithfully,

J. H. Finglass.

Wallasey.

CHEMICAL RECTIFIER DIFFICULTIES

Sir,—I am interested in wireless reception, and having much difficulty in getting my accumulators charged efficiently, am doing my own charging. I am up against several difficulties, and shall be glad if any of your readers can give me help to overcome them.

I have read some books on the subject and articles relating to it, but these are so at variance with one another and with my experience that it really seems they are not very reliable.

My house is wired for alternating current 240 volts. I purchased a chemical rectifier stated as suitable for charging a 6-volt accumulator at 3 to 4 amps. The cell is a stoneware jar to contain electrolyte with aluminium and steel electrodes. An auto-transformer reduces the voltage before rectification, and it is fitted with an ammeter.

The elements were stated as having a life of about a thousand hours.

The machine was put into action in accordance with instructions, distilled water from a reliable chemist being used. After a few hours' working the amperage fell off down to about one amp. The ammeter indicated continuous current showing little or no trembling of the needle.

The accumulators were efficiently charged, but very slowly.

After about 150 hours' running the aluminium element was completely eaten away and a thick, translucent sludge half-filled the jar. This seemed to indicate impure chemicals, but thinking it might be accidental, I obtained a second set of elements and salts from the makers. This acted in an exactly similar manner. The amperage fell off until less than half an amp. was indicated.

I then obtained pure ammonium phosphate from a chemist and used instead of the packet of salts supplied. This gives much better results, but only gives about ¾ amp. when charging a 6-volt accumulator.

The aluminium element is not corroded to anything like the same extent, but a hard substance forms on the iron, and the sludge is much reduced in quantity.

I wrote the makers, stating all the circumstances, but have had no reply.

I have since tried a four-cell Nodon valve, using ⅜-in. aluminium rods and 6-in. by 8-in. lead circular plates in glass jars 9 in. deep with ammonium phosphate, with the auto-transformer, but can only get about half an amp. on the 6-volt accumulator.

Another trouble is the creeping of the salts. I have used a good ½ in. of paraffin on the solution, and well coated the top of jar and metal parts with vaseline. Still the salts creep up and cover the metal with a thick crust.

All the books state that the cells should be kept cold and that the rectification falls off as temperature increases. I have found that the ammeter registers more rectified current passing as the temperature increases up to about 70 deg. It rises and falls consistently with the temperature of the cell contents.

Can any of your correspondents who have also experimented with Nodon valves give me information as to the correct proportions of the electrodes and electrolyte and how the salts can be prevented from reaching the vital parts of the machine?—Yours faithfully,

J. J. Boorman.

London, S.E.25.

At the Brussels broadcasting station a Marconi 6kw. transmitter is used. The rectifier panel may be seen on the left, while on the right are the independent drive, main oscillator and modulator panels.

ST.100 ON BOARD SHIP

Sir,—Having had an interesting experience with dull emitter (.06 amp.) valves, I thought it might interest you.

I have used your ST.100 circuit (Radio Press Envelope No. 1, by John Scott-Taggart, F.Inst.P., A.M.I.E.E.) ever since it was published, with very good results, the valves used being U.V.199 (American), .06 ampere ones. As is usual with these valves, after various periods, the dull emitter properties vanished, so I put them with the usual accumulation of "cast offs." About three weeks ago I decided to convert the ST.100 to a three-valve set (Det. 2LF), which gave very good results; in fact, the results were so good that I thought that I would try and get a last "kick" out of the old discarded valves (I had accumulated about five at this time). What was my surprise, on trying these valves, to find that they were nearly as good as new, say 85 per cent. The rheostats and accumulator were the same for both sets, the circuit being the only thing altered. These valves are now working with the rheostat (30 ohms) about one-quarter on, and in every respect seem, as already stated, about 85 per cent. new.

I am now trying Capt. Round's method of working the set from the ship's mains (*Modern Wireless*, October, 1925), but have not been very successful up to date. The positive side is earthed on board here, which may have some effect. As the voltage here is only 100, I have not put in R1, R2, R3, and I am taking, of course, the positive mains straight through the choke to the transformers. Yours faithfully,

M. BOSTON.
(Third Officer).

R.M.S. *Samaria.*

THE "TWIN-VALVE" RECEIVER

SIR,—I hope I shall not be boring you if I give you the results of my "Twin-Valve" Receiver (Radio Press Envelope No. 10, by John Scott-Taggart, F.Inst.P., A.M.I.E.E.), which I have constructed as instructions given. I am more than satisfied with it—the results are wonderful. I am receiving Daventry on a medium-sized loud-speaker at good volume (distance about 120 miles), and 2LO, 6BM, Radio-Paris and many other stations at excellent 'phone strength. London also is fairly good on the loud-speaker (50 miles).

Wishing your excellent journals every success.—Yours faithfully,

F. W. HUGGETT.

Lewes.

A READER'S RESULTS

SIR,—I have tried many of your excellent designs, of which I will give my experiences in this letter.

I made up the "New ST100," by John Scott-Taggart, F.Inst.P., A.M.I.E.E., which appeared in the first two numbers of that splendid little publication, *Wireless.* The results obtained were London, Bournemouth, Daventry, Radio-Paris, Toulouse, Rome and one other foreign station unidentified, all on the loud-speaker, and I received on the 'phones Birmingham, Newcastle, Glasgow, Cardiff, Aberdeen, Manchester, Plymouth (once only), Hull, Sheffield, Liverpool (exceptionally strong), Brussels, Hamburg, Hilversum, Madrid, Oslo and San Sebastian. The "New ST100" is sure the goods.

The "Anglo-American Six," described by Mr. Percy Harris, M.I.R.E., in the January, 1925, issue of *The Wireless Constructor,* was the next set I made, and after a little trouble in stabilising it, all the above stations, and many more, were easily obtained, and London, Bournemouth, Daventry, Radio-Paris, Rome, Toulouse, Newcastle and Manchester and three stations (one English and two foreign) were received on the loud-speaker.

Now, I am one of the "wireless fans" who is never satisfied with one set for more than a week or two, and so I made up the "Harmony Four," described by Mr. Harris in *Modern Wireless* for September, 1925, but I added one low-frequency stage, which is switched on and off by a D.P.D.T. switch.

Now this is really a splendid set; in fact, for purity and tone I cannot say enough to praise it, and the range, ease of control and volume, well—it is just like turning an indicator to the station you want, and you have it, and by judicious twiddling of the neutrodyne condenser you can bring it up to splendid volume, quite enough for anyone who likes to sit and listen to a nice concert, and unless the station is very distant and I require more volume, I only switch on the four valves, five being too loud and the loud-speaker cannot handle the volume. Up to the present I have received thirty-three stations on this set, and twelve of them were audible on the loud-speaker. Not a bad haul, is it?

Wishing you the best with all your publications.—Yours faithfully,

REGULAR READER.

Brighton.

ENVELOPE No. 2

SIR,—I should like to inform you that I have just constructed the "Family" Four-Valve set (Radio Press Envelope, No. 2, by Percy W. Harris, M.I.R.E.), and at present am very pleased with the result. I can tune in Daventry strong enough to be clearly audible on my loud-speaker on the detector valve alone, which for Devonshire must be fairly good.—Yours faithfully,

A. B. FORD.

Exmouth.

THE "A B C" WAVETRAP

SIR,—The following report on the "A B C" wave-trap (Radio Press Envelope No. 6, by G. P. Kendall, B.Sc.) may be of interest to some of your readers troubled by interference.

The trap was built some four months ago and has been in constant use about 2½ miles from 2LO on the "Family" Four-Valve set and a Five-Valve T.A.T. using geared condensers. The type of trap used was type "A" on a 7/22 bare copper wire aerial (twin) about 40 ft. long; it is badly screened, as it is erected outside the windows of a top floor flat. The earth is a water pipe in a different room to the set. A .001 μF variable condenser is used instead of a .0005 μF as the writer had a spare one.

No trace of 2LO can be found when receiving 6BM or any station from about 10 metres on either side of 2LO, nor can any loss in signal strength be noticed.

By connecting a coil plug in series with the large coil in the wave-trap and plugging in a home-made duolateral coil of 153 turns, Radio-Paris can be received without any trace of 5XX or loss of signal strength. This coil plug is shorted when the trap is used on B.B.C. wavelengths; it does not affect the efficiency of the trap in any way.

Wishing all your publications, of which I am an old and constant reader, the best of success.—Yours faithfully,

London, S.W. C. P. YAPP.

AN EFFICIENT SINGLE-VALVE RECEIVER

SIR,—I noticed "An Efficient Single-Valve Receiver" described by Herbert K. Simpson in *Modern Wireless* for June, 1924, and made this set up. I have a single-wire aerial of Electron wire 50 ft. and 40 ft. lead-in, 40 ft. high, badly shielded by flats in Palace Gate which are 40 ft. higher than my aerial. I get London on a loud-speaker, 5XX fairly loud on the 'phones. I also get a German station at crystal set strength which is fairly loud, and I also get Edinburgh, Glasgow, Cardiff, Birmingham, Bournemouth, Newcastle, Nottingham, Brussels, and lots of amateurs, one, 2KG, on a loud-speaker. This is the finest single-valve set I have heard. I can get London louder without an aerial by simply putting the earth wire on the aerial terminal; in fact, I can get London without aerial or earth by using 75 plug-in coil in A and 50 in reaction. I am using a Dutch 4/9 valve and 40 volts H.T. and 4-volt accumulator.—Yours faithfully,

E. J. BARROW.

Kensington, W.8.

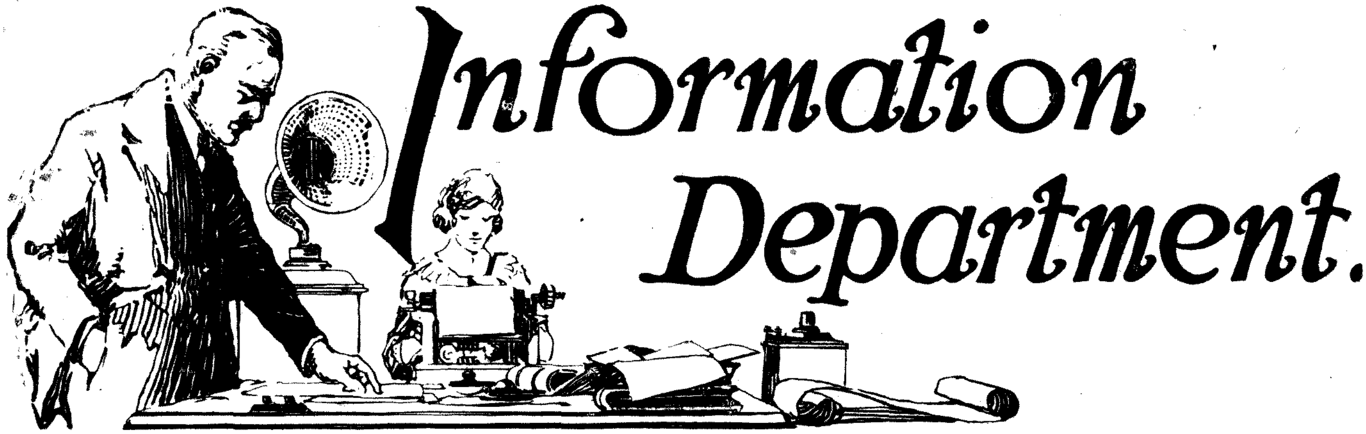
THE "NEUTRODYNE JUNIOR."

SIR,—I am writing this in thanks for the design of the "Neutrodyne Junior" (described in the March number of *Modern Wireless,* by Percy W. Harris, M.I.R.E.). I made this set a short time ago. Since then I have received: London, Newcastle, Cardiff, Birmingham, Glasgow, Belfast, and Nottingham at various strengths. I have not tried Daventry or Radiola because I have no neutrodyne unit for this wavelength. I have heard many loud-speaker sets, and I have made several sets myself, but I have heard nothing anywhere near this set for clearness and purity of both music and speech; and the other very important item, I cannot interfere with my neighbour when I have adjusted the neutrodyne condenser.—Yours faithfully,

J. PATON.

London, E.8.

P. S.—I must add that the set is more selective than any I have handled.



Information Department.

P. A. U. (THURSO) is experiencing difficulty with his high-tension supply, which is required for a large set. He would like to use high-tension accumulators, but lack of facilities for charging prevents him taking this course. He asks whether there is any way out of the difficulty.

If a slight amount of trouble is not objected to in the first place, we would suggest that our correspondent employs a Leclanché wet type H.T. battery, which in practice should be found to give good service over an extended period without requiring much attention. Wet batteries of Leclanché type are now obtainable for high-tension purposes from a number of firms, or alternatively the smaller sizes of the standard batteries normally employed for ringing bells may be used, if expense has not to be considered. A difficulty sometimes met with in Leclanché batteries is that of "creeping" of the electrolyte, which may be overcome by covering the liquid in the cells with a thin film of medicinal paraffin.

R. P. L. (BARMING) wishes to construct a frame aerial for his Supersonic heterodyne receiver, to cover a wavelength band of 200 to 600 metres with a .0005μF variable condenser in parallel.

If a simple "diamond" type frame is constructed with diagonals 3 ft. 6 in. long and wound with 12 or 13 turns separated by ½ in. spacing, the desired range should be obtained with a condenser of the capacity specified. No. 18 gauge copper wire will be suitable.

R.S.P. (TUNBRIDGE WELLS) states that he cannot obtain a good earth connection for his "All Concert de Luxe" receiver, since a waterpipe is not available sufficiently near to the room in which the set is to be used. The area at the back of the house is concreted and this would have to be

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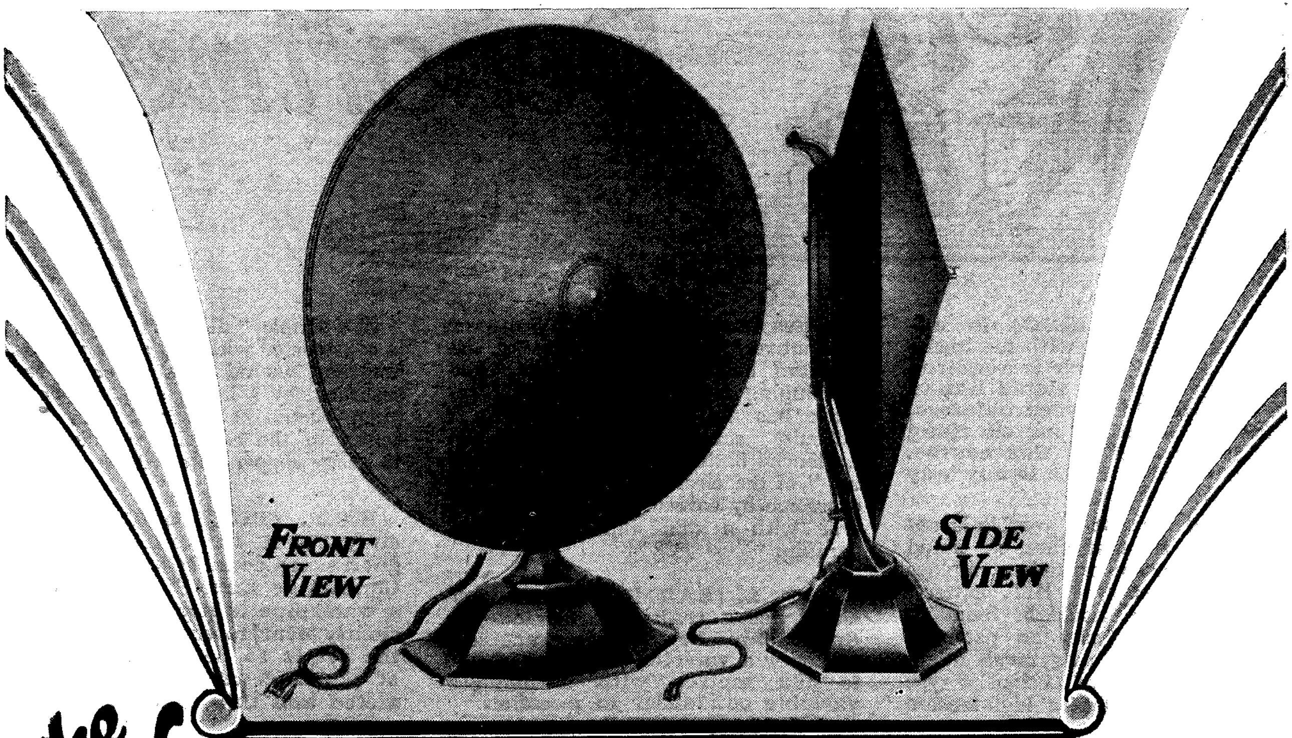

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Freedom from distortion. Greater purity of tone than any other Loud Speaker at present on the market. Even distribution of sound over wide area. Distinctive appearance.

It will operate successfully on any amplifier having an output impedance of 2000 to 5000 ohms. The ideal output impedance is 2000 ohms as in the "Kone" amplifier.

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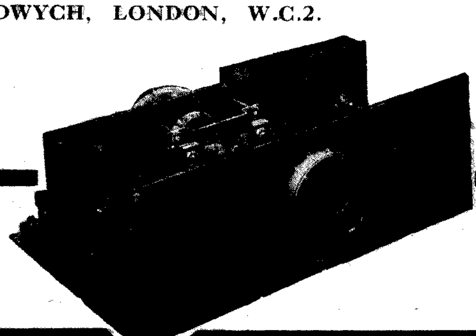

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broken, a somewhat difficult job, to allow an earth plate to be buried. He has room, however, for a counterpoise, and asks our advice as to how to erect this latter.

A counterpoise, to all intents and purposes, is a replica of the aerial itself erected directly underneath the latter, preferably six or eight feet above the ground. Equal attention should be paid to its insulation as to that of the aerial, and a double wire or a multiple wire type may be employed.

D. O. (FOLKESTONE) wishes to add a wavetrap to his "Family" Four-Valve receiver, in order to eliminate the transmission from 5XX when listening to Radio-Paris. He does not wish to wind his own coil for the wavetrap.

A type "D" trap on the lines of that described by Mr. G. P. Kendall, B.Sc., in *Wireless Weekly*, Vol. 4, No. 15, should prove helpful, and a theoretical diagram of this arrangement is given in Fig. 1, in which the connections to the first valve only of the set are given for simplicity.

It will be observed that the receiver is connected up in the normal manner for plain parallel tuning, and that a part of the trap coil L1 is included in the aerial circuit. In practice this coil may conveniently be one of tapped type, such as the Lissen X type, and in this case should be a No. 250 coil. If this type of coil is employed, the turns actually in the aerial circuit should be those between an aerial tapping and what is normally the earthed end of the coil. The method of operating the trap in practice is first to tune in Radio-Paris with the aerial connected to the normal aerial terminal, and then to bring the trap into circuit, tuning on the trap condenser C1 until a point is found where the 5XX transmission is cut out. The set condenser C2 should now be readjusted to bring in Radio-Paris at full strength, which will probably necessitate slight retuning on C1 also. With this arrangement it should be found possible with most aerial and earth systems to eliminate 5XX almost completely without reducing volume from Radio-Paris to any marked extent.

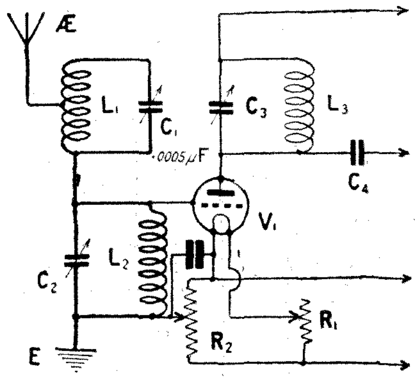
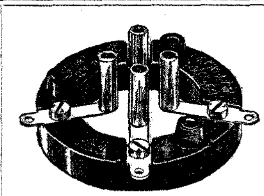


Fig. 1.—The coil L1 in this trap circuit may be a tapped plug-in coil (D.O. Folkestone).

S. F. (BIRMINGHAM) is constructing the S.T. 100 receiver, described in Radio Press Envelope No. 1, by John Scott-Taggart, F.Inst.P., A.M.I.E.E., and asks whether any changes are necessitated in the wiring by employing 1.8-volt type dull emitter valves.

No alterations in the wiring whatever are necessary, since bright-emitter type filament rheostats are suitable for 1.8 volt type dull-emitter valves, a 2-volt accumulator being used. With these latter, however, care should be taken to employ heavy flex leads for the low-tension connections from the accumulator to the low-tension terminals of the set, as if these are long and of appreciable resistance a considerable voltage drop may take place in them, so that the valves do not receive sufficient voltage to function correctly.



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Low loss, shock absorbing, non-microphonic and universal fitting, the Antipong Valve Holder gives your sets more valve-power and saves your valves from shocks and jars. Costing so little it adds much to the strength and purity of your signals. Fit Antipong in all your sets.

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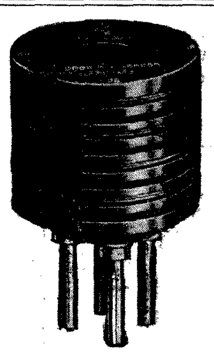

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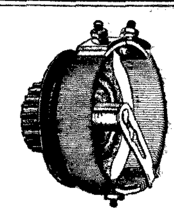

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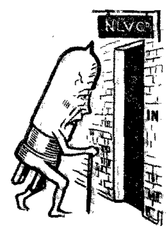

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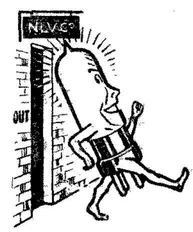

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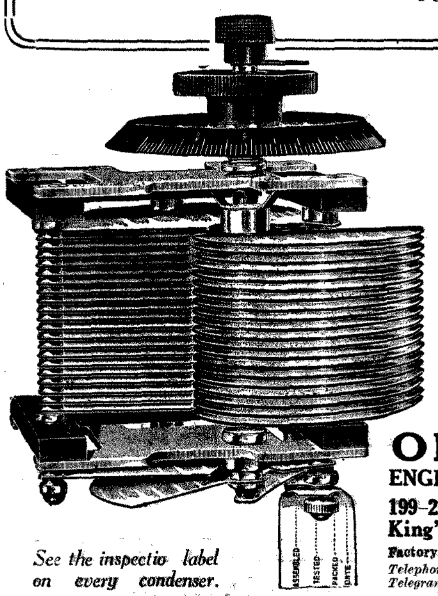

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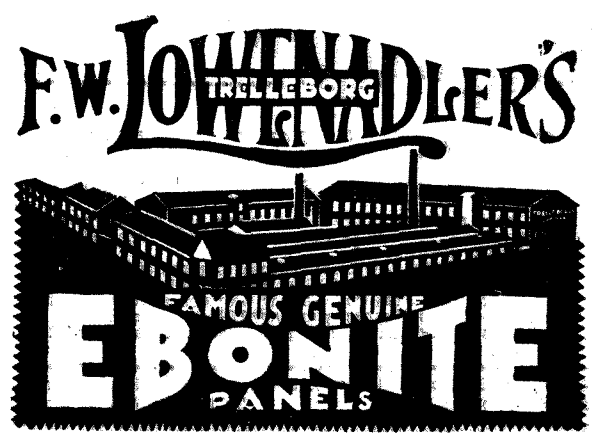

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